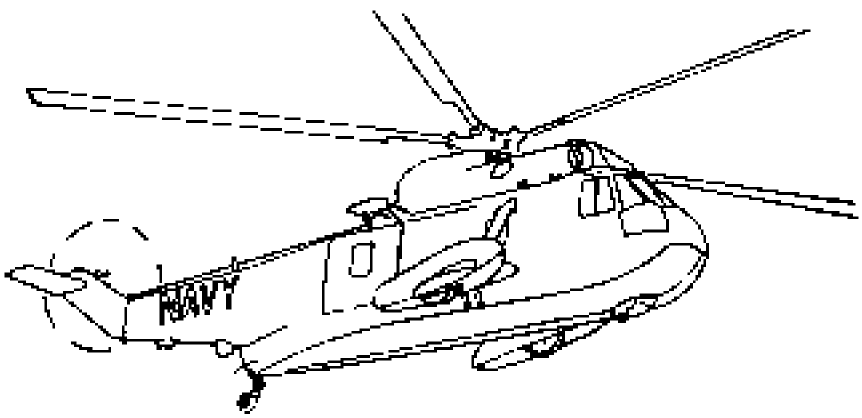
NAVAIR 01-230HLH-1

NATOPS FLIGHT MANUAL

NAVY MODEL

UH-3H and UH-3H EXECUTIVE TRANSPORT

AIRCRAFT



DISTRIBUTION STATEMENT C - Distribution authorized to U.S. Government agencies and their contractors to protect publications required for official use or for administrative or operational purposes only (15 September 1988). Other requests for this document shall be referred to Commanding Officer, Defense Distribution Depot Susquehanna Pennsylvania, Building 05, 5450 Carlisle Pike, Mechanicsburg, PA 17055-0789.

DESTRUCTION NOTICE - For unclassified, limited documents, destroy by any method that will prevent disclosure of contents or reconstruction of the document.

ISSUED BY AUTHORITY OF THE CHIEF OF NAVAL OPERATIONS
AND UNDER THE DIRECTION OF THE
COMMANDER, NAVAL AIR SYSTEMS COMMAND

THE AIRCRAFT
INDOCTRI-NATION
NORMAL PROCEDURES
FLIGHT CHARAC
EMERGENCY PROCEDURES
ALL-WEATHER OPERATIONS
COMM PROCEDURES
WEAPON SYSTEMS
FLIGHTCREW COORD
NATOPS EVAL
PERFORM DATA
INDEX & FOLDOUTS

0801LP1005326

(Reverse Blank)

9 JUNE 2000

This Page Left Blank Intentionally

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
2000 NAVY PENTAGON
WASHINGTON, D.C. 20350-2000

15 October 2001

LETTER OF PROMULGATION

1. The Naval Air Training and Operating Procedures Standardization (NATOPS) Program is a positive approach toward improving combat readiness and achieving a substantial reduction in the aircraft mishap rate. Standardization, based on professional knowledge and experience, provides the basis for development of an efficient and sound operational procedure. The standardization program is not planned to stifle individual initiative, but rather to aid the commanding officer in increasing the unit's combat potential without reducing command prestige or responsibility.

2. This manual standardizes ground and flight procedures but does not include tactical doctrine. Compliance with the stipulated manual requirements and procedures is mandatory except as authorized herein. In order to remain effective, NATOPS must be dynamic and stimulate rather than suppress individual thinking. Since aviation is a continuing, progressive profession, it is both desirable and necessary that new ideas and new techniques be expeditiously evaluated and incorporated if proven to be sound. To this end, commanding officers of aviation units are authorized to modify procedures contained herein, in accordance with the waiver provisions established by OPNAVINST 3710.7, for the purpose of assessing new ideas prior to initiating recommendations for permanent changes. This manual is the product of the UH–3H NATOPS Conference completed 9 June 2000, and is prepared and kept current by the users in order to achieve maximum readiness and safety in the most efficient and economical manner. Should conflict exist between the training and operating procedures found in this manual and those found in other publications, this manual will govern.

3. Checklists and other pertinent extracts from this publication necessary to normal operations and training should be made and carried for use in naval aircraft for use therein. It is forbidden to make copies of this entire publication or major portions thereof without specific authority of the Chief of Naval Operations.

M.J. McCABE
Rear Admiral, U.S. Navy
Director, Air Warfare

This Page Left Blank Intentionally

UH-3H, UH-3H ET
NATOPS Flight Manual

CONTENTS

Page No

CHAPTER 3 Servicing

Page No

CHAPTER 4 Operating Limits

PART II Introduction

CHAPTER 5 Introduction

CHAPTER 10 Functional Checkflight Procedures

Page No

PART V Emergency Procedures

CHAPTER 12 Emergency Procedures

Page No

PART VI All-Weather Operations

CHAPTER 13 Instrument Procedures

CHAPTER 14 Extreme Weather Operation

PART VII Communications-Navigation-Identification Systems

CHAPTER 15 Communications-Navigation-Identification Systems

PART X NATOPS Evaluation

CHAPTER 19 NATOPS Evaluation

CHAPTER 21 Takeoff

CHAPTER 22 Climb

CHAPTER 23 Range

CHAPTER 24 Endurance

CHAPTER 25 Emergency Operation

This Page Left Blank Intentionally

UH-3H, UH-3H ET
NATOPS Flight Manual

LIST OF ILLUSTRATIONS

This Page Left Blank Intentionally

LIST OF EFFECTIVE PAGES

TOTAL NUMBER OF PAGES IN THIS DOCUMENT IS 614, CONSISTING OF THE FOLLOWING:

Page Number.	Change
1 to 50	0
1-1 to 1-4	0
2-1 to 2-100	0
3-1 to 3-20	0
4-1 to 4-10	0
51 to 52	0
5-1 to 5-6	0
53 to 54	0
6-1 to 6-6	0
7-1 to 7-32	0
8-1 to 8-16	0
9-1 to 9-20	0
10-1 to 10-50	0
55 to 56	0
11-11 to 11-12	0
57 to 62	0
12-1 to 12-54	0
63 to 64	0
13-1 to 13-4	0
14-1 to 14-4	0
65 to 66	0
15-1 to 15-32	0
67 to 68	0
16-1 to 16-10	0
17-1 to 17-38	0
69 to 70	0
18-1 to 18- 26	0
19-1 t0 19-10	0
73 to 74	0
20-1 to 20-16	0
21-1 to 21-4	0
22-1 to 22-4	0
23-1 to 23-8	0
24-1 to 24-4	0
25-1 to 12	0
75 to 76	0
FO-1 to FO-8	0
Index 1 to 18	0

RECORD OF CHANGES

Change No. and Date of Change	Date of Entry	Page Count Verified by (Signature)

INTERIM CHANGE SUMMARY

The following Interim Changes have been canceled or previously incorporated in this manual:

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE

The following Interim Changes have been incorporated in this Change/Revision:

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE

Interim Changes Outstanding – To be maintained by the custodian of this manual:

INTERIM CHANGE NUMBER(S)	ORIGINATOR/DATE (or DATE/TIME GROUP)	PAGES AFFECTED	REMARKS/PURPOSE

This Page Left Blank Intentionally

RAAUZYUW RUENAAA0053 2961343-UUUU--RUENCGU.
ZNR UUUUU
R 231343Z OCT 02 ZYB
FM CNO WASHINGTON DC//N789J3//
TO ALL SEAKING HELICOPTER ACTIVITIES
INFO RUCTPOH/NAVOPMEDINST PENSACOLA FL//06//
RHMFIUU/NAVOPMEDINST PENSACOLA FL//06//
RHFJJBF/NAVAIRDEPOT JACKSONVILLE FL//3.3.3//
RHMFIUU/NAVAIRDEPOT JACKSONVILLE FL//3.3.3//
BT
UNCLAS //03711//
MSGID/GENADMIN/CNO WASHINGTON DC/-/OCT//
SUBJ/INTERIM CHANGES TO UH-3H - UH-3H ET AND VH-3A AIRCRAFT NATOPS
/FLIGHT PUBLICATIONS -- SAFETY OF FLIGHT//
REF/A/DOC/NAVAIR 01-230HLH-1/YMD:20000609//
REF/B/DOC/NAVAIR 01-230HLY-1/YMD:19930601//
REF/C/DOC/NAVAIR 01-230HLH-1B/YMD:20000609//
REF/D/DOC/NAVAIR 01-230HLY-1B/YMD:19930601//
REF/E/DOC/NAVAIR 01-230HLH-1F/YMD:20000609//
REF/F/DOC/NAVAIR 01-230HLY-1F/YMD:19930601//
NARR/REF A IS UH-3H AND UH-3H EXECUTIVE TRANSPORT (ET) NATOPS FLIGHT MANUAL (NFM). REF B IS VH-3A NFM. REF C IS UH-3H/UH-3H ET PILOT'S POCKET CHECKLIST (PPCL). REF D IS VH-3A PILOT'S/CREWMAN'S POCKET CHECKLIST (PCPCL). REF E IS UH-3H/UH-3H ET FUNCTIONAL CHECKFLIGHT CHECKLIST (FCFCL). REF F IS VH-3A FCFCL.//
RMKS/1. THIS IS INTERIM CHANGE (IC) NUMBER 42 TO REF A (UH-3H/UH-3H ET NFM), IC NUMBER 14 TO REF B (VH-3A NFM), IC NUMBER 14 TO REF C (UH-3H/UH-3H ET PPCL), IC NUMBER 1 TO REF D (VH-3A PCPCL), IC NUMBER 2 TO REF E (UH-3H/UH-3H ET FCFCL), AND IC NUMBER 3 TO REF F (VH-3A FCFCL).
2. SUMMARY. ADDS CHECKS TO ENSURE THAT BRAKES AND TAILWHEEL ARE SET AND LOCKED AS PART OF NORMAL AND FUNCTIONAL CHECKFLIGHT STARTING ENGINE AND ROTOR ENGAGEMENT PROCEDURES IN REFS A THROUGH F.
3. CHANGE REF A (UH-3H/UH-3H ET NFM), AND REF B (VH-3A NFM) AS FOLLOWS:
A. UH-3H/UH-3H ET NFM ONLY: PAGE 39 INTERIM CHANGE SUMMARY, IN TOP SECTION OF PAGE MARKED "THE FOLLOWING INTERIM CHANGES HAVE BEEN CANCELED OR PREVIOUSLY INCORPORATED IN THIS MANUAL:", IN INTERIM CHANGE NUMBER(S) COLUMN:
   (1) DELETE: NA
   (2) ADD: 1 THRU 41
B. UH-3H/UH-3H ET NFM PAGES 7-15 THROUGH 7-17, PARAGRAPH 7.6 STARTING NO.2 ENGINE AND ROTOR ENGAGEMENT (VH-3A NFM PAGES 7-11 THROUGH 7-13, PARAGRAPH 7.7):
   (1) DELETE: NA
   (2) ADD (INSERT) NEW STEP 1:
      1. BRAKES AND TAILWHEEL -- SET AND LOCKPIN VISUALLY CHECKED.

WARNING

FAILURE TO ENSURE THAT BRAKES AND TAILWHEEL ARE LOCKED PRIOR TO NO.2 ENGINE START COULD RESULT IN UNCOMMANDED YAW DURING ROTOR ENGAGEMENT.

   (3) RENUMBER OLD STEPS 1 THROUGH 22 AS NEW STEPS 2 THROUGH 23, RESPECTIVELY.

C. UH-3H/UH-3H ET NFM PAGES 10-20 THROUGH 10-24, PARAGRAPH 10.2.6 NO.2 ENGINE CHECKS (VH-3A NFM PAGES 10-17 THROUGH 10-20):
   (1) DELETE: NA
   (2) ADD (INSERT) NEW STEP 2:
        (DAGGER)2. BRAKES AND TAILWHEEL -- SET AND LOCKPIN VISUALLY CHECKED.

WARNING

FAILURE TO ENSURE THAT BRAKES AND TAILWHEEL ARE LOCKED PRIOR TO NO.2 ENGINE START COULD RESULT IN UNCOMMANDED YAW DURING ROTOR ENGAGEMENT.

   (3) UH-3H/UH-3H ET ONLY: RENUMBER OLD STEPS 2 THROUGH 29 AS NEW STEPS 3 THROUGH 30, RESPECTIVELY.
   (4) VH-3A ONLY: RENUMBER OLD VH-3A STEPS 2 THROUGH 28 AS NEW STEPS 3 THROUGH 29, RESPECTIVELY.
   (5) NOTE - "(DAGGER)" BESIDE THE STEP NUMBER IN SUBPARA 3.C(2) ABOVE INDICATES A NORMAL PROCEDURE CHECKLIST ITEM.

4. CHANGE REF C (UH-3H/UH-3H ET PPCL) AND REF D (VH-3A PCPCL), AS FOLLOWS:

A. UH-3H/UH-3H ET PPCL ONLY:
   (1) DELETE: NA
   (2) ADD INSERT A NEW IC SUMMARY AS PAGE 3A, SHOWING IC'S 1 THROUGH 13 AS HAVING BEEN PREVIOUSLY INCORPORATED. NEW PAGE B HAS BEEN PREPARED FOR DOWNLOADING AND INSERTION INTO REF C AND IS INCLUDED IN THE IC PACKAGE PLACED ON THE NATEC WEBSITE (SEE PARA 7 BELOW).

B. UH-3H/UH-3H ET PPCL PAGES 44 AND 45, AND VH-3A PCPCL PAGES 69 AND 71, STARTING NUMBER TWO ENGINE AND ROTOR ENGAGEMENT PROCEDURE, AS FOLLOWS:
   (1) DELETE: NA
   (2) ADD NEW STEP 1:
        1. BRAKES AND TAILWHEEL -- SET AND LOCKPIN VISUALLY CHECKED.
   (3) RENUMBER OLD STEPS 1 THROUGH 22 AS NEW STEPS 2 THROUGH 23, RESPECTIVELY.

5. CHANGE REF E (UH-3H/UH-3H ET FCFCL) AND REF F (VH-3A FCFCL), AS FOLLOWS:

A. UH-3H/UH-3H ET FCFCL ONLY: PAGE A INTERIM CHANGE SUMMARY, IN TOP SECTION OF PAGE MARKED "THE FOLLOWING INTERIM CHANGES HAVE BEEN CANCELED OR PREVIOUSLY INCORPORATED IN THIS MANUAL:", IN INTERIM CHANGE NUMBER(S) COLUMN:
   (1) DELETE: NA
   (2) ADD: 1

B. UH-3H/UH-3H ET FCFCL PAGES 10 THROUGH 12, AND VH-3A FCFCL PAGES 11 THROUGH 13, NUMBER TWO ENGINE CHECKS PROCEDURE:
   (1) DELETE: NA
   (2) ADD (INSERT) NEW STEP 2:
        (DAGGER)2. BRAKES AND TAILWHEEL -- SET AND LOCKPIN VISUALLY CHECKED.
   (3) UH-3H/UH-3H ET ONLY: RENUMBER OLD STEPS 2 THROUGH 29 AS NEW STEPS 3 THROUGH 30, RESPECTIVELY.
   (4) VH-3A ONLY: RENUMBER OLD VH-3A STEPS 2 THROUGH 28 AS NEW STEPS 3 THROUGH 29, RESPECTIVELY.
   (5) NOTE - "(DAGGER)" BESIDE THE STEP NUMBER IN SUBPARA 5.B(2)

ABOVE INDICATES A NORMAL PROCEDURE CHECKLIST ITEM.
6. IF QUESTIONS, CONTACT HC-2 H-3 NATOPS PROGRAM MANAGER, LT JOHN COMPTON AT DSN 565-4730 EXTN 338 OR 332 OR COMM (757)445-4730 EXTN 338 OR 332, EMAIL JCOMPTON@NSN.CMAR.NAVY.MIL.
7. THIS MSG WILL BE POSTED ON THE NATEC WEBSITE, WWW.NATEC.NAVY.MIL, WITHIN 15 DAYS OF RELEASE. NEW NATOPS IC MSGS MAY BE FOUND IN TWO PLACES ON THIS WEBSITE; (1) IN THE NATOPS IC DATABASE FOUND UNDER THE TMAPS OPTION, AND (2) IN THE AFFECTED PUBLICATION(S) JUST AFTER THE INTERIM CHANGE SUMMARY PAGE. THEY ARE NORMALLY POSTED IN THE DATABASE BEFORE APPEARING IN THE PUBLICATION. IF UNABLE TO VIEW THIS MESSAGE ON THE NATEC WEBSITE, INFORM THE CNO NATOPS OFFICE AT DSN 664-7763/7719 OR COMM (703)604-7763/7719.//
BT

INTERIM CHANGE SUMMARY

The following Interim Changes have been canceled or Previously incorporated in this manual.

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE
1 Thru 13	Previously incorporated

The following Interim Changes have been incorporated in this Change/Revision

INTERIM CHANGE NUMBER	REMARKS/PURPOSE

Interim Changes Outstanding - To be maintained by the Custodian of this manual

INTERIM CHANGE NUMBER	ORIGINATOR/DATE (or DATE/TIME GROUP)	PAGES AFFECTED	REMARKS/PURPOSE
14	CNO 231343Z OCT 02	44 - 45	Adds starting #2 Eng tailwheel locked step.

AIRFRAME CHANGE SUMMARY

The following Airframe Changes are those not incorporated on all aircraft. When all aircraft are modified, the Airframe Change will be deleted from this list.

CHANGE NUMBER	SUBJECT	ISSUE DATE	ISSUE
398	AN/ARC-186 VHF Radio Installation	3 Mar 86	Routine
399	Service Life Extension Program (SLEP)	2 Oct 1989	Routine
401	Main Trans Shaft	29 Jan 1992	Routine
402	Rotor Head Compatibility	12 May 1988	Routine
403	Rotor Head Compatibility Changes	12 May 1988	Routine
405	AN/APN-182(V) Doppler Radar System; mod	3 Mar 1986	Routine
419	AN/APN-182(V) TACAN Navigation Set, Installation of	15 Dec 1987	Routine
420	Installation of Improved AN/ASN-123C Tactical Navigation (TACNAV) System	1 Nov 1986	Routine
424	AN/ASN-123C Tactical Navigation Set Interface Wiring	1 Mar 1987	Routine
431	AN/ARN-126 VHF Radio Nav Sys	30 Nov 1993	Routine
433	C7821/A Torpedo Presetter and Jumper	8 May 1992	Routine
448	AN/APN-171(V) Radar Altimeter	20 Mar 1992	Routine
450	T58-GE-402 Engine Install Provisions	21 Aug 1989	Routine
453	Vertical Speed Indicator (VSI), Relocation	01 May 89	Routine
455	AQS-13 Wiring Change in SH-3H	13 Nov 1989	Routine
459	Inst Panel Map Case Relocation	11 Nov 1990	Routine
463	AN/APN-182(V) RF Absorbent Material, Removal of	28 Nov 1990	Routine
464	Pri, Aux and Util Panel Package Filter	30 Nov 1990	Routine
465	SH-3H Three Man Troops Seat Install	30 Aug 1991	Routine
466*	Ics Relocation	Prelim	Routine
467*	Floorboard Mods and Structure Upgrade	30 Nov 1993	Routine
468	AN/ARS-6 Downed Aircrew Locator Sys	10 Jan 1991	Urgent
469	Aviators Night Vision Imaging Systems (ANVIS) Compatible Lighting Install	11 Dec 1991	Urgent

470	Trimble Trimpack (GPS) Install	22 Jan 1991	Urgent
471*	Cargo Hook and Sling Install	29 Oct 1993	Routine
474*	ASW Equipment; Removal	Prelim	Routine
475	Special Warfare Support, Incorp of	30 Apr 1993	Routine
478	Utility Hydraulic Bypass Restrictor	12 Mar 1992	Routine
480	Negative Force Gradient (NFG) Spring Cylinder Assembly	28 May 1993	Routine
483	AN/ARC-182	1 Dec 1994	Routine
484	Tacnav Writing	24 Sept 92	Routine
487	Helo Trimpack, GPS	1 Apr 1994	Routine
492	Installation of 566359-849 ASE Amplifier		
493	AN/AIC-14 ICS Bleedthru Correction		
495	AN/ASN-163 Satellite Signals Navigation Set In the UH-3H Aircraft, Incorporation of		
501	Rotary Wing Blade, H-3 In-flight Blade Inspection System (IBIS), Installation of		

* UH-3H conversion requirements

LIST OF ABBREVIATIONS/ACRONYMS

A

AC Aircrew, Armament Control.

ADF Automatic Direction Finder.

AGC Automatic Gain Control.

AGL Above Ground Level.

AHRS Altitude Heading Reference System.

AIMS Airborne Identification Mobile System.

AMPS Amperes.

ASE Automatic Stabilization Equipment.

ASMD Anti-Ship Missile Defense.

B

BDHI Bearing Distance Heading Indicators.

BIM Blade Inspection Method.

BITE Built-In-Test Equipment

C

CAD Cartridge Activated Device.

CATCC Carrier Air Traffic Control Center.

CF3BR Bromotrifluoromethane.

CG Center Of Gravity.

CP Copilot.

CPR Cardiopulmonary Resuscitation.

CQ Carrier Qualification.

CRT Cathode Ray Tube.

D

DC Direct Current.

DG Directional Gyro.

DLQ Deck Landing Qualification

DME Distance Measuring Equipment

E

ELS Emergency Lubrication System

EMCON Emission Control.

ESM Electronic Warfare Support Measures.

ET UH-3H Executive Transport

F

FAM Familiarization.

FLIP Flight Information Publication.

FOD Foreign Object Damage.

FPM Feet Per Minute.

FRD Fleet Readiness Department.

FPS Feet Per Second.

FTP Fly To-Point.

G

GPM Gallons Per Minute.

GSDA Groundspeed Drift Angle.

GSI Glideslope Indicator.

H

H2P Helicopter Second Pilot.

HAC Helicopter Aircraft Commander.

HEED Helicopter Emergency Escape Device.

HEEL Helicopter Emergency Egress Lighting.

HF High Frequency.

HIFR Helicopter In-Flight Refueling.

HIGE Hover In Ground Effect.

HP Horsepower.

I

ICS Intercommunication System

IFF Identification Friend Or Foe.

IFR Instrument Flight Rule(S).

IMC Instrument Meteorological Conditions.

IVC Inertial Velocity Computer.

IVD Inertial Velocity Detector.

IVSC Inertial Velocity Systems Computer.

K

KIAS Knots Indicated Airspeed.

KVA Kilovolt Amperes.

KYD Kiloyard.

L

LF Low Frequency.

LS Left-Seat Pilot.

LSE Landing Signalman Enlisted.

M

MC Mission Commander.

MGB Main Gearbox.

MIM Maintenance Instruction Manual.

MS Multi Spot Ship

MSL Mean Sea Level.

MTI Moving Target Indicator.

N

NAMTD Naval Air Maintenance Training Detachment.

NAMTG Naval Air Maintenance Training Group.

NAVAIDS Navigation Aids.

NEC Naval Enlisted Classification Code.

Nf Free Turbine Speed.

Ng Gas Generator Compressor Speed.

NHC Nato Compatible High Capacity.

NOE Nap Of The Earth.

NON-ET UH-3H not modified as Executive Transport

NOTAMS Notices To Airmen.

Nr Rotary Wing Speed.

NVD Night Vision Devices.

O

OAT Outside Air Temperature.

OCE Officer Conducting The Exercise.

OFT Operational Flight Trainer.

OOD Officer Of The Deck.

OTC Officer In Tactical Command.

OTPI On Top Position Indicator.

P

P_3 Compressor Discharge Pressure.

PAC Pilot At Controls.

PIM Planned Intended Movement.

PMG Permanent Magnetic Generator.

PPH Pounds Per Hour.

PQM. Pilot Qualified In Model.

PQS Personnel Qualification Standards.

PSI Pounds Per Square Inch.

Q

QRA Quick Replaceable Assembly.

R

RADALT Radar Altimeter.

RLAWS Radar Altitude Warning System

RF Radio Frequency.

RMI Radio Magnetic Indicator.

RO Range Only.

RPM Revolutions Per Minute.

RS Right-Seat Pilot

S

SAR Search And Rescue.

SHP Shaft Horsepower.

SLQ Ship Landing Qualification.

SPR Single-Point Refueling.

SS Single Spot Ship

T

T_2 Ambient Air Temperature.

T_5 Power Turbine Inlet Temperature.

TACNAV Tactical Navigation.

TAS True Airspeed.

U

UHF Ultrahigh Frequency.

V

VAC Volts Alternating Current.

VDC Volts Direct Current.

VERT ACCEL Vertical Accelerometer.

VFR Visual Flight Rules.

VGI Vertical Gyro Indicator.

VHF Very High Frequency.

VIDS/MAF Video Information Display System/Maintenance Action Form

VLEA Variable Load Energy Absorber.

VMC Visual Meteorological Conditions.

VSI Vertical Speed Indicator.

W

Wf. Fuel Flow.

WOD Wind Over Deck.

WST Weapon System Trainer.

PREFACE

SCOPE

The NATOPS flight manual is issued by the authority of the Chief of Naval Operations and under the direction of Commander, Naval Air Systems Command in conjunction with the Naval Air Training and Operating Procedures Standardization (NATOPS) Program. This manual contains information on all aircraft systems, performance data, and operating procedures required for safe and effective operations. However, it is not a substitute for sound judgment. Compound emergencies, available facilities, adverse weather or terrain, or considerations affecting the lives and property of others may require modification of the procedures contained herein. Read this manual from cover to cover. It is your responsibility to have a complete knowledge of its contents.

APPLICABLE PUBLICATIONS

The following applicable publications complement this manual:

NAVAIR 01-230HLH-1B – UH-3H (NATOPS Pilot's Pocket Checklist)
NAVAIR 0l-230HLH-l.2B (NATOPS UH-3H Crewman's Pocket Checklist)
NAVAIR 0l-230HLH-lF (NATOPS Functional Checkflight Checklist)

HOW TO GET COPIES

One Time Orders

If this publication is needed on a one time basis (without future updates), order it from stock by sending an electronic DD 1348 requisition in accordance with NPFC Publication 2002D.

Automatic Distribution (With Updates)

This publication and changes to it are automatically sent to activities that are established on the Automatic Distribution Requirements List (ADRL) maintained by Naval Air Technical Data and Engineering Service Commad, NATEC), San Diego, CA. If there is a continuing need for this publication, each activity's Central Technical Publication Librarian must send a revised ADRL report on floppy disk to NATEC. If an activity does not have a library, then send a letter to:

Commanding Officer
NATEC,
Attn: Code 3.3A83
P. O. Box 357031
San Diego, CA 92135-7031

requesting assignment of a distribution account number (if necessary) and automatic mailing of future issues of the publications needed.

Note

The ADRL floppy disk can be used only to place an activity on the mailing list for automatic distribution of *future* issues of the publications. *It cannot be used to make one time orders of publications from current stock*. To get publications from stock, see One Time Orders above.

Once established on automatic distribution for this or any other NAVAIR technical publication, an activity must submit an ADRL report on floppy disk at least once every 12 months to update or confirm their automatic distribution requirements.

Note

Activities not submitting an ADRL report on floppy disk for more than 12 months may be dropped from distribution of all NAVAIR technical publications.

UPDATING THE MANUAL

To ensure that the manual contains the latest procedures and information, NATOPS review conferences are held in accordance with the current OPNAVINST 3710.7.

CHANGE RECOMMENDATIONS

Recommended changes to this manual or other NATOPS publications may be submitted by anyone in accordance with the current OPNAVINST 3710.7.

Routine change recommendations are submitted directly to the model manager on OPNAV 3710/6 (4-90) shown herein. The address of the model manager of this aircraft is:

NATOPS/TACTICAL CHANGE RECOMMENDATION
OPNAV 3710/6 (4-90) S/N 0107-LF-009-7900

DATE ______________

TO BE FILLED IN BY ORIGINATOR AND FORWARDED TO MODEL MANAGER

FROM (Originator)			Unit		
TO (Model Manager)			Unit		
Complete Name of Manual/Checklist	Revision Date	Change Date	Section/Chapter	Page	Paragraph

Recommendation (be specific)

☐ CHECK IF CONTINUED ON BACK

Justification

Signature	Rank	Title

Address of Unit or Command

TO BE FILLED IN BY MODEL MANAGER *(Return to Originator)*

FROM	DATE
TO	

REFERENCE

(a) Your Change Recommendation Dated ______________

☐ Your change recommendation dated ______________ is acknowledged. It will be held for action of the review conference planned for ______________ to be held at ______________

☐ Your change recommendation is reclassified URGENT and forwarded for approval to ______________ ______________ by my DTG ______________ .

/S/ ______________ MODEL MANAGER | ______________ AIRCRAFT

Commanding Officer
Helicopter Combat Support Squadron Two
564 A Street
Norfolk, VA 23511-4010
(COMM: (757) 445-4820
DSN: 565-4820)

Change recommendations of an URGENT nature (safety of flight, etc.) should be submitted directly to the NATOPS Advisory Group Member in the chain of command by priority message.

YOUR RESPONSIBILITY

NATOPS flight manuals are kept current through an active manual change program. Any corrections, additions, or constructive suggestions for improvement of its content should be submitted by routine or urgent change recommendation, as appropriate, at once.

NATOPS FLIGHT MANUAL INTERIM CHANGES

Flight manual interim changes are changes or corrections to the NATOPS flight manuals promulgated by CNO or NAVAIRSYSCOM. Interim changes are listed either as printed pages or as a naval message. The Interim Change Summary Page is provided as a record of all interim changes. Upon receipt of a change or revision, the custodian of the manual should check the updated Interim Change Summary to ascertain that all outstanding interim changes have been either incorporated or canceled; those not incorporated shall be recorded as outstanding in the section provided.

CHANGE SYMBOLS

Revised text is indicated by a black vertical line in either margin of the page, adjacent to the affected text, like the one printed next to this paragraph. The change symbol identifies the addition of either new information, a changed procedure, the correction of an error, or a rephrasing of the previous material. A change symbol in the margin by the chapter number and title indicates a new or completely revised chapter.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to "WARNING's," "CAUTION's," and "Note's" found throughout the manual.

WARNING

Explanatory information about an operating procedure practice, or condition, etc., that may result in injury or death if not carefully observed or followed.

CAUTION

Explanatory information about an operating procedure, practice, or condition, etc., that may result in damage to equipment if not carefully observed or followed.

Note

Explanatory information about an operating procedure, practice, or condition, etc., that is essential to emphasize.

WORDING

The concept of word usage and intended meaning that has been adhered to in preparing this manual is as follows:

"Shall" has been used only when application of a procedure is mandatory.

"Should" has been used only when application of a procedure is recommended.

"May" and "need not" have been used only when application of a procedure is optional.

"Will" has been used only to indicate futurity, never to indicate any degree of requirement for application of a procedure.

"Land Immediately" is self-explanatory.

"Land as Soon as Possible" means land at the first site at which a safe landing can be made.

"Land as Soon as Practicable" means extended flight is not recommended, the landing site and duration of flight is at the discretion of the pilot in command.

Note

This manual shall be carried in the aircraft at all times.

This Page Left Blank Intentionally

PART I

The Aircraft

This Page Left Blank Intentionally

CHAPTER 1
General Description

1.1 THE HELICOPTER

The model UH-3H helicopter is manufactured by Sikorsky Aircraft, Division of United Technologies, Stratford, Connecticut 06615. The helicopter is a Class 1B aircraft, designed for both shore and ship-based operations to provide logistic support and a search and rescue capability as required. The crew consists of a pilot, copilot, and two utility aircrewmen.

The UH-3H Executive Transport basic airframe is manufactured by Sikorsky Aircraft Corporation, a subsidiary of United Technologies Corporation, Stratford, CT., 06615. It is a Class 1B aircraft, designed for shore and ship based operations to provide executive transportation and logistic support. The crew consists of a pilot, copilot, and aircrew member.

Configuration is a single rotary wing, twin turbine powered helicopter with emergency amphibious capabilities. The emergency amphibious landing gear is composed of a flying boat type hull and two outrigger sponsons, into which the dual main landing wheels can retract. A fixed tailwheel is on the aft end of the hull. The fuselage is all-metal, semimonocoque construction and consists of the forward fuselage section, the hull, the aft fuselage section, the tail cone section, and the pylon.

The forward fuselage section and hull consist of the pilot compartment, engine compartment, transmission compartment, cabin, and fuel tanks. The electronics-radio compartment is in the forward portion of the hull. Above the electronics-radio compartment and forward of the cabin, is the pilot compartment that is entered from the cabin. The engine compartment is above the forward portion of the cabin. Both turbine engines are mounted side by side in the engine compartment with the engine shafts pointed aft into the main gearbox. Directly aft of the engine compartment is the transmission compartment, housing the main gearbox. The rotary wing assembly, to which the five rotary wing blades are attached, is splined to the main gearbox drive shaft. Shafting extends aft from the main gearbox lower housing to the intermediate and tail gearboxes to drive the tail rotor. Directly below the engine and transmission compartments is the cabin.

The cabin is 19 feet 3 inches long, 6 feet 6 inches wide, and 5 feet 10 inches high. The cabin may be entered either through the sliding cabin door on the right aft side of the cabin or through a hinged personnel door on the left side of the cabin. Entrance to the pilot compartment is through the cabin. A well in the cabin floor is empty. The tail cone section extends aft from the rear cabin bulkhead. The tail pylon is attached to the rear of the tail cone. A horizontal stabilizer is installed on the upper right-hand side of the pylon. The intermediate gearbox is installed on the lower portion of the pylon with a shaft extending upward to the rotary rudder gearbox at the top of the pylon. The five-blade rotary rudder is splined to the rotary rudder gearbox. To permit storing on an elevator 48 feet 6 inches (14.78 m) by 17 feet 8 inches (5.38 m), the five rotary wing blades are folded parallel to the fuselage and the pylon is folded forward along the right side of the tail cone.

The UH-3H Executive Transport cabin is 19 feet 3 inches (5.87 m) long, 6 feet 6 inches (1.98 m) wide, and 5 feet 10 inches (1.78 m) high. The cabin may be entered either through the left forward or right aft passenger doors. Entrance to the pilot compartment is through the cabin. The ET helicopter cabin area contains various seats, carpeting, soundproofing, cabin lighting, windows, emergency escape hatches, and a storage compartment for executive transportation.

The UH-3H Executive Transport has an auxiliary power unit, mounted above the right sponson, used to provide power for instrumentation, minimal lighting, and ground operation of the air conditioning system. The air conditioner system is designed to maintain a constant temperature at all times.

1.1.1 Performance. The helicopter is capable of airspeeds up to 120 KIAS. Endurance will vary between 3-1/2 and 5-1/2 hours depending upon model aircraft and amount of time spent hovering. Fuel consumption is approximately 1,200 pph in all flight regimes. The maximum gross weight, that is the maximum allowable weight of the helicopter;

including all its contents is 21,000 lbs. For a most forward cg loading of 258.0, the load upon the tailgear is 11 percent of the gross weight while each main gear supports 44.5 percent of the gross weight. For a most aft cg of 276.0, the load upon the tailgear is 18 percent of the gross weight while each main gear supports 41 percent of the gross weight. These wheel reaction loads are based on a static condition in a level attitude.

1.1.2 Engine Ratings. The T58-GE-402 engine has the following ratings: Military power: 1,500 shp, 30 minutes standard day at sea level. Maximum continuous: 1,300 shp, standard day at sea level.

1.1.3 Dimensions (See Figure 1-1).

LENGTH:

Maximum, rotary wing blades extended	72 feet 10.67 inches
Minimum, rotary wing blades and pylon folded	47 feet 3 inches

HEIGHT:

Maximum to top of rotary rudder, blade vertical	17 feet 2 inches
Minimum, pylon folded	16 feet 2 inches
Minimum rotary rudder ground clearance	6 feet 6 inches
Main landing gear tread	13 feet

WIDTH:

Maximum, rotary wing blades extended	62 feet 0 inches
Minimum, rotary wing blades and pylon folded	16 feet 4 inches
Minimum rotary wing ground clearance (tip clearance-forward section)	12 feet 1 inch
Minimum rotary wing ground clearance when folding (static)	18 inches

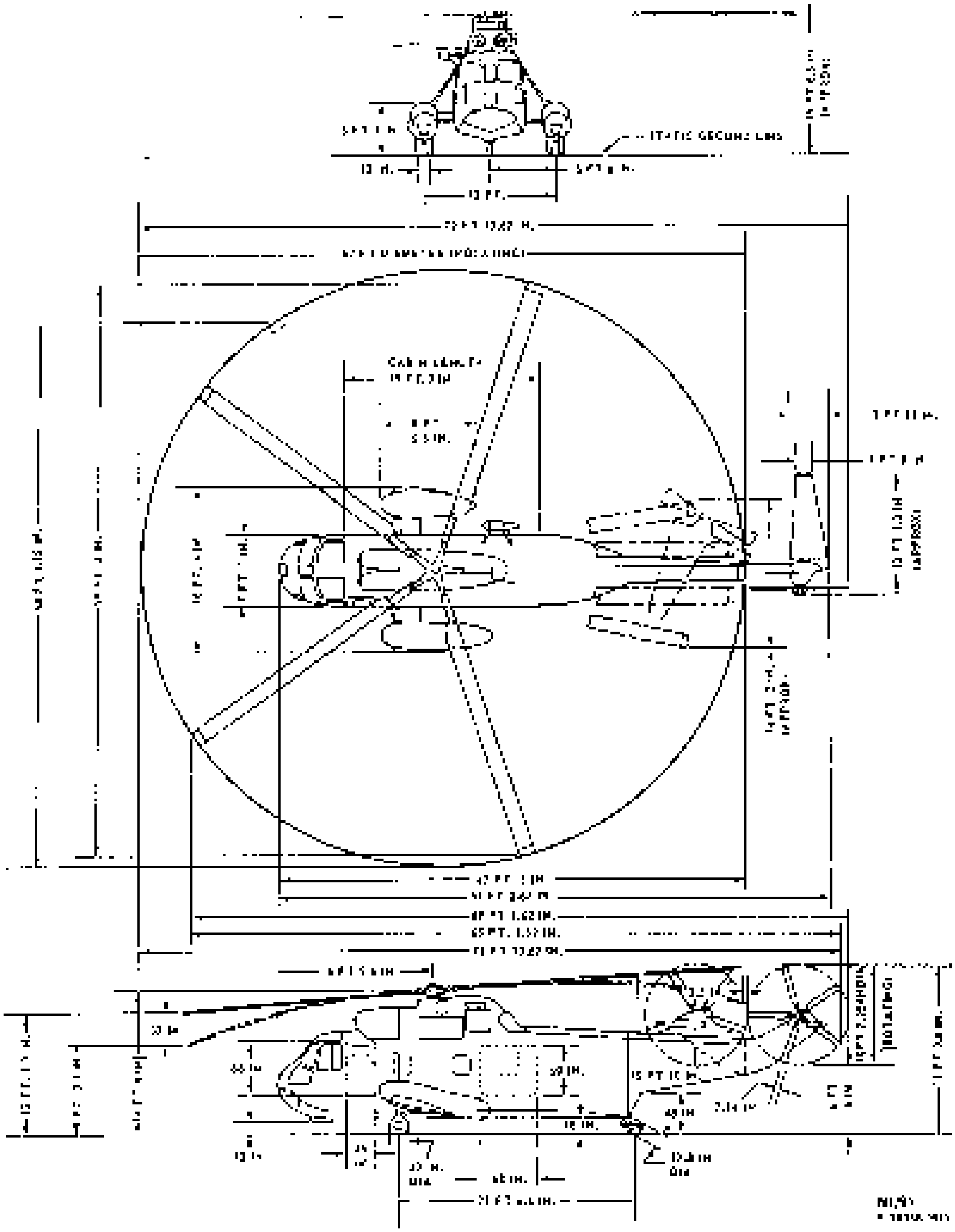


Figure 1-1. Dimension Diagram

This Page Left Blank Intentionally

CHAPTER 2

Systems

2.1 POWER PLANT SYSTEMS

The helicopter is powered by two General Electric T58-GE-402 axial flow gas turbine engines (Figure 2-1) of the turboshaft type, side by side above the cabin, forward of the main gearbox. A removable foreign object deflector (ice shield) (Figure 2-2) is installed to prevent chunks of ice from breaking off the top of the fuselage and being ingested by the engines. The ice shield kit contains a sleeve for each pitot tube that shall be installed whenever the ice shield is mounted. This is to prevent erroneous inputs to the barometric altitude controller and incorrect airspeed indications. Each engine (FO-1) consists of the following major components: an axial flow compressor, a combustion chamber, a two-stage turbine that drives the compressor, and a free power turbine that is mechanically independent of the two-stage turbine. The compressor and its two-stage turbine is referred to as the gas generator. The main advantage is a constant free turbine speed output that results in a constant rotor rpm. Variations in power requirements to maintain constant free turbine speed are done by automatic increases or decreases in gas generator speed. The engine fuel control system delivers atomized fuel in controlled amounts to the combustion chamber. The fuel flow must vary readily in volume (with related variation in pressure) in response to the range of power requirements encountered during flight. Flow of fuel and air through the combustion chamber is continuous, and once the mixture is ignited a continuous flame is sustained. Changes in air pressure, air temperature, and helicopter velocity affect engine performance.

2.1.1 Gas Generator Compressor Speed (N_g). N_g is primarily dependent upon fuel flow and is monitored by the engine fuel control unit. The principal purpose of monitoring compressor speed is to control acceleration and deceleration characteristics, prevent overspeed, and establish a minimum idle setting. Compressor speed controls mass airflow pumped through the engine and consequently the power available to the power turbine.

2.1.2 Free Turbine Speed (N_f). The N_f is dependent upon engine control input shaft position and rotor load. The principal purpose of monitoring free turbine speed is to regulate fuel flow to maintain an essentially constant turbine speed for a given control input shaft position.

2.1.3 Engine Fuel System. The engine fuel systems (FO-2), one for each engine, consist of a filter screen, dynamic filter, two-stage main fuel pump, fuel control unit, static filter, an oil cooler, flow divider, and 2 fuel manifolds containing 16 nozzles. The fuel control unit is supplied fuel from the engine-driven fuel pump. Metered fuel from the engine fuel control unit is piped through an oil-fuel heat exchanger and then enters the flow divider connected directly to the fuel manifolds on the engine. For normal flight, rotor speed is selected by positioning the engine speed selectors, and the engine fuel controls will meter fuel to maintain the selected rotor speed.

2.1.3.1 Fuel Pumps, Engine-Driven. A dual-stage engine-driven fuel pump is mounted on each engine, consisting of a positive displacement gear stage and a low-pressure centrifugal boost element. Power for these pumps is furnished from the engine accessory drive section. The shaft driving these pumps also transmits compressor speed information to the engine fuel control units.

2.1.3.2 Fuel Control Units. The engine fuel control units, one on each engine, are hydromechanical units that modulate engine fuel flow to maintain a constant, selected, free power turbine speed and thus maintain a constant helicopter rotor speed. Fuel from the engine fuel pump enters the fuel control unit through the inlet and passes through the fuel filter. Major fuel control elements consist of a metering valve and a pressure-regulating valve. The pressure regulating valve maintains a constant pressure across the main metering valve bypassing excess fuel back to the engine fuel pump inlet. The metering valve is positioned in response to speed selector position, T_2, N_g, N_f, and P3, and meters fuel to the engine as a function of these integrated signals.

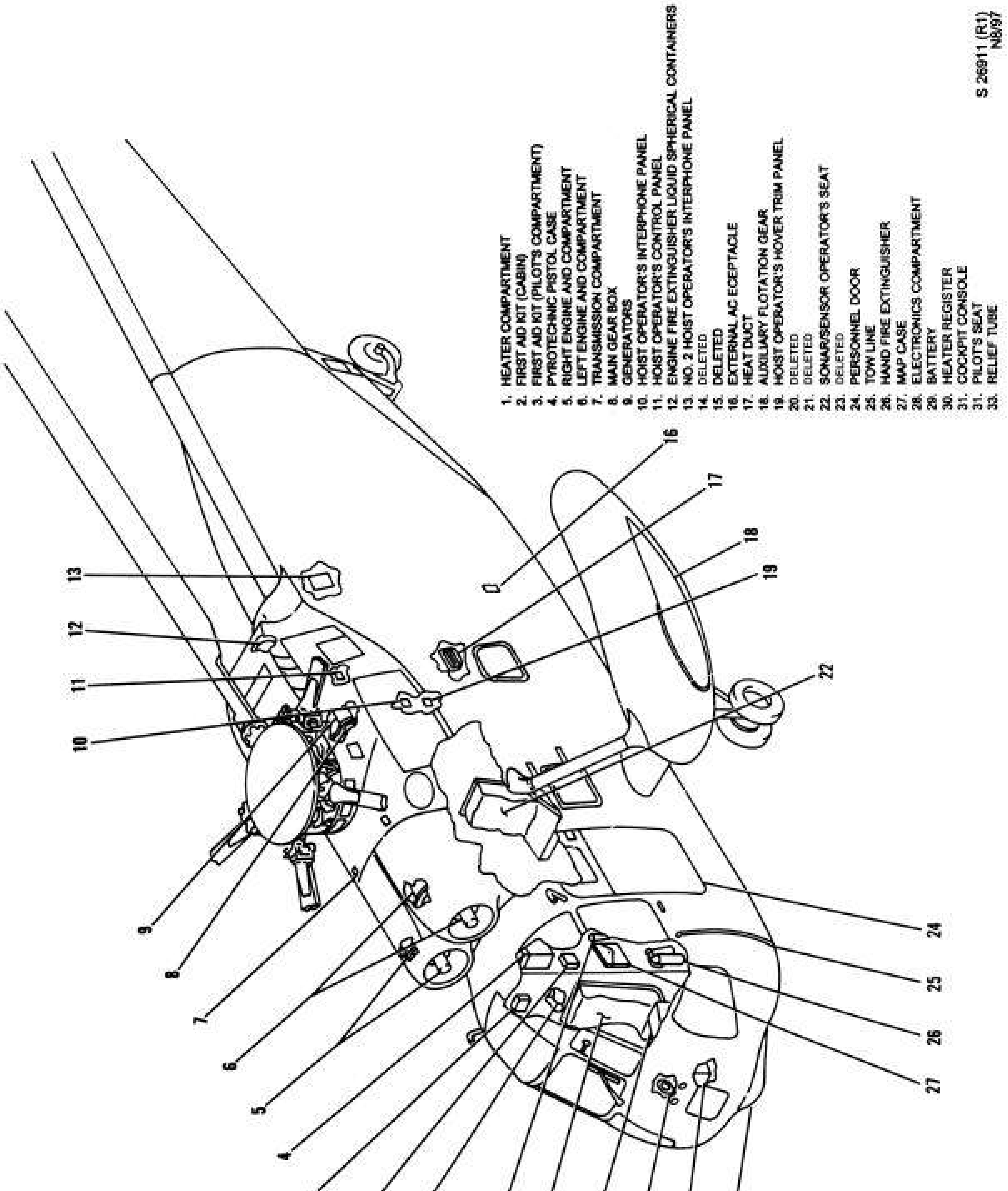


Figure 2-1. General Arrangement - Interior

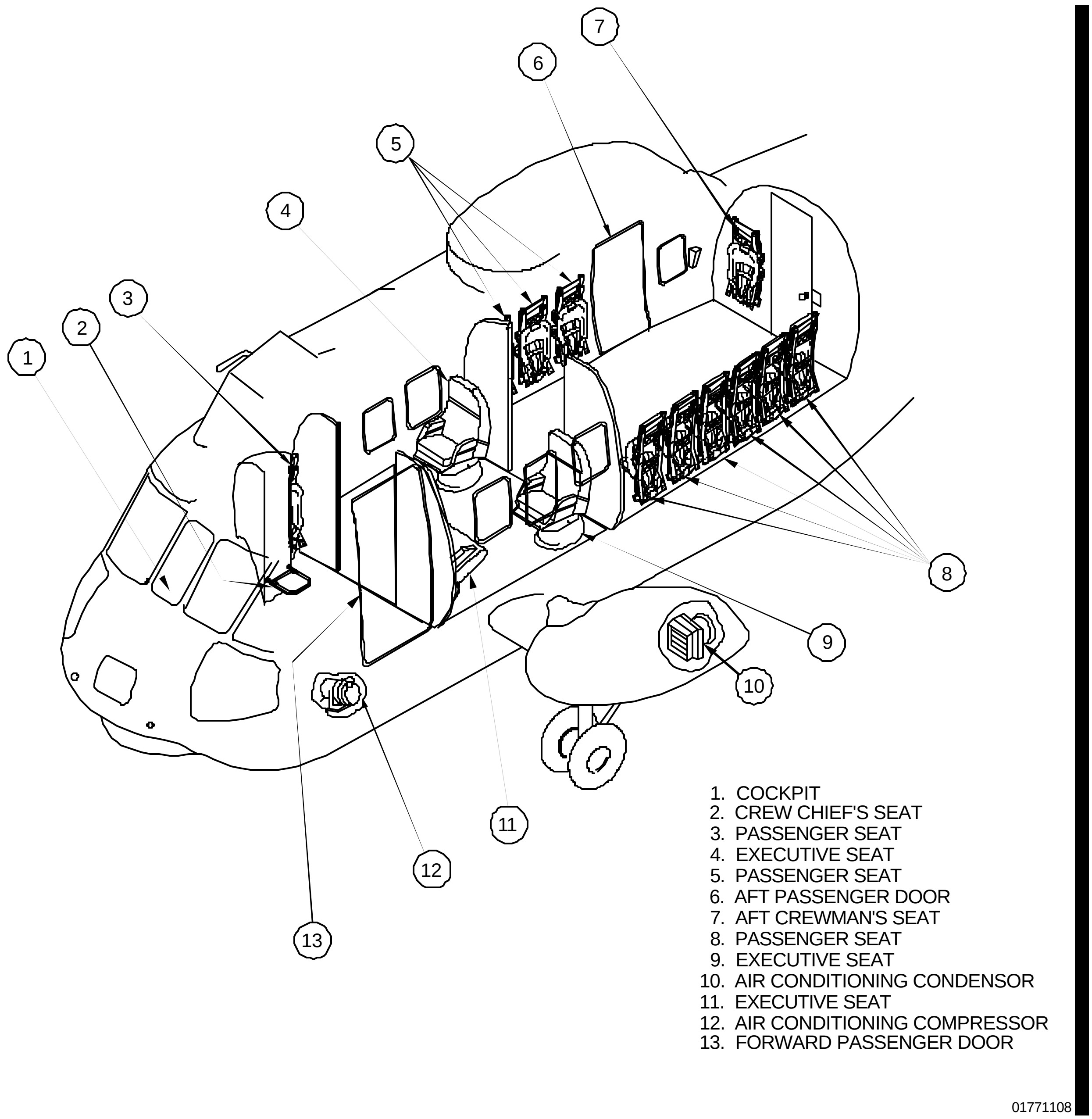


Figure 2-1.1 (ET) General Arrangement ¾ Interior

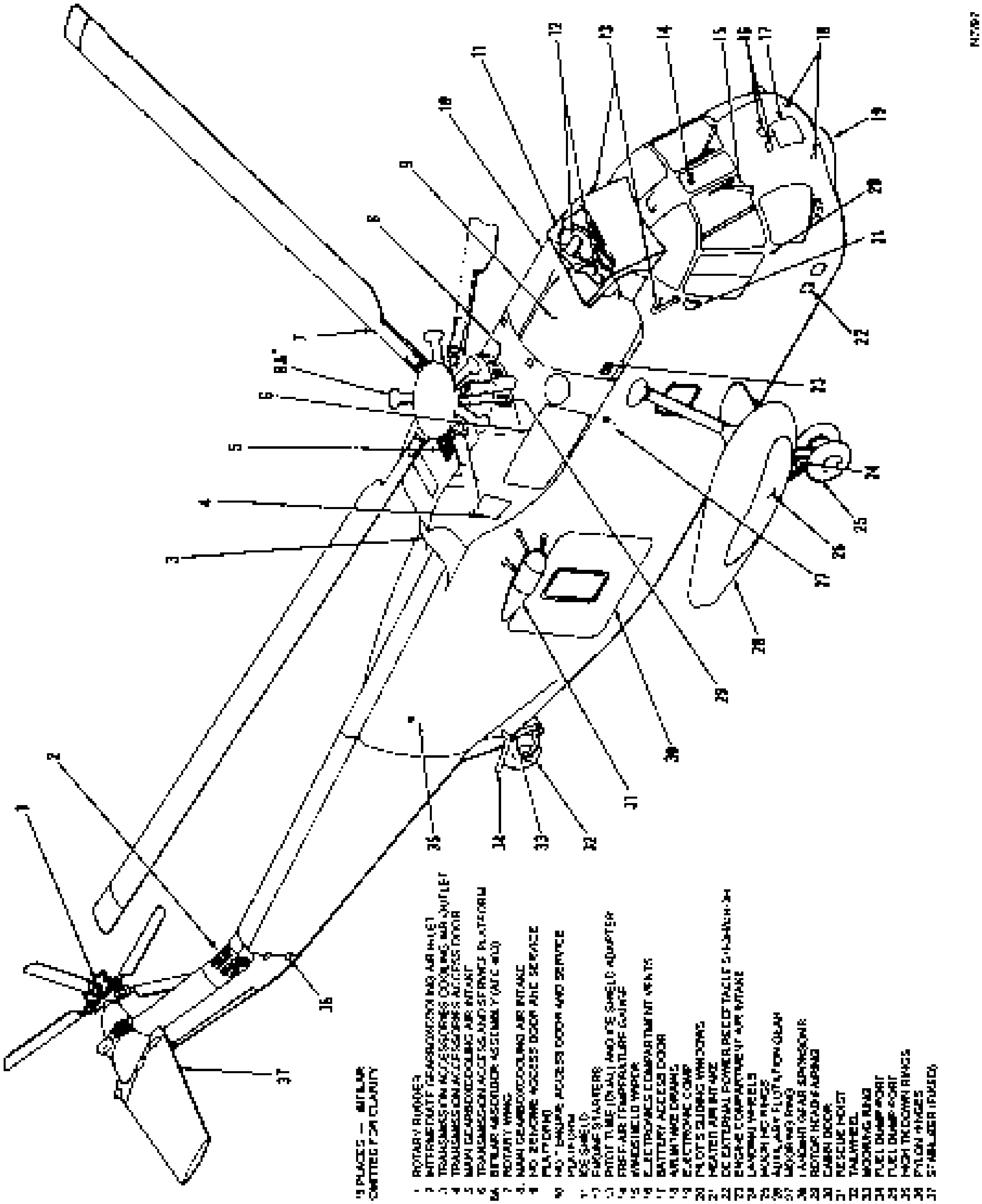


Figure 2-2. General Arrangement – Exterior (Sheet 1 of 2)

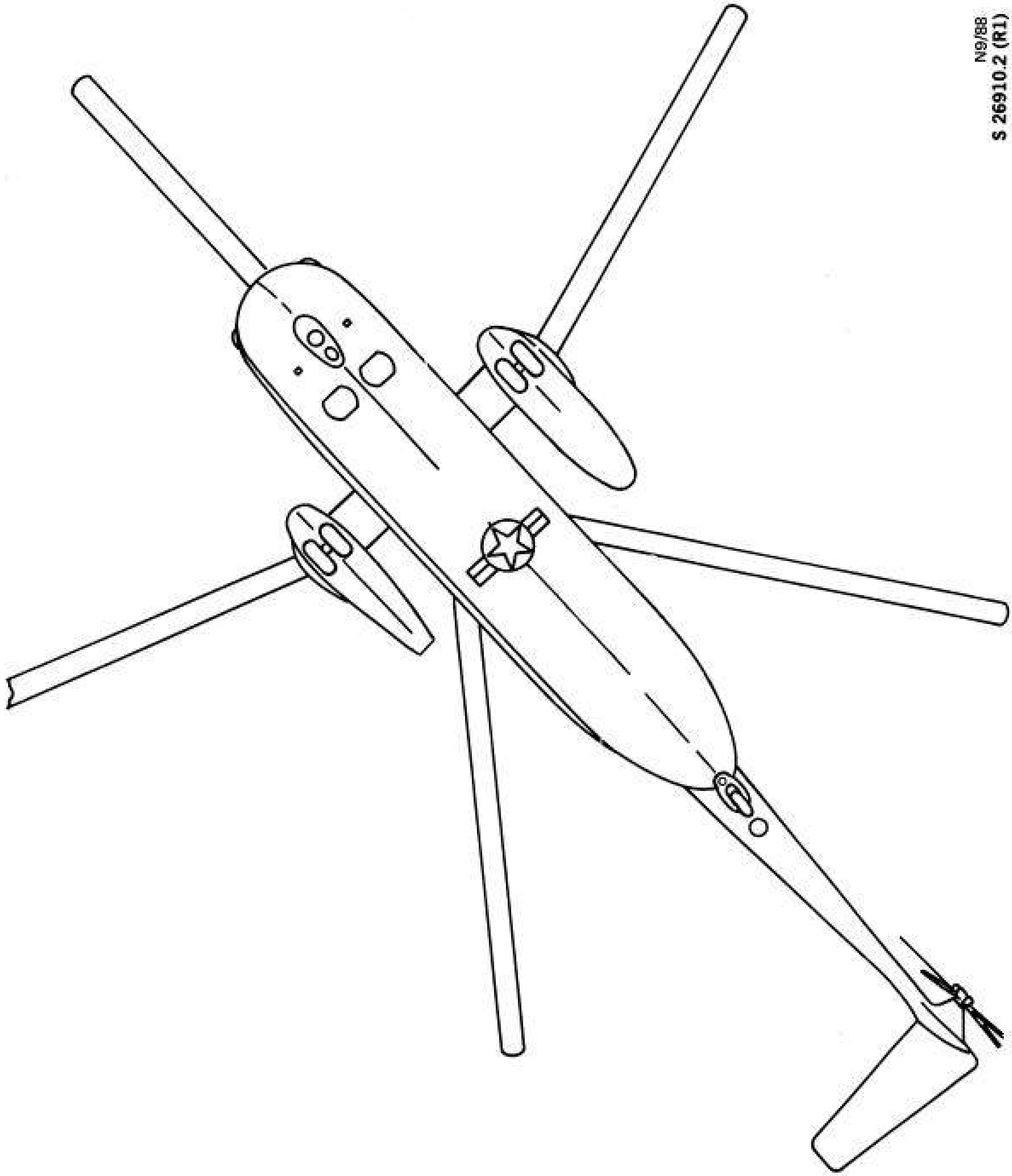
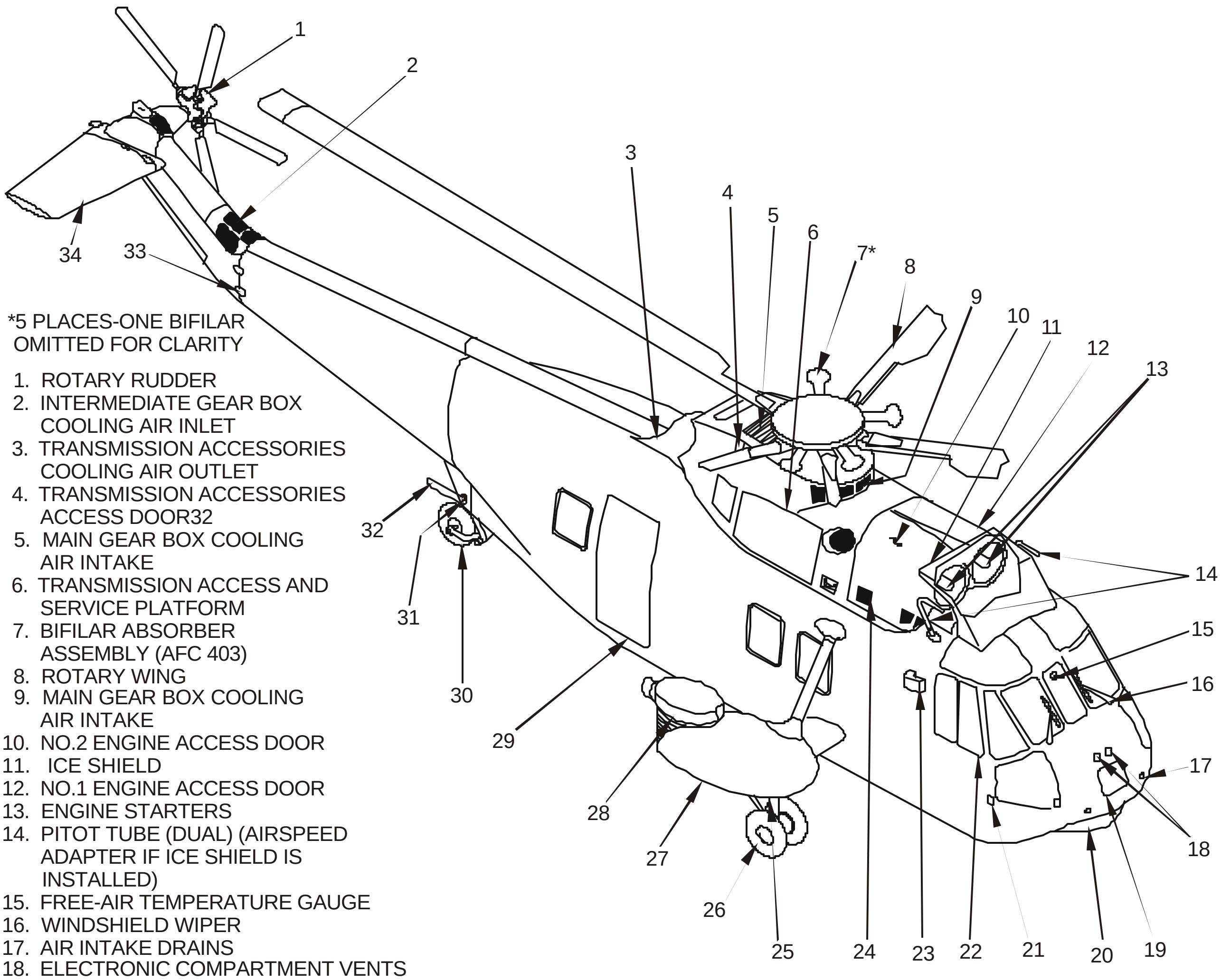


Figure 2-2. General Arrangement – Exterior (Sheet 2 of 2)

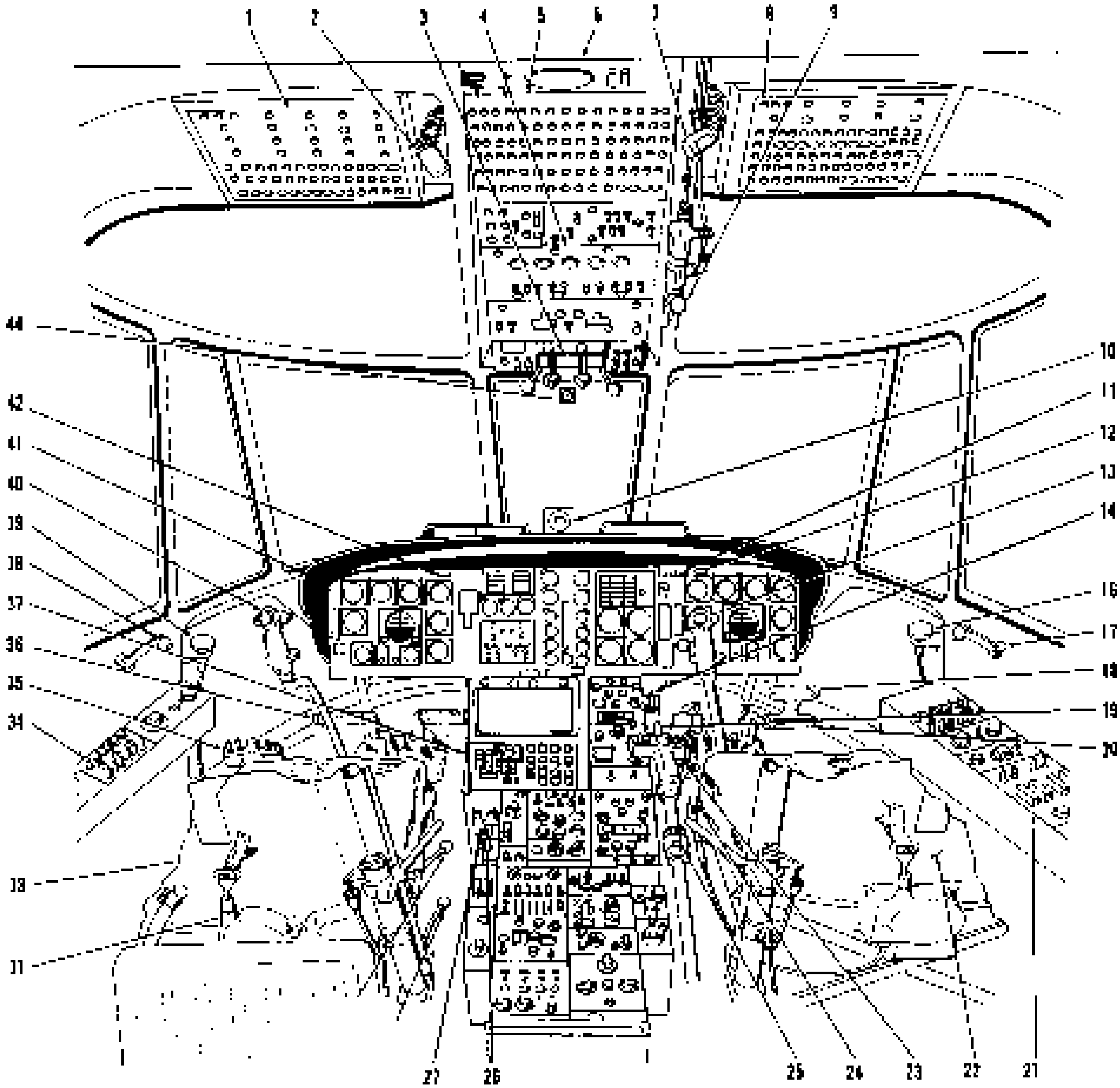


*5 PLACES-ONE BIFILAR OMITTED FOR CLARITY

1. ROTARY RUDDER
2. INTERMEDIATE GEAR BOX COOLING AIR INLET
3. TRANSMISSION ACCESSORIES COOLING AIR OUTLET
4. TRANSMISSION ACCESSORIES ACCESS DOOR32
5. MAIN GEAR BOX COOLING AIR INTAKE
6. TRANSMISSION ACCESS AND SERVICE PLATFORM
7. BIFILAR ABSORBER ASSEMBLY (AFC 403)
8. ROTARY WING
9. MAIN GEAR BOX COOLING AIR INTAKE
10. NO.2 ENGINE ACCESS DOOR
11. ICE SHIELD
12. NO.1 ENGINE ACCESS DOOR
13. ENGINE STARTERS
14. PITOT TUBE (DUAL) (AIRSPEED ADAPTER IF ICE SHIELD IS INSTALLED)
15. FREE-AIR TEMPERATURE GAUGE
16. WINDSHIELD WIPER
17. AIR INTAKE DRAINS
18. ELECTRONIC COMPARTMENT VENTS
19. BATTERY ACCESS DOOR
20. ELECTRONICS COMPARTMENT
21. DC EXTERNAL POWER RECEPTACLE
22. PILOT'S SLIDING WINDOW
23. HEATER AIR INTAKE
24. ENGINE COMPARTMENT AIR INTAKE
25. MOORING RINGS
26. LANDING WHEELS
27. LANDING GEAR SPONSON
28. AUXILIARY POWER UNIT
29. AFT PASSENGER DOOR
30. TAIL WHEEL
31. MOORING RING
32. FUEL DUMP PORT
33. PYLON HINGE
34. STABILIZER

01771009

Figure 2-2.2 (ET) General Arrangement ¾ Exterior



1. COPILOT'S CIRCUIT BREAKER PANEL
2. COPILOT'S SPOTLIGHT
3. ENGINE CONTROL QUADRANT
4. OVERHEAD SWITCH PANEL
5. CENTER CIRCUIT BREAKER PANEL
6. PILOT'S COMPARTMENT DOME LIGHT PANEL
7. PILOT'S SPOTLIGHT
8. PILOT'S CIRCUIT BREAKER PANEL
9. ROTOR BRAKE LEVER
10. STANDBY COMPASS
11. FIRE WARNING LIGHT
12. MASTER CAUTION LIGHT
13. PILOT'S CYCLIC STICK
14. PARKING BRAKE HANDLE
15. DELETED
16. PILOT'S TAIL ROTOR PEDAL ADJUSTMENT KNOB
17. PILOT'S WINDOW EMERGENCY RELEASE HANDLE
18. PILOT'S TOE BRAKES
19. TAILWHEEL LOCK HANDLE
20. PILOT'S TAIL ROTOR PEDALS
23. PILOT'S COLLECTIVE PITCH LEVER
24. PILOT'S SHOULDER HARNESS LOCK LEVER
25. COLLECTIVE STICK FRICTION CONTROL
26. EMERGENCY LANDING GEAR EXTENSION HANDLE
27. LANDING GEAR CONTROL PANEL

31. COPILOT'S SHOULDER HARNESS INERTIA REEL (TYPICAL)
32. DELETED
33. COPILOT'S SEAT
34. COPILOT'S CONSOLE
35. COPILOT'S COLLECTIVE PITCH LEVER
36. COPILOT'S TAIL ROTOR PEDALS
37. COPILOT'S CONSOLE
38. COPILOT'S TAIL ROTOR PEDAL ADJUSTMENT KNOB
40. COPILOT'S CYCLIC STICK
41. INSTRUMENT PANEL
42. MASTER CAUTION LIGHT
43. DELETED

Figure 2-3. (NON-ET) Pilot Compartment (Typical) (Sheet 1 of 2)

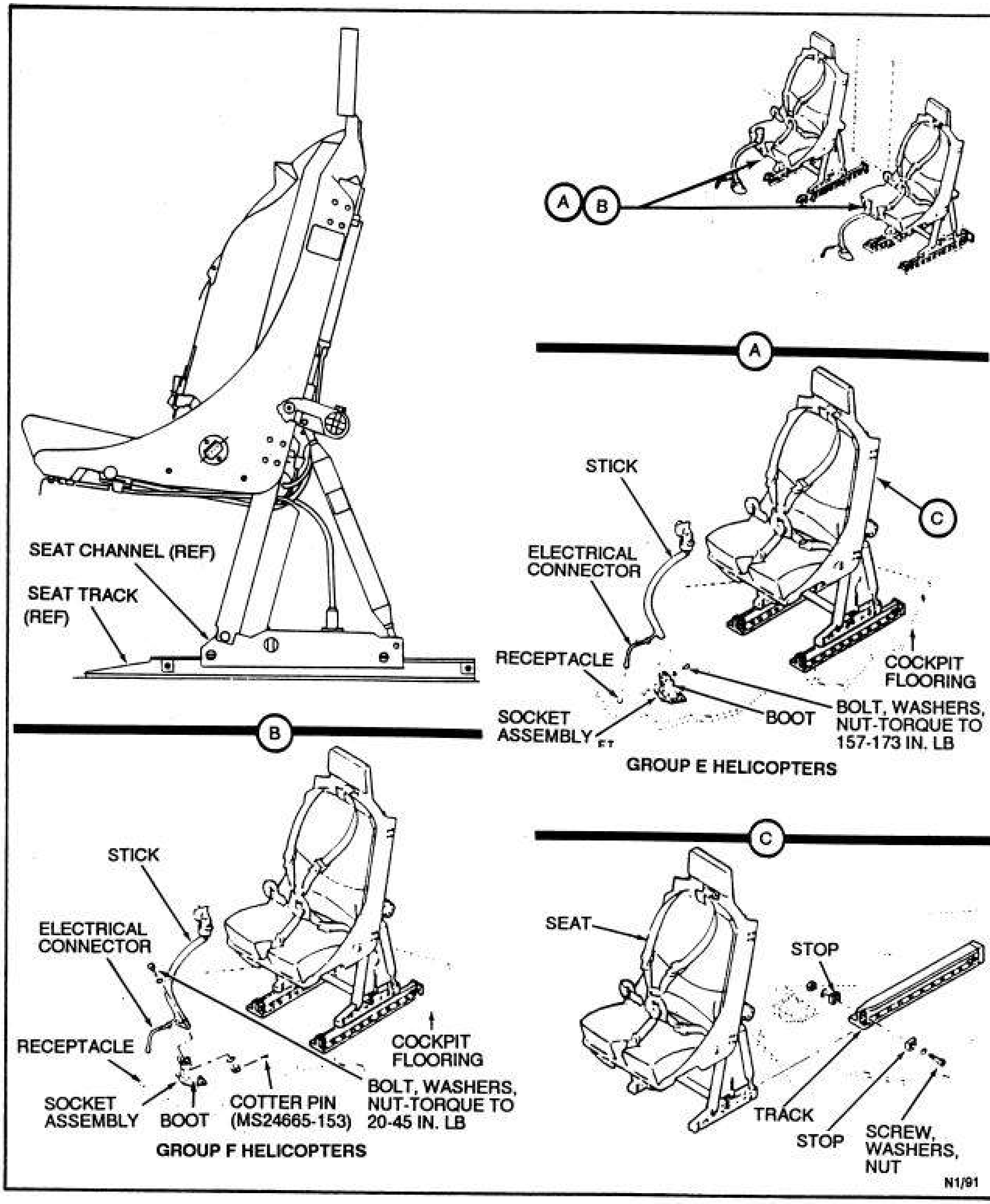


Figure 2-3. Pilot Compartment (Typical) (Sheet 2of 2)

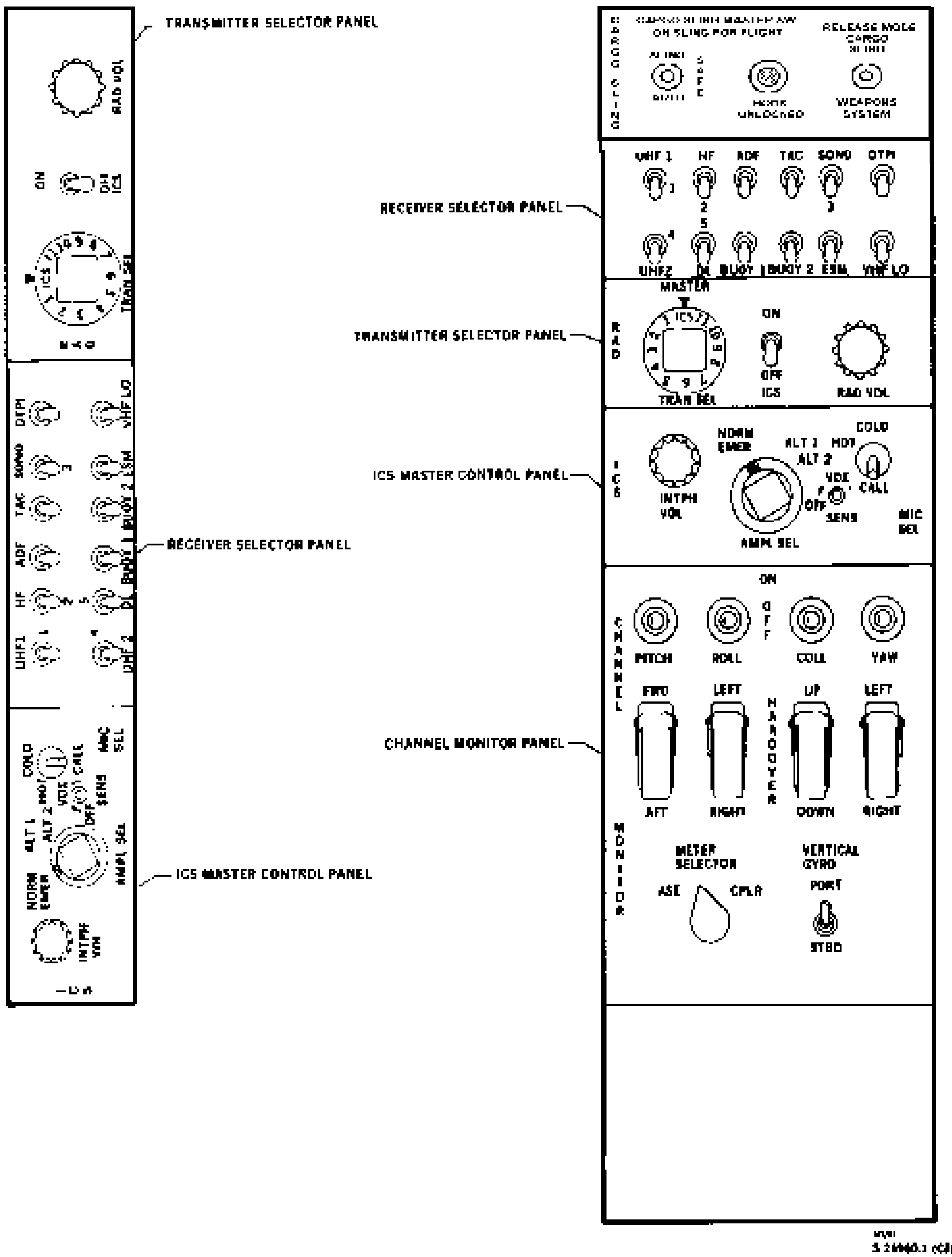


Figure 2-4. Pilot Console (Typical)

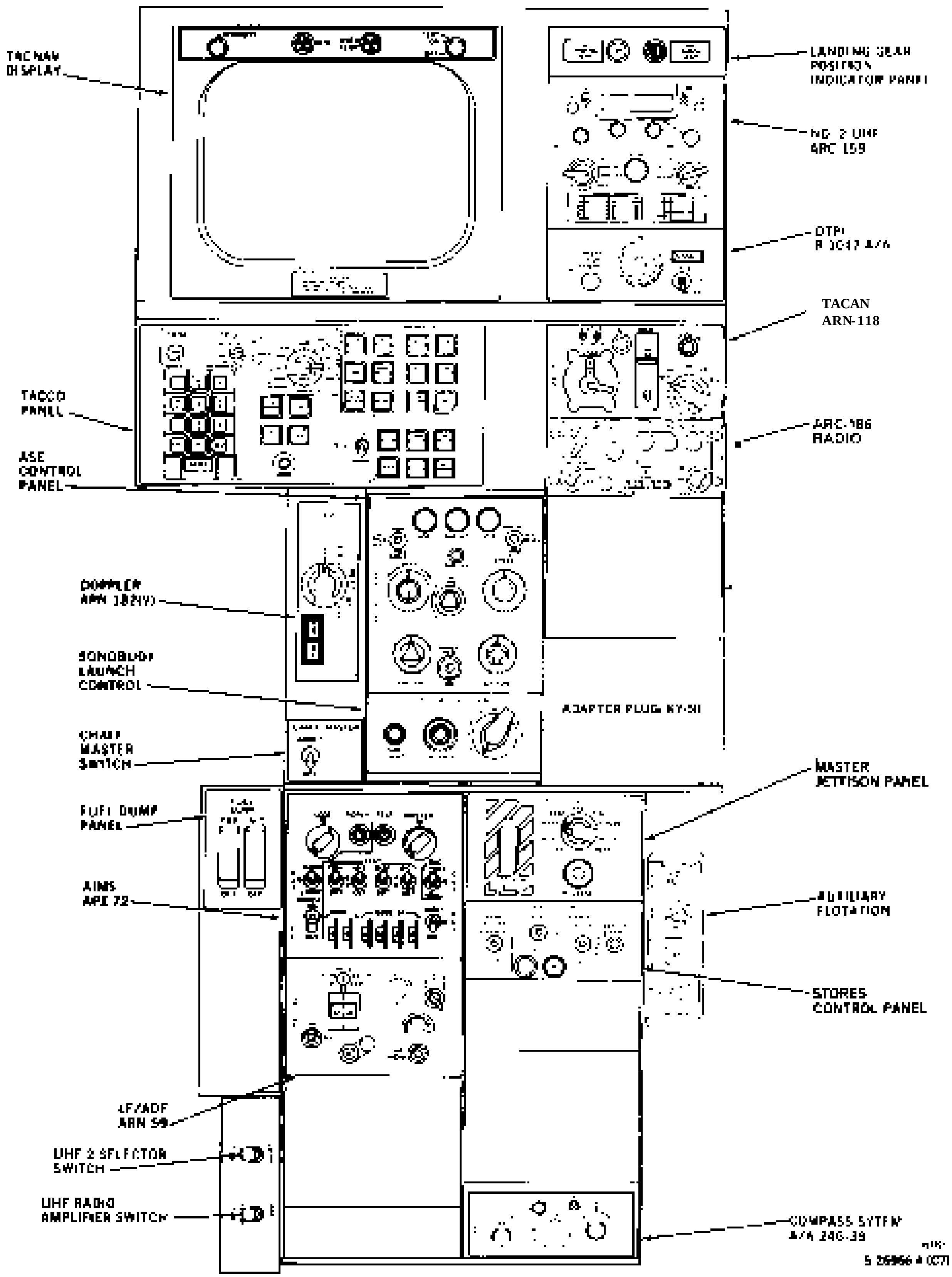


Figure 2-5. Cockpit Console (Typical)

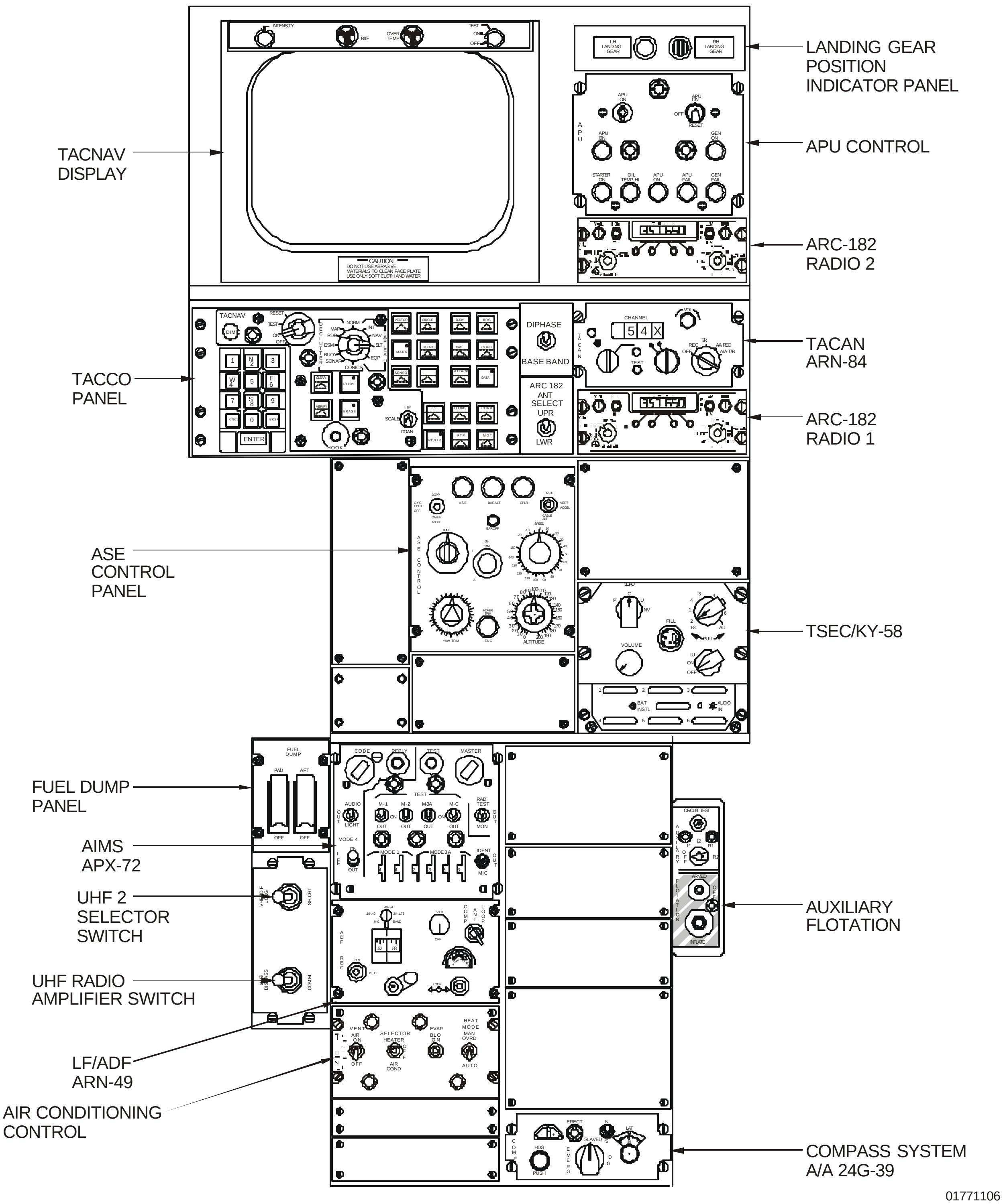


Figure 2-5.1 (ET) Cockpit Console

During the start cycle, the auxiliary metering valve provides additional fuel through the flow divider. This fuel may be shut off by means of the auxiliary start shutoff valve to prevent T_5 overtemperature. The engine fuel control prevents compressor stall, turbine over temperature, rich or lean flameouts, governs gas generator idle speed, and schedules inlet guide and stator vane positions to provide optimum compressor performance.

2.1.4 Engine Control System. The power available from the engine is directly determined by and in proportion to the T_5. It is therefore desirable to operate the engine at the highest turbine inlet temperature consistent with the physical limitations of the engine components. The engine control does this by maintaining operation within its own limits. The engine accelerates and decelerates according to preset schedules incorporated in the computing section of the engine control. These schedules are designed to prevent overspeed and overtemperature conditions. Therefore, engine response to a new power or speed setting is not instantaneous; a few seconds must be allowed for the engine to stabilize at the new condition. Acceleration because of increased power requirements or control lever movement is limited by the maximum ratio of fuel flow to compressor discharge pressure (W_f/P3) or by topping. Deceleration because of decreased power requirements or control lever movement is limited by the minimum ratio of fuel flow to compressor-discharge pressure, the negative feedback, or bottoming. Selected steady-state conditions are stabilized at optimum efficiency by a lead-lag servo system that dampens the effect of power transients and maintains power turbine speed within the specified 8.5-percent droop at 120^o fuel control input shaft position.

2.1.4.1 Fuel Flow Compressor Discharge Pressure Ratio. The fuel control does not monitor power turbine inlet temperature directly; it monitors compressor-discharge pressure and adjusts fuel flow to maintain engine temperatures within safe predetermined limits. The ratio of fuel to be burned to the amount of air available for both combustion and cooling directly determines the temperature of the combustion gases (and power available) at any point in a turboshaft engine. Therefore, the ratio of fuel flow to compressor-discharge pressure has been selected as the most convenient absolute value for determining engine potential for any given condition.

2.1.4.2 Engine Control Input Shaft. The position of the engine fuel control input shaft determines the power turbine speed and hence the helicopter rotor speed. The remaining parameters supplement the engine fuel control input shaft signal, working to satisfy the speed setting called for regardless of load demand. The engine fuel control shaft at the engine can be turned through a 120^o arc. In the 0^o position, the stopcock in the fuel control is closed, preventing any fuel from entering the engine. At 3^o, the stopcock starts to open, and at 6^o it is fully open. From l5^o to 47^o, the gas generator operates on deadband idle. From 47^o to 69^o, the control operates in a transition region. Power turbine speed is governed in the 70^o to 120^o range. The normal operating range of the engine is above the 70^o position, and power turbine speed increases in an essentially linear manner at a rate of 56 rpm per degree of control shaft rotation.

2.1.4.3 Fuel-Air Ratio Limits. Maintenance of a continuous flame within the gas generator combustor depends on proper mixture of fuel and air. As performance factors change, the values of both will change. The proportion between the two, however, must be controlled within limits or the flame will be lost (flameout). During deceleration, if fuel flow (which is decreasing) drops below a given amount, a lean flameout may occur; during acceleration, if fuel flow (which is increasing) rises above a given amount, a rich flameout may take place.

2.1.4.4 Stator Vane Actuating System. The purpose of the stator vane actuating system is to control the direction and velocity of the air leaving the stator vanes so that the proper angle of attack is preserved with respect to the compressor rotor blades. The inlet guide vanes and the first, second, and third stage stator vanes are varied in pitch by a hydraulic servo mechanism powered by engine fuel pressure and controlled by the gas generator governor section of the fuel control. The variable vanes that are closed during engine starting begin to open at about 60-percent N_g, depending on outside air temperature.

2.1.4.5 Temperature Limits. The amount of heat that engine components (particularly turbine buckets and turbine nozzles) can withstand without structural damage limits the amount of heat energy that can be released by burning fuel. Temperature is controlled by limiting the maximum fuel flow at any speed and inlet condition or, at full power conditions, by limiting the maximum gas generator speed.

2.1.4.6 Idle to Transition Range. A small advance of the engine speed selector will cause the engine to accelerate to the transition range. As the engine speed selector is advanced, T_5 will advance fairly rapidly as the fuel flow/compressor discharge pressure ratio increases until it is limited by the lever position. At this point, the feedback function of fuel lever will decrease the W_f/P3 ratio, lowering T_5 until a new steady-state operation is attained. During this time, N_g should show steady increase. Prolonged operation of the engine in the transition range is not recommended.

2.1.4.7 Idle to Normal Operating (N_f Governing) Range. As the engine speed selector is advanced from the GRD IDLE position into the normal operating range, T_5 and N_f will advance rapidly as the W_f/P3 ratio increases until it reaches the maximum acceleration schedule. Fuel flow will continue to increase in proportion to N_g according to the maximum acceleration schedule until the engine tops out. At this point, the W_f/P3 ratio and T_5 will decrease along the topping schedule as N_g increases to a new steady-state condition.

2.1.4.8 Increasing Engine Load. Increasing engine load causes the gas generator to accelerate. During acceleration, maximum fuel flow is delivered to the engine with the rate of increase limited by the 3D cam contours to avoid compressor stall, rich or lean flame-out, or turbine overtemperature. When the gas generator speed required to match output power to the new load is reached, fuel flow decreases to the level necessary to maintain the new steady-state speed.

2.1.4.9 Decreasing Engine Load. Decreasing engine load causes the gas generator to decelerate. During deceleration, the engine fuel control supplies the minimum fuel flow that will maintain combustion until the gas generator approaches the speed that will match output power to the new load. The engine fuel control then supplies the fuel flow necessary to maintain this speed.

2.1.4.10 Retarding Engine Speed Selector. Slightly retarding the engine speed selector under normal or military load conditions so that N_g does not drop below 80-percent N_g will yield a deceleration not affected by feedback. The W_f/P3 ratio decreases to the limit set by the new engine speed selector position and remains constant as the engine decelerates to the new steady-state condition.

2.1.4.11 Deceleration to Idle. Retarding the engine speed selector from the normal operating range to GRD IDLE decreases fuel flow until the minimum W_f/P3 stop is reached. The gas generator slows down on a minimum W_f /P3 schedule until it reaches about 80-percent speed. At this point, the negative feedback function of the engine fuel control starts increasing the W_f/P3 ratio until the bottoming schedule is reached. The gas generator then decelerates with an increasing W_f/P3 ratio determined by the bottoming schedule until idle speed is reached.

2.1.4.12 Shutdown. When the engine speed selector is moved to the closed position, the stopcock shuts off all fuel flow to the engine. The speed selectors can be immediately shut down from any operating condition in an emergency.

2.1.4.13 Engine Power. In the power regime, the engine drives the helicopter rotary wing at the speed and power level selected by the pilot. For normal operation, a power turbine speed within the range of 91 to 112.5 percent is selected. The engine control system maintains this selected speed by varying gas generator speed to meet the different power requirements produced by a change in the helicopter blade pitch angles, forward speeds, and atmospheric conditions. As blade pitch angle is increased, the engine fuel control increases gas generator speed until the maximum gas generator speed is reached. If the blade pitch angle is increased when the maximum gas generator speed is reached, a reduction in rotary wing speed will occur.

2.1.4.14 Compressor Stall Limit. Stall designates reversals of flow within the compressor. The severity of stall depends upon the number of reversals that take place per second. Compressor stall will result in most cases with the engine in a decelerating condition. The primary indication of a stall is a rise in T_5 and other engine parameters decreasing. It may or may not be accompanied by audible rumbling or other engine noise. Each compressor has a maximum pressure ratio for every speed at which it operates. The maximum pressure ratio sets a limit on the compressor discharge that can result from rotating the compressor at a particular speed. As long as the pressure at the compressor discharge equals or is below this limit, the compressor will deliver air smoothly; however, if this limit is exceeded, flow will be reduced and there will be some reverse flow through the compressor. If it were not for the engine fuel control system, stall could occur during an attempt to accelerate the engine. A sudden and excessive increase in fuel flow might generate a volume of gas that would create an excessive backpressure at the compressor discharge, and compressor stall would result. Because each compressor speed has its own maximum compressor ratio, each must have its own stall point (the point at which stall begins). Stall is avoided by limiting fuel flow during engine acceleration as a function of inlet air temperature, gas generator speed, and compressor discharge pressure.

2.1.4.15 Permanent Droop. Power turbine speed, minus droop, is maintained within the governed range (91 - to 112.5 percent N_f) as selected by the speed selectors. Droop is a characteristic built into the engine control system that establishes a permanent decrease in power turbine governed speed from that set at zero load as engine power increases to maximum load. This droop is 5 to 8.5 percent from no load to full load with proportional decreases at intermediate power settings. This difference in droop schedules will result in torque splits. Thus, if N_f is set at 108.5 percent in an autorotation with no load on the engine and speed selectors are not moved during recovery, the engine and rotor speed would decrease to 100-percent N_f as engine reaches full power. On the ground and at flat pitch, approximately 400 hp is absorbed by the rotor at 100- to 108-percent N_r; thus the engine has already drooped approximately 5-percent N_f from no load. This droop characteristic is incorporated to ensure N_f stability and provide load sharing in multiengine installations.

2.1.4.16 Transient Droop. The engine accelerates and decelerates in response to power demands on a preset schedule. Therefore, if power is demanded at a rate exceeding engine ability to accelerate, an additional momentary droop in N_f/N_r will be experienced, called transient droop. As the engine accelerates, transient droop is eliminated.

2.1.4.17 Speed Limits. The gas generator and the power turbine have maximum speeds that cannot be exceeded without danger or damage. These limits are established in Chapter 4. These are steady state speeds of 26,220 rpm 101.8 percent max continuous for the gas generator, and 21,275 rpm 112.5 percent for the power turbine.

2.1.5 Engine Controls

2.1.5.1 Engine Fuel Control System Operation. The engine fuel control system must schedule fuel flow and variable vane position during four general operating conditions. These conditions are starting, ground idle, minimum governing, and 100-percent speed. The regimes of these conditions are related to the various engine speed selector settings.

2.1.5.2 Engine Speed Selectors. Two engine speed selectors marked NUMBER 1 ENGINE and NUMBER 2 ENGINE are on the overhead engine control quadrant (Figure 2-6). Markings on the overhead quadrant are SHUT OFF, GRD IDLE, MIN GOV and 100% SPEED. When the engine speed selectors are at SHUTOFF, fuel flow to the fuel nozzles is stopped by means of a stopcock. This prevents fuel from entering the combustion chambers during coastdown of the engine gas generators or during operation of fuel boost pumps with the engine shutdown. The stopcock is directly actuated by the position of the engine speed selector. It is open whenever the engine speed selector position is 6° or more from SHUTOFF and is closed when the selector is 3° or less from SHUTOFF. The GRD IDLE position schedules fuel flow to produce a gas generator speed of about 56 ±3-percent N_g. Gas generator idle speed will vary with inlet air temperature. A limit stop at GRD IDLE prevents inadvertent retarding of the speed selectors below the idle speed of the engines. The speed selectors may be retarded from the limit stop by pulling the control out of the detent and exerting upward pressure. An accessory drive limit switch is incorporated at GRD IDLE on the No. 1 speed selector. This limit switch prevents switching from accessory drive to flight without first retarding the NUMBER 1 ENGINE speed selector lever to GRD IDLE. MIN GOV on the speed selector is the point where the governing range of the power turbine is entered, and is about 89-percent N_f. When the speed selector is at full forward, the engine is producing maximum power turbine speed. The starter abort switches are in each speed selector.

2.1.5.3 Engine Vernier Knobs. A vernier knob (see Figure 2-6) above each engine speed selector provides vernier control of the engine speed selectors. An arrow on the face of each knob is marked INC to indicate the direction of turning to increase rpm. Turning the knob in a clockwise direction mechanically moves its respective speed selector to increase rpm. Turning the knob in a counterclockwise direction decreases rpm.

2.1.5.4 Emergency Fuel Control Levers (Manual Throttles)

CAUTION

- At higher power settings, considerable dead band travel will normally be encountered before the emergency fuel control contacts the metering valve lever. This will be felt as a slight restriction in control movement. When this is felt, the control will be very sensitive and care should be taken not to exceed T_5 and N_g limits.
- The fuel control will not operate on manual throttle if the speed selector is stopcocked.
- To prevent stall, movement of manual throttle out of GRD IDLE should be slower than movement in the governing range.

Two emergency fuel control levers (hereafter referred to as manual throttles) (see Figure 2-6), one for each engine, marked EMERGENCY FUEL CONTROL with marked positions OPEN and CLOSE are on each side of the overhead quadrant. The manual throttles operate independently and are used in case of fuel control unit failure. Each manual throttle has positive open and closed stops and is connected directly to the main metering valve in each engine fuel control unit by a flexible cable and linkage. The primary function of the manual throttle is to manually override the automatic features of the fuel control. This may become necessary under some starting situations and during any fuel control malfunction that causes erratic engine operation. The manual throttle must be used with

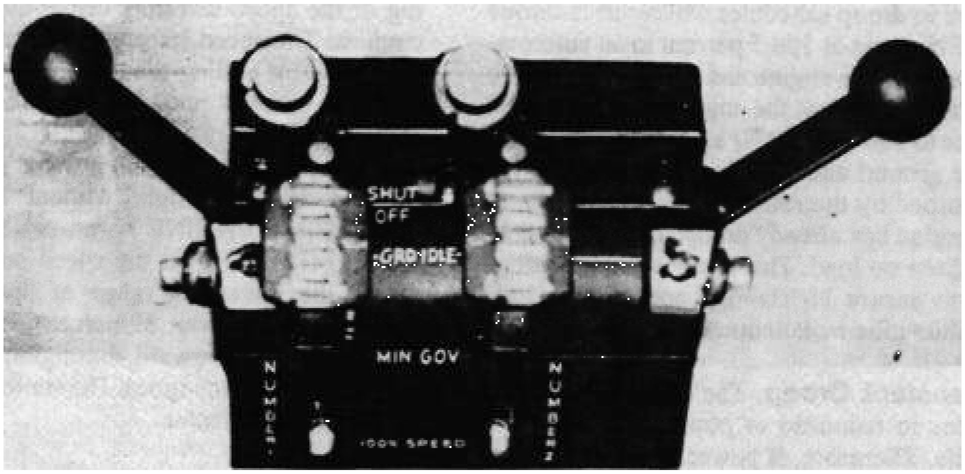


Figure 2-6. Overhead Engine Controls

extreme caution as it has a positive influence on fuel flow, and misuse can cause engine overspeed or overtemperature. The lever is mechanically connected to a cam within the fuel control that contacts the fuel metering valve. The initial position of the fuel metering valve is dependent upon the automatic features of the control as established by the setting of the speed selector. The cam, when actuated by advancing the manual throttle, contacts the fuel metering valve. Once contact is established, further advancement of the manual throttle will manually control fuel flow that in turn regulates engine power output. The manual throttle is unable to reduce the position of the metering valve below that called for by the speed selectors. Control below this point will depend upon the type of malfunction encountered. In all instances of manual throttle operation, it must be remembered that the speed selectors should not be retarded beyond GRD IDLE.

WARNING

With manual throttle actuated, resistance may occur in the speed selector during conditions requiring movement at or below the minimum governing range marking on the throttle quadrant. Attempts to retard speed selector beyond the point at which this resistance occurs may result in inadvertent engine shutdown.

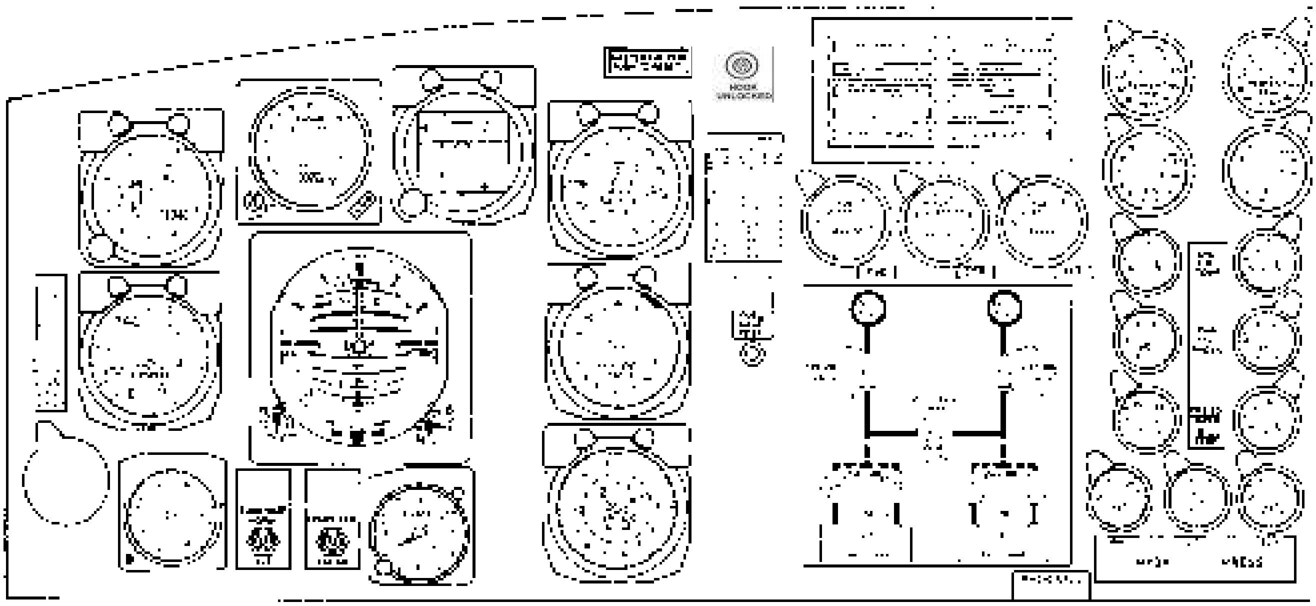
The fuel stopcock is downstream of the metering valve and is actuated by the speed selectors. Placing the speed selector to SHUTOFF will stop engine fuel flow regardless of manual throttle control lever position.

2.1.6 Engine Instruments

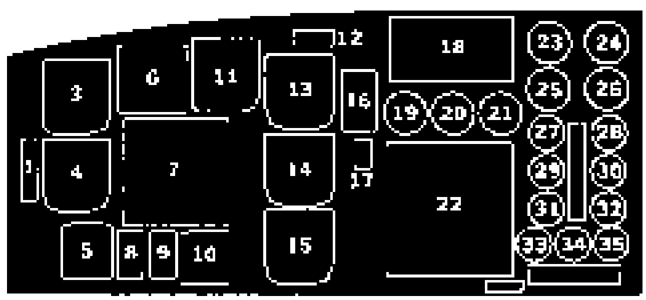
2.1.6.1 Power Turbine Inlet Temperature Indicators. Two of these indicators (Figure 2-7) marked EXH TEMP indicate engine power turbine inlet air temperatures in degrees celsius and are on the instrument panel. The indicators operate from thermocouples forward of the power turbine in the second-stage turbine casing on each engine. When the dissimilar metals of the thermocouples in the engine are heated, an electromotive force (independent of the helicopter electrical system) is created and a resulting current flow through a known resistance of the thermocouple circuit deflects the indicator needle that is read in degrees celsius. The pilot has no direct control for regulating the power turbine inlet temperatures; however, limited control for lowering these temperatures can be indirectly achieved by reducing collective pitch or power demand.

2.1.6.2 Oil Pressure Indicators. Two of these indicators (Figure 2-7), one for each engine, are on the instrument panel and indicate oil pressure in pounds per square inch. The indicators are powered by 26 vac and each is protected by circuit breakers.

2.1.6.3 Oil Temperature Indicators. Two of these indicators (Figure 2-7), one for each engine, are on the instrument panel and indicate engine oil temperature in degrees celsius. The engine oil temperature bulb in the bottom of the tank transmits indications to the respective temperature indicators. The indicators are powered by 28 vdc and protected by circuit breakers marked 1 ENG 2 under the general heading OIL TEMP on the center circuit breaker panel.



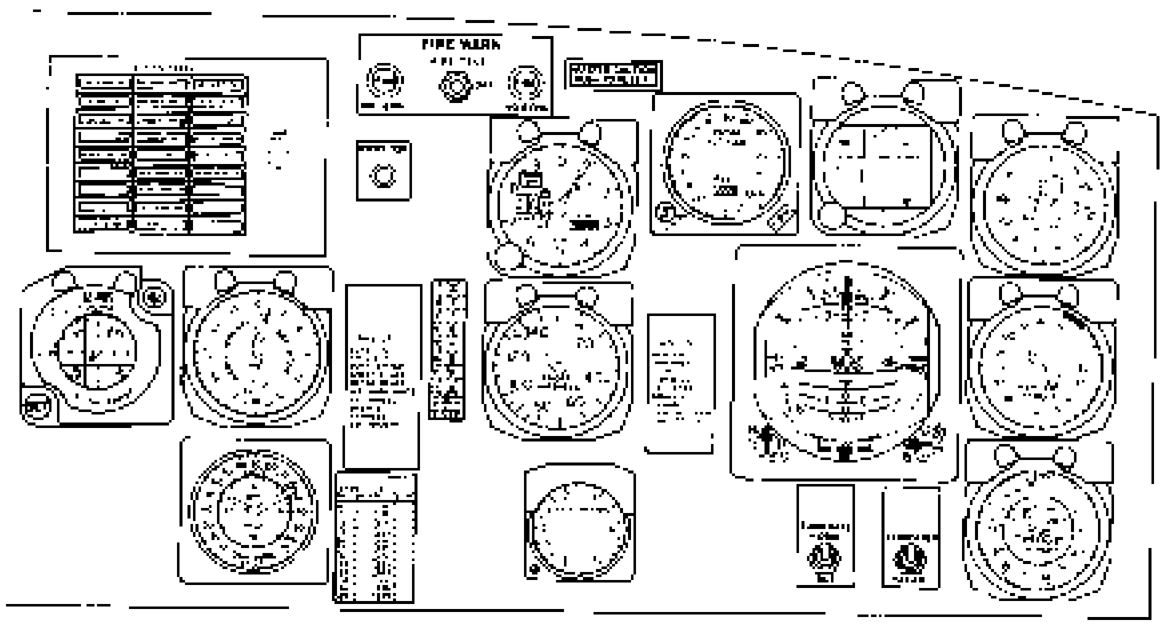
1. SPEED CORRECTION CARD
2. DELETED
3. BAROMETRIC ALTIMETER
4. AIRSPEED INDICATOR
5. VERTICAL VELOCITY INDICATOR
6. RADAR ALTIMETER
7. ATTITUDE INDICATOR
8. TURN RATE SWITCH
9. BDHI SELECTOR SWITCH
10. CLOCK
11. HOVER INDICATOR
12. MASTER CAUTION LIGHT
13. BDHI
14. TORQUE INDICATOR
15. TRIPLE TACHOMETER
16. COMPASS CORRECTION CARD
17. FUEL GAUGE TEST BUTTON
18. ADVISORY PANEL
19. FORWARD FUEL QUANTITY GAUGE
20. CENTER FUEL QUANTITY GAUGE
21. AFT FUEL QUANTITY GAUGE
22. FUEL MANAGEMENT PANEL
23. NO. 1 ENGINE Ng TACHOMETER
24. NO. 2 ENGINE Ng TACHOMETER
25. NO. 1 ENGINE T5 GAUGE
26. NO. 2 ENGINE T5 GAUGE
27. NO. 1 ENGINE OIL TEMPERATURE GAUGE
28. NO. 2 ENGINE OIL TEMPERATURE GAUGE
29. NO. 1 ENGINE OIL PRESSURE GAUGE
30. NO. 2 ENGINE OIL PRESSURE GAUGE
31. MAIN GEARBOX OIL PRESSURE GAUGE
32. MAIN GEARBOX OIL TEMPERATURE GAUGE
33. PRIMARY SERVO HYDRAULIC PRESSURE GAUGE
34. UTILITY HYDRAULIC PRESSURE GAUGE
35. AUXILIARY SERVO HYDRAULIC PRESSURE GAUGE



N6/97

Figure 2-7. Instrument Panel (Typical) (Sheet 1 of 2)

2.1.6.4 Gas Generator Tachometers. Two engine gas generator tachometers (Figure 2-7), one for each engine, are on the instrument panel. The gas generator tachometer indicates the speed of the gas generator in percent of total rpm. Each tachometer has two dials and pointers. The outer dial and pointer indicate 0- to 100-percent gas generator speed in units of 2 percent, and the small vernier dial and pointer in the upper left-hand position of the tachometer indicate gas generator speed from 0 to 10 in units of 1 percent. The gas generator tachometer-generator is driven by the engine lube pump on which it is mounted. The electrical power produced by the gas generator tachometer-generator is proportional to gas generator rpm. A 100-percent gas generator speed (100-percent N_g) is 26,300 rpm.



36. CAUTION PANEL
37. COURSE INDICATOR
38. RMI
39. DELETED
40. DSDA
41. ENGINE FIRE WARNING LIGHTS AND TEST SWITCH
42. RAWS TEST BUTTON
43. TAKEOFF CHECKLIST
44. COMPASS CORRECTION CARD
45. AIRSPEED CORRECTION CARD
46. DELETED
47. MASTER CAUTION LIGHT
48. BAROMETRIC ALTIMETER - ENCODER
49. AIRSPEED INDICATOR
50. VERTICAL VELOCITY INDICATOR
51. RADAR ALTIMETER
52. LANDING CHECKLIST
53. CLOCK
54. [illegible]
55. ATTITUDE INDICATOR
56. TURN RATE SWITCH
57. BDHI SELECTOR SWITCH
58. BDHI
59. TORQUE INDICATOR
60. TRIPLE TACHOMETER

N6/97

Figure 2-7. Instrument Panel (Typical) (Sheet 2 of 2)

2.1.6.5 Triple Tachometers. Two triple tachometers (Figure 2-7), one for the pilot and one for the copilot, are on the instrument panel. Each tachometer contains three pointers: the No. 1 pointer indicates power turbine speed of the No. 1 engine, the No. 2 pointer indicates the power turbine speed of the No. 2 engine, and the pointer marked R indicates the rotary wing rpm. The power turbine (N_f) tachometers are powered by their own tachometer-generators that are driven by the power turbine radial drive shaft via the flexible drive shaft to internal gearing in the fuel control. The rotary wing tachometer is powered by its own tachometer-generator geared to and driven by the main transmission output shaft for the No. 1 section of the tail rotor drive. The tachometers are read in percent of total rpm. A 100-percent turbine speed is 18,966 power turbine rpm (100-percent N_f), and 100-pcrcent rotary wing speed is 203 rotor rpm (100-percent N_r).

2.1.7 Starter System. The system consists of a starter, starter relay, start bleed valve, fuel shutoff valve, starter buttons, mode selector switch (manual or normal modes only), an abort switch, start bleed valve actuating switches, and an emergency start switch. The system operates on dc power and is protected by circuit breakers marked STARTER 1 ENG 2 on the center circuit breaker panel. The engine starting system (FO-3) consists of three modes of operation: normal, manual, or emergency. The normal mode provides a completely automated start that includes automatic starter dropout and increased start reliability through a start bleed valve. The manual mode provides an alternate means of starting, using external electrical power or the battery. In this mode, the starter relay dropout feature is bypassed. This permits the starter to motor the engine continuously until the starter abort switch is actuated by pulling down on the speed lever. An electrically operated solenoid valve aids in controlling overtemperature conditions. When the valve is actuated by the pushbutton-type switch mounted on the cyclic stick, auxiliary start fuel flow is blocked from entering the fuel flow divider. A series of safety interlocks in the normal or manual control circuit to each engine starter prevents the starter relay from closing should an unsafe condition exist.

For engine starts during flight or for starting the No. 1 engine when the tail pylon is folded, an emergency start switch provides a means of bypassing all safety interlocks, thus allowing either a manual or normal start. Before starting, check that the 10-ampere blade fold circuit breaker marked BLADE FOLD on the center circuit breaker panel is in.

Safety Interlocks For Engine Start	
No. 1 Engine	No. 2 Engine
1) Aux Servo Pressurized or Accessory Drive Switch in Access Dr	1) Aux Servo Pressurized
2) Pylon Locked In Flight Pos	2) Pylon Locked in Flight Pos
3) Blades Spread, Safety Valve Closed, Fold Power Master Switch Off, or Rotor Brake On	3) Blades Spread, Safety Valve Closed, Fold Power Master Switch Off.

2.1.7.1 Starter Dropout. Starter operation and dropout may be monitored by noting the magnetic compass heading before engine start. When the starter is energized, the compass will swing to a new heading. When the normal start circuit is used, the starter will drop out at 45-percent N_g. The compass should then swing back to its original heading, signifying the starter has dropped out. When the manual start circuit is used, the starter will drop out only when the abort switch is actuated.

2.1.7.2 Start Bleed Valve. The start bleed valves, one on each engine, operate automatically during the start cycle and require no specific pilot action. The function of the valve is to raise the compressor stall line during the start cycle in order to increase the reliability of the normal start system. This is done by bleeding compressor discharge air during start. The valve closes at the point where the starter, ignition circuit, and valve circuit are deenergized simultaneously. The valve remains fully closed during all regimes of engine operation except during starting.

2.1.7.3 Starter Buttons. Two starter buttons, one for each engine, are above the speed selectors. The starter is energized by holding the speed selectors at SHUTOFF and momentarily depressing the starter button. This energizes the starter relay and completes the circuit to the starter. When using the normal starting mode, after the engine fires and the electrical power load to the starter decreases, the starter relay will automatically drop out, deenergizing the starter. In the manual mode, when N_g reaches about 45 percent, the respective speed selector must be pulled down to actuate the abort switch that in turn drops out the starter.

2.1.7.4 Starter Abort Switch. A starter abort switch is in each speed selector. The switch is actuated by pulling down on the speed selector. This action breaks electrical circuit continuity to the ignition system and the starter relay.

2.1.7.5. Mode Selector Switch. This switch with marked positions MANUAL and NORMAL under the general heading START MODE is on the overhead dome light panel. When the switch is placed to NORMAL, the automatic dropout function of the starter relay is energized, allowing the starter to motor the engine to about 45-percent N_g. When the switch is placed to MANUAL, the automatic dropout feature of the starter relay is bypassed, allowing the starter to remain engaged until the abort switch is actuated. The switch operates on 28-vdc power.

2.1.7.6 Auxiliary Start Fuel Shutoff Valves. Two of these valves, one for each engine, are installed in the engine compartment between the engine fuel control and flow divider. When the valve is actuated during the start of either engine, the flow of auxiliary bypass starting fuel is blocked. This blockage decreases the total amount of fuel flow during starting, thus diminishing the possibility of an overtemperature condition because of excessive fuel flow. The valves operate on dc power and are protected by the main starting circuit breakers.

2.1.7.7 Auxiliary Start Fuel Shutoff Valve Switch. This pushbutton-type switch marked ENG ST is on each cyclic stick. In addition to pressing the switch, the starter relay for the engine to be started must be closed before the valve will operate. Either the pilot or copilot switch will control the operation of both valves. The switch operates on dc power.

2.1.7.8 Emergency Start Switch. Two switches (Figure 2-8) marked EMER START 1 ENG 2 are on the overhead control panel to the right of the engine speed selectors. The switches have two marked positions, ON and OFF. Normally the switches remain OFF and starting is done through the normal control circuit. When the switches are placed ON, the normal control circuit with its safety interlocks is bypassed. Power from the primary dc bus is fed directly to the starter button and a normal starting procedure is followed. Placing either engine emergency starter switch ON permits starting of that engine in flight should any of the safety interlocks fail to remain in the closed position when deenergized. The emergency starter switches also permit intentional interlock bypassing for maintenance purposes.

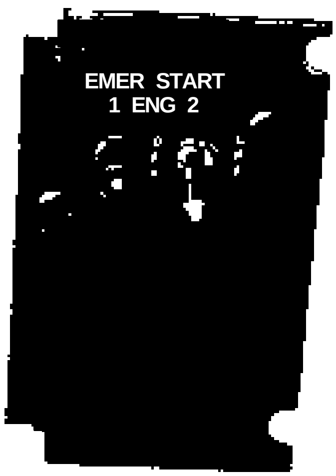


Figure 2-8. Engine Emergency Start Switches

2.1.7.9 Engine Starting. During start, as the engine speed selector is advanced to GRD IDLE, the stopcock opens and allows fuel to pass through the flow divider and to enter the No. 1 (low pressure) manifold to the nozzles where it is mixed with compressor-discharge air. As fuel-air mixture leaves the nozzles, it is ignited by the two igniter plugs in the combustion chamber and enters a sustained combustion process.

2.1.8 Ignition System. The ignition system consists of a sealed ignition unit and two igniter plugs on each engine that provide a spark to ignite the fuel-air mixture. The ignition unit is on the lower right side of the compressor casing. The ignition system provides ignition during starting with the ignition switch at NORM. When gas generator speed increases and the starter circuit load drops, the automatic dropout relay releases, deenergizing the starter and ignition systems, and combustion is self-sustained.

2.1.8.1 Ignition Switches. Two ignition switches, one for each engine, on the overhead switch panel (Figure 2-9) are marked IGNITION 1 ENG 2. Each switch has marked positions TEST, OFF, and NORM. The switches are normally at NORM. When the switch is at NORM with the starter engaged, the ignition unit is energized. Holding the switch at the spring-loaded TEST position energizes the ignition unit only. TEST is used (for ground operation only) without the starter to test the ignition circuit. A clicking noise can be heard when the switch is placed to TEST. When the switch is OFF, the ignition unit is deenergized. OFF is used to motor the engine, using the starter without ignition. The ignition switches are powered by dc current.

2.1.9 Torque Sensing System. This system determines input torque at the main gearbox and transmits this information to torquemeter indicators. Each torquemeter indicator presents this information in terms of percent of engine power being delivered to the main transmission. Components of the systems include two pressure chambers, two balancing valves, two pressure transmitters, one high-pressure oil pump, and two dual-needle torquemeter indicators. The system is designed to measure the oil pressures required to react against the forward displacement of the main gearbox second-stage helical gear as a result of the input shaft torque of each engine. These oil pressures, required to react against the forward movement of the second-stage helical gear, are sensed by two pressure transmitters that send electrical signals to the torquemeter indicators.

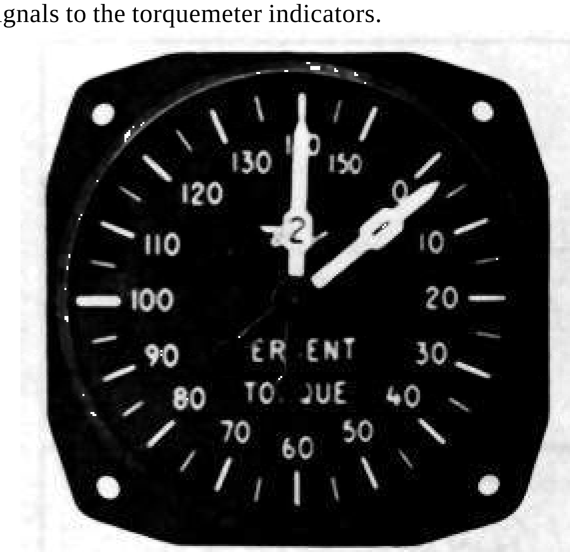


Figure 2-10. Torquemeter

2.1.9.1 Torquemeter Indicators. Two torquemeter indicators (Figure 2-10), one for the pilot and one for the copilot, are on the instrument panel. Each dual-needle indicator marked PERCENT TORQUE contains two pointers marked 1 and 2 that indicate input torque in percent of maximum engine power output of each engine. The electrical pressure torquemeter indicator dials marked percent torque are marked in units of 5 percent from 0 percent to 150 percent. The torquemeter indicators operate

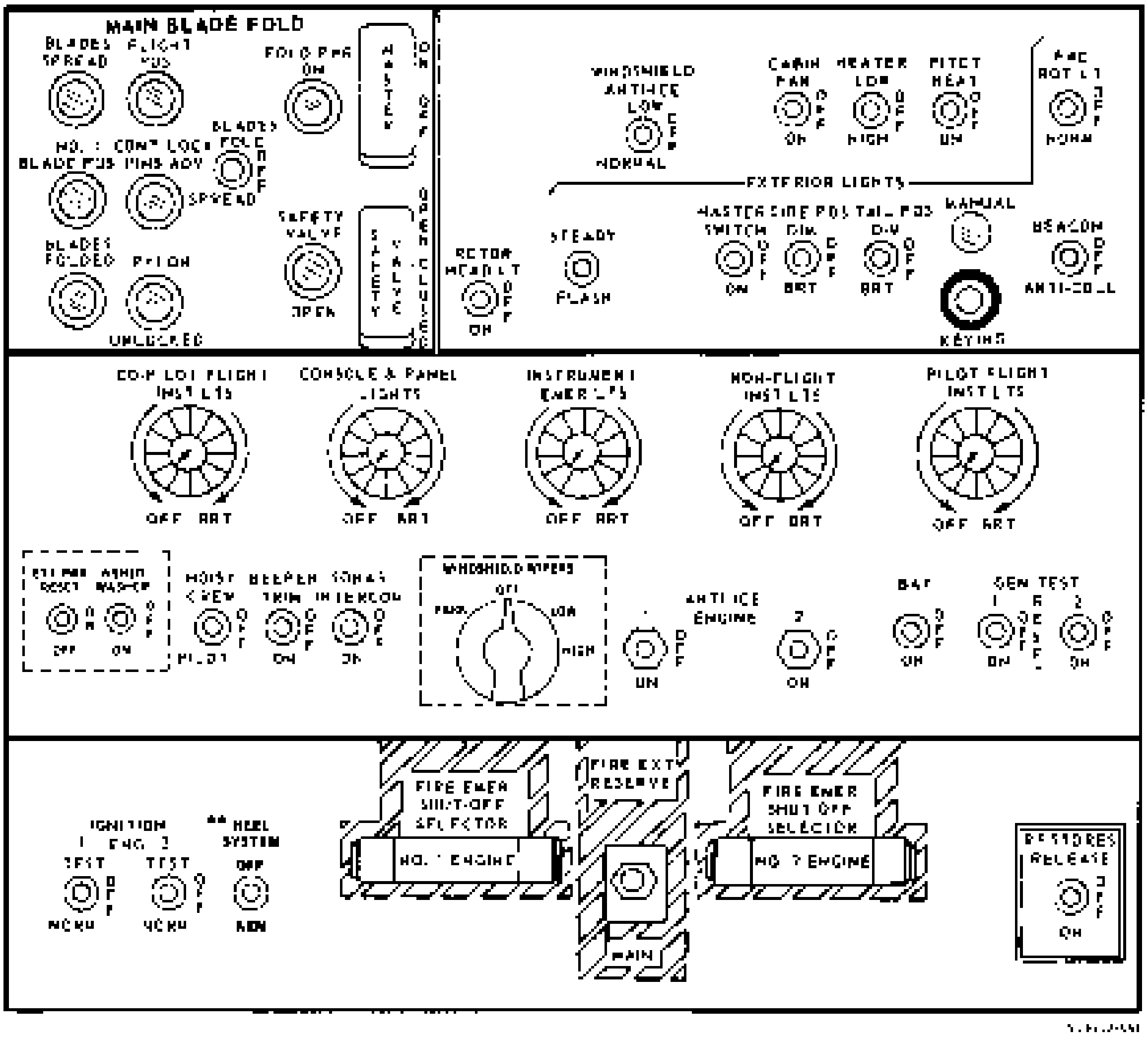


Figure 2-9. Overhead Switch Panel

on 26 vac and are protected by circuit breakers marked TORQUE SENSOR.

2.1.10 Overspeed Protection System

CAUTION

In case of flexible drive shaft failure, no mechanical overspeed protection is available.

The Nos. 1 and 2 engines are each equipped with an overspeed protection system that is available through all regimes of engine operation. The mechanical overspeed protection is provided by a shutoff valve that is incorporated in the fuel control. This prevents a destructive overspeed in the event of a complete loss of load, such as a high-speed shaft failure. Under such a condition, the acceleration rate of the power turbine is so great that fuel control would not react in time without the shutoff valve. The valve is attached to the N_f governor servo piston and closes at about 119-to 123-percent N_f. Any increase in power turbine speed moves the N_f servo piston and the shutoff valve with it. Motion beyond the normal control range causes the shutoff valve to bottom against the casing and cutoff discharge fuel.

2.1.10.1 Engine Overspeed Protection System. The No. 1 engine is equipped with an engine overspeed protection system effective only when operating in accessory drive. When an overspeed condition occurs, a frequency signal from the No. 1 PMG will actuate a solenoid that bleeds compressor discharge pressure (P3) sensed by the fuel control. With the No. 1 engine in accessory drive, two situations will cause activation of this overspeed system. Either No. 1 N_f at approximately 108 percent or N_r at approximately 104 percent or above will cause the N_f to oscillate. N_r reduction to less than 104 percent will restore normal No. 1 engine operation. (Mechanical engine overspeed protection is not affected by AFC 399.)

Note

With AFC 399, N_r above 104 percent, and in accessory drive No. 1 engine should sense an overspeed condition and drop to 60- to 70- percent N_f.

2.1.11 (ET) AUXILIARY POWER UNIT (APU) SYSTEM. The auxiliary power unit system provides an external source of 115/200 volts, three-phase, 400 Hz, ac electrical power in the same manner as an external power unit. The system consists basically of an auxiliary power unit, an Electronic Sequence Unit (ESU), a control panel, an APU fuel system, and a generator system. The APU system supplies power for instrumentation, minimal lighting, and ground operation of the environmental control system.

2.1.11.1 (ET) Auxiliary Power Unit (APU). The APU, mounted in a pod attached to the right sponson, supplies power to operate the APU generator system. The APU is a small gas-turbine engine capable of producing 90 horsepower. It is controlled by the ESU.

2.1.11.2 (ET) Electronic Sequence Unit (ESU). The ESU is the control element for the APU. The ESU is a microprocessor-based electronic component that monitors and controls all APU operations. It monitors speed and temperature and outputs signals to control APU functions. The ESU also shuts down the APU when monitored values exceed established operating parameters. Advisory lights on the APU control panel indicate system status.

2.1.11.3 (ET) APU Control Panel. The control panel (Figure 2-5.1), on the cockpit console, contains all of the controls necessary for APU operation. It consists of an APU ON switch, GEN ON/OFF/RESET switch, GEN ON indicator light, FUEL PUMP ON indicator light, and five warning and indicating lights.

2.1.11.4 (ET) APU Fuel System. The fuel system supplies fuel to the APU from the helicopter forward fuel tank. The APU fuel system consists of a APU fuel shutoff valve, fuel boost pump, and the necessary tube and hose lines to convey fuel from the main fuel line to the APU.

The APU fuel system is independent of the helicopter fuel system, except that it receives its fuel supply from the aircraft's fuel system. The fuel shutoff valve, a motor-operated gate valve, is in the right sponson. Normal fuel flow to the APU is accomplished by positioning the APU ON switch, on the cockpit APU control panel, to ON, which opens the fuel shutoff valve.

2.1.11.5 (ET) APU Generator System. The APU generator system, tied into the ac power supply system through the APU generator control unit, supplies power to all components operating off the No. 1 and No. 2 generators. In addition, to preventing paralleling of the APU generator with the generator in the basic ac power system, an APU interlock relay is provided.

2.1.11.6 (ET) APU Operation. Positioning the APU CONTROL switch, on the APU control panel, to ON sends a 28 vdc signal from the battery bus to the ESU. A start command from the ESU sends 28 vdc to the APU starter relay and causes the STARTER ON warning light to illuminate. The ESU also controls ignition and signals the fuel solenoid valve to open. This accelerates the APU to 100% speed. When speed reaches 70%, the ESU turns off the APU starter by transmitting a discrete dc signal closing the APU starter relay. The starter relay drops out and the STARTER ON warning light goes off. At 95% the ignition unit is deenergized and after a time delay the APU is at 100% speed. The APU ON light will illuminate. The helicopter's electrical requirements are supplied when the GEN ON switch is positioned ON, and the GEN ON light illuminates.

2.2 ENGINE OIL SYSTEM (F0-4)

Each engine has an independent oil tank and dry sump full scavenge oil system. Oil is gravity-fed from the tank to the engine-driven oil pump mounted on the forward right-hand side of the engine. The engine-driven pump distributes the oil under pressure through a filter to accessory gears and engine bearings. The oil serves both lubricating and cooling purposes and is a completely automatic system requiring no control action by the pilot. The scavenge side of the pump returns oil through an oil cooler to the oil tank.

The oil cooler is an oil-to-fuel heat exchanger with an associated oil bypass valve. The oil flow through the cooler depends on oil temperature. At lower temperature, the pressure differential across the cooler causes most of the oil to flow through the bypass valve. At higher temperatures, the lower viscosity reduces the pressure differential that closes the bypass valve and causes all of the oil to flow through the cooler. Each engine oil system has a 2.7-U.S. gallon capacity tank. The circular tanks are around the forward section of each engine. For oil specification and grade, see Figure 3-7.

2.3 ROTOR SYSTEMS

The rotor systems consist of a single main lifting rotary wing and an antitorque rotary rudder. Both systems are driven by the two engines through the transmission system and are controlled by the flight controls.

2.3.1 Rotary Wing System. The rotary wing system consists of the rotary wing head assembly and the rotary wing blades. The rotary wing head assembly, mounted directly above the main gearbox, consists of a hub assembly and a star assembly. The hub assembly, consisting of five sleeve-spindle assemblies and five hydraulic dampers clamped between two parallel plates, is splined to the rotary wing drive shaft. The root ends of the five rotary wing blades are attached to the sleeve-spindle assemblies that permit each blade to flap vertically, hunt horizontally, and rotate on their spanwise axis to change the angle of incidence. Antiflapping restrainers limit the upward movement of the blades. Droop stops limit the downward position of the blades. Both are in operation when the blades are stopped or turning at low speed. When the rotor system is accelerated, centrifugal force automatically releases the antiflapping restrainers at about 25 to 30 percent and the droop stops at about 65- to 75-percent rotary wing speed. During rotor deceleration, the droop stops will seat at about 50 to 60 percent and the antiflap restrainers at about 30-percent rotary wing speed. The hydraulic dampers lessen hunting movement of the blades about the vertical hinges as they rotate, prevent shock to the blades when the rotary wing is started or stopped, and aid in the prevention of ground resonance. The angle of incidence (or pitch) of the rotary wing blades is controlled by the rotary wing flight control system that is connected to the blades through a swashplate assembly below the hub assembly. The swashplate assembly consists of an upper (rotating) swashplate that is driven by the rotary wing hub, and a lower (stationary) swashplate that is secured by a scissors to the main gearbox. Both swashplates are mounted on a ball-ring and socket assembly that keeps them parallel at all times but allows them to be tilted, raised, or lowered simultaneously by components of the rotary wing flight control system that connect to arms on the lower (stationary) swashplate. Cyclic or collective pitch changes introduced at the stationary swashplate are transmitted to the blades by linkage on the rotating swashplate. The five all-metal rotary wing blades are made of aluminum alloy, with the exception of the forged steel cuffs on the blades that attach the blades to the sleeve-spindle assemblies on the rotary wing hub assembly. The main spar of the blade is a hollow aluminum alloy extrusion that forms the leading edge of the blade. Individual pockets constructed of sheet aluminum alloy form the trailing edge of the blades. The pockets are bonded to the spar. The rotary wing blades have an abrasion/erosion strip of hard nickel-plated stainless steel bonded to the leading edge. The tip caps have hard nickel bonded to the leading edge.

2.3.1.1 Blade Inspection Method Indicators

WARNING

When black is visible in the indicator, it may be an indication of blade damage that is a flight hazard. The cause of the black indication shall be determined before flight.

A cylindrical BIM indicator (Figure 2-11) is in the root end plate of each main blade, an air valve is in the backwall of the spar. The pressure indicator has a transparent cover through which color indication can be observed to determine blade serviceability. The indicator that is compensated for temperature changes compares a reference pressure built into the indicator with the pressure in the blades spar. When the pressure in the blade spar is within the required service limits, indicating the blade is serviceable, three white stripes show in the indicator. If the structural integrity of the spar is impaired, nitrogen pressure will decrease. If the pressure in the blade spar drops below the minimum permissible service pressure, the indicator will be actuated and will show three black stripes. To check the integrity of the BIM indicator, depress the manual test lever until a black indication appears, and then release the lever.

2.3.1.2 IBIS (In-Flight Blade Inspection System). The IBIS system consists of the five main rotor blade spars (individually pressurized with nitrogen), a pressure indicator (with radioactive source) on the root of each blade spar, a radiation detector on the main rotor fairing assembly, a signal processor with a test panel in the baggage compartment, and an amber blade pressure caution light located on the caution panel. The nitrogen with each main rotor blade spar is pressurized to approximately 10 psi at an ambient temperature of 10 to 24 degrees. The associated spar pressure indicator displays two white stripes when the pressure is safe. If the spar pressure drops to below the safe range, two black stripes will display in the spar pressure indicator windows, indicating that nitrogen is escaping through a crack in the spar or through a faulty seal.

WARNING

When black is visible in a spar pressure indicator, hazardous blade damage may exist. The unsafe blade shall be removed from service until the cause of the unsafe indicator is positively found and corrected.

A spar pressure indicator displaying two white (safe) stripes can be checked by pressing the manual test pushbutton in the indicator, which causes two black stripes (unsafe indication) to be displayed. Once two black stripes are displayed, regardless of the cause, the reset button on the spar pressure indicator must be pressed with the clear plastic test/shipping cover in place over the spar pressure indicator to prevent the escape of radiation.

The radioactive source is shielded when the spar pressure indicator displays white (safe). When the indicator moves to the black (unsafe) position, the radioactive source moves out of the shielded position and is exposed. As the rotating unsafe blade then passes over the radiation detector, the rays released by the blades' radioactive source are sensed by the detector, which sends an electrical signal to the signal processor, which in turn deenergizes a relay in the processor and causes the blade pressure caution light to illuminate.

To ensure that the radiation detector is capable of detecting radiation, a small radioactive source incorporated in the detector continuously emits radiation at a lower rate than the radioactive source in the spar pressure indicator. The radiation detector continuously senses its own radiation and sends a signal to the signal processor to energize a relay that extinguishes the BIM caution light. The No. 2 primary ac and the No. 2 primary dc buses furnish power to the system through two circuit breakers, both marked blade pressure, on the pilot circuit breaker panel. In addition to damage causing a loss of pressure in the spar, failure of the signal processor, or loss of 115-vac power will each result in illumination of the BIM caution light.

2.3.1.3 IBIS Test Panel. An IBIS test panel is mounted on the signal processor, which is located on the left-hand side of the cabin wall. The test panel is used for built-in tests (bits) to verify operation of the radiation detector and the signal processor. A bit selector switch, a press-to-test pushdown, a red warning light, a green safe light, and a decal that lists the bit procedures and associated light indications are mounted on the panel. Pressing the press-to-test pushbutton on the test panel will result in the following indications:

Note

In each bit switch mode, the press-to-test pushbutton must be held down for a minimum of 5 seconds to allow the signal processor to stabilize.

a. Selecting DET with the bit switch and pressing the press-to-test pushbutton simulates the detectors normal sensing of its own low radiation rate and illuminates the green safe light. This is an operational checkout of the detector.

b. Selecting LOW WARN and pressing the pushbutton simulates loss of the detectors own radiation rate and lights the blade pressure caution light and the red warning light. This is a functional checkout of the signal processor.

c. Selecting safe and pressing the pushbutton simulates the detectors normal sensing of its own low radiation rate and illuminates the green safe light. This is a functional checkout of the signal processor.

d. Selecting HIGH WARN and pressing the pushbutton simulates the detector sensing a high radiation rate from a spar pressure low indicator with low pressure. The blade pressure caution light illuminates and the red warning light illuminates. This is a functional checkout of the signal processor.

2.3.2 Bifilar Absorber. The main rotor system has a bifilar absorber assembly (helicopters modified by AFC 403) to reduce fatigue stress and improve the overall vibration comfort level throughout the helicopter. The bifilar absorber assembly secured to the main rotor hub consists of a five-pointed, star-shaped, aluminum forging with a 17-pound weight attached to each star point.

2.3.3 Rotary Rudder System. The system consists of the rotary rudder assembly and rotary rudder blades. The rotary rudder assembly mounted at the upper end of the pylon consists of a rotary rudder hub and the pitch-changing mechanism. The splined hub is supported and driven by the horizontal output shaft of the tail gearbox. The five rotary rudder blades are attached to the rotary rudder hub by flapping hinges and spindles so that they are

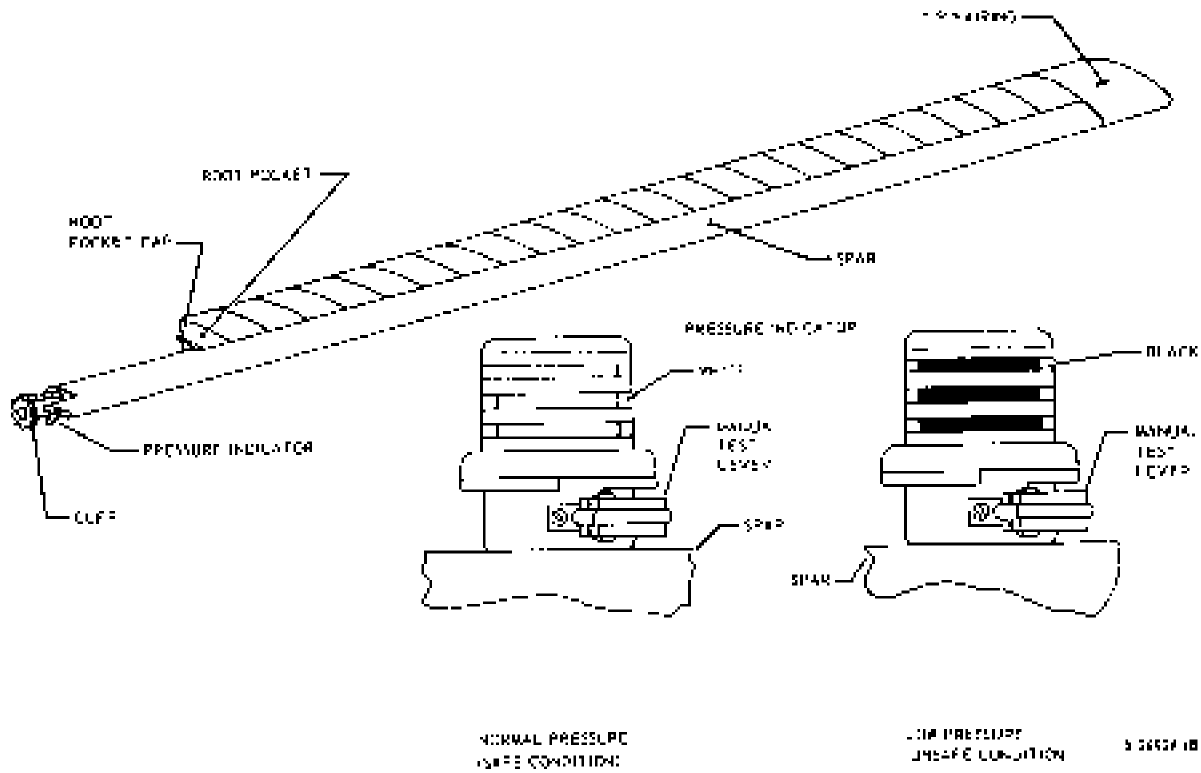


Figure 2-11. BIM Indicator

free to flap and rotate about their spanwise axis for pitch variation. The blade pitch-changing mechanism transmits rotary rudder control pedal movements to the rotary rudder blades through the hollow horizontal output shaft of the tail gearbox. The five all-metal rotary rudder blades are constructed of a single aluminum pocket bonded to a C-shaped spar. The rotary rudder negative force gradient system is installed to relieve the pilot of rotary rudder forces created by aerodynamic loads when the auxiliary servo system is inoperative. The system applies a force to cancel the aerodynamic loads only when the rotary rudder is operating at normal speeds. Because of this, when the system is checked on the ground with rotary rudder stationary and the auxiliary servo off, a negative spring centering effect is created. The tendency of the pedals is then to go normally to either extreme. Under these conditions, considerable force is required to push the rotary rudder pedals from the extreme positions; however, the forces will decrease as the positions approach neutral. The initial force to move the pedals toward the right from a full left position is between 30 and 40 pounds. With the primary servo ON, auxiliary servo OFF, and the rotary wing head stationary, pedal motion will cause the collective pitch lever to move up for a right pedal motion and down for a left pedal motion.

2.4 TRANSMISSION SYSTEM

The transmission system (Figure 2-12) consists of three gearboxes that transmit power to the rotary wing and rotary rudder. The three gearboxes are the main gearbox, intermediate gearbox, and the tail rotor gearbox.

2.4.1 Main Gearbox. The MGB (Figure 2-13), mounted above the cabin an of the engines, interconnects the two engines through a main gearbox to the rotary wing. Gearing reduces engine rpm at a ratio of approximately 93 to 1 for driving the rotary wing. Engine torque is transmitted by the main gearbox to the rotary wing drive shaft to drive the rotary wing, and aft to the intermediate gearbox and then to the rotary rudder gearbox to drive the rotary rudder. The main gearbox accessory section (Figure 2-14) at the rear of the main gearbox lower housing drives the primary, utility, and auxiliary hydraulic pumps, the high-pressure torquemeter oil pump; and the two generators. Dual oil pumps are installed on the accessory section. These pumps increase reliability through better lubrication and permit flight to be continued if one pump fails. A freewheeling unit at each engine input to the main gearbox permits the rotary wing to autorotate without engine drag in case of engine (or engines) failure, or when engine rpm decreases below the equivalent of rotor rpm.

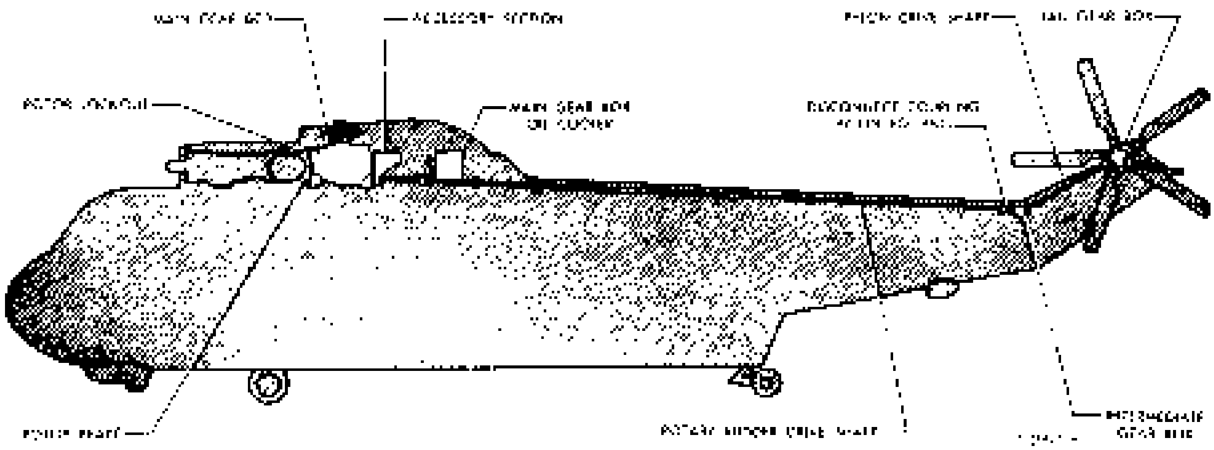


Figure 2-12. Transmission System

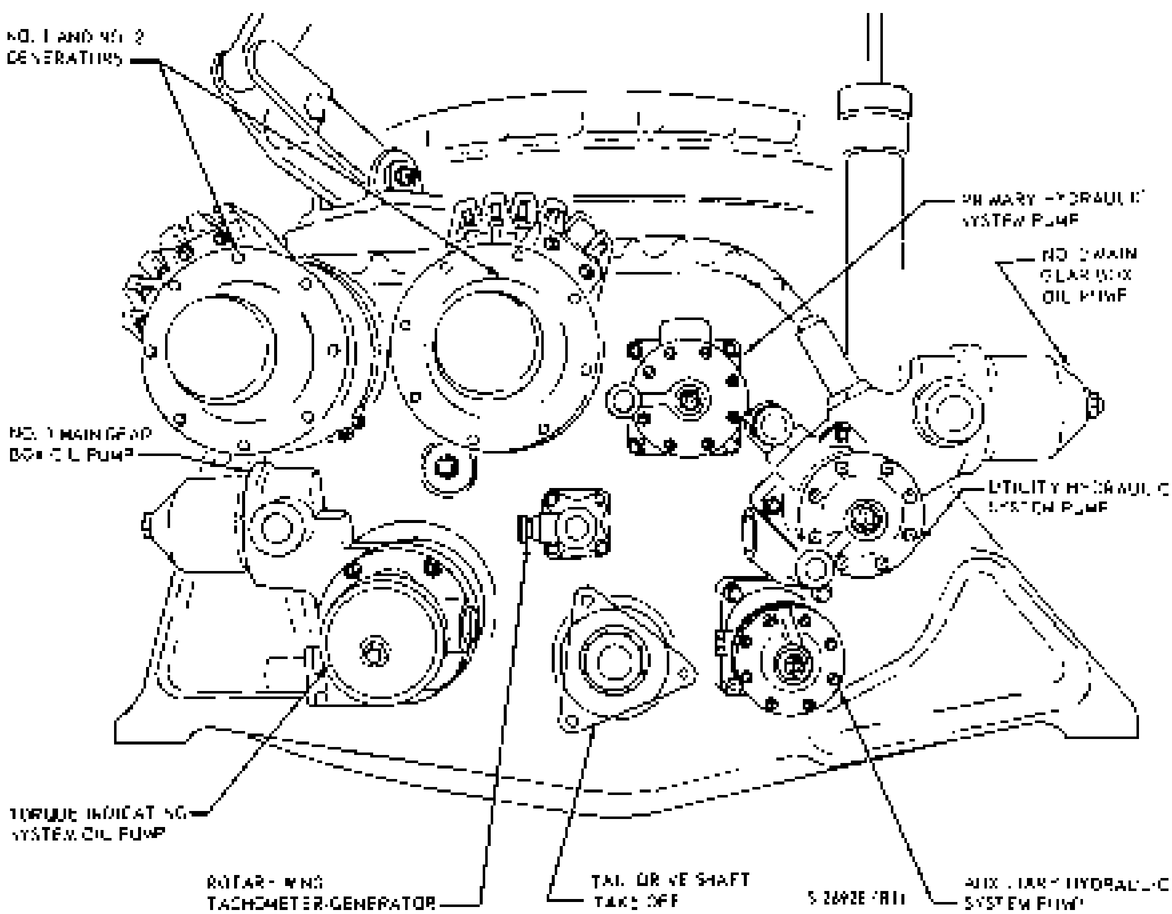


Figure 2-14. Main Gearbox Accessory Section

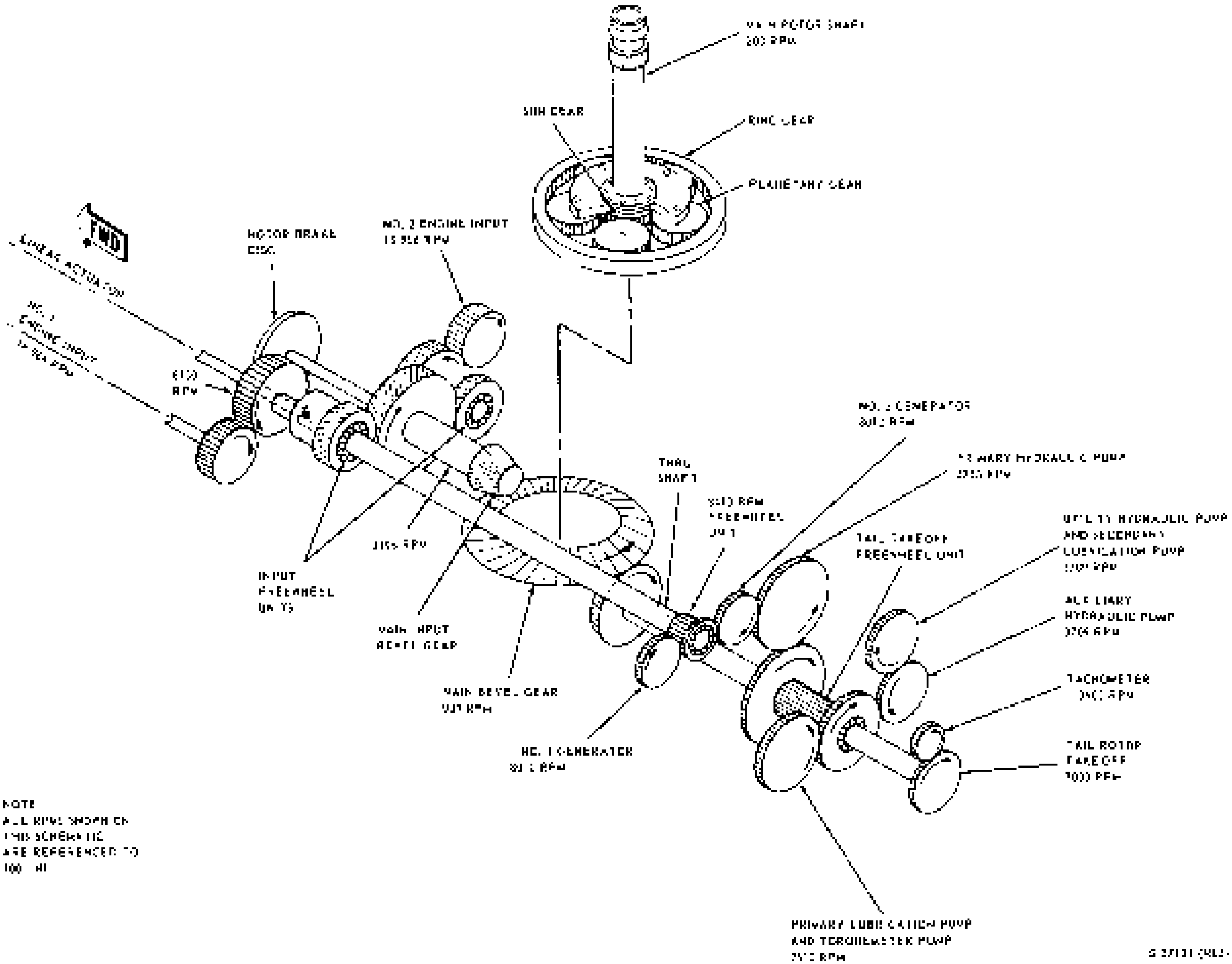


Figure 2-13. Main Gearbox Accessory Section

2.4.1.1 Accessory Drive Rotor Lockout System. This system permits the pilot to use engine power to drive the accessory section (hydraulic pumps, oil pumps, generators, etc.) of the main gearbox on the ground without rotating the rotary wing head. No. 1 engine is used to drive the accessories without turning the rotary wing head. A switch allows the pilot to position the linear actuator and divert power to either the accessory section or rotary wing.

2.4.1.2 Accessory Drive Panel. This panel (Figure 2-15) is beside the engine control quadrant. The accessory drive switch with marked positions FLIGHT and ACCESS DR is a lever-lock switch that must be pulled out before it can be moved from one position to the other. It allows the No. 1 engine to drive the accessory section of the main gearbox before starting the No. 2 engine and engaging the rotary wing head and/or when No. 2 engine rpm is lower than No. 1 engine rpm. Prior to starting the No. 1 engine, placing the switch to ACCESS DR positions the rollers in the input freewheel unit, permitting the No. 1 engine to drive the accessory section of the main gearbox. Also, at this time, the accessory drive (rotor lockout) warning light marked ON will go on and will remain on until the rollers are repositioned to drive the rotary wings. (On helicopters modified by AFC 401, the linear actuator will take 6 to 7 seconds to complete shift. Confirmation is provided by the appropriate light indicator on the accessory drive panel.) When both engines are operating and the rotor is being driven by the No. 2 engine, No. 1 engine speed should be reduced to GRD IDLE. When these conditions have been met, placing the accessory drive switch to FLIGHT energizes an actuator that repositions the input freewheel unit rollers, permitting the No. 1 engine to also drive the rotary wing shaft. An accessory drive limit switch is incorporated in the ground idle range of the speed selection. This limit switch prevents switching from ACCESS DR to FLIGHT without first retarding the No. 1 engine speed selector lever to the GRD IDLE range. After the rollers are repositioned, the accessory drive (rotor lockout) warning light will go off. (On helicopters modified by AFC 401, two interlocks prevent the linear actuator from repositioning. The No. 2 engine must be driving the rotors at 102- to 104-percent N_r and the No. 1 speed selector at ground idle. A guarded two-position override switch is also provided.) The accessory drive switch circuit operates on dc power and is protected by a circuit breaker marked ACCESS DRIVE on the center circuit breaker panel (Figures 2-23 and 2-25).

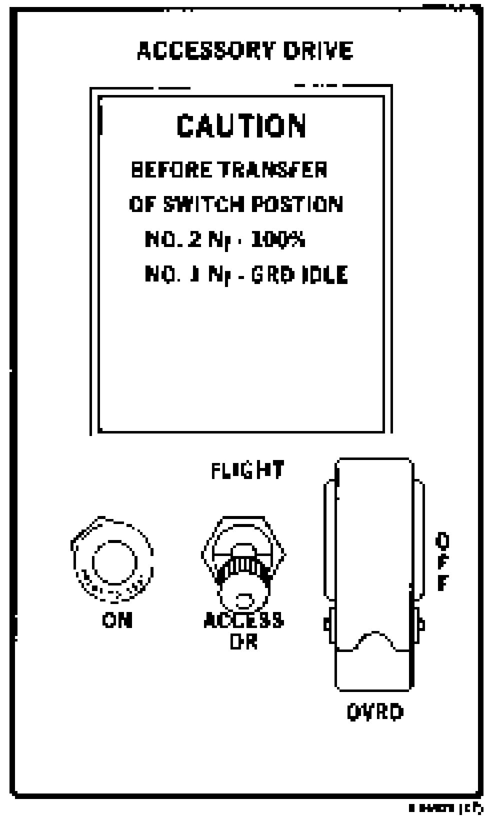


Figure 2-15. Accessory Drive Switch Panel

2.4.1.3 Accessory Drive Warning Light

CAUTION

On helicopters modified by AFC 401, when utilizing the override switch to reposition the actuator, the No. 2 engine must be driving the rotors at 102- to 104-percent N_r and the No. 1 speed selector must be positioned at GRD IDLE to prevent damage to the MGB. Use of this override switch is not a normal procedure.

Note

In the event of an input freewheeling unit failure while shifting from accessory drive to flight position on the No. 1 engine (with a positive indication of successful shift), no indication of torque on No. 1 eng. N_f marrying with N_r will be evident after the shift, regardless of speed selector lever position.

This light (Figure 2-15) is on the accessory drive panel. It will light when the rollers in the freewheel unit have been positioned to permit the No. 1 engine to drive the accessory section of the main gearbox. When No. 1 engine power is diverted to drive the rotary wing shaft, the warning light will go off. The accessory drive warning light on is the only positive indication of the input freewheeling unit in the accessory drive position, and the accessory drive warning light off is the only positive indication of the input freewheeling unit in the flight position. The press-to-test light operates on dc power and is protected by the circuit breakers marked PWR and TEST in the center circuit breaker panel (Figures 2-23 and 2-25) under the general heading of WARNING LTS.

2.4.1.4 Tail Takeoff Freewheel Unit Caution Light. The light marked TAIL TAKEOFF is on the caution panel (Figure 2-49). The caution light indicates failure of the tail takeoff freewheel unit in the main gearbox accessory drive train. When this failure occurs, the accessory section is being driven by the No. 1 engine through-shaft at reduced rpm. No. 1 generator output is normally used to sense this reduction in rpm that results in a reduction in generator frequency. In case the No. 1 generator has failed, the No. 2 generator output is used to sense this rpm reduction. When the generator frequency is reduced to less than that produced through the freewheel unit drive, the caution light will go on. Failure of the No. 1 engine subsequent to the caution light going on would result in loss of the equipment driven by the accessory section. The system operates on dc power. The sensing unit is in the electronics compartment.

Note

Flight regimes above 100-percent N_r may preclude detection of an actual tail takeoff freewheel unit failure.

2.4.2 Intermediate Gearbox. This gearbox (see Figure 2-12) at the base of the rotary rudder pylon contains a bevel gear direct-drive system to change the direction of the shafting that transmits engine torque to the tail gearbox. The intermediate gearbox is splash-lubricated. Screened intermediate gearbox cooling air inlets (Figure 2-2) in the pylon fairing permit the gearbox to be cooled by the rotary wing downwash.

2.4.3 Tail Gearbox. This gearbox (see Figure 2-12) at the upper end of the rotary rudder pylon contains a bevel gear reduction-drive system to transmit engine torque to the rotary rudder. The tail gearbox also contains part of the pitch change linkage that extends through the hollow horizontal output shaft to the rotary rudder hub. The tail gearbox is splash lubricated.

2.4.4 Intermediate and Tail Gearbox Oil Systems. Both the intermediate and the tail gearboxes are splash-lubricated from individual sump systems. Internal spiral channels ensure oil lubrication to all bearings. An oil filter plug, drain plug, and oil level window are in each gearbox casting. Oil capacity for the intermediate gearbox is about 0.2 gallon and for the tail gearbox, 0.4 gallon. For oil specification and grade, see Figure 3-7.

2.4.5 Chip Detector Caution Lights. These lights marked MAIN TRANS CHIP, INTMED TRANS CHIP and TAIL TRANS CHIP are on the CAUTION PANEL (Figure 2-49). The MAIN TRANS CHIP light serves a single function in that it visually indicates that one or both of the magnetic chip detectors in the main gearbox has picked up and retained metal particles or chips in the oil. The INTMED TRANS CHIP and TAIL TRANS CHIP lights, when on, indicate that the gearboxes have overheated or the magnetic chip detectors have picked up and held chips or metallic particles in the oil. The presence of either of these conditions could cause excessive wear and/or premature failure of the gearboxes. The system operates on dc power and is protected by a circuit breaker marked CHIP DET on the center circuit breaker panel.

2.4.6 Transmission Oil Systems

2.4.6.1 Main Gearbox Oil System (FO-5). Primary and secondary oil pumps are for lubrication. The primary oil pump is mounted on a common shaft between the torque indicating system oil pump and the transmission rear cover. The secondary oil pump is mounted on a common shaft between the utility hydraulic pump and the transmission rear cover (Figure 2-14). Oil is pumped from the gearbox sump through a hose to an oil cooler behind the main gearbox. If oil from the sump is less than 70°C, the thermostatic bypass valve in the oil cooler opens and the oil bypasses the radiator and goes directly to the jets. If the oil temperature is over 70°C, the valve closes, directing oil through the oil cooler to be cooled before going to the jets. Cooling air enters the forward end of the main gearbox fairing through a screened main gearbox cooling air intake (Figure 2-2) and is forced through the oil cooler by a blower driven by belts from the tail drive shaft. The air is then exhausted through a screened transmission accessories cooling air outlet at the rear of the fairing. After passing through the oil cooler; the oil returns to the main gearbox where it is sprayed onto the gears and bearings through jets built into the gearbox castings. An oil filler, reached from the left side of the rotary wing fairing, is on the left side of the gearbox. A window in the gearbox below the oil filler provides a sight check for the oil level in the main gearbox. Oil tank capacity is 16.6 gallons; normal servicing is 12.6 gallons.

2.4.6.2 Main Gearbox Oil Pressure Indicator and Caution Light. The main gearbox oil pressure indicator (Figure 2-7) is on the instrument panel. The indicator is marked in pounds per square inch, and is activated by a pressure transmitter connected to the gearbox inlet lubrication line. The main gearbox oil pressure indicator operates on 26 vac and is protected by a circuit breaker marked XMSN OIL PRESS. The main gearbox oil low-pressure caution light marked TRANS OIL PRESS is on the CAUTION PANEL (Figure 2-49) and is actuated by a pressure switch in the forward part of the main gearbox. The amber caution light operates on dc power and is protected by a circuit breaker marked WARNING LTS PWR on the center circuit breaker panel. The light will go on when the main gearbox oil pressure drops below 3-1/2 ±1 psi at the pressure switch at the forward right corner of the main gearbox at the point furthest from the pressure pumps. The different locations of the pressure sensors for the gauge and caution lights were incorporated to warn the pilot of an oil blockage within the gearbox that may not be indicated on the pressure gauge.

2.4.6.3 Main Gearbox Emergency Lubrication System. The ELS will permit continued main gearbox operation for a limited time following failure of the main lubrication system. The ELS was designed to allow continued flight for up to 30 minutes following a failure of the main lubrication system. In the event of a sudden massive loss of lubricating oil, vibrations and/or other secondary indications that require immediate action may occur within 2 minutes. The exact duration of safe flight using ELS will vary depending upon various conditions, including but not limited to, mode of main lube failure, aircraft weight, aircraft pitch attitude, balanced flight condition, and power requirements. An enlarged sump at the base of the main gearbox provides an additional 1.6 gallons of oil for the ELS. Upon a malfunction of the main lubrication system, a pressure-sensitive valve will activate when the oil pressure at the input sleeve bearings in the high-speed section of the main gearbox falls below 12 to 15 psi that corresponds to 20 to 25 psi on the oil pressure gauge. This valve directs the ELS oil to the sleeve bearings as well as the torque system. ELS oil pressure is provided by the torquemeter pump at the rate of 0.7 gpm. Although the pressure-sensitive check valve prevents oil from the torquemeter pump from being supplied to other parts of the transmission, the ELS is not a closed-loop system. ELS system oil returning from the input shaft bearing passes through the main sump on its way to the ELS sump. When a leak occurs in the main lube oil system, the primary and secondary lube oil pumps, if operating, will deplete a portion of the remaining ELS oil as it passes through the main sump. While the ELS operates, oil pressure, oil temperature, and the torque indicator will not register accurately. A low but steady torque reading rather than zero torque reading will confirm that the ELS is operating.

2.4.6.4 Main Gearbox Oil Temperature Indicator and Caution Light. The main gearbox oil temperature indicator (Figure 2-7) marked XMSN OIL TEMP on the instrument panel is graduated in degrees Celsius. The indicator is connected by direct current from the primary bus to an oil temperature bulb next to the main gearbox oil outlet port and is protected by a circuit breaker marked XMSN OIL TEMP. The main gearbox oil temperature caution light is on the caution panel and is activated by a temperature sensor on the inlet lubrication line. The amber caution light operates on dc power and is protected by a circuit breaker marked WARNING LTS PWR on the center circuit breaker panel (Figures 2-23). The transmission oil temperature caution light will go on when the transmission oil temperature at the oil cooler exit is over 120°C. The different locations of the temperature sensors for the gauge and light allow the pilot to monitor the gearbox operation by means of the gauge and the oil cooler operation by means of the caution light. Thus, if a malfunction occurs in the oil cooler (blockage, fan belt failure, etc.), the caution light will go on before the gearbox oil temperature rises to a dangerous level. The 120°C for the caution light limitation is sensed after the oil cooler, and the 145°C limitation noted on the oil temperature indicator is sensed before the oil cooler.

2.4.7 Rotor Brake. A hydraulically activated rotor brake mounted on a brake shaft forward of the main gearbox stops the rotation of the rotor system and prevents its rotation when the helicopter is parked. The rotor brake consists of a hydraulic cylinder and lever pressure gauge hydraulic brake cylinders, and a brake disc. The rotor brake hydraulic cylinder and lever on the pilot compartment ceiling operate independently from the hydraulic systems. A spring-loaded accumulator connected to the rotor brake hydraulic lines at the forward end of the transmission compartment assures continuous hydraulic pressure after the rotor brake lever is applied. The rotor brake hydraulic cylinder is gravity-fed with hydraulic fluid from the utility hydraulic system reservoir. In case of a broken or leaking hydraulic line from the utility hydraulic system reservoir, the rotor brake hydraulic cylinder contains enough fluid for braking the rotary wing system. The hydraulic brake cylinder is on supports attached to the main gearbox. The brake disc positioned on the input shaft of the main gearbox has a toothed edge that is engaged by the blade positioner drive unit to turn the rotary wing in the blade positioning cycle.

WARNING

The rotor brake will not prevent rotor movement with the No. 1 engine in flight position above ground idle or with the No. 2 engine above ground idle. Personnel injury and/or helicopter damage may occur as a result of inadvertent rotor engagement.

2.4.7.1 Rotor Brake Cylinder and Lever. A rotor brake lever (Figure 2-16) is connected directly to the rotor brake hydraulic cylinder to the right and forward of the overhead switch panel on the pilot compartment ceiling. The rotor brake is applied by pulling down and forward as indicated on the decal aft of the lever on the upper structure. The decal is marked TO ENGAGE ROTOR BRAKE PUSH LEVER FORWARD. The decal also has an arrow pointing forward. When actuated, a lock-lever at the forward outboard side of the cylinder locks the brake lever in the applied (forward) position. To release the rotor brake, reposition the lock-lever aft and swing the rotor brake lever aft and up against the bottom of the cylinder until it snaps into place. The lockpin may be made inoperative by turning it until it remains in the OUT position. For normal shutdown, the rotor brake should be applied firmly and smoothly. As rotor rpm approaches zero, rotor brake pressure should be reduced in order to ease rotor blades to a stop, precluding any tendency of whip stopping. When the rotary wing blades are folded, the rotor brake lever must be on to open interlock for a normal start. For emergency shutdown, the rotor brake lever may be forced forward into the full ON position after closing the engine speed selectors. In case of an emergency, the rotor brake, when fully applied, is designed to stop the rotors from 77-percent N_r in 14 seconds with engines at idle and from 91 percent in 20 seconds with engines at idle.

Figure 2-16. Rotor Brake Lever

2.4.7.2 Rotor Brake Pressure Gauge. The hydraulically actuated gauge is to the rear of the rotor brake lever (Figure 2-16) on the pilot compartment ceiling. The reading that is indicated by the needle indicates psi X 100. A decal, marked ROTOR BRAKE PRESS., ACTUATING RANGE 350-500 PSI., ENGINE START 320 PSI. MIN., PARKED POS., and RANGE 250/600 PSI., is next to the rotor brake pressure gauge. A pressure of 320 psi or more is needed before an engine start can be initiated with the blades folded.

2.4.7.3 Rotor Brake Caution Light. This light on the CAUTION PANEL indicates that either the manual or automatic rotor brake is on; however, the automatic rotor brake is not applied until the blade fold master switch is activated. The light will go off when the rotor brake is disengaged.

2.5 FUEL SYSTEM

2.5.1 Internal Fuel System. These helicopters are equipped with two pressure-type fuel systems (FO-7). The forward tank system supplies fuel to the No. 1 engine and the aft tank system supplies fuel to the No. 2 engine. On the ET the forward tank also supplies fuel to the auxiliary power unit (APU). The forward and aft systems each consist of a tank with two bladder type cells, a collector can equipped with two boost pumps, an ejector system that continually fills the collector can with a boost pump on, a main line filter, and a firewall shutoff valve. The collector can boost pump and ejector arrangement provide for a minimum of unusable fuel. A crossfeed line between the two pressure-type systems permits fuel from both the forward and aft tanks to be directed to one engine during single-engine operation, or fuel from one tank to supply both engines.

The center tank replaces consumed fuel in the forward and aft tanks. The center tank consists of a single bladder-type cell, two ejectors, and a common opening between the forward and center tanks. The opening allows fuel to spill freely into either tank. One center tank ejector is associated with the forward tank and the other with the aft tank. The center tank ejector associated with the forward tank will pump fuel into the forward tank when one or two forward tank boost pumps are on. This is the only means of transferring fuel from the center to forward tank once the fuel level drops below the common opening level. The center tank ejector associated with the aft tank will pump fuel into the aft tank when one or two aft tank boost pumps are on and the float valve in the aft tank is open. The aft tank float valve opens when the aft tank fuel level drops below 600 to 900 pounds.

When the aft tank fuel system is operating and the aft tank float valve is closed, fuel flow from the aft tank system to the center tank aft ejector transfers fuel from the aft tank into the center tank. To prevent overfilling the center and forward tanks, a float shutoff valve is incorporated in the center tank aft ejector line. The fuel management panel (Figure 2-17) on the instrument panel contains the four fuel boost pump switches, the boost pump failure warning lights, the crossfeed switch, and the two firewall shutoff switches. The tanks may be filled by either a pressure-refueling system or the conventional gravity feed through the filler necks. Each tank has a fuel quantity gauge that indicates the quantity of fuel in pounds. See Figure 2-22 for fuel quantity data and Figure 3-7 for fuel specification and grade.

2.5.1.1 Fuel Shutoff Valve Switches. Two fuel shutoff valve switches marked FIREWALL VALVE with the marked positions OPEN and CLOSE are on the fuel management panel. These switches control the fuel shutoff valves overhead in the cabin in front of the engine compartment. Placing the switches in the CLOSE position shuts off the flow of fuel to the engines. In case of electrical failure, the valves will remain in the last energized position. The switches and valves are powered by the primary bus, and protected by circuit breakers on the center circuit breaker panel marked 1 ENG 2 under the general headings FUEL SYSTEM and VALVES.

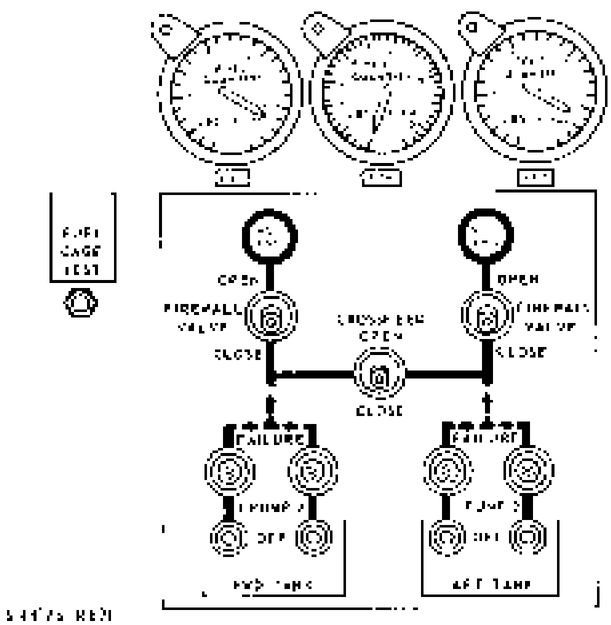


Figure 2-17. Fuel Management and Fuel Quantity Panel

2.5.1.2 Crossfeed Switch. A fuel crossfeed switch marked CROSSFEED is on the fuel management panel. The switch has marked positions CLOSE and OPEN and actuates a valve that operates on dc power and is protected by a circuit breaker marked X FEED on the center circuit breaker panel under the general headings FUEL SYSTEM and VALVES. Normally, the switch is in the CLOSE position. With the switch in the CLOSE position, the No. 1 engine receives fuel from the forward tank and the No. 2 engine receives fuel from the aft tank. Placing the switch in the OPEN position electrically opens the crossfeed valve that connects the systems. The crossfeed system may be used to supply fuel under pressure from both tanks to any one or both engines. The crossfeed system does not transfer fuel between tanks.

2.5.1.3 Fuel Boost Pumps. Two boost pumps in each collector can in the fuel tanks supply fuel under pressure to the two independent fuel systems. Normally, fuel flows from the tanks through a fuel filter, check valve, and firewall shutoff valve to the engine driven fuel pump and then to the engine fuel control unit. Should to engine-driven fuel pump fail, the engine will fail because of fuel starvation.

2.5.1.4 Fuel Boost Pump Operation

Note

> When starting No. 1 engine with an external dc power source or the battery, the boost pumps will be inoperative because of their ac power source requirement. If all fuel lines to the engine are full, the engine-driven fuel pumps will be capable of supplying sufficient fuel for starting.

2.5.1.5 Fuel Boost Pump Switches. Four boost pump switches on the fuel management panel control the fuel flow to the engine. The switches are in sets of two; those for the forward tank are marked FWD TANK while the two for the aft tank are marked AFT TANK. Above each switch is a number 1 or 2 to designate the pump in the tank controlled by that switch. Each switch has two marked positions: PUMP (ON position) and OFF. The boost pumps in the collector can in the forward cell of each fuel tank supply fuel to the engine-driven pump when the switches are in the PUMP position (FWD TANK and AFT TANK). The pump switches are controlled by dc power and are protected by four circuit breakers on the center circuit breaker panel. The boost pumps are operated on ac power with each pump protected by a circuit breaker.

2.5.1.6 Fuel Boost Pump Failure Warning Lights. Four pressure switches, two installed in each tank, are connected to the pressure feed line from each boost pump. The pressure switches are connected by direct current through the warning light circuit breaker on the center circuit breaker panel and are marked PWR and TEST under the general heading WARNING LTS. When the boost pumps are first turned on or the boost pump switches are tested, the fuel pump failure warning lights will go on and then off. They are lit until pressure is built up in the system. The switches close if the pumps fail, and the warning lights marked PUMP FAILURE on the fuel management panel will light. Pressure must decrease to approximately 16-1/2 psi to energize the warning circuit.

WARNING

If a fuel boost pump failure warning light goes on, activate the remaining boost pump for that tank before securing the affected pump. If the fuel boost pump failure warning light goes off when both pumps are activated, there may be a fuel leak.

2.5.1.7 Fuel Low-Level Caution Lights

CAUTION

When the fuel low-level caution lights go on, attitudes of over 6^{o} noseup should be avoided because of the possibility of fuel starvation.

The low-level caution lights are on the CAUTION PANEL on the instrument panel. The caution lights, operating on dc power, are tested by the master TEST button on the caution panel and are protected by circuit breakers marked LOW LEVEL FWD and AFT on the center circuit breaker panel.

On UH-3H helicopters, the FWD FUEL LOW and AFT FUEL LOW caution lights for the forward and aft tanks will go on when approximately 210 to 280 pounds per tank remain in a 3^{o} nosedown attitude, or between 170 and 200 pounds per tank remain when in a hover.

2.5.1.8 Fuel Quantity Gauges and Test Switch. The fuel quantity gauges on the instrument panel above the fuel management panel indicate the fuel quantity in each tank in pounds. UH-3 helicopters have three quantity gauges for the forward, center, and aft tanks, respectively. The tank unit capacitance system used in this helicopter is practically unresponsive to volumetric changes resulting from various temperatures. The dielectric between the two electrodes will vary as the fuel varies. The fuel quantity gauges are calibrated to measure this voltage differential in pounds of fuel. Fuel quantities are shown in the fuel quantity data tables. The fuel quantity indicating system may be tested by pressing the fuel quantity gauge test switch marked FUEL GAGE TEST to the left of the fuel management panel. Pressing the button-type switch will induce a current reversal that causes the needles to turn to zero. Upon release of the test switch, the normal current should cause the needles to return to the previous reading. This test shows that the fuel quantity indicating system is operating correctly. The fuel quantity indicating system operates on ac power and is protected by circuit breakers.

2.5.1.9 Fuel Filter Bypass Caution Lights. The fuel filter bypass caution lights will light whenever fuel bypass is imminent. This normally occurs when a pressure differential of approximately 1.1 to 1.7 psi is sensed at the filter. As the contamination increases and the pressure differential increases to 1.9 to 2.3 psi, the bypass valve opens and, at this point, the filter is being bypassed. The caution lights are marked FWD FUEL BYPASS and AFT FUEL BYPASS, indicating which fuel system is in a condition of impending filter bypass. The lights operate on dc power and are protected by the WARNING LTS PWR circuit breaker on the center circuit breaker panel.

2.5.1.10 Pressure Fueling-Defueling System. The system is a single-point fueling-defueling system. The pressure-refueling filler cap (Figure 2-18) is on the right side of the fuselage, inside the step below the cargo door. The filler cap is marked CAP-FUEL FILLER SINGLE POINT SERVICNG. To fill the fuel tanks, the refueling nozzle is connected to the adapter connection and fuel is pumped through the fuel lines and the fueling and defueling valves in the forward and aft fuel tanks. The fueling and defueling valves are normally closed; for refueling, the valves open with pressure at the inlet until high-level shutoffs close the valves. The high-level shutoff valve for the forward tank is in the center tank. This allows both the forward and center tanks to fill simultaneously through the common opening. When the center tank is full, the refueling process is stopped for those tanks. For defueling, the valves open with vacuum at the inlet until the low-level shutoffs close the valves. The low-level shutoffs are only in the forward and aft tanks.

2.5.1.11 Pressure-Refueling Switches. The switches marked PRI TEST and SEC TEST are on a panel (Figure 2-18) marked PRESS REFUELING PRECHECK next to the refueling-defueling adapter connection. The switches are used to check the reliability of the fuel high-level shutoffs. The panel contains information on the refueling precheck that must be followed prior to using the pressure refueling system.

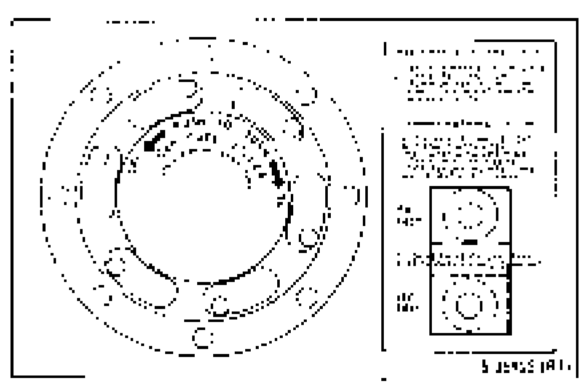


Figure 2-18. Single-Point Servicing Panel

2.5.2 (NON ET) Helicopter In-Flight Refueling System (HIFR). Helicopters are equipped with a system for refueling from a surface vessel while in flight. Fuel is pumped on board the helicopter under pressure through a Wiggins quick-disconnect nipple. The Wiggins quick-disconnect nipple is in the cabin floor near the sliding cabin door. The nipple is provided with a cover marked REPLACE COVER AFTER FILLING. A separate grounding receptacle is provided at this station. A filter is incorporated in the system to prevent contaminated fuel from entering the helicopter. In addition, the station is equipped with a dome light with a control switch. See Chapter 9 for Helicopter In-Flight Refueling Procedures.

2.5.3 Fuel System Management. For normal operation of UH-3 helicopters (Figure 2-19) with crossfeed closed and one boost pump on in each tank, the forward and center tank will furnish fuel to the No. 1 engine and the aft tank will furnish fuel to the No. 2 engine. This causes the aft tank quantity gauge to drop more rapidly than the forward and center tank gauges. In addition, as long as the center tank float shutoff valve is open and the aft tank float valve is closed, fuel will be transferred at a low rate from the aft tank to the center and forward tanks. This also causes the aft tank quantity gauge to drop more rapidly than the center and forward tank gauges. Once the aft tank fuel is depleted below the level at which the aft tank float valve opens (600 to 900 pounds), the center tank aft ejector starts to transfer fuel into the aft tank.

For operation under unusual conditions, the fuel quantity in the tanks can be equalized by operating both engines from either the forward or aft tank systems. This can be done by opening the crossfeed and turning on both boost pumps in the tank system being used, and one boost pump on in the tank system not being used. The tank with two boost pumps on will supply fuel to both engines, because of the greater pressure furnished by the two pumps that close the check valve downstream of the tank with only one pump operating.

2.5.4 Fuel Dump System. This system will dump fuel from a single tank at a rate of 400 to 500 pounds per minute, and simultaneously from both tanks at approximately 800 pounds per minute. Fuel will stop dumping in either tank when the associated tank's fuel low caution light goes on, since the caution light sensor and the dump standpipe are at approximately the same level. The tank's dump pump should be turned off at this time to prevent the pump from overheating. If the pump is not turned off, a thermal device in the pump will automatically turn it off and the pump will have to be removed to reset the thermal device.

	CONDITION	CROSSFEED SWITCH	FUEL SHUTOFF VALVES	BOOST PUMP SWITCHES
BOTH ENGINES OPERATING	Normal Operation - Fwd tank to left engine and Aft tank to right engine	CLOSED	Both - OPEN	Pumps - As required, refer to Cruise Checks, Chapter 7
	Either tank both engines	OPEN	Both - OPEN	Tank in use - BOTH ON Tank not in use - ONE ON
ONE ENGINE OPERATING	Fwd tank to left engine or Aft tank to right engine	CLOSED	Good engine - OPEN	Good engine - ON
			Failed engine - CLOSED	Failed engine - OFF
	Both tanks to either engine	OPEN	Good engine - OPEN	Both tanks - ON
			Failed engine - CLOSED	
	Either tank to opposite engine	OPEN	Good engine - OPEN	Tank in use - BOTH ON
			Failed engine CLOSED	Tank not in use ONE ON
CENTER FUEL TANK OPERATION	Fuel to both forward and aft tanks			One pump in each tank - ON

Figure 2-19. Fuel System Management

The system (FO-7) uses the center point pressure-fueling plumbing to dump fuel overboard through a tube near the right side of the tailwheel. The forward and aft tanks each have a dump pump and dump valve that are off and closed respectively when not dumping. A system dump valve incorporated in the center point fueling system is closed when not dumping to prevent dumping when pressure fueling. When dumping, the high-level shutoff sensor is actuated and closes the fueling/defueling valve to prevent dump fuel from reentering the tank.

The primary dc bus furnishes control power to the tank dump systems through two FUEL SYSTEM circuit breakers on the center circuit breaker panel marked FWD and AFT above the general heading DUMP. The forward tank dump pump operating power is furnished by the No. 1 primary ac bus through a circuit breaker on the copilot circuit breaker panel marked DUMP FWD under the general heading FUEL PUMP. The aft tank dump pump operating power is furnished by the No. 2 primary ac bus through a circuit breaker on the pilot circuit breaker panel marked DUMP AFT under the general heading FUEL PUMP. The system dump valve is controlled by primary dc bus power through a FUEL SYSTEM circuit breaker on the center circuit breaker panel marked FUEL SYSEM above the general heading DUMP.

2.5.4.1 FUEL DUMP Control Panel. The panel marked FUEL DUMP (Figure 2-20) is on the cockpit console. There are two guarded switches on the panel, one with marked positions FWD and OFF and the other AFT and OFF. Placing the forward tank switch to FWD opens the tank dump valve, turns the dump pump on, actuates the high-level shutoff to close the fueling/defueling valve, and opens the system dump valve. The aft tank switch operates the same way.

WARNING

Electrical malfunction in either the forward or aft dump valves or both may cause inadvertent fuel dumping without pilot knowledge. If this happens, rapid fuel loss will result.

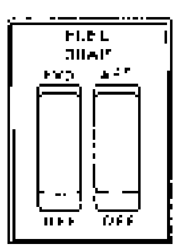


Figure 2-20. Fuel Dump Panel

2.6 ELECTRICAL POWER SUPPLY SYSTEM (FO-8)

Two ac generators supply power to the electrical system. Four transformers provide 26-volt single-phase ac power. Two rectifiers provide 28-vdc control and operating power. One inverter supplies 115-vac power. One battery supplies 24-vdc power.

2.6.1 Alternating Current Power Supply System. Ac power is supplied by two generators designated as Nos. 1 and 2. Associated system components are designated in a similar manner. System operation is automatic; control switches on the overhead switch panel and monitoring light capsules on the caution and advisory panels are provided. Normally, associated primary bus loads are assumed by each generator and the monitored bus load is powered by the No. 2 generator. Primary bus loads are those that are essential for night and/or instrument flight and for operation of equipment necessary for mission requirements. The monitor bus load is not essential for this type of flight. If either generator fails, its primary bus load is automatically transferred to the remaining generator. With a failed generator, the monitor bus load is automatically dropped. An external ac power receptacle permits use of an external ac power unit for ground power application.

2.6.1.1 Generators. Two 115-/200-volt, three-phase, 400-Hz, brushless PMGs are mounted on and driven by the accessory section of the main gearbox. Generator output varies with temperature and altitude. Generator ac voltage is delivered to the associated supervisory panel and generator contactor relay. The permanent magnet sections of the generators develop ac power that is rectified to dc power in the supervisory panel to be used in the control circuits.

2.6.1.1.1 (ET) APU Generator. One 115-/200-volt, 3-phase, 400-Hz generator is mounted on the APU and is used for instrumentation, minimal lighting, and ground operation of the air conditioning system. The generator output varies with temperature and altitude. (Approximately 32 kVA at sea level.)

2.6.1.2 Supervisory Panels. The supervisory panels designated Nos. 1 and 2 provide control for relays in the electrical system. When the No. 1 generator is developing normal ac power and the generator switch is placed ON, PMG ac power from the same generator rectified to dc power by its associated supervisory panel will be used by the supervisory panel to close the generator contactor relay. Closing the No. 1 generator contactor relay permits the No. 1 generator to power the No. 1 primary ac bus and the supervisory panel to deliver 28 vdc to the ac monitor bus relay. In addition, it opens the No. 1 generator caution light circuit causing the light to go off. The No. 2 supervisory panel operates the same way to power the No.

2 primary ac bus and to turn off the No. 2 caution light. Dc power from the No. 2 supervisory panel also closes the ac monitor bus control relay that permits 28 vdc from the No. 1 supervisory panel to close the dc monitor bus relay and the ac monitor bus contactor relay. Therefore, 28-vdc power is required from both the Nos. 1 and 2 supervisory panels to energize the ac and dc monitor buses. If either generator fails to produce PMG ac power, the primary dc bus supplies backup dc voltage to each supervisory panel through circuit breakers on the center circuit breaker panel marked 1 and 2 under the general heading PMG BACK-UP. The supervisory panels provide protection for the electrical system. Three-phase AC power delivered to the panel from its associated generator is monitored by the panel at all times for open phase, overvoltage, and undervoltage. The panel monitors for underfrequency (Figure 2-21) when the helicopter is on the ground with its main landing gear struts compressed. In flight, the underfrequency protection is eliminated by action of the microswitch attached to the scissors of each landing gear. In this condition, the generators will remain on the line throughout the entire normal rotary wing speed range. If any of the monitored conditions are not normal, the generator contactor relay will open, taking the associated generator off the line, deenergizing the ac and dc monitor buses, and lighting the associated generator caution light. In case of a generator failure, primary ac bus loads will be switched automatically to the remaining generator.

2.6.1.3 Generator Switches. These switches are on the overhead switch panel (Figure 2-9) under the general heading 1 GEN 2 and have the marked positions ON, OFF-RESET, and TEST. Placing the switch ON puts the respective generator on the line by closing the generator contactor relay. The OFF-RESET position turns the generator off and resets the cycle. When the generators drop off the line because of an overvoltage or undervoltage they will have to be reset; however, when the generators drop off the line because of an underfrequency, they will come back on automatically. The TEST position is used for maintenance.

FLIGHT POSITION		ACCESSORY DRIVE POSITION		
PERCENT N_f or N_r	GENERATOR FREQ	PERCENT N_f	N_r	GENERATOR FREQ
95	380.0	99	0	380.0
100	400.5	104	0	400.0
105	420.0	109	0	420.0

FLIGHT POSITION

NOTES

1. Under frequency protection is locked out during flight.

1. Generator should pickup (come on the line) between 92.1% and 96.8% N_f/N_r and should drop out within minus 2% of the pickup value. (These figures assume a 2% tachometer system accuracy.)

ACCESSORY DRIVE POSITION

NOTES

1. During ground operation frequency is set at 377-383 Hz for pickup, 374-380 Hz for dropout.

2. Generator should pick up (come on the line) between 95.8% and 101.3% N_f and should dropout within minus 2% of the pickup value. (These figures assume a 2% tachometer system accuracy.)

Figure 2-21. Generator Frequency at Various Rotor and Power Turbine Speeds

(JP-4 AT 15.6^{o}C)

GRAVITY REFUELING

	FORWARD TANK		CENTER TANK		AFT TANK		TOTAL FUEL	
	GALLONS	POUNDS	GALLONS	POUNDS	GALLONS	POUNDS	GALLONS	POUNDS
UNUSABLE	2.65	17.2	.83	5.4	2.65	17.2	6.13	39.8
USABLE	344.35	2238.3	147.17	956.6	350.35	2277.3	841.87	5472.2
FULLY SERVICED	347.00	2255.5	148.00	962.0	353.00	2294.5	848.00	5512.0

PRESSURE REFUELING

UNUSABLE	2.65	17.2	.83	5.4	2.65	17.2	6.13	39.8
USABLE	338.35	2199.3	145.17	943.6	341.35	2218.8	824.87	5316.7
FULLY SERVICED	341.00	2216.5	146.00	949.0	344.00	2236.0	831.00	5401.5

1. Data basis 0^{o} fuselage attitude.
2. Fuel density JP-4 = 6.5 pounds per gallon.

.

(JP-5 AT 15.6^{o}C)

GRAVITY REFUELING

	FORWARD TANK		CENTER TANK		AFT TANK		TOTAL FUEL	
	GALLONS	POUNDS	GALLONS	POUNDS	GALLONS	POUNDS	GALLONS	POUNDS
UNUSABLE	2.65	18.1	.83	5.6	2.65	18.1	6.13	41.8
USABLE	344.35	2341.6	147.17	1000.8	350.35	2382.4	841.87	5724.8
FULLY SERVICED	347.00	2359.7	148.00	1006.4	353.00	2400.5	848.00	5766.6

PRESSURE REFUELING

UNUSABLE	2.65	8.1	.83	5.6	2.65	18.1	6.13	41.8
USABLE	338.35	2300.7	145.17	987.2	341.35	2311.1	824.87	5599.0
FULLY SERVICED	341.00	2318.8	146.00	992.8	344.00	2339.2	831.00	5640.8

1. Data basis 0^{o} fuselage attitude.
2. Fuel density JP-5 = 6.8 pounds per gallon.

Figure 2-22. Fuel Quantity Data

2.6.1.4 Generator Caution Lights. Two generator caution lights marked #1 GENERATOR and #2 GENERATOR, respectively, are on the caution panel. These lights will go on whenever the associated generator is taken off the line by the opening of the generator contactor relay that causes the caution light circuit to be completed. The generator caution lights are powered by the primary dc bus and protected by circuit breakers Nos. 1 and 2 under the general headings GENERATOR and WARNING LTS on the center circuit breaker panel.

2.6.1.5 Inverter. A 100-volt ampere, 115-volt inverter is incorporated in the electrical system to provide ac power to the fire detection system, fuel quantity indicating system, electrical autotransformer, and the isolation transformer. The inverter is automatically turned on when ac power is not present in the helicopter, and the primary dc bus is activated by an external dc power unit, or the battery switch is turned on. Primary dc bus operating power for the inverter is protected by a circuit breaker marked INV on the center circuit breaker panel. Inverter ac power is protected by two circuit breakers on the copilot circuit breaker panel marked PWR A and PWR C under the general heading INVERTER.

2.6.1.6 Transformers. Four transformers in the ac system convert 115-volt power from the primary ac buses to 26 volts. The Nos. 1 and 2 radio autotransformers are powered by the No. 1 primary ac bus. The No. 1 radio autotransformer supplies power to the TACNAV or navigation system, LF/ADF, BDHIs, TCDI, and GSDA.

The No. 2 radio autotransformer supplies power to the tacan, UHF-DF, and compass system. The radio autotransformers are protected by two circuit breakers on the copilot circuit breaker panel under the general heading AUTO XMFR and are marked 1 and 2, respectively. The electrical autotransformer is powered by the No. 1 primary ac bus or the inverter and supplies power to the No. 1 engine oil pressure indicator, primary servo hydraulic pressure indicator, utility hydraulic pressure indicator, and the No. 1 engine torquemeter. The electrical autotransformer is protected by a circuit breaker on the copilot circuit breaker panel marked AUTO XMFR 0 C. The isolation transformer is powered by the No. 2 primary ac bus or the inverter and supplies power to the No. 2 engine oil pressure indicator, the auxiliary servo hydraulic pressure indicator, main gearbox oil pressure indicator, and the No. 2 engine torquemeter. The isolation transformer is protected by a circuit breaker on the pilot circuit breaker panel marked XMFR NO.2 Ø C.

2.6.1.7 Utility Ac Power Receptacle. There are one or two 115-/200-vac utility receptacles on the sensor operator console. There is one ac utility receptacle at the No. 2 hoist operator station.

2.6.1.8 External Ac Power Receptacle. The external ac power receptacle is mounted on the left aft side of the fuselage. This receptacle is used to introduce 115-/200-volt, three-phase, 400-Hz ac power into the helicopter electrical system.

Note

On the UH-3H Executive Transport helicopters, the BRIGHT/DIM switch on the CABIN LIGHTS panel should remain in the DIM position while operating on external power.

An external power monitor panel monitors external power voltage level, frequency, and phase rotation. If these are correct, dc power will pass through the external power monitor panel and energize the external power contactor relay, introducing external three-phase power into the electrical system. A switch marked RESET-ON-OFF under the heading EXT PWR on the overhead switch panel (Figure 2-9) must be ON to allow power to pass through the power monitor panel. At OFF, ac power is removed by the power monitor panel. If ac power voltage level, frequency, and phase rotation are not correct, 28-vdc power will not energize the external power contactor. When the fault in the external ac power source is corrected, the EXT PWR switch must be momentarily placed to RESET to reactivate the external power monitor panel. Dc control power is protected by a circuit breaker on the center circuit breaker panel marked EXT PWR. The EXT PWR ON advisory light will go on when the ac power receptacle door is open.

2.6.1.9 External Power Advisory Light. This light on the advisory panel marked EXT PWR ON will go on when the ac external power door is open or when external dc power is being supplied to the helicopter.

2.6.1.10 Ac Circuit Breakers. Ac circuit breakers are on the pilot and copilot circuit breaker panels (Figure 2-23).

2.6.2 Direct Current Power Supply System. Dc power is supplied by two rectifiers, designated as Nos. 1 and 2 that are powered by the Nos. 1 and 2 primary ac buses, respectively. The dc system operation is automatic; control switches and rectifier caution lights are provided. Normally, primary and monitor bus loads are assumed by both rectifiers. Primary bus loads are those loads essential for flight under night instrument conditions and for operation of equipment necessary for mission requirements. The monitor bus loads are those not essential for this type of flight. If one rectifier fails, the associated reverse current cutout relay will remove the failed rectifier from the primary dc bus. The remaining rectifier will assume the primary dc bus loads and the monitored dc bus load will be dropped. The battery can provide power to the primary dc bus when no other source is available. The external dc power receptacle and associated circuitry permit use of an external power unit for ground power application.

2.6.2.1 Rectifers. Two 200-ampere, 28-vdc rectifiers are incorporated in the system. The rectifiers require an ac input from the generators or from an external ac power source. The rectifiers are designated as Nos. 1 and 2, and the associated components are designated in a similar manner. Both rectifiers normally supply power to the primary dc bus. The primary dc bus supplies power to the monitor dc bus. The No. 1 rectifier receives three-phase power from the No. 1 primary ac bus, and the No. 2 rectifier receives three-phase power from the No. 2 primary ac bus. The ac input is stepped down, rectified, and filtered within each rectifier; the dc output is fed to the associated reverse current cutout relay. During normal operation, dc power from the reverse current cutout relay is fed to the primary dc bus. The reverse current cutout relay prevents current flow from the primary dc bus to a failed rectifier. The monitor dc bus will be dropped from the line if the ac monitor bus relay is open. The dc monitor bus relay must be closed for the monitor bus to receive power. Power to close this relay comes from the primary dc bus and is routed through the No. 2 and the No. 1 reverse current cutout relays. If either the rectifier, reverse current cutout relay, or ac generator is inoperative, the monitor dc bus will be dropped from the line and the appropriate caution light/lights will go on. The No. 1 rectifier is protected by a circuit breaker on the copilot circuit breaker panel marked RECTIFIER NO. 1. The No. 2 rectifier is protected by a circuit on the pilot circuit breaker panel marked RECTIFIER NO. 2.

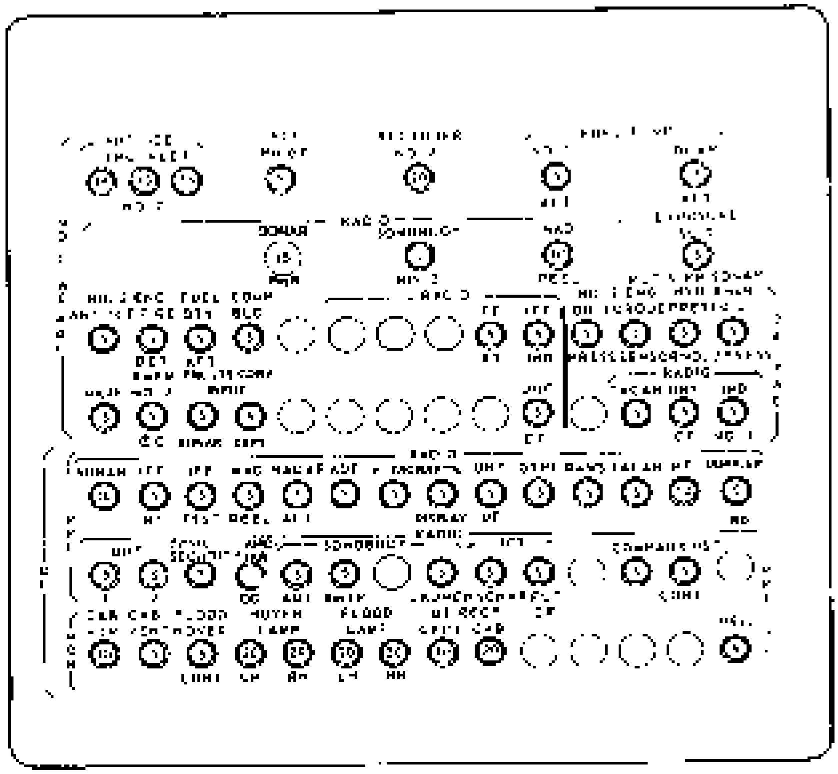
2.6.2.2 Rectifier Caution Lights. Two rectifier caution lights are on the caution light panel marked #1 RECTIFIER and #2 RECTIFIER. Failure of a rectifier or reverse current cutout relay will light the associated caution light.

2.6.2.3 Battery. A 24-volt, 20-ampere hour, nickel cadmium battery in the nose section forward of the pilot compartment is reached from outside the helicopter. Battery power is used for limited ground operations when no external power is available and as an emergency source of power to the primary dc bus. The transformer-rectifiers supply charging current for the battery.

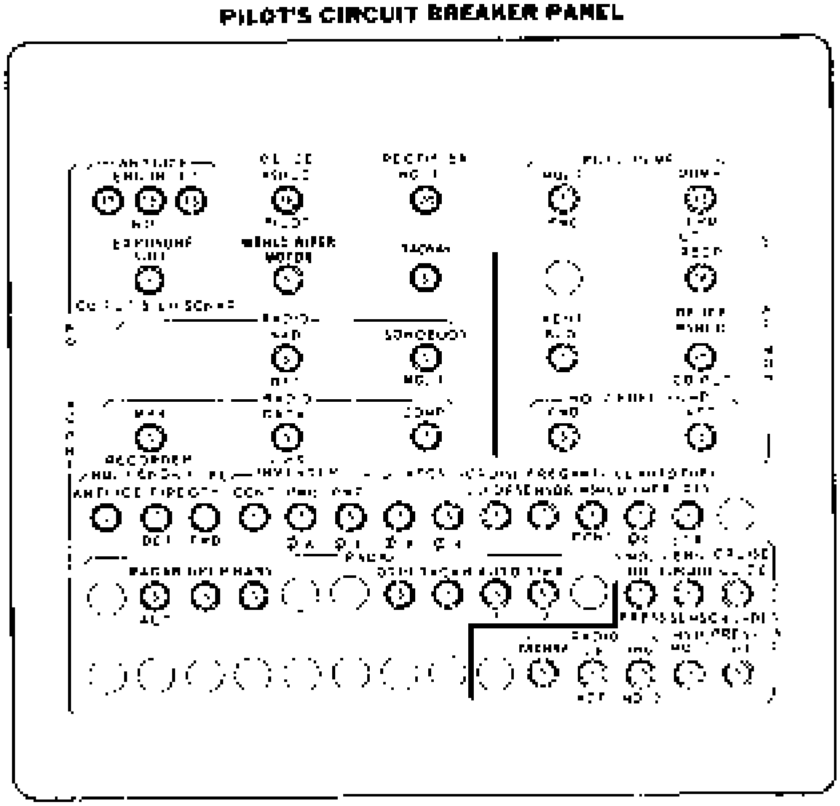
2.6.2.4 Battery Switch. The battery switch is on the overhead switch panel (Figure 2-9) in the cockpit. The switch is marked BAT and has marked positions OFF and ON. The ON position energizes the battery relay that connects the battery to the primary dc bus.

2.6.2.5 Utility Dc Power Receptacles. One utility dc power receptacle is on the pilot overhead control panel and another is on the right side of the cabin at the No. 2 hoist operator station. These receptacles are powered by the monitor dc bus and protected by two circuit breakers on the pilot circuit breaker panel under the general heading UT RECP and marked CKPT and CAB, respectively.

2.6.2.6 External Dc Power Receptacle. The 28-volt external dc power receptacle is on the right side of the helicopter below the pilot window. External power can be connected and used for all ground operation until the generators are in operation. As soon as external power is connected, the external power relay is energized, external power is supplied to the primary dc bus, the EXT PWR ON advisory light goes on, and the monitor bus relay is energized to permit the primary dc bus to furnish power to the monitor dc bus. The dc external power unit to be used for starting should provide 28 vdc, 300 amperes continuous, and 750 amperes current limited.



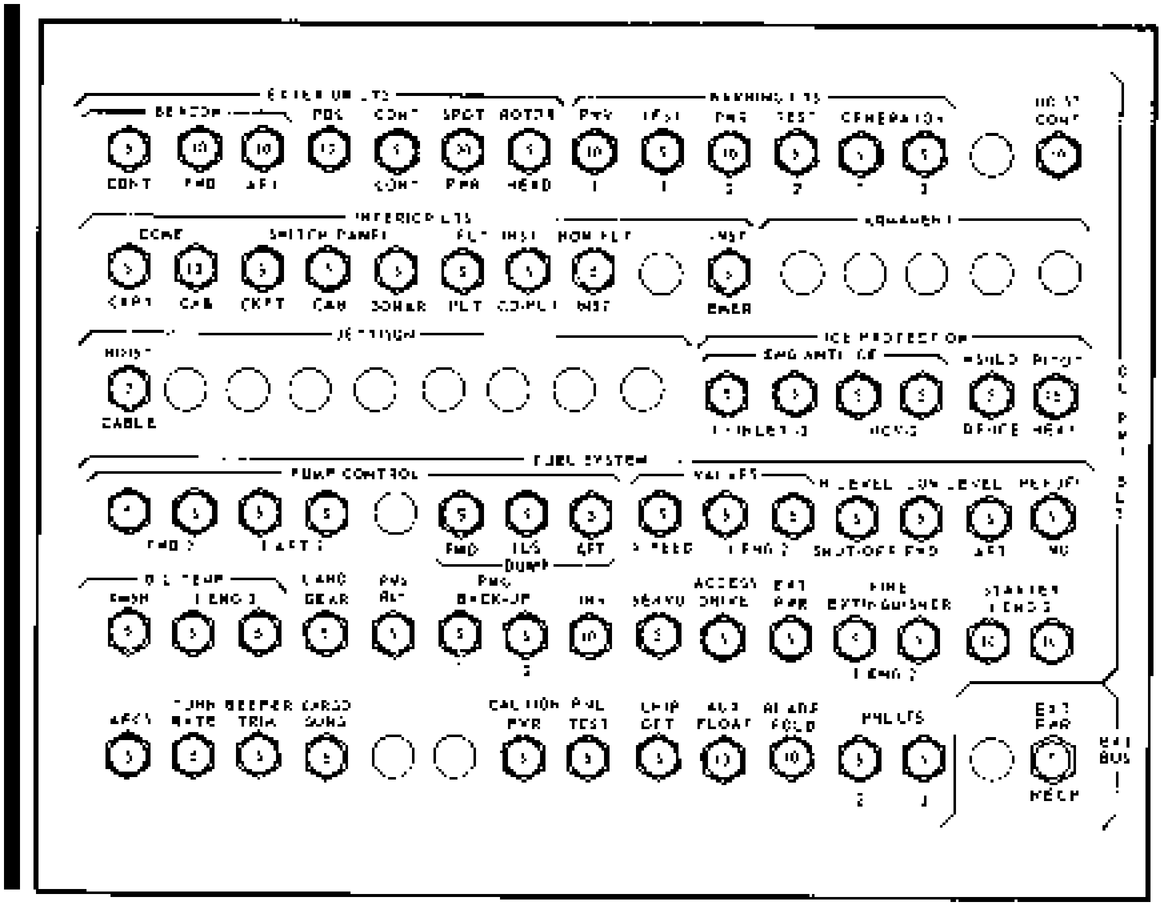
PILOT'S CIRCUIT BREAKER PANEL



COPILOT'S CIRCUIT BREAKER PANEL

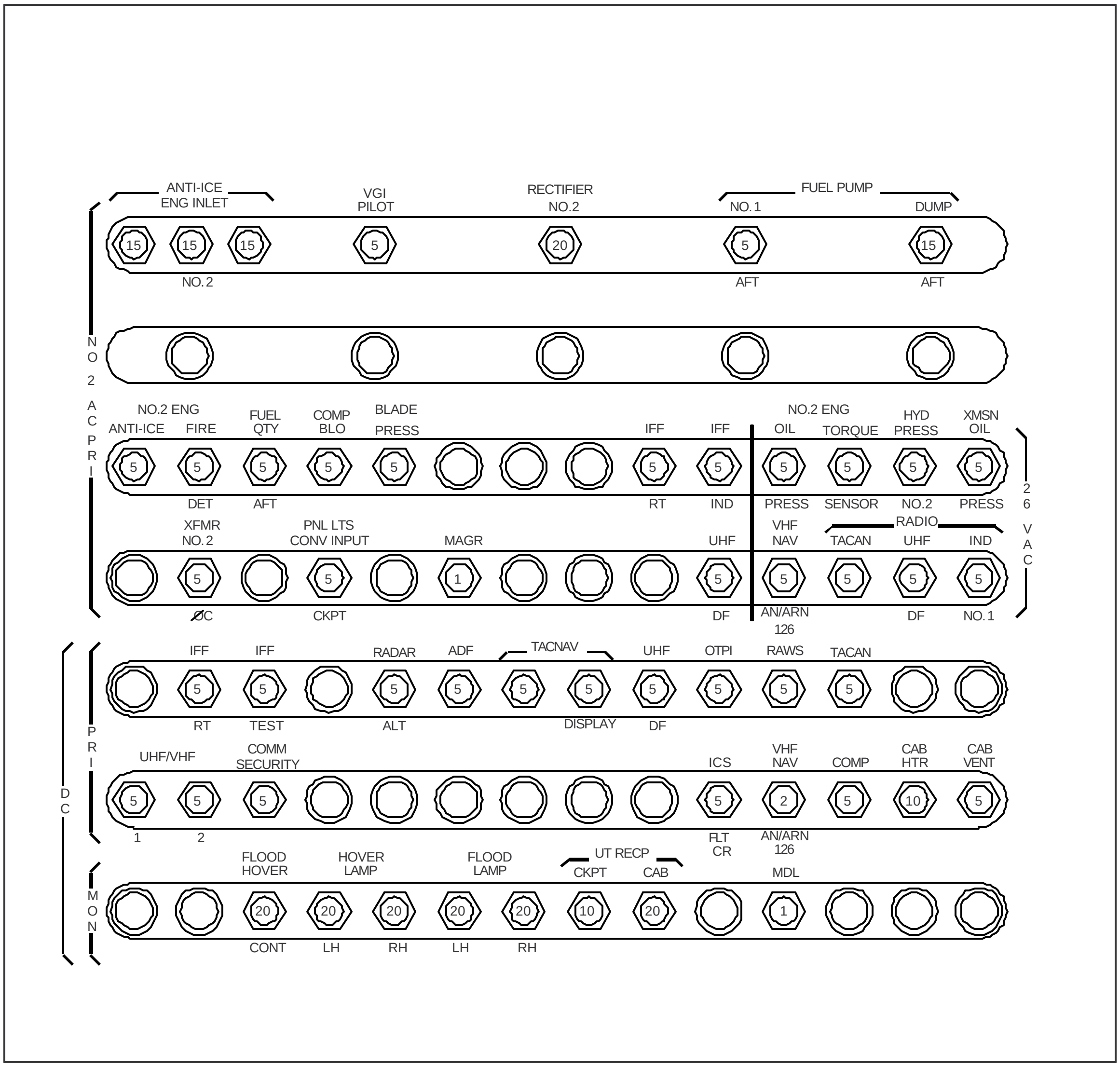
N1/91

Figure 2-23. Circuit Breaker Panels (Typical) (Sheet 1 of 2)



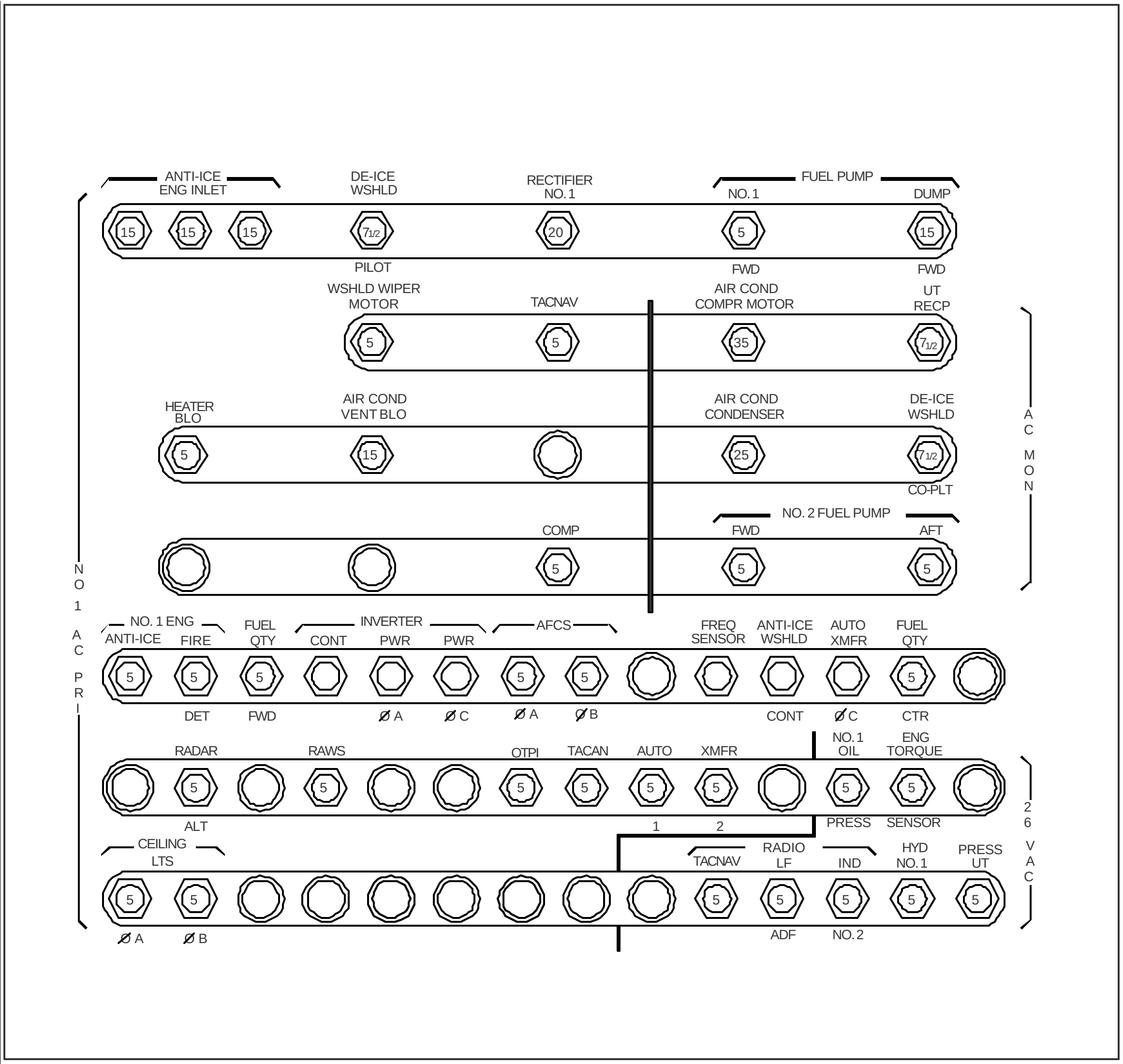
Center Circuit Breaker Panel

Figure 2-23. Circuit Breaker Panels (Typical) (Sheet 2 of 2)



PILOT'S CIRCUIT BREAKER PANEL
UH-3H EXECUTIVE TRANSPORT

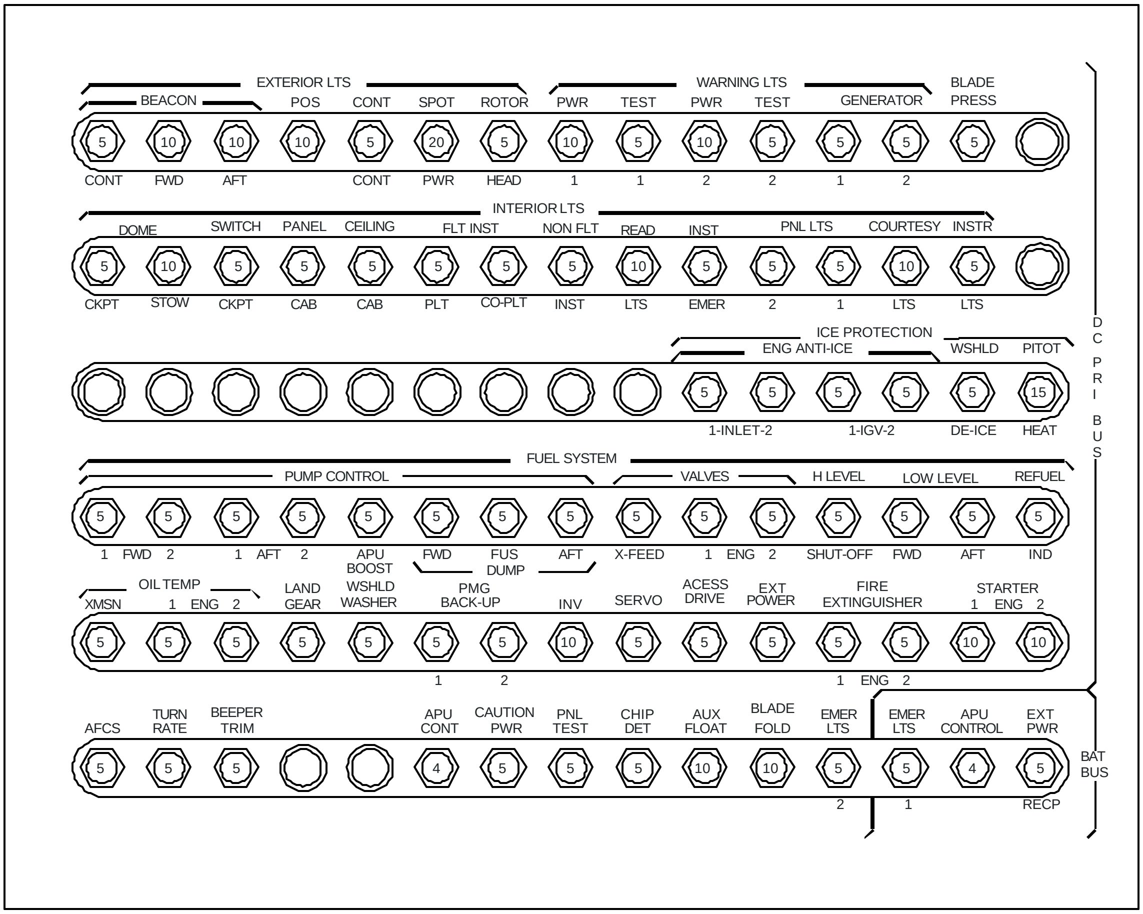
Figure 2-23.1.1 (ET) Circuit Breaker Panels (Sheet 1 of 3)



CO-PILOT'S CIRCUIT BREAKER PANEL
UH-3H EXECUTIVE TRANSPORT

01771228

Figure 2-23.1.1 (ET) Circuit Breaker Panels (Sheet 2 of 3)



OVERHEAD CIRCUIT BREAKER PANEL

01771230

Figure 2-23.1.1 (ET) Circuit Breaker Panels (Sheet 3 of 3)

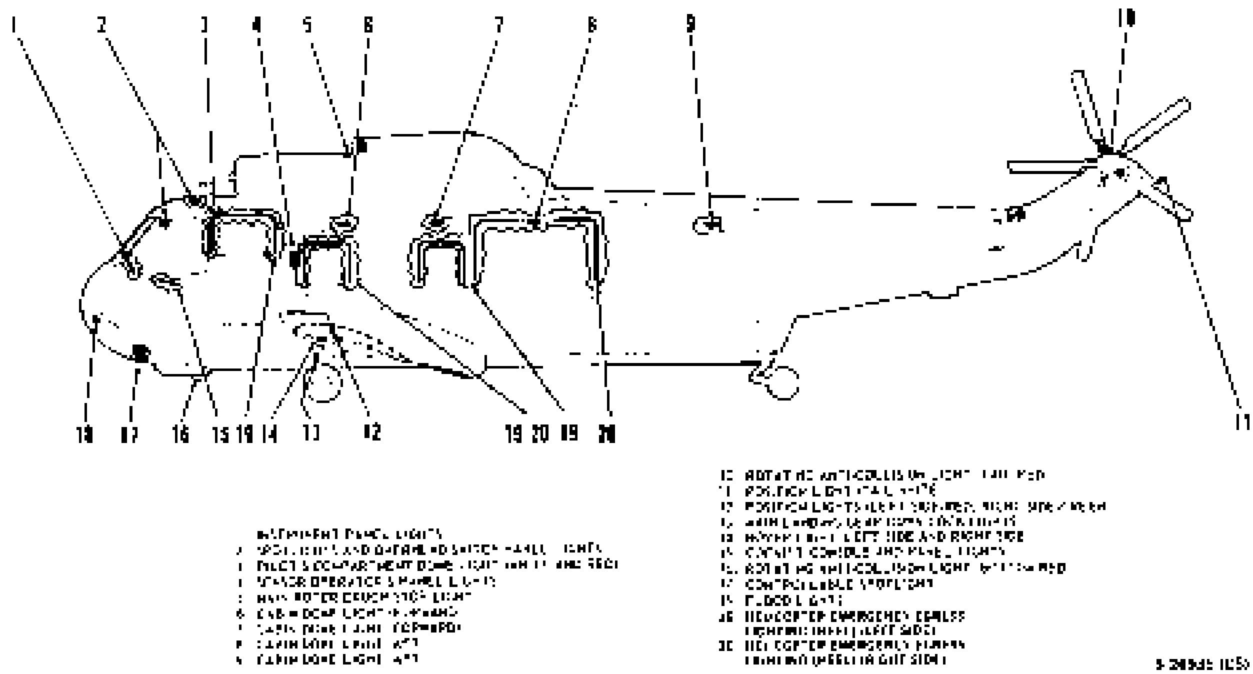
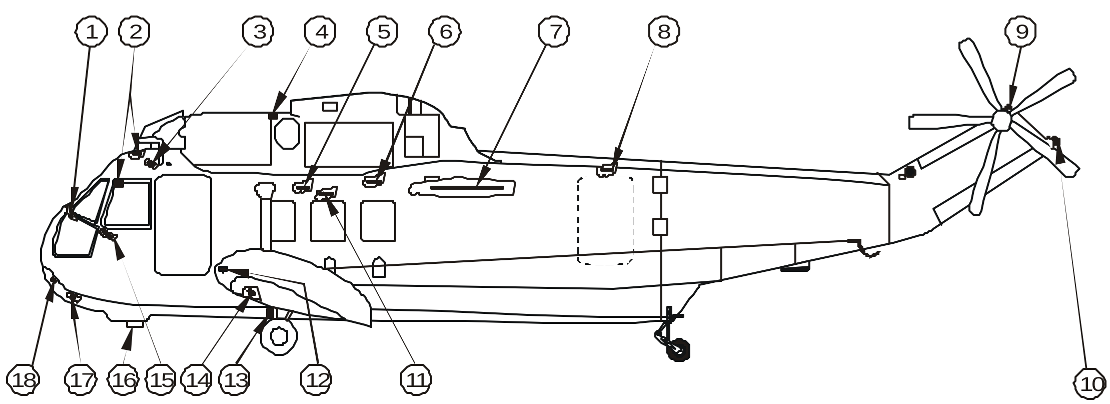


Figure 2-24. (NON-ET) Lighting System



1. INSTRUMENT PANEL LIGHTS
2. SPOTLIGHTS AND OVERHEAD SWITCH PANEL LIGHTS
3. PILOT'S COMPARTMENT DOME LIGHT (WHITE AND RED)
4. MAIN ROTOR DROOP STOP LIGHT
5. READING LIGHTS (8 EACH - RIGHT SIDE)
6. READING LIGHTS (8 EACH - LEFT SIDE)
7. CEILING LIGHTS (9 EACH)
8. EMERGENCY EXIT LIGHT
9. ROTATING ANTI-COLLISION LIGHT (TAIL - RED)
10. POSITION LIGHT (TAIL - WHITE)
11. EMERGENCY EXIT LIGHT
12. POSITION LIGHTS (LEFT SIDE - RED, RIGHT SIDE - GREEN)
13. MAIN LANDING GEAR DOWN - LOCK LIGHTS
14. HOVER LIGHT (LEFT SIDE AND RIGHT SIDE)
15. COCKPIT CONSOLE AND PANEL LIGHTS
16. ROTATING ANTI - COLLISION LIGHT (BOTTOM RED)
17. CONTROLLABLE SPOTLIGHT
18. FLOOD LIGHTS

01771105

Figure 2-24.1. (ET) Lighting System

2.7 LIGHTING EQUIPMENT

All lights operate on direct current and are protected by circuit breakers. Switches and rheostats for operating all lights, except, cabin dome light, flood-hover lights, and spotlight, are on the overhead switch panel.

2.7.1 Interior Lights

2.7.1.1 Pilot and Copilot Flight Instrument Lights. The pilot and copilot flight instrument panel lights (Figure 2-24) are individually controlled by rheostats marked PILOT FLIGHT INST LIGHTS and COPILOT FLIGHT INST LIGHTS, both with marked positions OFF and BRT on the overhead switch panel (Figure 2-9). The intensity of the flight instrument light may be varied by turning each rheostat. When the pilot flight instrument light rheostat is moved out of the OFF position, it automatically dims the master reset light, caution panel, advisory panel, landing gear warning light, and fuel boost pump failure warning lights. The pilot and copilot flight instrument lights operate from the primary dc bus and are protected by circuit breakers marked PLT and CO-PLT under FLT INST on the center circuit breaker panel and overhead control panel (Figures 2-23).

2.7.1.2 Nonflight Instrument Lights. These lights on the instrument panel are controlled by a rheostat marked NON-FLIGHT INST LIGHTS with marked positions OFF and BRT on the overhead switch panel. The intensity of the engine instrument lights, the hydraulic pressure gauge lights, the fuel management panel lights, the fuel quantity lights, and the engine and transmission oil pressure and temperature lights may be varied by turning the rheostat. The nonflight instrument lights operate from the primary dc bus and are protected by a circuit breaker marked NON-FLT INST on the center circuit breaker panel and overhead control panel (Figure 2-23).

2.7.1.3 Console and Panel Lights. The lights on the cockpit console, the overhead switch panel, the pilot right console, and the copilot interphone control panel are controlled by a rheostat marked CONSOLE & PANEL LIGHTS with marked position OFF and BRT on the overhead switch panel. The cockpit console and panel lights operate from the primary dc bus and are protected by a circuit breaker marked CKPT under the general heading SWITCH PANEL on the center circuit breaker panel. On UH-3H helicopters, the console and panel lights also require power from the No. 2 primary ac bus. They are protected by a circuit breaker marked CKPT under the general heading PNL LTS CONV INPUT on the pilot circuit breaker panel.

2.7.1.4 Instrument Emergency Light. This light is controlled by the rheostat marked INSTRUMENT EMER LTS with marked positions OFF and BRT on the overhead switch panel. The intensity of the instrument emergency light that is a red light in the pilot compartment dome light (Figure 2-25) may be varied by turning the rheostat on the overhead switch panel. The instrument emergency light operates on dc power, and it is protected by a circuit breaker marked INST EMER on the center circuit breaker panel.

2.7.1.5 Pilot Compartment Dome Light. This light (Figure 2-25) is controlled by a guarded switch marked DOME LIGHTS - CKPT with marked positions RED, OFF, and WHITE on the pilot compartment dome light panel. The dome light has a red and white lamp. The red light may also be turned on by adjusting the instrument emergency light rheostat. The white light may be turned on only if the guard is lifted to permit moving the switch to the white position. The white light in the pilot compartment dome light operates on dc power and is protected by a circuit breaker.

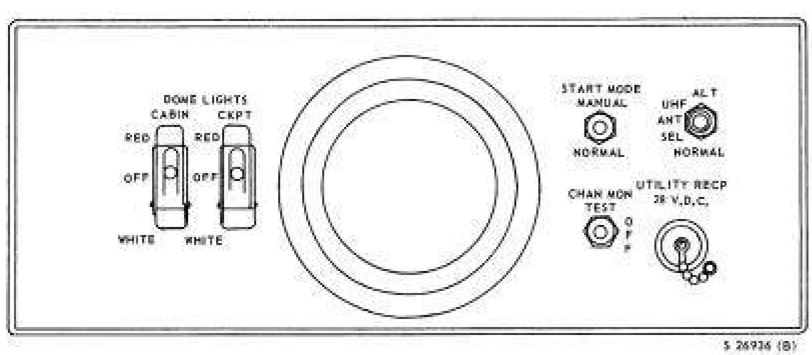


Figure 2-25. Pilot Compartment Dome Light Panel

2.7.1.6 Pilot Compartment Spotlights. Two portable spotlights (Figure 2-24) with coiled cord are secured one on each side of the overhead switch panel. Two additional spotlights are installed, one on each side of the compartment mounted on the window frame alongside each pilot. The lights may be adjusted on their mountings to direct the light beams where required, or they may be removed and used as portable spotlights. The spotlights are controlled either by rheostat with marked positions OFF and BRT, or the pushbutton on the end of the spotlight casing. The lens casing of the light may be turned to focus the beam and to position a red filter converting the white light to a red light. The pilot compartment spotlights operate on dc power and are protected by a circuit breaker.

2.7.1.7 Cabin Dome Lights. These lights (Figure 2-24) are controlled by a guarded switch marked DOME LIGHTS - CABIN with marked positions RED, OFF, and WHITE on the pilot compartment dome light panel (Figure 2-25). The cabin dome lights have a red and white lamp. The white light may be turned on only if the guard is lifted. The intensity of the cabin dome lights may be varied by turning the rheostat marked CABIN DOME LIGHTS (Figure 2-26) at the sensor operator station. On UH-3H helicopters, the panel contains two knobs marked FWD and AFT, respectively, each with the marked positions DIM and BRT. The FWD knob controls the forward pair of dome lights, and AFT knob controls the aft pair of dome lights.

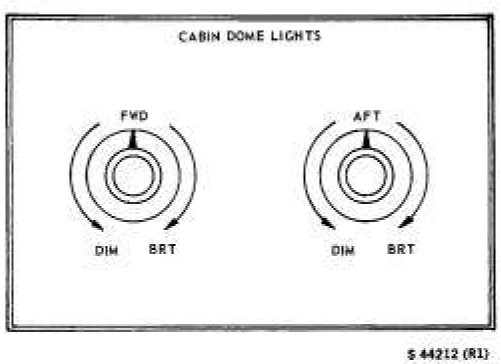


Figure 2-26. Cabin Dome Light Panel

2.7.1.8 Cabin Panel Lights. These lights are controlled by a panel at the hoist operator station, marked CABIN PANEL LIGHTS with a knob marked DIM and BRT to control light intensity. The cabin panel lights operate from the primary dc bus and are protected by a circuit breaker marked CAB under the general heading SWITCH PANEL on the center circuit breaker panel.

2.7.1.9 (ET) Ceiling Lights. The ceiling lights are mounted overhead in the cabin. The ceiling lights are controlled from either the forward bulkhead, STA 160, or aft bulkhead, STA 425, when the overhead control panel CABIN LTS MASTER switch is ON. Each station is equipped with a pair of toggle switches. One switch for ON/OFF operation and the other for BRIGHT/DIM operation. The lights receive power from the primary ac bus and are protected by circuit breakers marked CEILING LTS ϕA and CEILING LTS ϕB on the copilot's circuit breaker panel.

Note

On the UH-3H Executive Transport helicopters, the BRIGHT/DIM switch on the CABIN LIGHTS panel should remain in the DIM position while operating on external power.

2.7.1.10 (ET) Reading. Reading lights are mounted overhead in the cabin. The CABIN LTS MASTER switch must be ON to activate the individual pushbutton controls. The lights are powered by the primary dc bus and are protected by a circuit breaker marked READING on the overhead circuit breaker panel.

2.7.1.11 (ET) Instruction. The instruction lights provide NO SMOKING and FASTEN SEAT BELT information to the cockpit and cabin areas. In the cockpit the information is displayed on the advisory panel. In the cabin area it is displayed on the forward bulkhead, STA 160, and aft bulkhead, STA 425. The information lights are controlled by the PASSENGER INSTRUCTION LIGHT switch located on the overhead control panel. Circuit protection is provided by a circuit breaker marked INST LTS on the overhead circuit breaker panel.

2.7.1.12 (ET) Emergency Exit. There are three emergency exit lights. One located over each cabin emergency escape hatch. The lights are operated by the EMERGENCY LIGHTS switch. The lights receive power from the primary dc bus and are protected by circuit breakers marked EMER LTS 1 and EMER LTS 2.

2.7.2 Exterior Lights

2.7.2.1 Flood-Hover Lights

CAUTION

> The flood-hover lights should not be on for more than 15 minutes at a time to prevent overheating. Allow a 10-minute cooling period.

The floodlights (Figure 2-24 and 2-24.1(ET)) are on the electronics compartment door. A hover light is on the lower leading edge of each stub wing. The flood-hover lights are controlled by a switch (Figure 2-27) with marked positions HOVER LT, OFF, and FLOOD LT on the pilot collective pitch lever grip. When the switch is placed to FLOOD LT, the floodlights on the electronics compartment door light an area forward of the helicopter. When the switch is placed to HOVER LT, the hover lights on each wing section and the floodlights light an area below and forward of the helicopter. Placing the switch to the OFF centered position turns off the flood-hover lights. The flood-hover lights operate from the monitored dc bus and are protected by circuit breakers.

2.7.2.2 Exterior Lights MASTER SWITCH. This switch marked MASTER SWITCH with marked positions ON and OFF is on the overhead switch panel (Figure 2-9). The MASTER SWITCH must be placed ON before any of the position lights and rotating anticollision lights will operate. The tail beacon light may be operated with the exterior lights MASTER SWITCH OFF.

2.7.2.3 Position Lights. The side position lights (Figure 2-24) on the sponsons are controlled by a switch marked SIDE POS with marked positions DIM, OFF, and BRT on the overhead switch panel. The tail position light on the tip of the tail pylon is controlled by a switch marked TAIL POS with marked positions DIM, OFF, and BRT on the overhead switch panel. The keyer operates only when the position light switches are at either OFF or DIM. A switch marked STEADY and FLASH is on the overhead switch panel to permit automatic flashing of the position lights. The position light switches are inoperative until the exterior light MASTER SWITCH is turned on. The position lights operate on dc power and are protected by a circuit breaker.

Figure 2-27. Flood, Hover, and Spotlight Control Switches

2.7.2.4 Anticollision Lights. These lights (Figure 2-24), one on top of the tail pylon and the other on the bottom of the ARA-25A antenna, are controlled by two switches. The aft two-position switch marked OFF and NORM on the overhead switch panel controls the forward anticollision light. The forward three-position switch marked BEACON, OFF, and ANTI-COLL on the overhead switch panel controls the aft anticollision light and beacon. When the forward switch is placed to the BEACON position, an aft white strobe light is activated. When the forward switch is placed to the ANTI-COLL position an aft red strobe is activated. When the aft switch is placed to the NORM position, the forward red anticollision light illuminates and rotates. The rotating anticollision light switch is inoperative until the exterior light MASTER SWITCH is turned on. The forward anticollision light will not operate unless the aft anticollision light is turned on. The anticollision lights operate from the primary dc bus. The control circuit is protected by a circuit breaker on the center circuit breaker panel. The anticollision lights are protected by circuit breakers marked FWD and AFT under the general heading BEACON on the center circuit breaker panel. For day operations, the white beacon is recommended; for night, ground, and shipboard operations, the red anticollision lights are recommended.

2.7.2.5 Controllable Spotlight. Two spotlight control switches on the pilot collective pitch lever grip (Figure 2-27) control a swivel-type controllable spot-light (Figure 2-24) on the bottom right side of the fuselage aft of the electronic compartment door opening. The left switch is marked CONT SPOT LT with marked positions MASTER, OFF, and RETRACT. The right switch is a spring-loaded four-position thumb switch, center position OFF, with marked positions EXTEND-RETRACT-L-R.

Placing the left switch to MASTER lights the controllable spotlight and furnishes power to the right switch to control the spotlight. When the right switch is placed to EXTEND, the controllable spotlight is extended and may be stopped by releasing the switch to direct the light beam at any vertical angle between the stowed position to about 30^{o} above the horizon. By placing the switch to RETRACT, the light beam may be directed at a progressively decreasing angle until the spotlight is in the fully stowed position. By placing the switch to L or R, the spotlight will turn to the right or left to any point in a 360^{o} arc. If the left switch is placed to RETRACT while the controllable spotlight is extended, the spotlight will automatically go out and retract to the stowed position. The switch is then placed OFF. The controllable spotlight operates from the primary dc bus and is protected by circuit breakers.

2.7.2.6 Landing Gear Downlock Lights. These lights (Figure 2-24) on the main strut of each main landing gear provide additional landing gear position information for an outside observer. Electrical power for the lights is supplied by the primary dc bus through contacts of the LDG GEAR DOWN LIGHT relay. The relay is energized whenever the exterior lights MASTER SWITCH is placed in the ON position; however the circuit is not completed, thus preventing the lights from going on until the landing gear is down and locked.

2.7.2.7 Droop Stop Light. The light (2-24) inside the forward edge of the transmission fairing provides a means of determining the position of the droop stops at night during rotor shutdown. The droop stop light is controlled by the ROTOR HEAD LT switch with marked positions OFF and ON on the overhead switch panel. The light is dc powered and is protected by a circuit breaker marked ROTOR HEAD on the center circuit breaker panel.

2.8 FLIGHT CONTROL SERVO HYDRAULIC SYSTEMS

The flight control servo hydraulic systems (FO-10) consists of a primary and an auxiliary flight control servo system. The servo systems are required for a power boost for the pilot to operate the controls. The servos also prevent feedback of vibratory loads to the control sticks and rudder pedals. Both servo systems operated from independent hydraulic systems and both use similar servo hydraulic units to vary the rotary wing and rudder blade pitch through the mechanical linkage of the regular flight control system. Each servo unit consists of a bypass valve, sloppy link, power piston, pilot valve, and the ASE valve in the auxiliary servo units only. The flight control system actuates the pilot valve that admits hydraulic oil into the servo unit. The servo output is connected to the flight control linkage to provide the power boost. The continuity of the direct control linkage is maintained from the controls in the pilot compartment through the auxiliary and the primary servos to the rotary wing blades except for a slight amount of end play at each servo unit to permit the pilot valves to move before the direct control linkage. Normally, both servo systems are in operation at all times.

2.8.1 Primary Flight Control Servo System. The system consists of three hydraulic servo units that connect the flight control linkage to the stationary swashplate of the rotor wing assembly. The servos provide the power necessary for operation of the rotary wing flight control system only. The three servo units of the primary servo systems are at the stationary swashplate. All three servo units respond simultaneously and move in the same direction in response to movements of the collective pitch lever. Two of the servo units (lateral servo units) respond simultaneously, but move in opposite directions in response to lateral movements of the cyclic stick. One of the servo units (fore-and-aft servo unit) responds to fore-and-aft movements of the cyclic stick. Since all three movements can occur simultaneously through the action of the mixing unit, the position of any primary servo unit is the result of the combined input of the cyclic stick and collective pitch lever. This results in a primary servo system in which any one servo has an effect on both collective pitch and cyclic (lateral or fore and aft) pitch. The primary servo hydraulic pump is driven by the accessory section of the main gearbox. The primary hydraulic system reservoir (Figure 3-1), mounted aft of the main gearbox, has a capacity of about 0.45 gallon of hydraulic oil. The PRI SERVO PRESS caution light will go on when the primary servo pressure drops below 1,000 psi or is turned off.

2.8.2 Auxiliary Flight Control Servo System. The four servo units of the auxiliary servo systems are between the mixing unit and the flight controls. Each control input acts independently on the corresponding servo. The rotary rudder pedals position the yaw servo. The collective pitch lever positions the collective servo. The cyclic stick positions either the fore-and-aft servo, the lateral servo, or both. The auxiliary flight control servo system receives corrective signals from the ASE and automatically introduces these into the flight control system. It provides for controlled flight if the primary servo fails. The auxiliary servo hydraulic pump is driven by the main gearbox accessory section. The auxiliary hydraulic reservoir (Figure 3-1), aft of the primary hydraulic system reservoir, has a capacity of about 0.45 gallon of hydraulic oil. The AUX SERVO PRESS caution light will go on when the auxiliary servo pressure drops below 1,000 psi or is turned off.

2.8.3 Flight Control Servo Switch. Both the primary and auxiliary flight control servo systems are controlled by the same three-position flight control servo switch on the collective pitch grip lever (Figures 2-28 and 2-29). The marked switch positions are PRI OFF and AUX OFF. The flight control servo switch is protected by a dc circuit breaker marked SERVO on the center circuit breaker panel.

Both servo systems are normally in operation with the switch in the unmarked center (ON) position. To turn off the primary servo, the switch is placed to the forward PRI OFF position; to turn off the auxiliary servos, the switch is placed to the aft AUX OFF position. Stronger cyclic, collective, and rotary rudder pedal forces and the absence of pedal damping will be encountered with auxiliary servos inoperative. The systems are interconnected electrically in such a way that, regardless of the switch position, it is impossible to turn either one off unless there is 1,000 psi in the remaining system for proper operation. The servo shutoff valves operate on dc power.

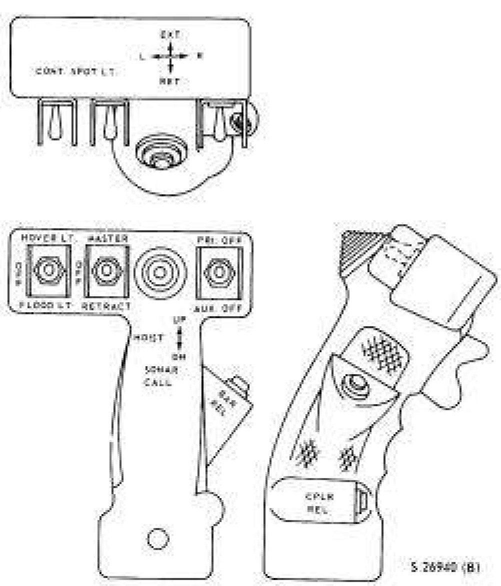


Figure 2-28. Pilot Collective Pitch Lever Grip

2.8.4 Servo Hydraulic Pressure Indicators. The primary and auxiliary servo pressure indicators operate on 26 vac and are protected by circuit breakers. If either servo system malfunctions, the malfunctioning system may be turned off and the helicopter flown on the other servo system. If the pressure in either the primary or the auxiliary system drops below 1,000 psi, a pressure switch prevents the other system from being shut off regardless of the position of the servo switch.

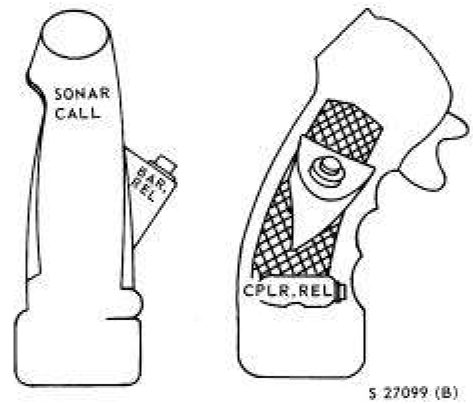


Figure 2-29. Copilot Collective Pitch Lever Grip

2.9 FLIGHT CONTROL SYSTEM

The flight control system is divided into three systems as follows: the rotary wing flight control system, the rotary rudder flight control system, and the flight control hydraulic power supply system with the three following unique characteristics: (1) the collective to yaw coupling, (2) the collective to the cyclic coupling, and (3) the negative force gradient installation. An ASE and coupler system is installed, that, when engaged, provides corrections of limited authority to the flight control system to cause the helicopter to respond in a stable manner to the maneuver referenced by the positions of the flight controls. This equipment also provides automatic cruising flight and constant altitude. The description and operation of the ASE are included in the AUTOMATIC STABILIZATION EQUIPMENT AND COUPLER SYSTEM, paragraph 2.10. A beeper trim system is installed to provide cyclic stick feel and to aid hands-off control with the ASE and coupler system in operation.

2.9.1 Rotary Wing Flight Control System. This system provides both vertical control and directional control. Vertical control is accomplished by changing the collective pitch of the rotary wing blades to increase or decrease the angle of attack and consequently the lift developed by the blades. Directional control is accomplished by changing the pitch of each blade individually as it rotates. The change in pitch causes the blades to rise and fall as they rotate through 360°, tilting the tip-path plane of the rotation of the rotary wing blades, thereby obtaining a horizontal, as well as a vertical, component of thrust. The horizontal component of thrust moves the helicopter horizontally in whichever direction the tip-path plane of rotation is tilted. Control motions from the collective pitch lever for vertical control and from the cyclic stick for directional control are combined in a mixing unit in the ASE control compartment aft of the pilot seat, and are transmitted to the rotary wing assembly by mechanical linkage. Control action is assisted by two hydraulically-operated flight control servo systems. The rotary wing flight controls terminate at the stationary swashplate of the rotary wing head. Control action is transmitted through the rotary swashplate and linkage on the rotary wing hub to the blades.

2.9.1.1 Collective to Yaw Coupling. When the auxiliary servo is pressurized, there is a proportional but irreversible transfer of collective pitch motion into the rotary rudder blade angle (collective pitch motion will act to displace the rotary rudder but rotary rudder pedal motion will not affect rotary wing collective pitch blade angle). This coupling provides automatic rotary rudder pitch changes to compensate for collective pitch changes. Rotary rudder blade angle changes result from both collective pitch lever and rotary rudder pedal inputs.

Any combination of collective pitch lever position and rotary rudder pedal position, wherein the total would exceed the system limits, is nonattainable during flight. The collective pitch lever has overriding authority and therefore is always free to move within its full travel. If a collective pitch lever position, added to the rotary rudder pedal position, creates a rotary rudder blade angle equal to the system limits, additional collective pitch lever motions to exceed the limits is only possible at the sacrifice of rotary rudder pedal position; the pedals will be forced to move but the blade angle remains at the limit. With auxiliary servo on, collective pitch lever low, and rotary rudder pedal full left, raising the collective pitch lever to high will be accompanied by pedal motion to the right. With the collective pitch lever high and rotary rudder pedal full right, reducing collective pitch lever to low will be accompanied by pedal motion to the left. With the auxiliary servo switch OFF, the operation is the same except the irreversibility is not effective. Therefore, when the combination of collective and pedal positions reaches the system limit, additional collective motion is possible by sacrificing pedal position. This trading of motion is not likely to occur but may be noted during ground check with the auxiliary servo off. During rapid rotary rudder pedal motions on the ground, noise can be heard aft of the pilot seat when the pedals reach their right or left limits. The sound is created by the system stops and indicates that the collective pitch and the pedals have reached the limits of the rotary rudder control. Additional rotary rudder pedal motion is possible by reciprocal motion of the collective pitch lever.

2.9.1.2 Collective to Cyclic Pitch Coupling. A bias in the collective to cyclic pitch (fore and aft) coupling is incorporated in the mixing unit to apply a nosedown pitching correction automatically when the collective pitch lever is raised and noseup when the collective is lowered. This provides attitude control during transitions especially during ASE transitions while operating in coupler mode.

2.9.1.3 Collective Pitch Levers. Two collective pitch levers (Figure 2-30) are in the pilot compartment, one to the left of the pilot seat and the other to the left of the copilot seat. Both levers operate simultaneously to change the collective pitch of the rotary wing blades. A nut on the pilot collective pitch lever marked COLLECTIVE PITCH LOCK with an arrow pointing left marked INCREASE FRICTION can be turned to apply friction to prevent the collective pitch lever from creeping while in flight.

WARNING

The collective friction nut should not be completely disengaged from the friction block, as this may result in the collective stick binding or jamming.

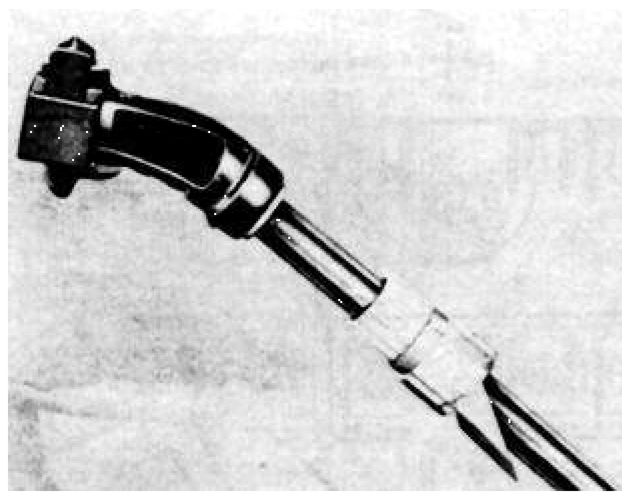


Figure 2-30. Collective Pitch Lever

2.9.1.4 Cyclic Sticks. The cyclic stick in front of each pilot seat provides directional control of the helicopter. Moving the cyclic stick in any direction tilts the tip-path plane of rotation of the rotary wing blades in that direction and moves the helicopter in the same direction. The stick grip (Figure 2-31) contains pushbutton and thumb-operated switches for controlling various equipment installed in the helicopter.

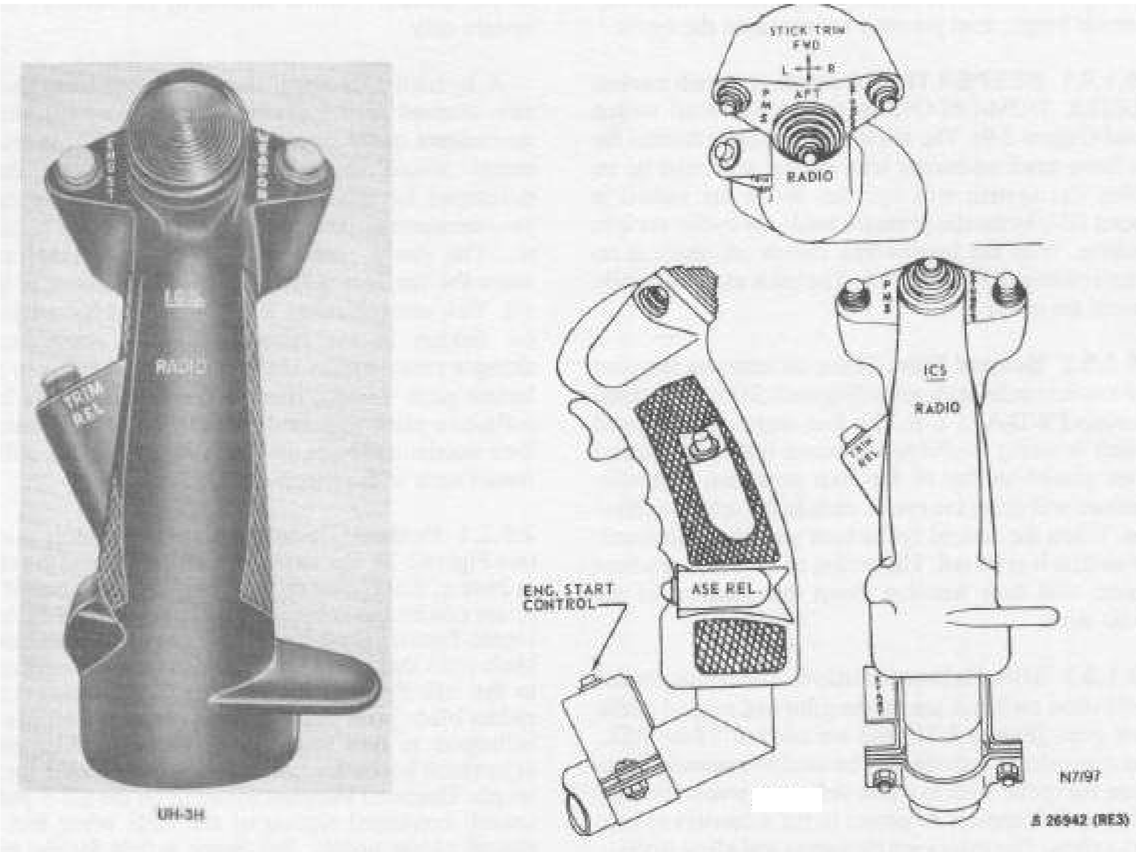


Figure 2-31. Pilot and Copilot Cyclic Stick Grip

2.9.1.5 Force Gradient-Beeper Trim System. The system permits a fine degree of adjustment of the cyclic stick and provides cyclic stick feel. When used with the ASE engaged, the system permits hands-off flight by holding the stick in a selected trim position. The system consists of two electrically controlled hydraulic actuators, one mounted on the fore-and-aft channel of the auxiliary servo and one on the lateral channel of the auxiliary servo. Additional components of each trim actuator consist of the following: trim valve, force gradient spring, trim release button, beeper trim button, and master beeper trim switch. The system is supplied with 28-vdc power and is protected by a circuit breaker marked BEEPER TRIM on the center circuit breaker panel. Hydraulic pressure for operation of the system is supplied by the auxiliary hydraulic system at a reduced pressure of 60 psi. The cyclic stick may be manually displaced without disengaging the trim system by applying about 1 to 1-1/2 pounds of pressure to the cyclic in the desired direction. A resistance force, caused by force gradient spring compression, will increase about 1/2 pound for each additional inch of cyclic stick displacement. When the pressure on the cyclic stick is released, the spring compression will return the stick to its original trimmed reference point. The force gradient-beeper trim system will operate as long as there is both dc power and auxiliary hydraulic pressure to the actuators. With the loss of auxiliary hydraulic pressure only, the cyclic stick may be repositioned by depressing either trim release button, moving the cyclic to desired position, and releasing the trim release button. The cyclic will then be held in its new position by hydraulic fluid trapped on both sides of the actuator trim piston. In each case, the effect of the force gradient spring will be felt when the cyclic is displaced without pressing the trim release button. With system electrical failure, the pilot must manually override beeper trim pressure to reposition the cyclic.

2.9.1.5.1 BEEPER TRIM Switch. A switch marked BEEPER TRIM-ON-OFF is on the overhead switch panel (Figure 2-9). The switch is the master control for the force gradient-beeper trim system and must be on before the system will operate. When the switch is placed ON, hydraulic pressure holds the cyclic stick in position. With the beeper trim switch off, there is no force holding the cyclic stick. The pilot must manually control the cyclic.

2.9.1.5.2 Beeper Trim. These switches on the pilot and copilot cyclic stick grips (Figure 2-31) have marked positions FWD-AFT-L-R. This four-way thumb-operated switch is spring loaded to the center (off) position and when placed to any of the four positions, hydraulic pressure will drive the cyclic stick in the selected direction. When the desired cyclic stick position is obtained, the switch is released. The action of the force gradient system will then function about this location of the cyclic stick.

2.9.1.5.3 Trim Release Button. The spring-loaded pushbutton switches are on the pilot and copilot cyclic stick grips (Figure 2-31) and are marked TRIM REL. The trim release buttons may be used to manually reposition the cyclic stick to a new reference point. Pressing either switch applies dc power to the solenoids of both trim valves. The valves are then open and allow hydraulic fluid to pass through the return port. Both trim pistons may then move unrestricted within their cylinders. Releasing the trim button deenergizes the solenoids, and the trim actuators will then maintain the new cyclic stick reference.

2.9.2 Rotary Rudder Flight Control System.

The functions of this system are to compensate for rotary wing torque and to permit changing the heading of the helicopter. The torque developed by the rotary wing blades turning counterclockwise tends to turn the fuselage in a clockwise direction. Gross weight, altitude, rate of climb, airspeed and the corresponding power settings, and collective pitch will vary the amount of rotary wing torque. To compensate for torque variations, the pitch and resulting thrust of the rotary rudder blades can be increased or decreased. Turns are accomplished by increasing rotary rudder thrust that overcompensates for rotary wing torque and changes the heading of the fuselage to the left, or by decreasing the rotary rudder thrust that undercompensates for the rotary wing torque and changes the heading of the fuselage to the right. Rotary rudder control pedal movements are transmitted to the rotary rudder assembly by mechanical linkage and cables. Control action is assisted by the auxiliary servo system only.

A hydraulic damping device, incorporated in the yaw channel of the auxiliary servo, prevents abrupt movements of the rotary rudder pedals. These movements would cause sudden changes in thrust developed by the rotary rudder with resulting rapid yaw acceleration and possible damage to the helicopter. The rotary rudder pedal damper is inoperative when the auxiliary servo system is inoperative or shut off. Yaw compensation is accomplished by mechanical linkage in the mixing unit that automatically changes rotary rudder blade angles for changes in collective pitch without moving the pedals, unless both collective pitch and rotary rudder blade angle are at their maximum limits, in which case the pedal will be forced back with collective pitch change.

2.9.2.1 Rudder Pedals. The rotary rudder pedals (see Figure 2-3), one set in front of the pilot and the other in front of the copilot, change the pitch and thrust of the rotary rudder and consequently the heading of the helicopter. Pressing the left pedal increases the rotary rudder blade pitch that increases thrust and turns the helicopter to the left. Pressing the right pedal decreases rotary rudder blade pitch that decreases thrust and allows the helicopter to turn to the right. Rotary rudder pedal adjustment knobs are used to adjust the pedals for leg length. Electrical switches mounted on the UH-3 pedals cancel directional signals of the ASE when feet are placed on the pedals. Toe brake pedals for the main landing gear wheelbrakes are mounted on the pilot rotary rudder pedals.

Rotary rudder control pedal movements are transmitted to the rotary rudder by a series of mechanical linkages and cables. Control inputs are transmitted from the pilot's and copilot's rudder pedals to the auxiliary servo by linkages and bellcranks and from the auxiliary servo by two steel cables. These cables are routed through a series of pulleys in the overhead of the cabin. Forward of the tailfold hinge, the tail rotor control cables are attached to a bellcrank that is attached to a series of control rods that transmit control inputs to the tail rotor pitch beam (star).

A rotary rudder NFG spring is installed parallel to the center pylon control rod at the top of the tail pylon just below the tail gearbox. The NFG spring is designed to relieve the pilot of rotary rudder forces created by aerodynamic and inertia loads when the auxiliary hydraulic servo is inoperative, imparting a force into the flight control system against the rotary rudder aerodynamic forces.

Because of the rocker assembly bellcrank connecting the NFG spring to the center pylon control rod, the spring acts as an anticentering device that attempts to drive the tail rotor pitch and pedals away from the center (neutral pedal) position to maximum pitch in either direction. With the main rotor static, when the auxiliary servo is secured and the rudder pedals are displaced from neutral, the spring will drive the tail rotor to either the full left or full right pedal position depending on the direction of the initial pedal displacement.

2.9.2.2 Rudder Pedal Adjustment Knobs. These knobs are on each side of the cockpit, just forward of the ashtrays. The adjustment knobs are connected to mechanical linkage that provide for fore-and-aft adjustment of the rotary rudder pedals. The knobs are turned to the right, as indicated by the arrow marked FWD, for forward adjustments and to the left, as indicated by the arrow marked AFT, for the aft adjustment.

2.10 AUTOMATIC STABILIZATION EQUIPMENT (ASE) COUPLER SYSTEM

The ASE provides added attitude and directional stabilization and barometric hold. On UH-3H aircraft, an SIU installed between the AHRS pitch and roll output and the ASE enhances transitions to automatic approach in the RAD ALT and the VERT ACCEL modes of the ASE coupler. The coupler system is used with the ASE for the following: automatic approaches and doppler hovers using signals from the Doppler, radar altimeter, and accelerometers. These signals are processed by the IVSC. The auxiliary servo system provides the means for introducing ASE signals to the flight controls. UH-3H Executive Transport helicopters do not use the Doppler or sonar cable altitude signals. AC power supplies excitation and reference voltage for the ASE. The system is protected by the three circuit breakers: two ac circuit breakers and one dc circuit breaker.

2.10.1 Automatic Stabilization Equipment. The ASE improves the handling characteristics of the helicopter and permits hands-off automatic flight. The ASE may be engaged at all times, has less control authority than the primary flight control system, and may be easily overridden through normal use of the flight controls. The pilot has direct control of the ASE at all times and can engage or disengage the entire system or any channel as desired by means of switches on the ASE CONTROL panel, CHANNEL MONITOR panel, cyclic sticks, and collective levers. The hover indicators (UH-3H helicopters) or flight directors (UH-3H Executive Transport helicopters) visually provide all ASE signals into the pilot and copilot. The hover indicators visually indicate all ASE signals to the pilot and copilot. The ASE has attitude and directional stabilization and barometric altitude hold modes of operation.

Attitude and directional stabilization are controlled through the pitch, roll, and yaw channels; and barometric altitude hold is controlled through the collective channel. The ASE is capable of maintaining the barometric altitude of the helicopter during normal flight, or when hovering out of ground effect by using barometric altitude reference. In the pitch and roll channels, the fuselage attitude is held constant by comparing the actual attitude signal received from the vertical gyro with the reference attitude trim signal provided by the cyclic stick position sensor. Automatic pitch and roll attitude stability correction occurs anytime the helicopter is displaced from the trimmed attitude. Pitch and roll gyro information source is selected on the CHANNEL MONITOR panel. In the yaw channel, the helicopter is held constant by comparing actual heading signals received from the compass system with reference heading signals received from the YAW TRIM knob and the yaw synchronizer. While the pilot establishes a reference heading by use of the pedals, the yaw channel is placed in a synchronizing mode (no heading correction signal is developed) until his feet are removed from the pedal switches. During the synchronizing mode, the yaw rate gyro develops a signal proportional to the manual heading displacement rate of the helicopter. This signal initiates an open-loop spring condition that produces a proportional feedback force at the pedals. As the pilot presses either pedal, he feels the proportional feedback force opposing the pedal pressure applied. The feedback force remains until the pilot has established the new reference heading. Heading stability correction occurs anytime the helicopter is displaced from the desired reference heading. In the collective channel, the altitude of the helicopter is held constant by signals developed from the barometric altitude controller that senses changes in barometric pressure from the engage point. Automatic barometric altitude stability correction occurs anytime the helicopter is displaced up or down from the reference altitude. The ASE may be engaged 3 minutes after power has been applied to the system.

2.10.1.1 ASE CONTROL Panel (BASIC ASE). The ASE CONTROL panel (Figure 2-32) is on the center console.

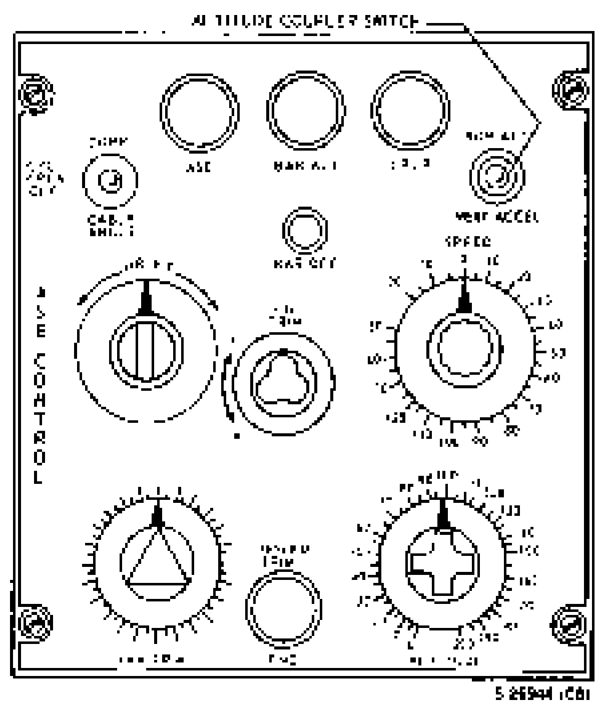


Figure 2-32. ASE CONTROL Panel

2.10.1.2 ASE Button. Pressing the ASE button will engage the pitch, roll, and yaw channels of the ASE and the button will light. Once the ASE is engaged, the only noticeable difference in flight is that the helicopter is dynamically stable.

2.10.1.3 Barometric Altitude Button. Pressing the BAR ALT button engages the barometric altitude controller and the button will light. Engaging the altitude controller provides altitude hold. Once the BAR ALT button is engaged, the pilots can momentarily release the altitude hold with the BAR REL button on both collectives (Figures 2-28 and 2-29). For proper operation, it is important that BAR ALT be engaged at a zero vertical velocity and at the selected forward speed.

2.10.1.4 Barometric Altitude Off Button. Pressing the BAR OFF button on the ASE control panel disengages the collective channel and the barometric altitude controller (BAR ALT) if the coupler is not engaged.

2.10.1.5 YAW TRIM Knob. The triangle-shaped YAW TRIM knob is used for small trim changes in forward flight and small turns while hovering without disengaging the yaw channel. A large heading change with the YAW TRIM knob during forward flight will result in a flat turn. For large heading changes, the pilot operates the cyclic and rotary rudder pedals in the normal manner.

2.10.1.6 CG TRIM Knob. The cloverleaf-shaped CG TRIM knob is used to compensate for changes in the center of gravity. The pilot should adjust the cg trim whenever the hover indicator (NON-ET) or flight indicator (ET) indicates a need for adjustment. With the hover indicator operating in the A mode and the METER SELECTOR switch on the CHANNEL MONITOR panel in the ASE position, there may be a tendency for the pitch bar to remain above or below the centerline. Such a condition indicates the need for cg adjustments. Maladjustment of the CG TRIM knob reduces the efficiency of the pitch stabilization and may make the helicopter unstable in pitch.

2.10.1.7 Automatic Stabilization Button. The AUTO STAB RELEASE button on the pilot and copilot cyclics will disengage all ASE modes when depressed.

2.10.2 (NON ET) Coupler System. The coupler enables the helicopter to seek and retain selected absolute altitudes, fore-and-aft groundspeeds, and drift groundspeeds. The coupler will maintain a constant absolute altitude over the water. To do this, the coupler must control the helicopter in absolute altitude and the longitudinal and lateral axes. The pitch, roll, and altitude channels of the coupler provide the signals that will control the helicopter in the three axes needed for coupler operation.

The pitch and roll channels are identical in their operation. The altitude channel has two modes of operation: radar altitude, and vertical accelerometer. The vertical accelerometer mode is used when collective pumping is experienced and for alternate approaches. The ASE must be engaged before operating the coupler. Raw Doppler signals are used in the Doppler mode. When operating in the DOPP mode, the pilot selects the fore-and-aft groundspeed and drift groundspeed at which he desires to fly. This is done through the use of the SPEED and DRIFT set knobs, on the ASE CONTROL panel. The Doppler signals that are proportional to selected speed and drift of the helicopter are compared to the output of these controls and will maintain the helicopter at the selected speed. The helicopter groundspeed and attitude are controlled by the position of the cyclic stick, and the ASE couplers operate around the cyclic stick position. Therefore, if the cyclic stick is moved, the ASE and coupler operating reference will move with it. If the coupler is engaged and a coupled error signal exists, the beeper circuit develops an electrical signal that actuates the appropriate hydraulic beeper valve to automatically reposition the cyclic stick. It is through this operation that the ASE maintains its authority.

The radar altitude, ALTITUDE set potentiometer controller knob (POT), and the Doppler vertical position signal (Vz) develop signals for the RDR ALT mode of operation. The radar altimeter, ALTITUDE set POT, and the vertical accelerometer (V_A) develop signals for the V_A mode of operation. When operating in any of the coupler modes, the pilot selects the altitude at which he desires to fly with the ALTITUDE set knob on the ASE CONTROL panel. In the RDR ALT mode, the signal from the radar altimeter that is directly proportional to the absolute altitude over the surface is compared to the output of the ALTITUDE set knob, and the result will maintain the helicopter at the selected altitude. The METER SELECTOR switch on the CHANNEL MONITOR panel (Figure 2-33) must be at ASE to present a proper indication.

2.10.2.1 (NON ET) ASE CONTROL Panel (Coupler). The automatic stabilization equipment must be engaged before engaging the coupler.

2.10.2.2 (NON ET) Coupler Button. Pressing the CPLR button engages the coupler; and the button lights whenever the coupler is engaged. Engagement of the CPLR automatically engages BAR ALT. The BAR ALT cannot be disengaged with the BAR REL buttons on the collective sticks or with the BAR OFF button on the ASE CONTROL panel.

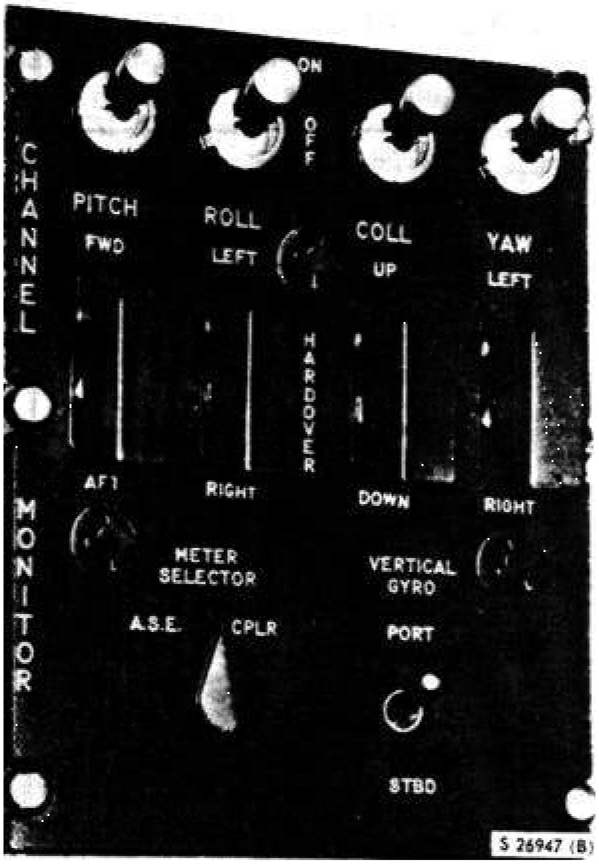


Figure 2-33. Channel Monitor Panel

2.10.2.3 (NON ET) Cyclic Coupler Switch. The CYC CPLR switch OFF position makes it possible to disable the cyclic coupler even though the altitude coupler is working. The DOPP position selects the Doppler radar input for automatic cruise, transition, and hover.

2.10.2.4 (NON ET) Altitude Coupler Switch. The RAD ALT and VA positions of the altitude coupler switch engage the appropriate altitude channel sensors for absolute altitude reference. The VERT ACCEL position engages the vertical accelerometer mode to eliminate collective pumping over high sea states. The CYC CPLR need not be engaged in order to engage the RAD ALT or VA modes of the altitude coupler.

2.10.2.5 (NON ET) DRIFT Knob. The bar-shaped DRIFT groundspeed set knob permits the pilot to preselect the lateral drift of the helicopter to be maintained by the cyclic coupler.

2.10.2.6 (NON ET) SPEED Knob. The indented circle-shaped, fore-and-aft ground SPEED set knob permits the pilot to preselect fore or aft groundspeed to be maintained by the cyclic coupler.

2.10.2.7 (NON ET) ALTITUDE Knob. The cross-shaped absolute ALTITUDE set knob permits the pilot to preselect accurate absolute altitudes from 0 to 200 feet with the ASE and altitude coupler engaged. The ALTITUDE set knob is scaled from 0 to 200 feet.

2.10.2.8 (NON ET) Hover Trim Engage Button. The HOVER TRIM ENG button transfers doppler groundspeed and drift control to the crewman at the hoist station for positioning the helicopter during hoisting or rescue operation. The HOVER TRIM ENG button lights when engaged and can only be engaged when the CYC CPLR switch is at DOPP.

2.10.3 Hover Indicators.

2.10.3.1 Pilot Hover Indicators. The pilot hover indicators (Figure 2-34), mounted on the instrument panel, is a four-axis indicator and has two modes of operation that are selected by a knob on the face of the indicator. A single OFF flag is used in both modes of operation. In the A mode, it will retract when the ASE is engaged. In D mode, the flag appears when the system is off or in memory C mode is disabled.

2.10.3.2 A Mode. The A mode monitors the ASE or coupler, depending on the position of the METER SELECTOR switch. With the METER SELECTOR switch on the CHANNEL MONITOR panel in the ASE position, the hover indicator will operate as a null indicator, indicating the input to the ASE servo valves. The hover indicator horizontal bar is used to monitor the pitch channel; the vertical bar is used to monitor the roll channel; the vertical pointer is used to monitor the altitude channel; and the horizontal pointer is used to monitor the yaw channel. The hover indicator scale factor in this mode is a 2-milliampere per division of servo valve differential current with 8 milliamperes considered as a hardover. The A mode with the METER SELECTOR switch at CPLR, is used to monitor coupler output.

2.10.3.3 D Mode. The D mode connects the hover indicator to the Doppler. In this mode, the horizontal bar indicates fore or aft velocity, the vertical bar indicates left or right drift, the vertical pointer indicates vertical velocity, and the horizontal pointer is inoperative. The scale factor for the D mode is 10 knots per division on horizontal and vertical bars for groundspeed. To maintain a Doppler hover, the pilot can assume the cyclic stick is in the center of the indicator. If the horizontal bar moves upward, the pilot should move the cyclic toward the bar or in a forward direction. The pilot flies the helicopter to the bars. The vertical pointer can be used as a vertical velocity indicator with each division equal to 250 fpm.

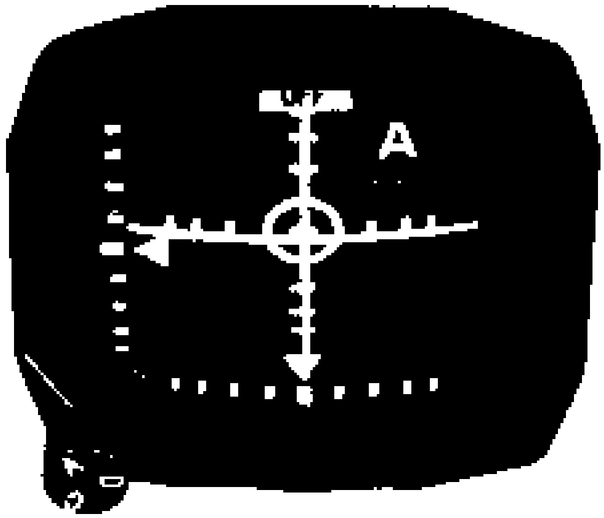


Figure 2-34. Hover Indicator

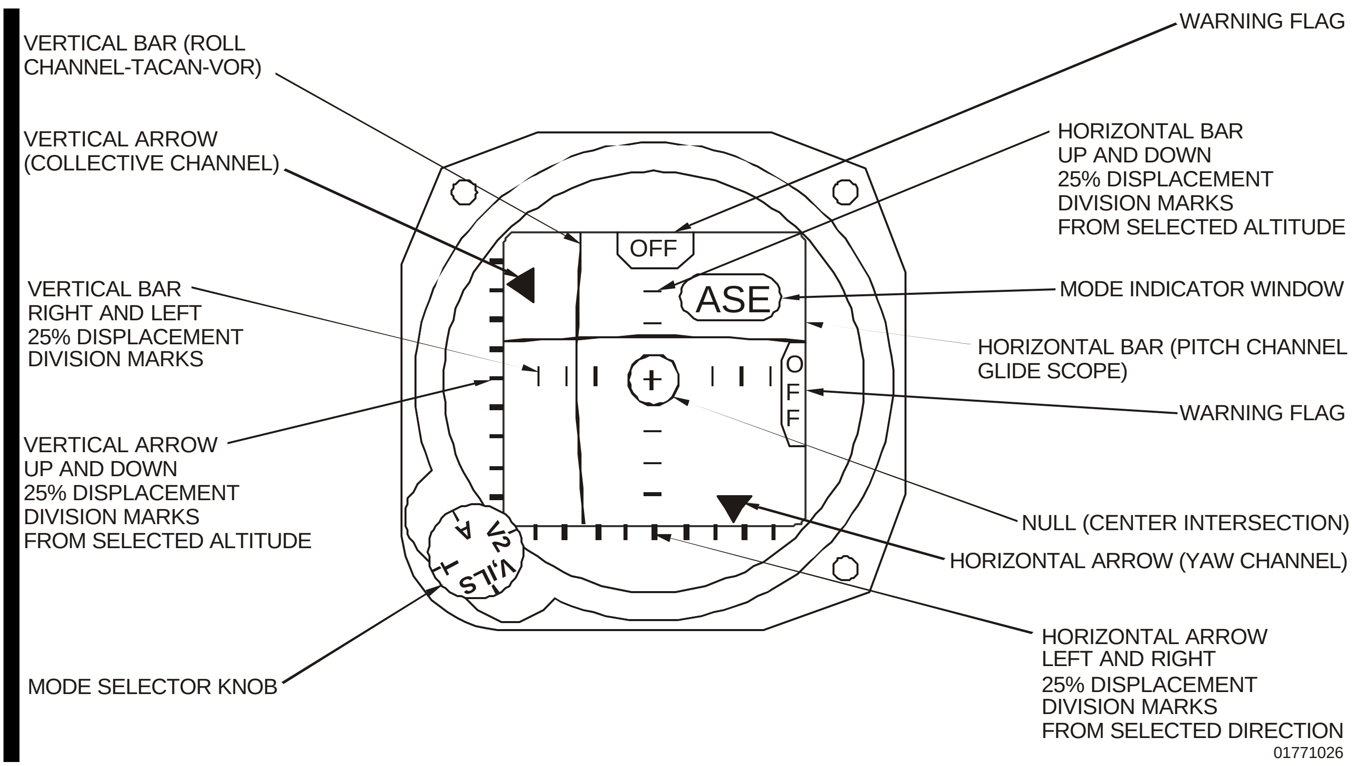


Figure 2-34.1. (ET) Flight Director

2.10.3.4 (ET) Flight Director The flight director (Figure 2-34.1), on the instrument panel, allows the pilot and/or copilot to visually monitor composite information from the ASE, VOR #1, and VOR #2 receivers, glideslope receiver, and TACAN set. It has four modes of operation that are determined by the position of the mode selector knob. The pilot and copilot can monitor the same mode or any combination of modes by placing either knob in the A, T, V1, ILS, or V2 position. The mode indicator window in the upper right quadrant of the face indicates ASE, TAC, VOR 1, ILS, or VOR 2 depending upon which mode has been selected. With ASE engaged and the knob at A (ASE visible in mode indicator window), the indicator monitors output signals from the pitch, roll, collective, and yaw ASE channels. Each output signal represents the amount of differential current flow to the servo valve in a particular channel. The warning flags disappear when ASE is engaged. During ASE mode of operation, all meter movements are used. The horizontal bar monitors signal output from the pitch channel and indicates forward or aft displacement from selected attitude. The vertical bar monitors signal output from the roll channel and indicates left or right displacement from selected attitude. The vertical arrow monitors signal output from the collective channel and indicates up or down displacement from selected attitude. The horizontal arrow monitors signal output from the yaw channel and indicates left or right displacement from selected direction. All ASE signal inputs to the indicator are routed through the channel monitor control panel. Power for warning flag operation is supplied from the AUTO STABE circuit breaker through the ASE ENG button. The warning flag in the top center of the face indicates when the indicator is operating or is turned off for a particular mode of operation. The flight director has four-meter movements consisting of two bars and two arrows. The horizontal bar deflects up and down along a straight line of parallel reference marks on the vertical axis. The vertical bar deflects left and right along a straight line of parallel reference marks on the horizontal axis. The horizontal and vertical reference marks intersect and form a cross within a circle. This intersection point is the center, or null, of the horizontal and vertical bars. The vertical arrow deflects up and down along a straight line of parallel reference marks that are perpendicular to the vertical reference edge. The horizontal arrow deflects left and right along a straight line of parallel reference marks that are perpendicular to the horizontal reference edge. The reference marks (divisions) are speeds equal to 0, 25, 50, 75, and 100 percent of full-scale deflection in either direction. When the TACAN set is turned on and the mode selector knob is at T (TAC), the Indicator monitors lateral deviation from the selected course, relative to a surface navigation beacon. The center warning flag disappears when the TACAN set is turned on and the bearing signal received is reliable. During TAC mode of operation, only the vertical bar is used. The vertical bar monitors signals received from the indicator coupler and indicates lateral position deviation from the selected course on the TACAN course indicator. The flight director does not indicate if the lateral position deviation from a selected course is a bearing to or from a surface navigation beacon. When the knob is at T, power for warning flag operation is supplied from the TACAN set. Exact bearing information is available on the TACAN course indicator that is connected in parallel with the flight director. Since there are two completely independent VOR receivers, separate operating modes are available to the flight director. When the VOR #1 receiver is turned on and the knob is at V1, ILS, the indicator monitors lateral deviation from a VOR course that was selected on the VOR #1 course indicator, and longitudinal deviation from a corresponding glideslope signal. The top center warning flag on the flight director disappears when the radio is turned on and the bearing signal received is reliable. The right middle warning flag disappears when the glideslope signal received is reliable. The flight director does not indicate if the lateral position deviation from a selected course is a bearing to or from an omnidirectional range source. Power for the warning flag during VOR #1 operations is supplied from the VOR #1 receiver. Exact bearing infomation is available on the VOR #1 course indicator that is connected in parallel with the flight director. With the VOR #2 receiver turned on and the knob at V2, the entire operation is identical to VOR #1 operation except that glideslope information will not be displayed

2.10.4 HOVER TRIM Control Panel. The panel is mounted just forward of the cabin door. The hover trim stick is mounted on the panel in the center of a diamond-shaped outline marked R (right), L (left), F (forward), and A (aft) directional control. To use the hover trim stick, the coupler must be functioning in the DOPP mode and the HOVER TRIM ENG depressed. The red engage light on the tip of the stick will go on when the hover trim controls are ready for use. Two knobs on the panel are marked ROLL BIAS and PITCH BIAS. The ROLL BIAS knob has direction-indicating arrows marked RIGHT and LEFT and the PITCH knob has arrows marked FWD and AFT. The use of these knobs permits trimming for an accurate hover when the hover stick is centered by permitting the aircrewman to introduce signals into the amplifier to correct any slight drifting while hovering in the Doppler mode.

2.10.4.1 Hover Trim Stick. The hover trim stick (Figure 2-35) has been incorporated to give the crewman longitudinal and lateral control of the helicopter. The 6-inch stick is mounted on the HOVER TRIM control panel and is used in the same manner as the cyclic stick. The HOVER TRIM control panel allows the operator to control the helicopter drift from 0 to 11 ±4-1/2 knots. When the hover stick is centered, the ROLL BIAS and PITCH BIAS knobs allow trimming for an accurate hover by allowing the hoist operator to induce signals into the amplifier to correct any slight drifting of the helicopter while hovering in the Doppler mode. The hover trim stick can only be engaged by the pilot during the Doppler mode of operation.

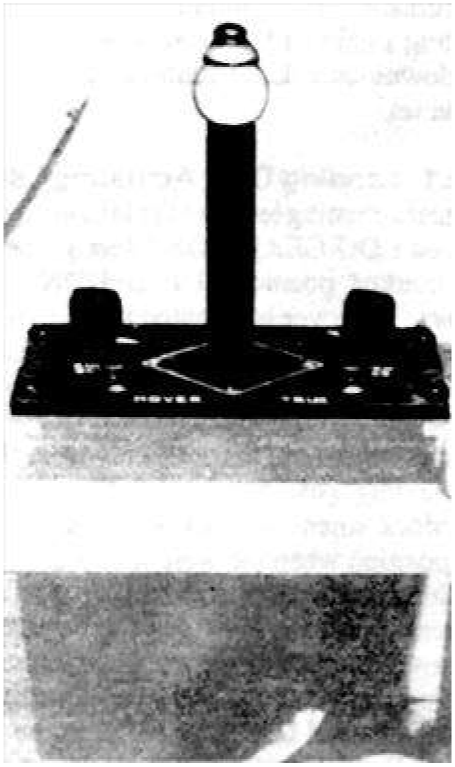


Figure 2-35. Hover Trim Stick

2.10.5 CHANNEL MONITOR Panel. The CHANNEL MONITOR panel (Figure 2-33) on the pilot console has four ASE channel disengage switches mounted across the top of the panel. Directly beneath the channel disengage switches are four associated guarded hardover switches marked PITCH, ROLL, COLL, and YAW.

2.10.5.1 Channel Disengage Switches. These switches with marked positions ON and OFF allow the pilot to disengage individual channels as desired.

2.10.5.2 Hardover Switches. These switches permit maintenance personnel to introduce hardover signals to individual channels of the ASE for testing. The hardover PITCH switch has marked positions FWD and AFT; the hardover ROLL switch has marked positions LEFT and RIGHT; the hardover COLL switch has marked positions UP and DOWN; and the hardover YAW switch has marked positions LEFT and RIGHT.

2.10.5.3 (ET) METER SELECTOR Switch. The METER SELECTOR switch permits either ASE or CPLR inputs to be monitored on the hover indicators (UH-3H helicopters) or flight directors (UH-3H Executive Transport helicopters) when the mode selector knob is in the A mode

2.10.5.4 VERTICAL GYRO Selector Switch. The VERTICAL GYRO selector switch with marked positions PORT and STBD allows the pilot to select either the port or starboard gyro for ASE pitch and roll reference; however, PORT is the preferred position. Electrical power for the CHANNEL MONITOR panel is supplied from the primary bus and is protected by a circuit breaker.

2.10.6 Channel Monitor Test Switch. The CHAN MON test switch on the pilot compartment dome light panel (Figure 2-25) has two marked positions, TEST and OFF. OFF disables all hardover switches but does not affect any of the other switches. TEST permits use of the hardover switches by maintenance personnel for testing.

2.10.7 Vertical Gyros. The 1080Y starboard gyro always provides pitch and roll information to the pilot vertical gyro indicator and also to the ASE when the VERTICAL GYRO switch on the CHANNEL MONITOR panel is at STBD. The compass system always provides pitch and roll information to the copilot attitude indicator and also to the ASE when the VERTICAL GYRO selector switch is at PORT. Power failure flags will be displayed on the pilot attitude indicators whenever a power failure is sensed or an imbalance in the ac power applied to the vertical gyros is sensed.

2.11 UTILITY HYDRAULIC SYSTEM. The utility hydraulic system (FO-11) provides hydraulic pressure for all hydraulic equipment not included in the flight control servo and ASE systems. The utility hydraulic system reservoir (Figure 3-1), aft of the main gearbox, supplies hydraulic fluid to the utility system. In addition, the rotor brake hydraulic cylinder is gravity-feed with hydraulic fluid from the utility reservoir. The utility hydraulic reservoir has a capacity of 1.09 gallons of hydraulic oil. The utility hydraulic pump on the accessory drive section of the main gearbox provides 3,000-psi hydraulic pressure. Equipment operated by the utility hydraulic system includes the main landing gear, rescue hoist, and fold system. On UH-3H Executive Transport the rescue hoist and sonar reeling machine have been removed.

2.11.1 Utility Hydraulic Pressure Indicator. The utility hydraulic pressure indicator (Figure 2-7) on the instrument panel operates on 26-vac power and is protected by a circuit breaker. The gauge marked UTI indicates pressure in the utility hydraulic system in psi.

2.12 LANDING GEAR SYSTEM. The landing gear system consists of sponsons, retractable main landing gear assemblies, a hydraulic system, and a fixed tailwheel. The main landing gear consists of dual wheels, equipped with hydraulic brakes, that are attached to the sponsons by retractable oleo shock struts. The main landing gear is equipped with a one-shot pneumatic emergency blowdown feature that permits lowering the main landing gear. The main landing gear hydraulic system (FO-12) operates on 3,000-psi hydraulic pressure from the utility hydraulic system. The system is actuated by dc electrical power and is protected by a circuit breaker (marked LAND GEAR on the center circuit breaker panel). The tailwheel beneath the tail fin is full swiveling and self-centering and may be locked in the center position. The sponsons are fixed, hollow, outrigger-type floats attached to the fuselage that enable the helicopter to maintain a level, upright position in the water. The landing gear control panel (Figure 2-36) marked LDG GEAR CONT is on the copilot side of the cockpit console. The landing gear actuating lever, the warning light test button marked HDL LT TEST, and the downlock release marked DN LCK REL are on the panel.

2.12.1 Landing Gear Actuating Lever. The landing gear actuating lever on the landing gear control panel marked LDG GEAR CONT has a wheel-shaped knob and marked positions UP and DN, with directional arrows. The lever is actuated to raise or lower the main landing gear and to energize or deenergize the armament release. When at UP, the armament release is energized, and when at DN, the armament release is deenergized. A red warning light in the wheel-shaped knob is on when the landing gear is cycling. An electrically actuated downlock solenoid locks on the actuating lever in the DN position when the weight of the helicopter is on the landing gear. After becoming airborne, the lock is automatically released that permits the actuating handle to be moved to UP. Should the downlock solenoid electrical circuit become inoperative, a mechanical downlock release marked DN LCK REL can be actuated to mechanically release the landing gear actuating lever from the DN position. Placing the actuating lever to UP opens an electrically operated solenoid valve, allowing hydraulic fluid to pass through a two-way restrictor valve to the main landing gear cylinder, forcing the piston in the cylinder into the up position. The main landing gear, when fully raised, is held in position by a mechanical uplock. A hydraulically operated uplock cylinder or a mechanical release must be a actuated to release the mechanical uplock. Placing the actuating lever to DN opens an electrically operated solenoid valve, allowing hydraulic fluid to release the mechanical uplock and to force the piston in the main landing gear cylinder to the down position. A limit switch will be actuated when the main landing gear is fully extended or retracted and the electrically operated solenoid valve will return to the trail position.

2.12.2 Down-Limit Release (Scissors) Switch. One down-limit release switch is attached to the scissors of each main landing gear. With the weight of the helicopter on the wheels, the main landing gear strut is compressed and the scissors switch is electrically open. As the main landing gear strut extends, the scissors switch closes and the 28-vdc circuit is completed, allowing the down-lock solenoid to disengage, disabling underfrequency protection for the aircraft electrical system and enabling the jettison control panel.

2.12.3 Landing Gear Warning Light. When the landing gear is fully extended, the red indicator pin in the center of the drag link should be in.

The main landing gear warning light in the landing gear actuating lever knob goes on whenever the actuating handle is moved and the landing gear is in transit to the up or down position. The intensity of the landing gear warning light is controlled by the pilot flight instrument lights rheostat on the overhead switch panel. When the rheostat is OFF, the light will be on at full strength, but as the rheostat is moved from OFF, the landing gear warning light will go to the dim position. When the landing gear is locked in either UP or DOWN, the light will go off. The warning light operates on dc power and is protected by a circuit breaker marked LAND GEAR on the center circuit breaker panel.

Figure 2-36. Landing Gear Control Panel

2.12.3.1 Landing Gear Warning Light Test Button. A landing gear actuating lever warning light test button marked HDL LT TEST is on the landing gear control panel on the pilot compartment console. Pressing the button tests the warning light in the landing gear actuating lever knob. The warning light test button operates on dc power and is protected by circuit breakers.

2.12.4 Landing Gear Position Indicators. The indicators are on the cockpit console. The indicators read UP only if the landing gear wheels are in the up and locked position, and show pictures of landing gear wheels only if the wheels are in the down and locked position. During landing gear extension or retraction (when the landing gear is neither up and locked nor down and locked) and whenever electric power is not available, the indicators show black and white diagonal lines. The indicators operate on direct current and are protected by a circuit breaker marked LAND GEAR on the center circuit breaker panel.

2.12.5 Landing Gear Emergency System. The system is used to lower the main landing gear pneumatically if the hydraulic system fails. The landing gear emergency system consists of a 50-cubic inch, 3,000-psi maximum capacity air bottle in the auxiliary servo controls enclosure (broom closet) immediately aft of the pilot, an emergency landing gear extension handle on the copilot side of the cockpit console, and an emergency landing gear release lever on the side of the auxiliary servo controls enclosure. A gauge, visible through a window on the control enclosure door indicates the nitrogen pressure in the air bottle. Nitrogen pressure must be 2,500 to 3,000 psi for the system to function. An air bottle filler cap is behind a hinged panel marked EMERGENCY LANDING GEAR RELEASE AIR CHARGING CONNECTION on the side of the auxiliary servo controls enclosure.

2.12.5.1 Emergency Landing Gear Extension Handle. The handle (Figure 2-37) painted with orange-yellow and black diagonal stripes is on the copilot side of the cockpit console. The emergency landing gear extension handle is used to lower the main landing gear in case of failure of the normal system. The handle must be turned and pulled to withdraw the emergency uplock release pins, release air into the landing gear system, and pneumatically actuate the emergency bypass valve to vent hydraulic fluid from the uplines, forcing the landing gear to the down and locked position. The emergency bypass valve displaced by the air charge and actuated by the emergency landing gear extension handle must be manually reset before the landing gear can be retracted or the air bottle recharged. An instruction plate marked EMER L.G. EXTENSION, TURN THEN PULL is beside the handle. When the emergency landing gear release system has been actuated, the warning light on the landing gear actuating lever will go on whenever the landing gear is in transit, regardless of lever position. The landing gear position indicator will indicate down or unsafe only.

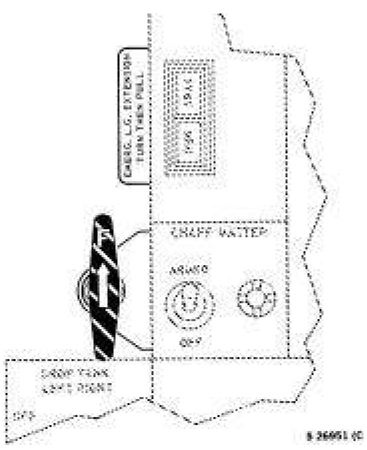


Figure 2-37. Emergency Landing Gear Extension Handle

2.12.5.2 Emergency Landing Gear Release Lever. The lever (Figure 2-38) marked EMERGENCY LANDING GEAR RELEASE PULL FWD, ONLY IF AIR RELEASE FAILS is behind the pilot seat on the broom closet. Pulling the emergency landing gear release lever manually actuates the emergency bypass valve, allowing hydraulic fluid trapped in the uplines to be vented to the hydraulic system. Gravity will then lower the landing gear to the down position. The emergency landing gear release lever should be pulled only after the emergency landing gear extension handle has been pulled and the landing gear still does not lower. Do not attempt to reset the lever after it has been placed to the forward or emergency position.

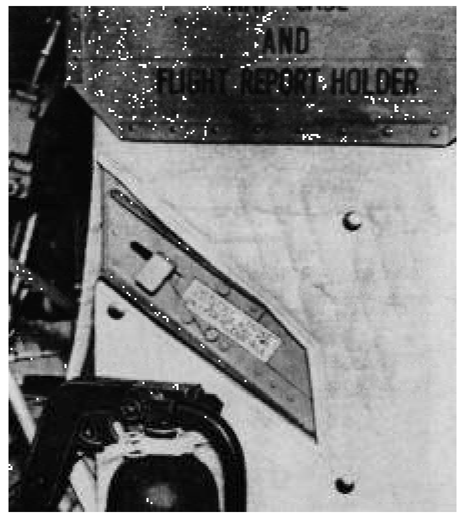


Figure 2-38. Emergency Landing Gear Release Lever

2.12.6 Tailwheel Lock Handle. The handle, next to a decal marked TAILWHEEL LOCK - PULL TO LOCK, is on the right side of the cockpit console. Pulling the handle out permits a spring-loaded lockpin to engage at the swivel joint after the tailwheel is centered. Pushing the handle in releases the lock and allows the tailwheel to swivel. There are positive detents in the LOCK and UNLOCK positions. To UNLOCK the tailwheel, depress the button in the center of the handle to release the handle from the upper detent, then depress the handle fully down. It is not necessary to continue to depress the center button, as the handle will automatically remain in the down position when it engages the lower detent. The tailwheel maybe unlocked before taxi since the tailwheel will not actually unlock until all side loads on the lockpin are relieved. To lock the tailwheel, depress the button in the handle. This will allow the handle to rapidly spring out to the locked position. The tailwheel should be locked only for straight takeoffs and landings. During maneuvers on the ground, the tailwheel should be unlocked to reduce strain on the pylon and the possibility of shearing the tailwheel lockpin. If any side loads are imposed on the tailwheel, the lockpin will not disengage.

2.12.7 Wheelbrake System

CAUTION

The parking brake can be set for one wheel without the other which could be hazardous during night carrier operations. Make sure that both rudder pedals are pressed firmly when setting the parking brake.

Note

The advisory light only indicates that the parking brake handle is up. It does not infer the wheelbrake system is pressurized.

The main landing gear wheels have hydraulic brakes operated by toe pedals on the pilot rotary rudder pedals. The fluid for these brakes is self-contained within the master cylinders. A parking brake handle operates a hydraulic valve to lock the wheel-brakes. A light on the advisory panel goes on whenever power is applied to the helicopter, allowing the pilot to see the marking PARKING BRAKE ON.

2.12.8 Brake Pedals. The main landing gear wheels are individually braked by pressing the corresponding toe brake pedals (Figure 2-3) mounted above the pilot rotary rudder pedals. The brakes operate on hydraulic pressure developed by pressing the brake pedals.

2.12.9 Parking Brake Handle. The handle (Figure 2-3) marked PARKING BRAKE is on the right side of the cockpit console. A decal next to the parking brake handle is marked ON-DEPRESS TOE BRAKE THEN PULL, OFF-DEPRESS TOE BRAKE. The parking brake is applied by first pressing the toe brake pedals and then pulling the parking brake handle out. Pressing the left brake pedal will release the parking brake, causing the parking brake handle to return to OFF.

2.13 AUTOMATIC BLADE FOLD SYSTEM

The automatic blade fold system positions the rotary wing blades into the proper radial position for blade folding, extends the dampers and turns the blades a full 3^{o} forward on the drag hinges, locks the rotary wing controls when the blades are folded, provides a means of applying the rotor brake automatically, and automatically disengages the blade lockpins. Controls for the system are grouped on a panel marked MAIN BLADE FOLD on the cockpit overhead switch panel. The blade fold system is a part of the utility hydraulic system. A light on the advisory panel goes on when dc power is applied and the blade fold interlock system is not in flight condition, allowing the pilot to see the marking CHECK BLADE FOLD. The system is protected by a circuit breaker marked BLADE FOLD on the center circuit breaker panel.

2.13.1 Rotary Wing Blade Folding. The rotary wing blades may be folded by a full automatic operation that is controlled by either the pilot or copilot. The operation may be halted at any stage of the folding or spreading cycle and reversed if so desired. Hydraulic power from the utility hydraulic system is used in conjunction with hydraulic and electrical sequencing. Power is supplied by a variable delivery pump on the accessory drive of the main gearbox. The folding is done by actuating the proper switches on the blade fold control panel (Figure 2-39) on the overhead switch panel and observing the blade positioning and folding in conjunction with appropriate lights on the panel. The No. 1 engine should be running at 104-percent N_f for blade folding. The No. 1 blade positions directly aft and does not fold. After the rotary wing blades are folded and stowed, the tail pylon may be manually folded without any interference. The blade positioner control valve is a four-way trail position solenoid-operated valve mounted on the upper right side of the main gearbox input housing. It controls the operation of the positioning units. When the folding switch is placed to FOLD, a solenoid energizes the control valve that directs hydraulic fluid to engage the rotor brake disc teeth and position the No. 1 blade aft. After positioning the blades, the control valve is energized by the other solenoid to direct hydraulic fluid to disengage the rotor blade positioners and, through a pressure reducer, to engage the automatic rotor brake. When the folding switch is placed to SPREAD, the control valve is energized to direct hydraulic fluid to ensure disengagement of the positioner from the rotor brake disc and, through a pressure reducer, to engage the rotor brake.

Note

A manual blade fold procedure is described in Chapter 7.

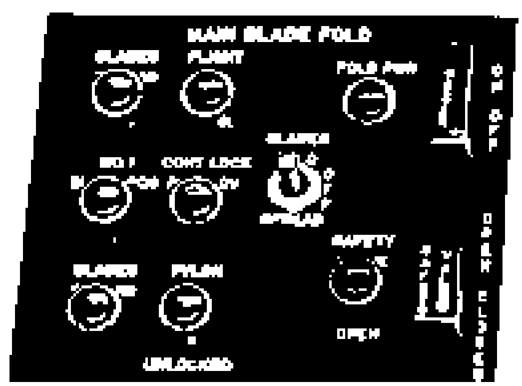


Figure 2-39. Blade Fold Control Panel

2.13.2 Blade Fold Control Panel. The panel (Figure 2-39) marked MAIN BLADE FOLD on the overhead switch panel contains all control switches for the blade fold system and the warning and indicator lights that show the sequence of operation during the folding and spreading of the rotary wing blades. Three switches are marked MASTER, SAFETY VALVE, and BLADES with marked positions FOLD, SPREAD, and OFF. The indicator lights are marked BLADES SPREAD, FLIGHT POS, NO. 1 BLADE POS, CONT LOCK PINS ADV BLADES FOLDED, and PYLON UNLOCKED. Two warning lights are marked SAFETY VALVE OPEN and FOLD PWR ON. The lights may be dimmed by turning the caps.

2.13.2.1 SAFETY VALVE Switch. A guarded switch marked SAFETY VALVE with positions OPEN and CLOSED is on the blade fold control panel. A red warning light to the left of the safety valve switch indicates the OPEN position. The switch operates a motor-driven, three-way, two-position, selector valve on the bulkhead on the right side of the cabin next to the gearbox and prevents inadvertent application of hydraulic pressure to the blade fold system and automatic rotor brake during flight. When the safety valve switch is turned to OPEN, the safety valve red warning light will go on and the FLIGHT POS green indicator light will go off.

2.13.2.2 Blade Fold MASTER Switch. The switch marked MASTER with two positions ON and OFF on the blade fold control panel completes the circuit to furnish electrical power to actuate the hydraulic sequences for automatic blade folding. The master switch will not furnish electrical power to the blade fold system to fold the blades if the pylon is folded, accessory drive switch is in FLIGHT, No. 2 engine fuel firewall valve is open, or safety valve is closed. A red indicator light marked FOLD PWR ON indicates that the folding power is available.

2.13.2.3 Blades FOLD Spread Switch. A three-position BLADES switch marked FOLD, SPREAD, and OFF on the blade fold control panel is used to select the folding cycle that consists of rotary wing head positioning cycle, blade folding cycle, or the spread cycle.

2.13.2.4 Blades Spread Indicator Light. An amber light marked BLADES SPREAD on the blade fold control panel is actuated when the blade lockpins are engaged and the control lockpins are completely disengaged. The blade spread indicator light will go off when the accessory drive switch is placed to FLIGHT. The BLADES SPREAD light will go off as soon as any control lockpin starts to advance or any blade lockpin retracts.

2.13.2.5 Flight Position Indicator Light. A green light on the blade fold control panel marked FLIGHT POS indicates that the rotary wing blades are in the flight position. The flight position indicator light will go on, primary hydraulic pressure will rise to 1,300 to 1,600 psi, and the primary servo caution light will go off when the blades are completely spread, pylon locking pin is properly positioned, safety valve is closed, and master switch is off. When the safety valve switch is open and the master switch is on, the flight position indicator light will go off, SAFETY VALVE and FOLD POWER lights will illuminate, primary pressure will drop to zero, primary servo caution light will go on, automatic rotor brake will come on, and rotor brake caution light will remain on.

2.13.2.6 No. 1 Blade Position Indicator Light. An amber light marked NO. 1 BLADE POS on the blade fold control panel will go on during the folding cycle after the rotary wing head positions with the No. 1 blade directly aft.

2.13.2.7 Control Lockpins Advanced Indicator Light. An amber light marked CONT LOCK PINS ADV on the blade fold control panel will go on during the folding cycle as soon as one flight control lockpin moves forward. It will remain on until all the flight control lockpins are fully disengaged at the end of the spreading cycle.

2.13.2.8 Blades Folded Indicator Light. An amber light marked BLADES FOLDED on the blade fold control panel will go on when all blades are folded. During the spreading cycle, the BLADES FOLDED indicator light will go off when any blade moves forward. The blade fold accumulator located in the No. 1 main rotor blade sleeve spindle is a piston-type oleo-pneumatic system designed to maintain hydraulic pressure in the blade fold system when the blades are folded and power is off the system. By maintaining pressure on the system, the blade damper-positioners are maintained in the extended position, locking the blades in the folded position. Additionally, the blade fold accumulator compensates for expansion and contraction of trapped hydraulic fluid because of temperature changes and helps dampen out pressure surges during the fold/spread cycle. A pressure gauge on the No. 1 blade sleeve spindle indicates accumulator pressure. Normal pressure indication is 1,500 psi with the blades spread.

2.14 PYLON FOLDING

The tail pylon may be folded forward, parallel to the fuselage, so the helicopter can be parked in a small area. The pylon is attached to the tail cone at four points just forward of the intermediate gearbox. The two right-hand points form a hinge (Figure 2-2) about which the pylon folds forward against the right side of the tail cone. A locking strut holds the pylon in the folded position (Figure 2-40). A pylon hinge lock locks the left side of the pylon to the tail cone in the spread position. Retractable lockpins are actuated in and out of hinge-like lugs by a ratchet wrench that is secured against the tail cone when not in use. The rotary rudder pedals should be centered before the pylon is folded to assure minimum rotary rudder pitch change as the pylon is swung forward. A red lockpin position flag-type indicator, operated mechanically, extends from the left side of the tail cone whenever the pylon lockpins are not fully seated.

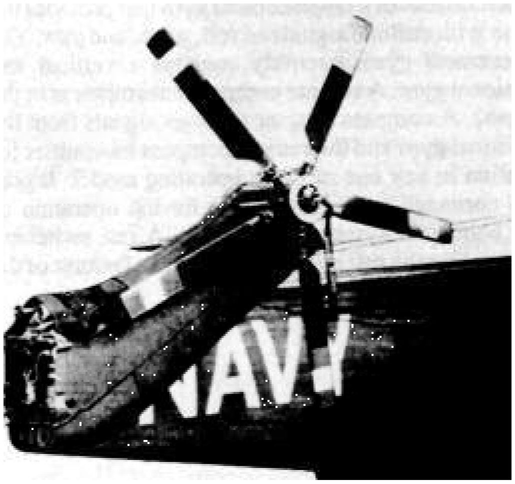


Figure 2-40. Pylon Folded

2.15 FLIGHT INSTRUMENTS

2.15.1 Standby Compass. A magnetic standby compass is at the top center of the instrument panel. A standby compass correction card is on the pilot side of the instrument panel.

2.15.2 Free-Air Temperature Gauge. A bimetallic free-air temperature gauge is on the centerline of the helicopter on the windshield glass panel.

2.15.3 Clocks. Two 8-day, 12-hour, elapsed time clocks (Figure 2-7) are installed on the instrument panel. The control knob for the elapsed time mechanism is at the upper right corner of the clock face. The clock is stem wound and stem set with a knob in the lower left corner of the clock face.

2.15.4 Pitot-Static System. Two pitot tubes with static ports are mounted over the cockpit, one on the right side and the other on the left side of the helicopter, forward of the engine air intakes. The lines carrying static pressure from both pitot-static tubes are connected together so that the pilot and copilot airspeed and vertical velocity indicators, the TAS transducer, and BAR ALT controller are fed from a common static line. The starboard pitot pressure line feeds the pilot airspeed indicator and the TAS transducer. The port pitot pressure line feeds only the copilot airspeed indicator. A restrictor is installed in the static pressure line to the BAR ALT controller sensing unit to filter transient pressure changes, thereby contributing to a more stable flight-path. The TAS transducer converts pitot-static airspeed information to an electronic TAS signal that is fed to the TACNAV or navigation system. Sleeves are installed on both pitot tubes to ensure correct airspeed readings and to prevent erroneous inputs to the BAR ALT controller when the ice shield is installed. Both pitot tube heads may be heated to prevent icing. Refer to Pitot Heaters, paragraph 2.18.5.

2.15.5 Attitude and Heading Reference System (A/A24G-39 AHRS). This system provides PORT GYRO attitude information (pitch and roll) for display on the copilot instrument panel, attitude indicator, and the ASE when in the PORT VERTICAL GYRO mode. (A separate Model 1080Y vertical gyroscope provides STARBOARD GYRO attitude information for display on the pilot instrument panel, attitude indicator, and pitch/roll to the ASE when in the STBD VERTICAL GYRO mode.) The A/A24G-39 AHRS is the only source of heading information for the ASE yaw channel and the aircraft avionics systems (tacan, TACNAV, and cockpit BDHI, RMI, and course indicator displays).

The source of the magnetic heading information used by the AHRS is a remote compass transmitter unit located within the aft tail cone area. Loss of reliable attitude and/or heading from the AHRS is evidenced by illumination of the COMPASS FAIL light on the caution panel, and display of the OFF flag on the copilot attitude indicator. The standby compass located on the cockpit instrument panel glareshield is a completely separate backup wet compass provided for instances of complete loss of AHRS heading information or aircraft electrical power.

Electrical power to the AHRS may be controlled only by engaging or disengaging the circuit breakers. Power for the COMPASS FAIL caution panel light is supplied by the COMP dc breaker located in the pilot circuit breaker panel (Figure 2-23). Power for the AHRS is supplied by the COMP ac breaker located in the copilot circuit breaker panel (Figure 2-23).

Prior to application of power to the AHRS, adjust the two copilot attitude indicator trim knobs so that each knob arrow points to the black reference dot (Figure 2-43). After initial power application, a 2-minute warmup and gyro erection period is required before reliable attitude information is available. (During this period, the COMPASS FAIL caution light and the copilot attitude indicator flag are visible.) Any residual attitude errors remaining after warmup can be eliminated by depressing the ERECT button located on the AHRS control panel (Figure 2-44) until the copilot attitude indicator displays satisfactory pitch and roll values. (If erected with the UH-3H on a flat and level ramp, the copilot attitude indicator will display level roll attitude and a slight noseup attitude in pitch.) Attitude correction can also be performed during straight and level flight by use of the ERECT button.

Note

- The quality of electrical power available at ship flight deck launch spots is so poor that AHRS reliability can be severely degraded. COMPASS and PHASE B (∅B) circuit breakers should be pulled when the UH-3H has deck edge power applied, and engaged only with another source of external power or after operating on helicopter power.

- When operating aboard ship, the deck motion in pitch, roll, and yaw will be reflected in the AHRS outputs.

- Use of the ERECT button should be limited to a maximum period of 3 minutes to avoid thermal reliability problems. After a 1-minute wait, the ERECT button may be used again.

- Because of the high inertia of the AHRS gyro, it is still spinning down for 20 minutes after electrical power is removed, and is vulnerable to reliability problems if the helicopter is moved in an erratic fashion or if electrical power is reapplied before rundown is completed. To minimize AHRS gyro failures, avoid reapplying electrical power to the gyro once 45 seconds have elapsed. Also, minimize the severity of helicopter towing impulses using steady and smooth starting and stopping techniques.

SLAVED is the UH-3H helicopter primary mode of AHRS heading operation. In this mode, heading is furnished by a directional gyro that is continually corrected for magnetic heading by the remote compass transmitter (e.g., the gyro is slaved in the raw magnetic heading source). For this normal mode of operation, set the mode selection switch on the compass control panel (Figure 2-44) to the SLAVED position for the entire mission. Verify that the hemisphere switch is set to the N position if in the northern hemisphere or S if operating in southern latitudes. Set the LAT control to the approximate average latitude expected for the mission. Hemisphere and latitude settings are especially important for minimizing heading error buildup during sustained periods of helicopter maneuvering (such as starboard delta patterns).

After AHRS warmup is completed and the COMPASS FAIL advisory light has extinguished, the directional gyro must be synchronized to the remote compass transmitter by depressing the HDG PUSH knob until the SYNC meter needle is centered (Figure 2-44). After takeoff (when at altitude with a straight and level attitude), check the SYNC meter again to determine whether initial magnetic heading errors because of ship or helicopter launch pad magnetic fields have biased the AHRS initial synchronization. If the needle is not centered, push the HDG PUSH knob to remove the errors. To avoid TACNAV navigation error buildup, the SYNC meter needle should be checked periodically.

Note

The SYNC meter needle does not function when helicopter accelerations exceed preset values, such as during turns. In these flight conditions, the needle is stowed in the center of the meter and no needle oscillations are seen. This stowed needle condition during maneuvers should not be mistaken for properly synchronized AHRS heading operation.

Note

During flight, the COMPASS FAIL advisory light will occasionally illuminate momentarily as part of the normal AHRS operation. This will usually occur upon rolling out of turns or upon selecting the SLAVED mode if the DG or EMERG modes have been in use. Brief heading fluctuations may also be seen on the cockpit instruments during mode changes.

The DG mode of operation is normally used when the Earth's magnetic field is an unreliable reference (i.e., in polar regions or when the remote compass transmitter has failed). Aircraft heading is furnished only by the directional gyro and is subject to error buildup if the correct latitude and hemisphere are not inserted into the LAT and N/S controls located on the control panel (Figure 2-44). The DG mode allows the pilot to set the AHRS heading to any selected reference by pushing and turning the HDG PUSH knob until the desired heading is displayed on the cockpit indicators and TACNAV. In polar regions, the DG mode heading estimate should be based on the best available information to avoid large navigation errors.

The EMERG mode of operation is used only when the normal heading information from the AHRS is unreliable. Magnetic information is passed directly from the remote compass transmitter for use until the AHRS can be replaced. However, the magnetic heading information in the EMERG mode is not as accurate and is not damped by the directional gyro. Since no automatic reversion to the mode occurs for AHRS gyro failures (COMPASS FAIL light or copilot altitude indicator flag visible), the EMERG mode must be selected manually.

CAUTION

Because of the oscillatory nature of the compass information in the EMERG mode, the pilot should immediately discontinue the use of the ASE yaw channel.

Note

If it is necessary to troubleshoot the system when in the EMERG mode with the yaw channel engaged, follow these procedures to avoid driving rudder pedal forces when returning to the SLAVED mode. Place feet on rudder pedals and disengage the yaw channel. Switch to the SLAVED mode. Synchronize the compass heading by pressing the HDG PUSH knob until the SYNC needle is centered. Cheek that the BDHI/ RMI compass card and standby compass are within ±5° of each other (if not, repeat the procedure until they are). Engage the yaw channel and remove feet from rudder pedals.

2.15.6 Compass System Control Panel. This panel (Figure 2-44) is on the center console. When in the SLAVED mode, pressing and holding down the HDG PUSH knob automatically causes synchronization of heading outputs of the directional gyro with the compass transmitter heading. In the DG mode, the HDG PUSH knob may be pushed and turned clockwise or counterclockwise to set the heading on the BDHIs and RMI, and the system works with the directional gyro.

In the SLAVED mode, the SYNC window indicates synchronization of the directional gyro in the compass transmitter heading. The EMERG position provides emergency operation using only the compass transmitter and is used when a directional gyro failure has occurred.

The N/S switch selects polarity of latitude correction signal: N for northern hemisphere and S for southern hemisphere. The LAT knob selects latitude of flight (0^o to 90^o) to correct for heading gyro drift because of Earth rotation. The N/S switch and LAT knob must be set for the SLAVED mode as well as DG mode since the system automatically switches from SLAVED to DG mode whenever the helicopter is in a turn.

The ERECT pushbutton, when pressed, increases the roll erection rate of the vertical gyro.

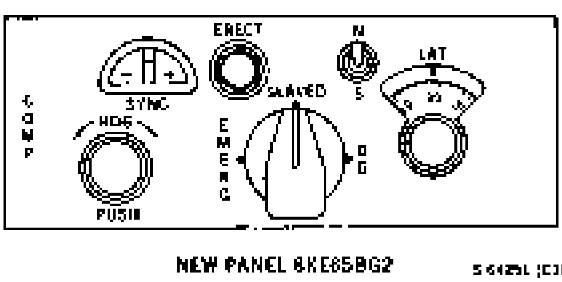


Figure 2-44. Compass System Control Panel

2.15.7 Attitude Indicators. Two attitude indicators (Figure 2-43) on the instrument panel visually indicate the helicopter attitude. The indicator face consists of a stationary miniature aircraft representing the helicopter, a bank angle scale, bank index, and a moving two-colored sphere with a distinct white horizontal line dividing the two colors, white above and black below. A warning flag marked OFF will appear in the face of the indicator when the indicator is inoperative. The warning flag will appear until about 68 seconds after ac power has been applied to the circuit, when any unbalance of the three phases of ac power occurs, or the directional gyro system for the indicator has failed. Two trim adjustment knobs are on the front of the attitude indicators, one at the lower left of the panel for adjusting roll, and the other at the lower right of the panel for adjusting pitch. The pilot attitude indicator operates on ac power and is protected by a circuit breaker. The copilot attitude indicator operates on ac power and is protected by circuit breakers.

Each attitude indicator also has a turn-and-slip indicator mounted on the bottom that visually indicates the helicopter rate of turn and flight condition.

Note

The warning flag marked OFF on the copilot gyro will appear momentarily when the helicopter is in a high vibratory flight regime. This may be when the helicopter is entering a hover or in any situation of impending translational lift. The warning flag will disappear when the helicopter leaves the high vibratory flight regime.

2.15.8 Turn Rate Switches. Two turn rate switches (Figure 2-7), one each for the pilot and copilot, are on the instrument panel. The switches are marked TURN RATE and have marked positions NORM and ALT. When the switches are placed to NORM, the copilot indicator receives rate of turn information from the ASE rate gyro amplifier demodulator, and the pilot indicator receives rate of turn information from the dc powered rate gyro transmitter. This system remains operative when the OFF flag in the attitude indicator appears, provided dc power is available. When either switch is placed to ALT, that indicator receives rate of turn information from the other system.

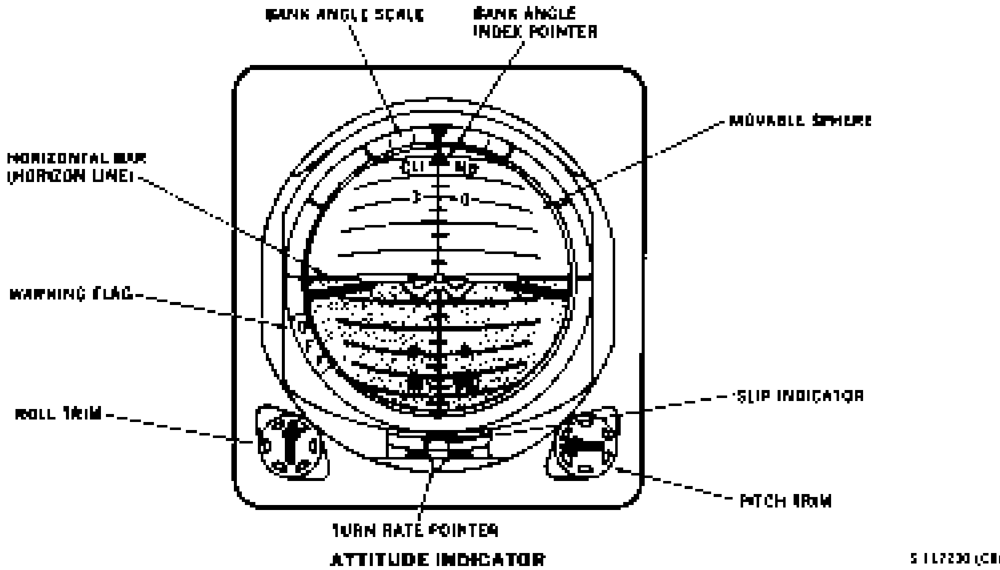


Figure 2-43. Attitude Indicator

2.15.9 Altitude Encoder. The altitude/encoder (Figure 2-45) functions as a barometric altimeter for the pilot and a pressure altitude sensor for the AN/APX-72 IFF transponder.

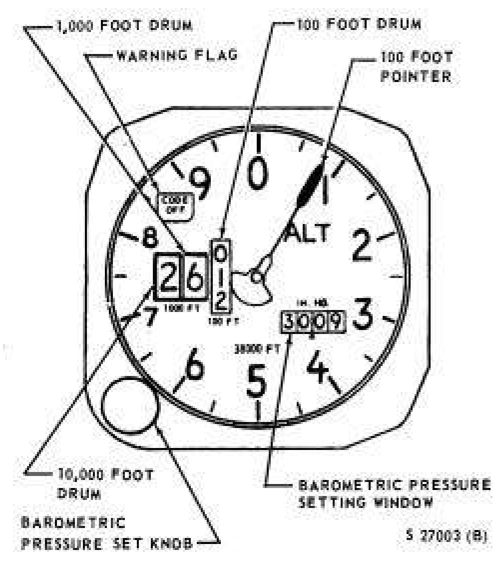


Figure 2-45. Altitude Encoder

2.15.9.1 Altimeter. The AAU-21/A altitude indicator (Figure 2-7) is on the pilot side of the instrument panel. The altimeter operating range is from -1,000 to +38,000 feet. The face of the instrument indicates readings in feet in 50-foot units with the numerals representing hundreds of feet. The pointer makes one revolution for every 1,000-foot change in altitude and drives a drum that also indicates altitude in hundreds of feet. The 100-foot drum will cause the 1,000-foot drum to index one digit when it moves through the short period between 9 and 0, and the 1,000-foot drum actuates the 10,000-foot drum in a similar manner. During the long period between 0 and 9, the 1,000- and 10,000-foot drums are locked in position. In the space corresponding to zero, the 10,000-foot drum is marked with striped lines. The pointer acts as a vernier of the 100's drum as well as being an indication of trend information. The barometric set knob permits altimeter setting from 28.10 to 31.00 inches Hg and these settings will be displayed by the barometric pressure setting window. The combined readings of the drums and pointer indicate an altitude measurement in thousands and hundreds of feet based on the selected altimeter setting.

Two techniques may be used to read indicated altitude on the drum and pointer-type altimeter. Read the drums without referring to the 100-foot pointer as a direct digital readout of both thousands and hundreds of feet, or read the digital readout in thousands without referring to the 100-foot drum, and then add the 100-foot pointer indication. The 100-foot pointer serves as a precise readout of values less than 100 feet required for determining lead points for level-off altitudes, maintaining level flight, and during instrument approaches. The system is equipped with a continuously operating vibrator to improve altitude measuring accuracy. Power to operate the vibrator is furnished through a dc circuit breaker marked IFF TEST.

2.15.9.2 Encoder. The AAU-21/A encoder provides a digital output of pressure altitude in units of 100 feet to the AN/APX 72 IFF transponder for automatic pressure altitude transmission. The encoder's operating range is from - 1,000 to +38,000 feet and has a permanent altimeter setting of 29.92. Loss of 115-vac, 400-Hz power will cause the warning flag marked CODE OFF on the pilot altimeter indicator to be displayed. Power to operate the encoder is furnished through an ac circuit breaker marked IFF IND.

Note

Only when the altimeter is set to 29.92 will the transmitted altitude be the same as the displayed altitude.

2.15.9.3 Altimeter (AAU-24/A). The altimeter (Figure 2-7), mounted on the copilot side of the instrument panel, is identical to and operates in the same manner as the pilot AAU-21/A altitude encoder except that there is no warning flag on the indicator.

2.15.10 Radar Altimeter

CAUTION

After turning equipment on, allow about 3 minutes for systems to reach operating temperature. To avoid damage to system components, do not place system in operation until 3 minutes have elapsed since system was last turned OFF.

The radar altimeter system (AN/APN-171(V)) provides instantaneous indication of actual clearance between the helicopter and terrain from 0 to 1,000 feet. Altitude in feet is indicated by the two radar altimeter indicators on the instrument panel in front of the pilot and copilot. The radar altimeter (Figure 2-46) contains a pointer that indicates altitude on a linear scale from 0 to 100 feet in 2-foot units, 100 to 200 in 10-foot units, and 200 to 1,000 in 50-foot units. A control knob on the lower left corner of the indicator combines functions to serve as a test switch, a low-level warning index set control, and an on/off power switch. The system is turned on by turning the control knob marked PUSH-TO-TEST clockwise from OFF, and is the only control necessary for equipment operation. Operation of the control knob on either indicator will turn the system on; however, both control knobs must be turned fully counterclockwise to turn the system OFF. Continued clockwise turning of the control knob toward the SET position will permit the pilot to select any desired low-altitude limit that will be indicated by the low-level warning index marker on the indicator. Depressing the PUSH-TO-TEST control knob provides a testing feature of the system at any time and altitude, provided the CPLR mode of ASE is disengaged. When the PUSH-TO-TEST control knob is depressed, a visual indication of 100 ±15 feet on the indicator indicates satisfactory system operation. Releasing the PUSH-TO-TEST control knob restores the system to normal operation. A low-level warning light on the lower right corner of the indicator will light and show the marking LOW anytime the helicopter is at or below the low-altitude limit that has been selected. Loss of system power or tracking condition will be indicated by a black and yellow striped flag that appears in the indicator window on the lower center portion of the indicator. If the system should become unreliable, the black and yellow striped flag will appear and the indicator pointer will go behind a mask marked NO TRACK to prevent erroneous readings. While hovering at low altitudes over smooth surfaces, fluctuations of about ±1.5 feet can be expected for altitudes under 100 feet. During normal flight operations above 1,000 feet, the altimeter indicates an unreliable condition.

The system requires both ac and dc power for operation and is protected by a circuit breaker.

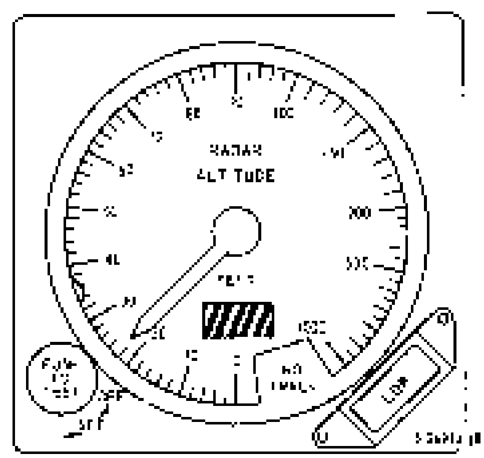


Figure 2-46. Radar Altimeter

2.15.11 Radar Altitude Warning System. The AN/APQ-107 RAWS provides the pilot and copilot with aural and/or visual warning signals of low-altitude conditions and/or failure of the radar altimeter. The visual indication is provided by a pulsating ALTITUDE light on the caution panel. The aural tone is channeled through the intercommunications system to pilot and copilot headsets. These signals are triggered under any of the following conditions: (1) Whenever the radar altimeter decreases through 100 ±5 feet when the coupler is not engaged or reaches 30 ±5 feet with the landing gear up, (2) When the radar altimeter output signals are unreliable and if

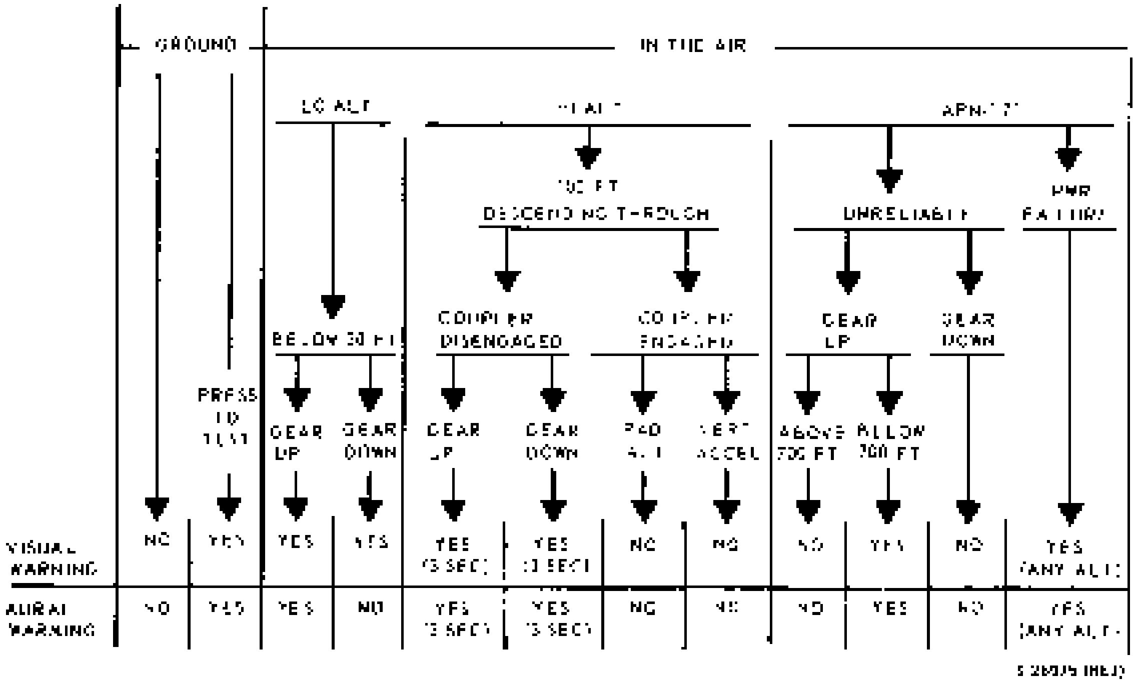


Figure 2-47. RAWS Warning – All Conditions

electrical power to the radar altimeter fails (Figure 2-47). A test switch marked RAWS TEST is on the instrument panel to the right of the caution panel. To test system reliability, make certain that the radar altimeter is energized and ac and dc power is being supplied, and then depress the test button. The aural and visual warning signals should occur simultaneously. The system operates on 115-vac power and 28-vdc power. The system is protected by circuit breakers.

WARNING

With the landing gear down, the RAWS will not provide an indication of an unreliable radar altimeter.

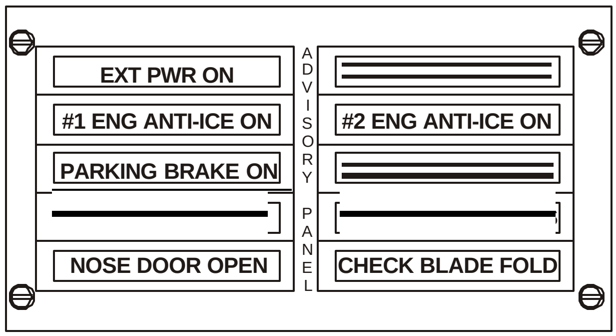
2.16 WARNING, CAUTION, AND ADVISORY LIGHTS

2.16.1 Advisory Panel. The advisory panel (Figure 2-48) marked ADVISORY PANEL is on the copilot side of the instrument panel. The advisory panel gives the pilots visual indication of certain operating conditions in flight or while on the ground. The advisory panel contains placard-type green advisory lights, each having its own operating circuit, to indicate a particular system is in operation or an unsafe condition exists. When a system is in operation or an unsafe flight condition exists, the advisory light for that particular system or condition comes on and remains on until the system is turned off or the unsafe flight condition is corrected. Pressing the switch marked TEST on the caution panel tests lights of both the caution and advisory panel.

2.16.1.1 Advisory Panel Lights. Refer to Figure 2-48 for a detailed description of the advisory panel.

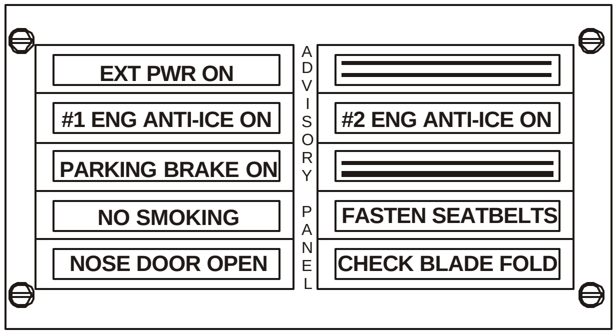
2.16.2 Caution Panel. The caution panel (Figure 2-49) marked CAUTION PANEL is on the pilot side of the instrument panel. The caution panel gives the pilot visual indication of failure or unsafe conditions of certain critical power equipment in the helicopter. The caution panel contains placard-type amber caution lights, each having its own operating circuit, to indicate a particular condition in the helicopter. If a failure or unsafe condition occurs in one of the systems, the caution light for that particular condition remains on until the failure or unsafe condition is corrected. A master light marked MASTER CAUTION - PUSH TO RESET is on either side of the instrument panel. The master light goes on when any of the caution panel lights are energized by a malfunction. The master light will remain on until the malfunction is corrected or until deenergized by the pilot. Pressing the light deenergizes the master light, permitting the master light to indicate a second malfunction if one should occur while the first malfunction is still present. The MASTER CAUTION lights are simultaneously dimmed when the caution panel is dimmed. This is done using the PILOTS FLIGHT INST LTS rheostat on the overhead switch panel. The caution lights operate through circuit breakers marked WARNING LTS PWR and TEST that are on the center circuit breaker panel. The circuit breaker marked PWR provides electrical power for the normal operation of the caution lights and the circuit breaker marked TEST provides power for the test circuit only.

2.16.2.1 Caution Panel Lights. Refer to Figure 2-49 for a detailed description of the caution panel.



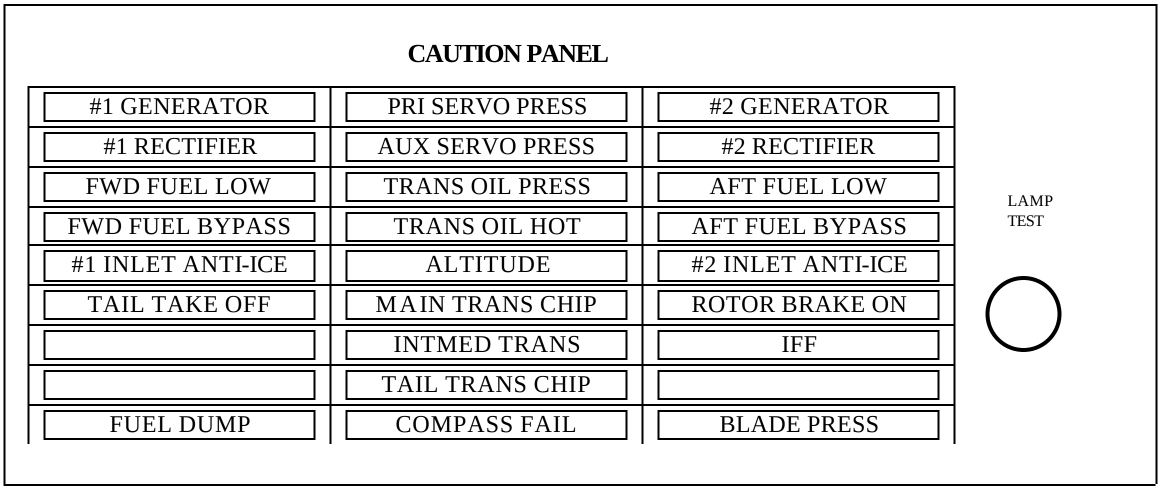
ADVISORY LIGHTS INDICATION	CONDITION	ACTION
EXT PWR ON	**AC power receptacle door is open.**	**Light will extinguish when door is secured.**
# 1 ENG ANTI-ICE ON **# 2 ENG ANTI-ICE ON**	**No. 1 anti-ice switch is on.** **No. 2 anti-ice switch is on.**	**Light will extinguish when engine anti-ice switch is placed off.**
PARKING BRAKE ON	**Parking brake handle not fully retracted.**	**Reset and release parking brake.**
NOSE DOOR OPEN	**Electronic compartment door is open or not fully secure.**	**Check door security.**
CHECK BLADE FOLD	**DC power is applied and blade fold interlock system is not in flight condition.**	**If blade spread, call trouble-shooter.**

Figure 2-48. (NON-ET) Advisory Light Panel



ADVISORY LIGHTS INDICATION	CONDITION	ACTION
EXT PWR ON	**AC power receptacle door is open.**	**Light will extinguish when door is secured.**
# 1 ENG ANTI-ICE ON **# 2 ENG ANTI-ICE ON**	**No. 1 anti-ice switch is on.** **No. 2 anti-ice switch is on.**	**Light will extinguish when engine anti-ice switch is placed off.**
PARKING BRAKE ON	**Parking brake handle not fully retracted.**	**Reset and release parking brake.**
NOSE DOOR OPEN	**Electronic compartment door is open or not fully secure.**	**Check door security.**
NO SMOKING	**Passenger instruction light switch is on.**	**Light will extinguish when passenger instruction is placed off.**
FASTEN SEATBELTS	**Passenger instruction light switch is on.**	**Light will extinguish when passenger instruction is placed off.**
CHECK BLADE FOLD	**DC power is applied and blade fold interlock system is not in flight condition.**	**If blade spread, call trouble-shooter.**

Figure 2-48.1. (ET) Advisory Light Panel



CAUTION LIGHT	CAUSE/DESCRIPTION	ACTION*
#1 GENERATOR #2 GENERATOR	Associated generator contactor relay opens and falls off line.	Recycle generator; if recycle fails, - LAND AS SOON AS PRACTICAL. If both fail, - LAND AS SOON AS POSSIBLE.
#1 RECTIFIER #2 RECTIFIER	Failure of rectifier or associated reverse current cutout relay.	Single rectifier – LAND AS SOON AS PRACTICAL. Both rectifiers – LAND AS SOON AS POSSIBLE.
PRI SERVO PRESS AUX SERVO PRESS	Pressure falls below 1,000 psi or 1,000 psi switch failure.	LAND AS SOON AS POSSIBLE. If pressure is below normal, secure affected system.
FWD FUEL LOW AFT FUEL LOW	210 to 280 pounds per tank 3^0 nose down – 170 to 200 pounds per tank in a hover.	Avoid altitudes above 6^0 nose up, crossfeed, land as fuel remaining permits.
FWD FUEL BYPASS AFT FUEL BYPASS	Pressure drop of 1.1 to 1.7 psi at the fuel filter.	Crossfeed from the good tank. – LAND AS SOON AS PRACTICAL.
TRANS OIL PRESS	Main gearbox oil pressure is below 3.5 psi at the forward right corner of the main gearbox.	LAND AS SOON AS PRACTICAL. Check for other indications.
TRANS OIL HOT	Main gearbox oil temperature above 120^0 at oil cooler outlet.	LAND AS SOON AS PRACTICAL. Check for other indications.

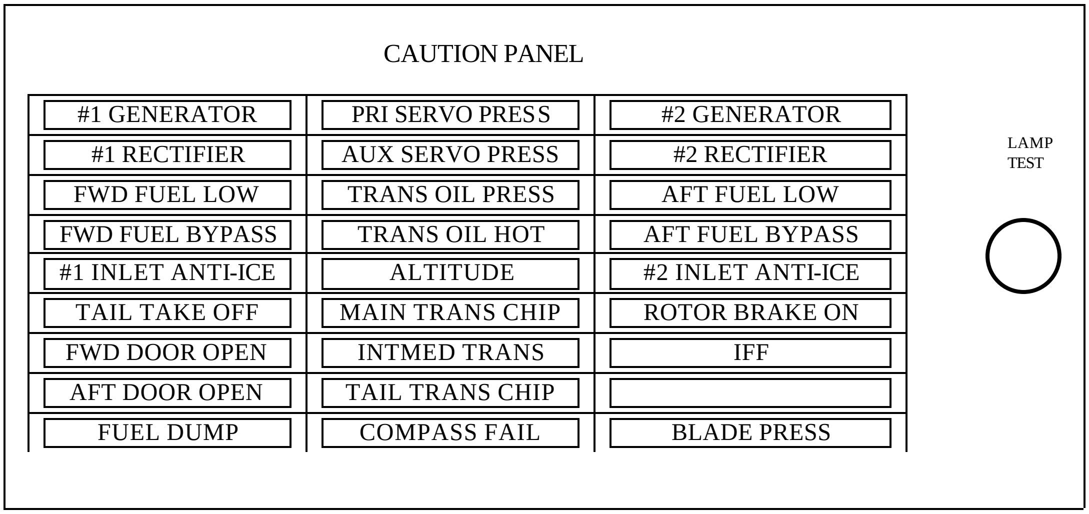
* Procedures contained in the action column of this matrix shall not supersede the more detailed EMERGENCY PROCEDURES of chapter 12.

Figure 2-49. Caution Light Panel (Typical) (Sheet 1 of 2)

CAUTION LIGHT	CAUSE/DESCRIPTION	ACTION*
MAIN TRANS CHIP	Metallic particles in main gearbox oil.	LAND AS SOON AS PRACTICAL. Check for other indications.
INTMED TRANS CHIP TAIL TRANS CHIP	Metallic particles or over heat condition in the associated gearbox oil.	LAND AS SOON AS POSSIBLE. Check for other indications.
#1 INLET ANTI-ICE #2 INLET ANTI-ICE	Anti-ice system failure or inability to maintain 38^0 inlet temperature.	Check circuit breaker; continue flight as conditions permit.
ALTITUDE	Activation of the RAWS.	Check altitude.
TAIL TAKE OFF	1. Tail takeoff free wheel unit failure. 2. Tail takeoff warning system failure. 3. N_r at 96 percent or below.	Check N_r. -LAND AS SOON AS POSSIBLE. (Except for low N_r).
ROTOR BRAKE ON	Manual or automatic rotor brake pressurized.	On deck – secure both speed selectors. In flight – LAND AS SOON AS POSSIBLE.
IFF	1. Mode 4 code zeroized. 2. Transponder is not replying to Mode 4 interrogations.	1. MASTER SWITCH to NORM. 2. Check Mode 4 toggle is on.
COMPASS FAIL	1. A/24g compass has failed. 2. Synchro interface unit (SIU) has failed. 3. VERTICAL GYRO in the fast erect mode.	Switch to STBD VERTICAL GYRO on CHANNEL MONITOR panel to preclude erroneous ASE inputs.
FUEL DUMP	Fuel dump valve is open.	Monitor fuel remaining.
BLADE PRESS	Loss of blade pressure.	1. Airspeed – 80 KIAS, minimize maneuvering. 2. Altitude – Minimum safe. 3. Blade Pressure Circuit Breaker – Check in. 4. LAND AS SOON AS PRACTICABLE

* Procedures contained in the action column of this matrix shall not supersede the more detailed EMERGENCY PROCEDURES of chapter 12.

Figure 2-49. Caution Light Panel (Typical) (Sheet 2 of 2)



CAUTION LIGHT	CAUSE/DESCRIPTION	ACTION
FWD DOOR OPEN	**Forward door is open or not fully secure.**	**Check door security.**
AFT DOOR OPEN	**Aft door is open or not fully secure.**	**Check door security.**

Figure 2-49.1. (ET) Caution Light Panel

2.17 FIRE DETECTOR SYSTEM

Two fire detector systems (one for each engine) are installed to warn the pilot of an engine fire. Three hermetically sealed temperature sensitive sensing loops and two interconnecting cables that have no heat sensing function are in each engine compartment. They are wired into a closed series loop connected to a control unit that turns on warning lights in the pilot compartment in case of a fire. The engine fire detector systems operate on ac power. The Nos. 1 and 2 fire detector systems receive power from the inverter when the generators are inoperative.

2.17.1 Fire Warning Lights and Test Switch. Two red engine fire warning lights and test switch (see Figure 2-7) are on a plate marked FIRE WARN on the pilot side of the instrument panel. The lights are marked NO. 1 ENG and NO. 2 ENG. The switch has two marked positions FIRE TEST and OFF. In addition, four red engine fire warning lights, two for each engine, are in the engine fire emergency shutoff selector handles marked FIRE EMER SHUTOFF SELECTOR NO. 1 ENGINE and NO. 2 ENGINE on the overhead switch panel (Figure 2-9). A light on the instrument panel and a light in either the No. 1 or No. 2 engine fire emergency shutoff selector handle will go on in case of a fire in the corresponding engine compartment. To test the engine fire detector system, place the spring-loaded switch to the up FIRE TEST position. The fire warning lights on the instrument panel and in the fire emergency shutoff selector handle will go on. The switch will return to OFF when released, and the lights will go off.

2.18 HEATING SYSTEM

The heating system (Figure 2-50) consists of a fan, an internal combustion heater, a plenum chamber, and ducts that run along the right side of the cabin wall and into the pilot compartment. A fire access port is in the aft heater duct aft of the broom closet on the starboard bulkhead. In addition, a spring-loaded fire extinguisher door is in the heater compartment access cover on the aft side of the ASE compartment. The heater unit in the heater compartment next to the control enclosure in the cabin operates on fuel pumped from the forward fuel tank by a heater fuel pump cycling valve to the heater unit, where it is ignited by a spark plug. Fuel consumption of the heater unit, operating continuously in the HIGH position, is 1.2 gallons (8 pounds) per hour. The spark plug operates electrically on 28-vdc current from the monitored bus, boosted by the heater ignition unit mounted in the heater compartment. Air is drawn into the heater intake port on the fuselage above and to the rear of the pilot window, and then through a heat exchange unit surrounding the combustion unit. Heated air is then blown into the plenum chamber, the cabin heater duct containing four diffusers, and the pilot compartment heater ducts, each containing two diffusers. The fan also supplies air to the heater combustion chamber.

2.18.1 Cabin Heater Switch. The heating system is operated by a switch, marked CABIN HEATER with three marked positions LOW, OFF, and HIGH on the overhead switch panel (Figure 2-9). The heater switch controls the heater fuel pump and cycling valve and the ignition unit. When the switch is at LOW, the heater will maintain a temperature of about 65°C in the ducts. When the switch is at HIGH, the heater will automatically maintain a temperature of about 149 °C in the ducts. An overheat switch will shut off the heater if for any reason the heat in the plenum chamber rises to 177°C. During the start sequence of the heater, if the fuel does not ignite within 40 ±5 seconds, the thermal switch in the exhaust tube will not actuate, causing the overheat relay circuit to be completed through the contacts of the time delay relay. These contacts close after 40 ±5 seconds, shutting off electrical power and fuel flow to the heater. The heater may be restarted by recycling the HEATER HEAT circuit breaker (CAB HTR UH-3H) with the heater control switch OFF. The heater will also shut off if the fan fails to operate. The heater switch is energized by the 28-vdc monitored bus and is protected by a circuit breaker.

2.18.2 Cabin Heater Fan Switch. The switch marked FAN and mounted on the overhead switch panel (Figure 2-9) has two positions marked OFF and ON. The fan switch controls a relay connecting 115-vac power to the heater fan (blower) in the upper part of the heater unit. The fan switch is energized by the 28-vdc monitored bus and is protected by a circuit breaker. Placing the cabin heater fan switch ON without operating the cabin heater switch will draw outside air into the heater system and ventilate the pilot compartment and cabin.

2.18.3 Heating and Ventilating Diffusers. A heater diffuser and register are in each heater duct that extends along the outside of the pilot compartment, just above the floor. Four diffusers are in the heater duct that extends along the right side of the cabin on the floor. Knobs marked OPEN and CLOSED are used to regulate the flow of warm air through the diffusers. The diffusers and fan are also used as a ventilating system.

2.18.4 Normal Operation.

1. Heater switch - HIGH OR LOW.

WARNING

Hot exhaust from the heater may burn personnel in the vicinity of the heater exhaust.

2. Heater diffusers - ADJUST AS DESIRED.

CAUTION

Before operating heater, check all heater outlets for clearance from luggage, clothing, inflatable equipment, and other gear that might be damaged by heat.

Note

The heater is shut off by moving the heater switch OFF. The fan will continue to operate after the heater is shut off until the temperature in the plenum chamber drops to 49°C. If the temperature in the plenum chamber should rise to 49°C during hot weather, the fan will begin to operate whenever the monitored bus is actuated.

2.18.5 Pitot Heaters. A pitot heater switch marked PITOT HEAT with marked position ON is on the overhead switch panel (Figure 2-9). When placed ON, an electric heater in each pitot head is turned on to prevent ice formation in the pitot head. Each pitot heater operates on dc power and is protected by a circuit breaker marked PITOT HEAT on the center circuit breaker panel.

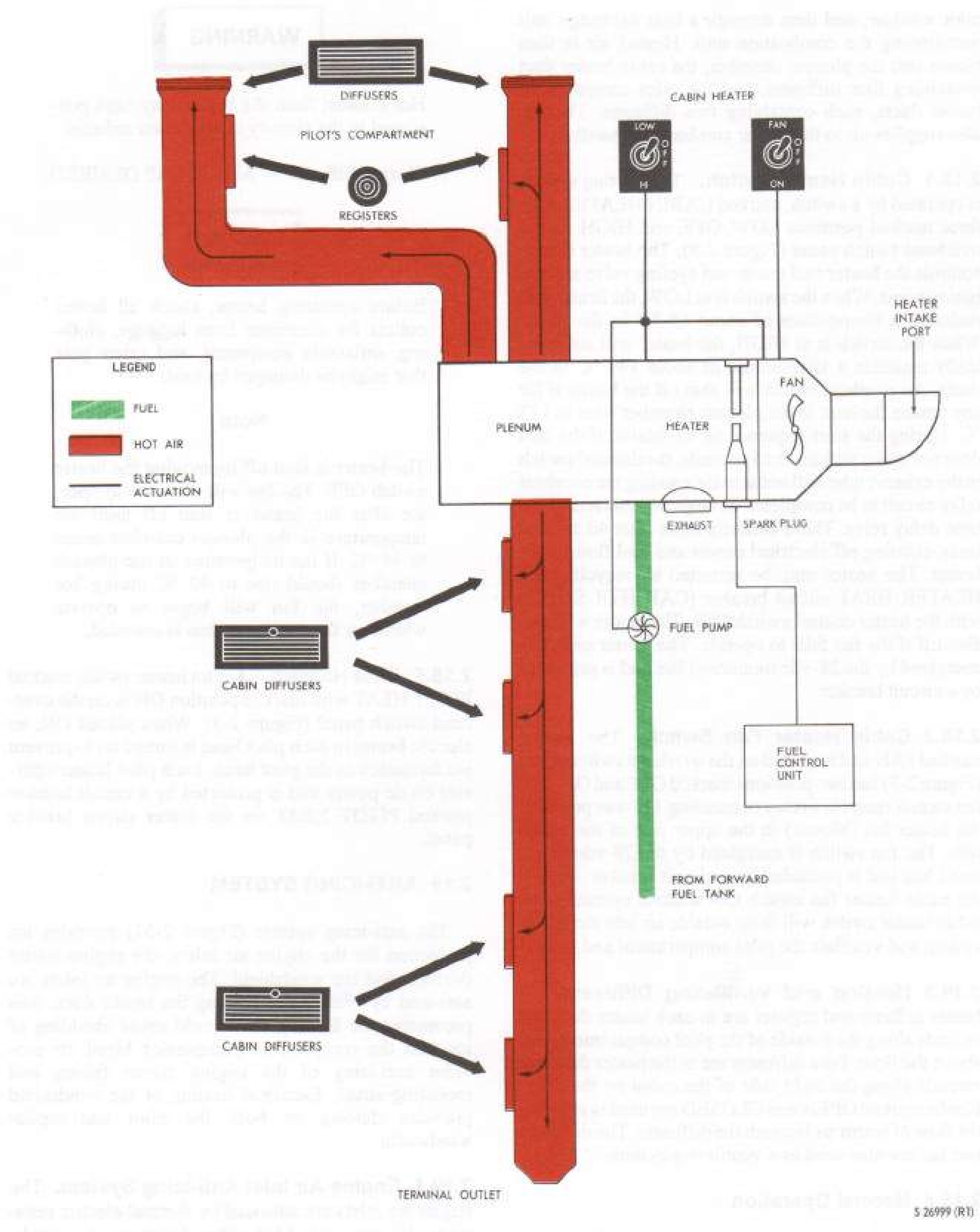


Figure 2-50. (NON-ET) Heating System

2.18.6 (ET) ENVIRONMENTAL AIR SYSTEM

The environmental air system provides for the heating, cooling, or ventilating of the cockpit and cabin (Figure 2-50.1). 52,000 BTU/hour of cooling is provided at the evaporator outlet throughout the aircraft flight profile and during ground operation. The system may also be operated prior to engine start through the use of the sponson-mounted auxiliary power unit. The system is divided into functional sections of temperature control, distribution, heating, and air-conditioning. The temperature control system includes the components that automatically control heater or air-conditioner operation to maintain the desired temperature. The monitored dc bus supplies electrical power for control circuitry. The distribution system directs heated air to the cockpit and cabin diffusers, and cooled or ventilated air to both diffusers and gaspers in the cockpit and cabin. The heating system includes the heater and basic controls for manual or thermostatically controlled operation as well as associated fuel and air systems. In manual operation, the heater is operated continuously; while during automatic operation, the cabin heat level and air-conditioning heat-loss level is controlled by setting the CABIN AIR TEMPERATURE rheostat at the crew chief’s ICS station. The air-conditioning system includes air-conditioner components and basic controls to thermostatically cool the cockpit and cabin. The ventilation system utilizes the distribution system and the heater or air conditioner blower to provide ventilated air to the diffusers and gaspers in the cockpit and cabin.

2.18.6.1 (ET) Air Conditioning System. The air conditioning system equipment is divided into functional sections of temperature control, distribution, heating, and air conditioning. The temperature control system consists of an AIR COND CONTROL panel, a CABIN AIR TEMPERATURE rheostat, sensing elements, and a control unit. These units provide an automatic thermostatically controlled temperature in the cockpit and cabin. The heating system can be operated manually or automatically, and the blowers may be operated without the heater or air conditioner system to ventilate the cockpit or cabin. The air conditioner system is operated automatically to cool the cockpit and cabin. In manual operation, the heater is operated continuously, while during automatic operation, setting the CABIN AIR TEMPERATURE rheostat on the control panel, at the crew chief’s ICS station, controls the cabin heat level and the air conditioning heat-lost level. The distribution system directs heated, cooled, or ventilated air to the diffusers in the cockpit and cabin. The heating system includes the heater and basic controls for manual or thermostatically controlled operation as well as associated fuel and air systems. The air conditioning system includes the air conditioner components and basic controls to thermostatically cool or ventilate the cockpit or cabin. The air conditioning system requires 115/200 volt, 3 phase, 400 Hz alternating current for operation. Electrical power for the control circuitry is supplied by the monitored bus at 28 volts dc through the HEATER HEAT and CABIN VENT circuit breakers on the No. 1 junction box. The No. 1 generator, at 200 volts ac through the AIR COND CONDENSER circuit breaker, supplies electrical power for the condenser motor. Electrical power for the compressor motor, air conditioner vent blower, and the heater vent blower is supplied by the No. 1 generator through the AIR COND COMPR MOTOR, HEATER BLOWER, and the AIR COND VENT BLO circuit breakers. The air conditioning system provides cool air to the cockpit and cabin compartments. The system is charged with HFC 134a that is readily vaporized or changed back to a liquid at low temperatures and pressures. When the system is operating, the refrigerant is compressed, which reduces the overall volume. The heat of compression is given up to the outside air as the high-pressure vapor passes through the condenser, which is cooled by the condenser blower. This heat transfer changes the vapor into a high-pressure liquid, which is collected in the filter drier. The liquid is subjected to a condition of reduced pressure and increased surface area upon passing through the expansion valve into the coils of the evaporator. The liquid vaporizes in the coils. The heat necessary for vaporization is taken from the air that is to be cooled. The vaporized liquid is then passed back into the motor-compressor, where the process begins again.

2.18.6.2 (ET) Manual Operation. When all heater/air conditioner system circuit breakers are engaged and the SELECTOR switch is positioned to HEATER, electrical power energizes the heater blower relay and air conditioner blower relay and the blowers start. When the heater blower has delivered sufficient air to the heater combustion chamber, the air pressure switch closes, directing electrical power through the overheat relay to operate the master fuel valve and the ignition unit. When the HEAT MODE switch is positioned to MAN OVRD, a circuit through the 140.6°C (285°F) cycling thermal switch and the HEAT MODE switch opens the fuel control unit solenoid valve, passing fuel to the heater. When the ignition unit and the fuel valve are energized, the 45-second time delay relay is simultaneously energized through the 93.3°C (200°F) exhaust thermal switch. If exhaust temperature does not reach 93.3°C (200°F) within 45 seconds after starting the heater, the time delay relay closes and energizes the 176.7°C (350°F) overheat relay, which interrupts power to the fuel valve and ignition unit and shuts off the heater. Cycling the SELECTOR switch on the control panel may then restart the heater. With the air fuel mixture and ignition spark being supplied, the heater operates, supplying heated ventilating air for the cockpit and cabin and discharging exhaust gases overboard. The heater continues to operate until the 140.6°C (285°F) normally closed thermal switch opens and de-energizes the fuel control unit solenoid valve to shut off fuel supply. The blower continues to operate until the plenum chamber temperature drops, and the 140.6°C (285°F) thermal switch closes to resume heater operation. If air in the plenum chamber approaches unsafe temperatures, the 176.7°C (350°F) normally open thermal switch closes and energizes the overheat relay. The overheat relay opens the heating system circuit to stop fuel flow and ignition to the heater, while the blower continues to operate to bring the plenum chamber temperature down to safe limits. Under these circumstances, or when the HEAT MODE switch is OFF, the blowers, powered through the normally open 48.9°C (120°F) thermal switch, will continue operating regardless of the position of the selector switch. The thermal switch circuit bypasses the VENT AIR and the SELECTOR switches to continue blower operation until the plenum chamber temperature is below 48.9°C (120°F), to provide safe cooling of the heater and proper exhaust of combustion gases. The air conditioner blower operates whenever the heater blower is operating, to provide ventilating air in the upper ducts which is controlled by gaspers in the ducts.

2.18.6.3 (ET) Automatic Operation. When all heater/air conditioner system circuit breakers are engaged and the SELECTOR switch is at HEATER, power energizes the heater blower relay and air conditioning blower relay and the blowers start. When sufficient air is being delivered to the heater combustion chamber, the air pressure switch closes. This causes power to be supplied through the overheat relay to operate the master fuel valve and ignition unit. When the HEAT MODE switch is positioned to AUTO, a circuit through the 140.6°C (285°F) cycling thermal switch and the HEAT MODE switch opens the fuel control unit solenoid valve, passing fuel to the heater. The air-fuel mixture and ignition spark assures heater operation, thus supplying heated air for the cockpit and cabin. The heater continues to operate until the sensing elements or the rheostat balances the heater control unit bridge to shut the heater off. The blower continues to operate until the plenum chamber or cabin temperature drops. The sensing elements or the temperature selector then unbalance the heater control unit bridge to start the heater. If the heater control unit should malfunction when the heater system is operating, the 140.6°C (285°F) thermal switch will cycle the heater as during manual operation. The thermal switch will start the heater when the temperature falls below 140.6°C (285°F), and shut the heater off when the temperature exceeds 140.6°C (285°F). If the plenum chamber approaches an unsafe temperature, the 176.7°C (350°F) normally closed thermal switch will open and de-energize the overheat relay circuit to stop fuel and ignition. The blower will continue to operate to provide safe cooling of the heater and proper exhaust of combustion gases.

2.18.6.4 (ET) Air Conditioning Operation. When all air conditioning circuit breakers are engaged and the SELECTOR switch is positioned to AIR COND, electrical power energizes the air conditioning blower relay to start the blower. Electrical power simultaneously flows to the sensing elements, the control unit bridge and the CABIN AIR TEMPERATURE rheostat. The compressor motor, which is an integral part of the motor-compressor, and the condenser motor, which is an integral part of the condenser, are started by action of their respective relays when the SELECTOR switch, on the AIR COND CONTROL panel in the cockpit, is positioned to AIR COND. A COMPR light, on the crewman's radio control panel, illuminates while the motor-compressor is running and goes out when the motor compressor stops. The motor-compressor and the condenser motor relay energizing circuits are interlocked with the engine anti-ice system to prevent simultaneous operation of the engine anti-ice system and the air conditioning system. The air conditioning system supplies cooled air to the cabin until the compartment sensing elements or the CABIN AIR TEMPERATURE rheostat balances the control unit bridge. Once the bridge is balanced, the motor-compressor relay de-energizes and shuts off the motor-compressor. The motor-compressor also shuts off when the pressure switch senses the pressure is below 10 psi or above 270 psi. A time delay relay in the system prevents the compressor from coming on until 15 seconds have elapsed since compressor shut-off. The system is protected against extremely high pressure by a relief valve set at 320 psi. When maximum cooling of the cabin is desired, the CABIN AIR TEMPERATURE rheostat is turned to the RECIRCULATE position and electrical power flows to the damper actuator relay, energizing the damper actuator and closing the outside air duct. This allows the cabin air to recirculate through the air conditioning

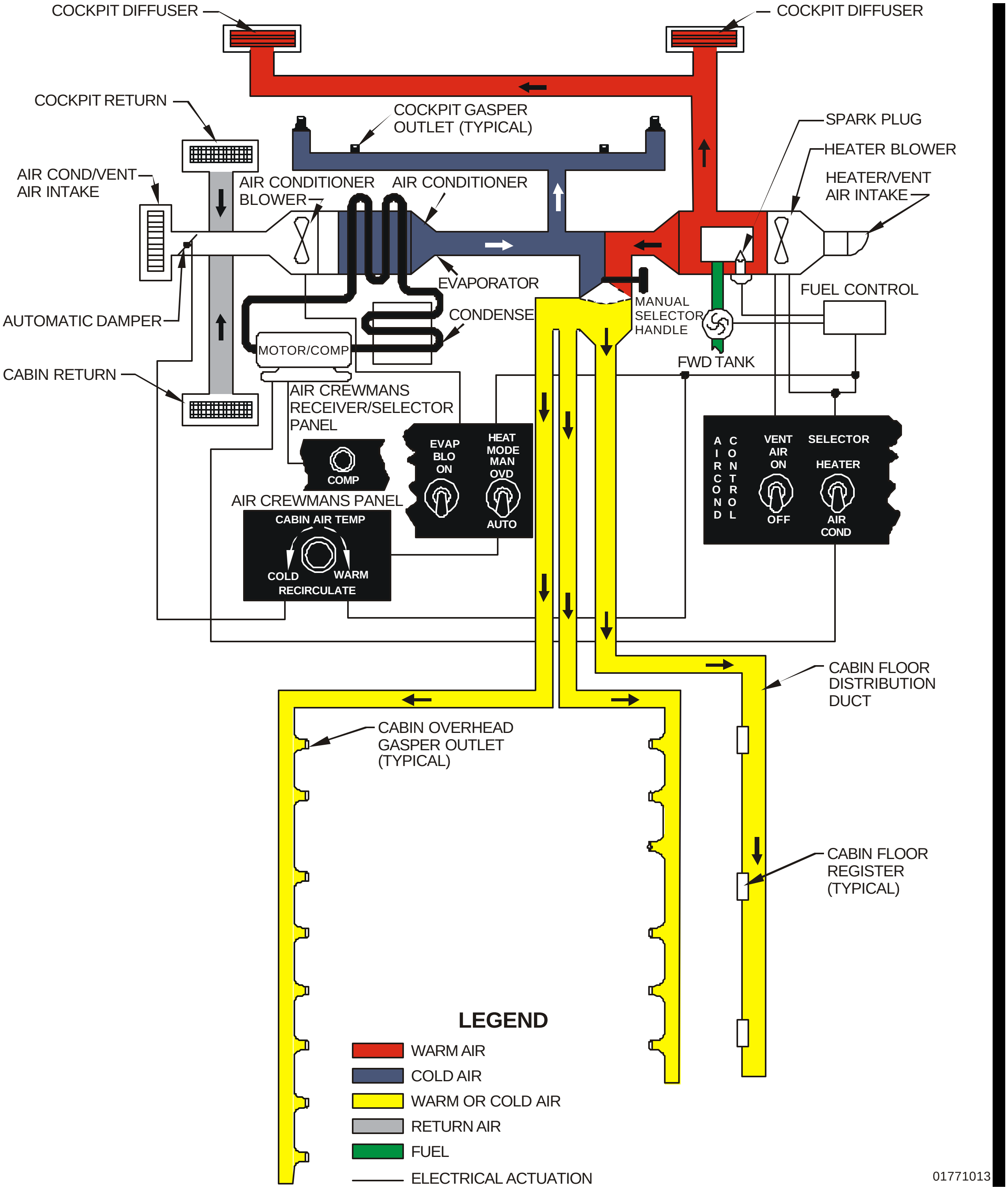


Figure 2-50.1. (ET) Environmental Air System

system, cooling the air quickly. Positioning the SELECTOR switch to OFF will shut off the air conditioning system.

2.18.6.5 (ET) Air Conditioner Control Panel. The air conditioner control panel (Figure 2-50.2) contains the necessary switches and relays to control heating, air conditioning, or ventilating operations. The SELECTOR and the HEAT MODE switches control manual or automatic cycling of the heater. When the SELECTOR switch is positioned to HEATER, electrical power flows to the HEAT MODE switch, sensing elements, control unit, CABIN AIR TEMPERATURE rheostat, heater master fuel valve, and ignition unit. At this time, the heater may be operated manually by positioning the HEAT MODE switch to MAN OVRD, or automatically by positioning the HEAT MODE switch to AUTO. With the HEAT MODE switch in the manual position, the heater will be cycled by the 140.6°C (285°F) thermal switch. With the HEAT MODE switch positioned to AUTO, the heater will be cycled by the sensing elements, the control unit, and the CABIN AIR TEMPERATURE rheostat. The air conditioning system will start when the selector switch is positioned to AIR COND. The VENT AIR switch controls operation of the heater blower and air conditioning blower. When the VENT AIR switch is positioned to ON, both blowers will circulate air through the cabin. The heater relay and the damper relay are also in the control panel. The SELECTOR switch actuates the heater relay, which energizes the heater blower relay and air conditioning blower relay to start the blowers. The damper relay is energized to close the damper when the CABIN AIR TEMPERATURE rheostat is in RECIRCULATE

2.18.6.6 (ET) Cabin Air Temperature Control. The cabin air temperature control panel (Figure 2-50.2) is mounted on the bulkhead behind the copilot. It is a variable resistor which varies the resistance to unbalance the control unit bridge until the desired cockpit and cabin temperature is achieved. For maximum cooling, the knob may be rotated to RECIRCULATE. This closes the outside air damper and recirculates the cabin air through the air conditioner system.

2.18.6.7 (ET) Sensing Elements. Five sensing elements form part of the control unit bridge circuit. These elements include: two cabin sensing elements in the cabin; a heater discharge sensing element on the plenum chamber; an outside air temperature sensing element in the heater intake duct; and an air conditioner discharge sensing element in the air conditioner duct which extends through the cabin floor at station 180. Each compartment-sensing element includes two thermistors, a fan, and a radio noise filter. One thermistor in each cabin air-sensing element is not used. The outside air temperature sensing element has one thermistor and the air conditioning discharge sensing element has two thermistors. The heater discharge-sensing element has two thermistors. One of the heater discharge sensing thermistors is connected in series with the outside air temperature sensing element, the cabin sensing elements, and one of the air conditioning discharge thermistors, through the control unit control relay. The other heater discharge sensing thermistor is connected in series with the CABIN AIR TEMPERATURE rheostat through the control unit control relay and is also connected in series with the compartment sensing thermistor. The resistance in the sensing elements will vary to unbalance the control unit bridge to start the heating or air conditioning system.

2.18.6.8 (ET) Heater Control Unit. The heater control unit is located in the electronics compartment. It operates in conjunction with the CABIN AIR TEMPERATURE rheostat, AIR COND CONTROL panel, and sensing elements to provide thermostatic control of the cockpit and cabin temperature. The control unit incorporates a bridge circuit, polarized switch, control relay, heat relay, and cooling relay. The temperature selector and the sensing elements vary the resistance to energize or de-energize the fuel control solenoid valve. With the heating system operating, the CABIN AIR TEMPERATURE rheostat or the sensing elements unbalance the bridge and actuate the polarized switch. At this time, the control relay is de-energized, permitting current to flow through the CABIN AIR TEMPERATURE rheostat, the heater discharge sensing element, the outside air temperature sensing element, the cabin sensing elements, and the heat relay, bypassing the air conditioning discharge sensing element. When the bridge is balanced, the polarized switch is de-energized, cutting power to the control unit heat relay, which, in turn, de-energizes the fuel control valve solenoid to stop the heater. When the bridge is unbalanced, current flow across the bridge energizes the polarized switch allowing electrical power to flow to the heat relay, which in turn energizes the fuel control valve solenoid, starting the heater cycle. With the air conditioning system operating, the control relay energizes and unbalances the bridge. At this time, the energized control relay cuts current to the heater discharge sensor and permits current flow through the CABIN AIR TEMPERATURE rheostat, outside air temperature sensing element, cabin sensing elements, and the air conditioning sensing element. When the bridge is unbalanced, the polarized switch is energized, allowing electrical power to flow to the motor-compressor.

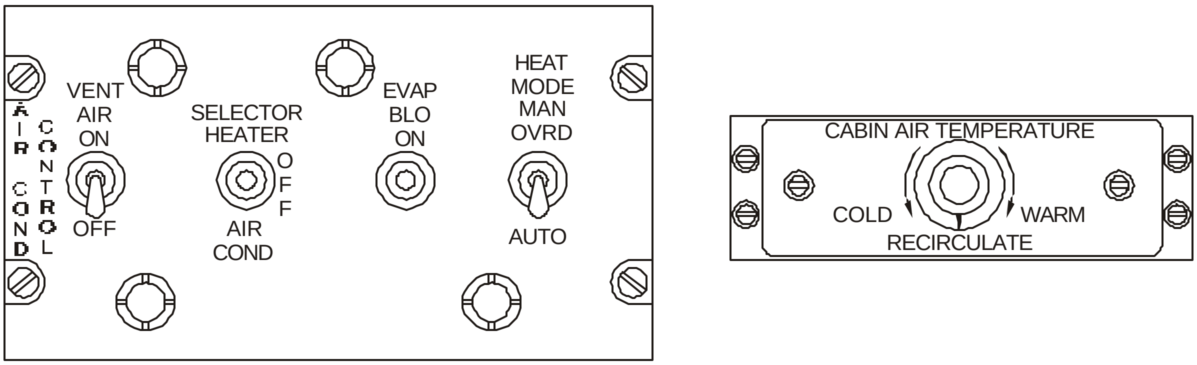


Figure 2-50.2. (ET) Air Conditioning Control and Cabin Air Temperature Controls

2.18.6.9(ET) Air Distribution System. The distribution system consists of a manually operated damper, electrically operated damper, actuator, automatic damper, air conditioning blower, heater blower, diffusers and registers, plenum chamber, transition duct, and the necessary heating and ventilating ducts to conduct the flow of air through the cockpit and cabin area. A manually operated damper governing air conditioning or ventilating air for the cabin is mounted on the ductwork, under the one-place seat, on the right side of the forward entrance compartment. The electrically operated damper, controlled by the actuator, is in the forward tub compartment and is a normally open damper. During recirculation of interior air, the damper remains in the closed position. The automatic damper, in the forward tub compartment, automatically controls the flow of either heated air or air-conditioned air into the cabin area, depending upon which system is in operation. The air-conditioning blower, in the forward tub compartment, draws outside air into the helicopter for the air conditioning system through an intake vent forward of the forward passenger door. The blower is also utilized to recirculate interior air, at which time the electrically operated damper is closed. The heater blower draws outside air and forces it through the otherwise inoperative heating system and into the helicopter. The overhead ducts, on both sides of the cabin ceiling, include individual units called gaspers. The gaspers control the flow of ventilating or air conditioning air into the cabin for individual passenger comfort. Two heating, ventilating, and air conditioning ducts, connected to the manually operated damper, run forward under the cockpit floor to registers and diffusers on both sides of the cockpit. A single heating, ventilating, and air conditioning duct, connected to the plenum chambers by a transition duct, runs aft along the right-hand side of the cabin. Two circular adjustable and eight nonadjustable diffusers in the cabin disperse heated, ventilated, and air conditioned air.

2.18.6.10 (ET) Heating System. The heating system is similar to that installed on the UH-3H helicopters, except that it can operate as an automatic thermostatically controlled system. Refer to the following subparagraphs for specific differences. Refer to NAVAIR 01-230HLH-2-1.1 for complete system description and theory of operation.

2.18.6.10.1 (ET) Heater. The heater is similar to that installed on the UH-3H helicopters, except that it is a 200,000 BTU heater, the exhaust is on the bottom of the heater instead of at the center, and the spark plug is at a 90-degree angle to the ground electrode.

2.18.6.10.2 (ET) Plenum Chamber. The plenum chamber is similar to that of the heater installed on the UH-3H helicopters, except that the 65.6°C (150°F) thermal switch has been removed and the heater discharge-sensing element has been installed in its place.

2.18.6.10.3 (ET) Thermal Switches. The thermal switches are similar to those of the heater installed on the UH-3H helicopters, except that the 65.6°C (150°F) switch is not installed.

2.18.6.11 (ET) Air Conditioning System. The air conditioning system is a vapor cycle system that provides a comfortable environment for crew members and passengers.

2.18.6.11.1 (ET) Evaporator Pallet Assembly. The evaporator pallet assembly is an aluminum honeycomb pallet located below the cabin floor at station 180, horizontally-mounted on the centerline of the aircraft. Major components mounted to the pallet are:

1. Compressor/motor Assembly
2. Evaporator Fan
3. Inlet Transition Duct
4. Heat Exchanger
5. Demister Assembly
6. Temperature Sensors
7. Hot Gas Bypass Valve

2.18.6.11.1.1(ET) Compressor/motor Assembly. The compressor/motor, mounted in the forward tub compartment, compresses and circulates the refrigerant in the air conditioner system. The compressor/motor assembly is a single, hermetically sealed unit, requiring 115/200-volt, 400 Hz, three-phase ac current for operation. A thermally protected six horsepower motor is mounted vertically over a vane rotary type pump that compresses and circulates refrigerant throughout the system. Mounted on the aluminum compressor/motor housing is a connector for the electrical power, refrigerant discharge and suction ports, and an oil level sight glass. The No. 1 generator, through the 35-ampere AIR COND COMPR MOTOR circuit breaker on the copilot's circuit breaker panel, provides power for the motor-compressor.

2.18.6.11.1.2 (ET) Evaporator Fan. The evaporator fan is a 6-inch diameter, two-stage axial vane type fan with internal motor windings, and an explosion proof housing. It requires 115/200-volt ac, three-phase, 400 Hz power for operation. The fan draws return air from the cabin interior and circulates it through the evaporator heat exchanger. The fan is located between the cabin return duct and the inlet transition duct.

2.18.6.11.1.3 (ET) Inlet Transition Duct. The inlet transition duct is located between the evaporator and the heat exchanger. The duct directs the flow of air from the fan outlet to the heat exchanger inlet. It is constructed of three layers of epoxy impregnated fiberglass laminate.

2.18.6.11.1.4 (ET) Evaporator Heat Exchanger. The evaporator heat exchanger is located between the inlet transition duct and the demister assembly. It is of a plate fin design and constructed of aluminum. The heat exchanger transfers heat from the cabin air to the refrigerant.

2.18.6.11.1.5 (ET) Demister Assembly. The demister assembly is mounted on the outlet of the heat exchanger and provides a mounting surface for the outlet duct. The demister assembly consists of an aluminum housing, a fine aluminum wire mesh demister pad mounted between a screen and two mounting brackets, and a drain tube for the removal of condensation. The demister removes moisture from the conditioned air. The moisture condenses and collects on the wires of the demister pad forming droplets. The droplets are pulled by gravity down to the drain pan where they are then dumped overboard through the drain tubes.

2.18.6.11.1.6 (ET) Low Temperature Switch. The low temperature switch is mounted on the aft side of the demister housing. The low temperature switch will trip the low temp fault indicator and disengage the compressor if the evaporator outlet temperature drops below -1.1 - 4.4°C (30-40°F). The system will automatically resume normal operation when the temperature rises to 12.8°C (55°F).

2.18.6.11.1.7 (ET) Hot Gas By-pass Valve. The hot gas by-pass valve is located on the evaporator pallet next to the heat exchanger. The valve provides regulation of the evaporator outlet air temperature. By adjusting the cockpit temperature control, through the temperature controller in the electronic box, the hot gas by-pass valve will discharge hot refrigerant gas from the compressor discharge tube directly into the heat exchanger. The valve receives input from the low temperature switch mounted on the demister housing and the temperature controller. The valve bypasses the expansion valve with hot gas regulating the evaporator pressure; with an increase in refrigerant pressure the temperature is also increased.

2.18.6.11.1.8 (ET) Thermal Electric Expansion Valve. The thermal electric expansion valve meters the refrigerant flow into the evaporator heat exchanger during the air conditioner operation. The orifice flow of the valve is controlled by voltage applied to the electrical terminals on the valve head. The valve incorporates a resistance wire on the valve head. The valve incorporates a resistance wire-wound, bimetal motor. The valve is operated by, and responds to, low voltage electrical power. The amount of electrical power applied to the valve controls the degree of valve opening. At zero voltage, the valve is closed. As voltage is applied, heat deflects the bimetal motor causing the valve needle to follow.

2.18.6.11.1.9 (ET) Liquid Sensing Thermister. The liquid sensing thermister is located in the evaporator suction line and regulates the voltage to the thermal electric expansion valve. The thermister reacts to the refrigerant, increasing or decreasing the voltage to the valve, depending on the state of the refrigerant exiting the evaporator. Liquid closes the valve and gas opens the valve.

2.18.6.11.2 (ET) Condenser Assembly. The condenser assembly is mounted horizontally in the left sponson. Refrigerant, after being heated and brought to a high pressure by the compressor, passes through the condenser where cooling air condenses the gas. Major components of the condenser assembly are as follows:

1. Heat Exchanger
2. Transition Duct
3. Condenser Fan
4. Check Valve
5. High Pressure Relief Valve

2.18.6.11.2.1 (ET) Heat Exchanger. The heat exchanger is located in the aft portion of the left sponson. It is of a plate fin design and constructed of aluminum to minimize weight. The heat exchanger transfers heat from the refrigerant to the ambient air.

2.18.6.11.2.2 (ET) Transition Duct. The transition duct connects the heat exchanger and fan. It is attached to flanges on the components and is supported by brackets.

2.18.6.11.2.3 (ET) Condenser Fan. The condenser fan draws ambient air through the heat exchanger and exhausts it overboard. The 12-inch axial vane fan motor requires 115/200 volts, 400 Hz, three-phase electrical current for operation. The fan is explosion proof and thermally protected.

2.18.6.11.2.4 (ET) Check Valve. The check valve is mounted on the refrigerant inlet port of the heat exchanger. It is a poppet-type valve that prevents a back flow of refrigerant when the system is shut down.

2.18.6.11.2.5 (ET) High Pressure Relief Valve. The high pressure relief valve is located in the high pressure liquid line and is designed to vent refrigerant from the system in the event that the high pressure switch fails and the system refrigerant pressure exceeds 475 psig. The valve vents refrigerant overboard. As pressure decreases below 475 psig, the valve will automatically reseal and normal air conditioning operation will continue.

2.18.6.11.3 (ET) Auxiliary Servicing Pallet. The auxiliary servicing pallet is an aluminum honeycomb pallet, located in the forward tub compartment under the cabin floor. Major components of the auxiliary servicing pallet are:

1. Filter Dehydrator
2. Refrigerant Liquid Line Indicator (Sight Glass)
3. High Pressure Switch
4. Low Pressure Switch
5. Refrigerant Servicing Ports

2.18.6.11.3.1 (ET) Filter Dehydrator. The filter dehydrator is mounted on the auxiliary service pallet in the high pressure (liquid) refrigerant line between the condenser and the expansion valve. Contaminants and moisture are removed from the refrigerant through the filter dehydrator's molded porous core.

2.18.6.11.3.2 (ET) Refrigerant Liquid Line Indicator. The liquid line indicator, or sight glass, is located in the liquid line between the condenser heat exchanger outlet and the filter/dehydrator. Its primary purpose is to allow visible evidence of liquid (clear) or vapor (bubbles) in the liquid line to determine the state of the system's refrigerant charge. The sight glass is not used to determine the adequacy of the refrigerant charge. The liquid line indicator also contains a moisture indicator. The indicator turns yellow if moisture is in the system refrigerant and green when the system is dry.

2.18.6.11.3.3. (ET) High Pressure Switch. The high-pressure switch will disengage the compressor if system refrigerant pressure reaches 350 ± 20 psi. The compressor will reengage as refrigerant pressure decreases to 150 psig. The high-pressure switch is mounted on the refrigerant servicing manifold on the auxiliary service pallet.

2.18.6.11.3.4 (ET) Low Pressure Switch. The low-pressure switch, in the event of complete refrigerant loss, will disengage the compressor when the system pressure drops below 50 ± 3 psig. When the system pressure rises above 65 psig, the compressor will reactivate. The low-pressure switch is mounted on the refrigerant-servicing manifold on the auxiliary service pallet.

2.18.6.11.4 (ET) Electrical Control Box Assembly. The electrical control box contains all the major electrical components necessary for air conditioning operation. The control box is mounted in the forward tub compartment and includes the following components:

1. Control Relays
2. Time Delays
3. Temperature Controller
4. Fault Indicator Panel

2.18.6.11.4.1 (ET) Control Relays. The three phase electrical power is controlled by power contactor type relays. One relay is used for each of the major air conditioning system components.

2.18.6.11.4.2 (ET) Time Delays. Two time delays are used in the control of the air conditioning system to prevent all of the electrical loads from starting simultaneously, thereby reducing the electrical surge. A five-second-time delay controls the power contactor for the condenser fan. A ten-second-time delay relay controls the power contactor for the compressor.

2.18.6.11.4.3 (ET) Temperature Controller. The temperature control unit contains solid-state circuits necessary for thermostatic temperature control of the air conditioning system. The controller requires two inputs for operation; one input from the rotary temperature selector set at the desired cabin temperature and one input from the supply air temperature sensor. In the air conditioning mode the temperature controller cycles the hot gas bypass valve on and off to control the outlet temperature.

2.18.6.11.4.4 (ET) Fault Indicator Panel. The fault indicator is mounted in the electrical control box cover to indicate extremes in either pressure or temperature during air conditioning operation. The panel consists of three one-amp circuit breakers. The fault indicators are labeled High Pressure, Low Pressure, and Low Temperature. The system will automatically resume operation after a fault condition subsides. The affected circuit breaker should be reset prior to the next flight.

2.18.6.11.5 (ET) Remote Service Manifold. The remote service manifold assembly is installed at station 155 on the left side of the aircraft. Removal of an external access panel permits external servicing of the air conditioning system.

2.18.6.11.6 (ET) Ventilating System. A ventilating system is incorporated in the heating and air conditioning system. It provides circulation of outside air throughout the inside of the helicopter. Positioning the VENT AIR switch, on the air conditioning control panel, to ON actuates the system. This energizes the air conditioning and heater blower relays that start the blowers.

2.19 ANTI-ICING SYSTEM

The anti-icing system (Figure 2-51) provides ice protection for the engine air inlets, the engine starter fairings, and the windshield. The engine air inlets are anti-iced by electrically heating the intake duct, thus preventing ice buildup that would cause shedding of ice into the compressor. Compressor bleed air provides anti-icing of the engine starter fairing and mounting struts. Electrical heating of the windshield provides deicing of both the pilot and copilot windshield.

2.19.1 Engine Air Inlet Anti-Icing System. The engine air inlets are anti-iced by thermal electric resistance elements embedded within the epoxy glass intake ducts. Electrical current is applied to the resistance elements to heat the duct skin higher than the temperature at which ice will form for OATs above -18°C. The engine air inlet anti-icing system should be turned on when operating in conditions of 10°C OAT and below where visible moisture (rain, fog, clouds, etc.), ice, or snow accumulation is noted on the helicopter. Significant locations to be observed for ice or snow accumulation include the windshield wipers, the pitot tubes, and the stub wings. The engine air inlet anti-ice should remain off when flying in dry snow and no accumulation is noted on the helicopter. The engine anti-ice switches (Figure 2-52) on the overhead switch panel (Figure 2-9) turn the system on. The inlet temperature is limited to a maximum of 93°C by an overheat sensor, embedded in the intake duct, and recycled on at a minimum of 81°C by the engine controller. The resistance elements of the Nos. 1 and 2 engines are operated by ac power and 28 vdc provides control.

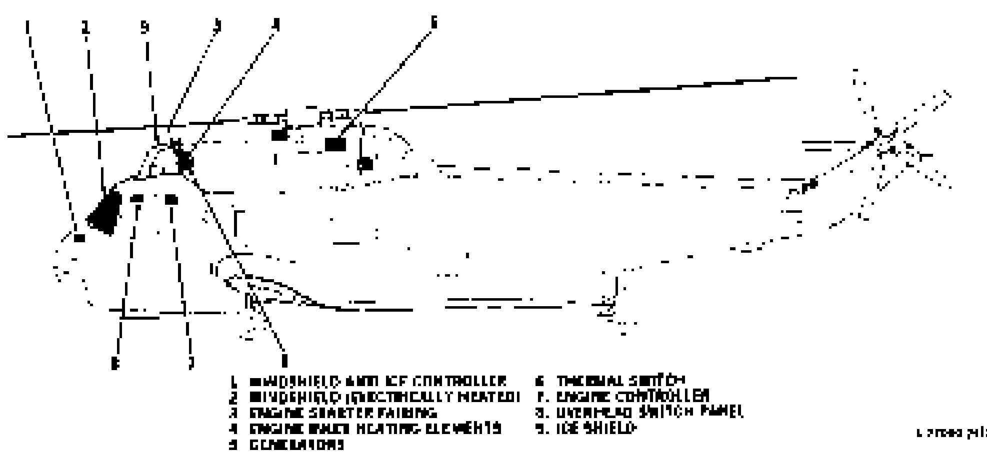


Figure 2-51. Anti-Icing System

The thermal switch in the air inlet duct closes to connect dc power to the CAUTION PANEL, lighting the #1 INLET ANTI-ICE and/or #2 INLET ANTI-ICE when the air inlet temperature drops below 38°C with the ENGINE ANTI-ICE switch ON. If OAT is -18 $^{\circ}$C or above, and the engine anti-icing system is on, the CAUTION PANEL lights coming on will indicate anti-ice system failure. If OAT is –18°C or below and the engine anti-ice system is on, the CAUTION PANEL lights will go on, indicating no anti-ice protection, as electrical heating is not enough to maintain 38°C under these ambient conditions. However, as previously mentioned, the engine air inlet anti-icing system should not be turned on unless there is a visible moisture or ice or snow accumulation. (For a more detailed discussion refer to Extreme Weather Operations, Chapter 14.)

2.19.2 Engine Anti-Icing System. The engine starter fairing (Figure 2-51), the inlet guide vanes, and the top, right, and left struts of the front frames of each engine are anti-iced by diverting engine tenth-stage compressor air to heat them. Actuating the engine anti-ice switch (Figure 2-52) on the overhead switch panel (Figure 2-9) deenergizes an engine-mounted solenoid valve to the open position, allowing hot compressor air to flow through the engine front frame to the inside of the starter fairing and the inlet guide vanes. When the engine solenoid is deenergized, lights are illuminated on the advisory panel, displaying to the pilot the markings #1 ENG ANTI-ICE ON and/or #2 ENGINE ANTI-ICE ON. The engine anti-icing system is turned on simultaneously with the engine air inlet anti-icing system. If the engine anti-ice advisory light on the advisory panel lights during flight when the engine anti-ice switches are OFF and the anti-icing system is not in operation, it indicates that the engine anti-ice solenoid valve has opened (deenergized) because of electrical failure and that a loss of about 6-percent engine horsepower will occur. The solenoid valves are held in the closed (energized) position by 28-vdc power. This 6-percent loss will occur only if the engine is operating at topping power. With complete dc power failure, the solenoid valve will open but the advisory panel light will not go on.

2.19.3 Engine Anti-Ice Switches. Two engine anti-ice switches (Figure 2-52) marked ANTI-ICE ENGINE 1 and 2 with marked positions OFF and ON are on the overhead switch panel (Figure 2-9). ON energizes the engine air inlet anti-icing system and activates the engine anti-icing system. OFF turns the anti-icing systems off. If the ambient temperature is 38°C or below, placing the engine anti-ice switches ON turns on the engine anti-ice and engine air inlet anti-ice systems and lights the #1 INLET ANTI-ICE and #2 INLET ANTI-ICE caution lights and the advisory panel lights marked #1 ENG ANTI-ICE and #2 ENG ANTI-ICE. When the engine air inlet anti-icing system has increased the duct air temperature to 38°C, the caution panel lights will go off.

2.19.4 Windshield Anti-Ice System. The pilot and copilot windshields are anti-iced by an electric current that passes through a transparent resistant film on the inner surface of the outer pane of the windshield (Figure 2-51). The windshield anti-icing system consists of the treated windshields, a windshield anti-ice controller, transformers, and a switch on the overhead switch panel. The windshield anti-icing also serves to defog the windshield.

2.19.4.1 Windshield Anti-Icing Switch. This switch (Figure 2-53) marked WINDSHIELD with marked positions LOW, OFF, and NORMAL is on the overhead switch panel (Figure 2-9). When placed to LOW, the windshield controller is energized, current heats the windshield. The low temperature setting is used for defogging and light icing conditions.

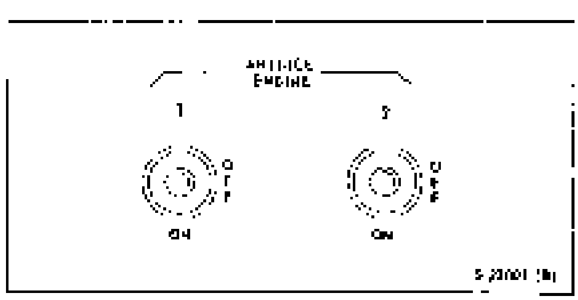


Figure 2-52. Engine Anti-Ice Switches

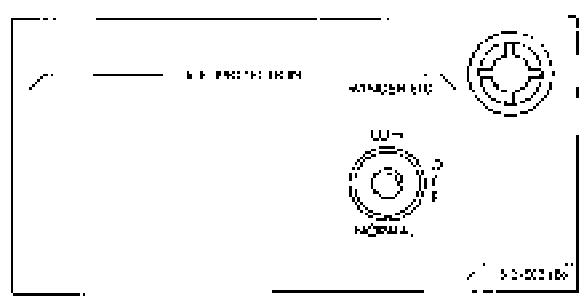


Figure 2-53. Ice Protection Switches

When placed to NORMAL, the windshield is heated and is capable of keeping the windshield ice-free in conditions as severe as ambient temperature of –18 °C.

The windshield anti-icing systems operate on ac power. Single-phase ac power provides power to the anti-icing switch. Dc power is used to operate the temperature controller and is protected by a circuit breaker on the center circuit breaker panel.

2.20 CREWMEMBER SEATS. The pilot, copilot, and crewmen have crash resistant seats that are similar in design. The pilot and copilot seats are side by side in the pilot compartment and the crewmen's seats are in the cabin. Each seat consists of a graphite-fiber bucket with metal structural members, a five-point restraint system, and foam-padded seat cushions, headrest, and adjustable lumbar support. The five-point restraint system consists of shoulder harness, lap belt, and lap tiedown strap. The lap tiedown strap has a rotary buckle to which the shoulder harness and lap belt fasten. The lumbar support pad is attached by Velcro fastener strips to the seatback cushion, and is adjustable for maximum crewmember comfort. Each seat has a vertical adjustment control lever, horizontal adjustment control lever, and restraint system control lever. In addition, a VLEA control dial is provided that adjusts the VLEA system limits for the individual crewmember. The VLEA system limits sudden vertical deceleration to acceptable limits.

2.20.1 Vertical Adjustment Control Lever. The vertical adjustment control lever is at the right, front underside of each seat. The lever is pulled forward to release locking pins, allowing the seat to be adjusted up or down at various heights at increments of 0.625 inch. Weight will move the seat downward. When weight on the seat is reduced, the spring-loaded adjusting mechanism will move the seat to the highest position. Releasing the lever will set the locking pins and hold the seat at the desired position.

2.20.2 Horizontal Adjustment Control Lever. The horizontal control lever is at the left, front underside of each seat. The lever is pulled forward to release locking pins, allowing the seat to be moved fore and aft on tracks. The pilot seats can lock in position at increments of 0..50 inch, and the sensor operator seats can lock in position at increments of 1.00 inch. Releasing the lever will set the track locking pins and hold the seat at the desired position.

2.20.3 Restraint System Control Lever. A two-position restraint system inertia reel control lever is at the left side of each seat. When the lever is in the unlocked (aft) position, the shoulder harness cable will extend to allow the occupant to lean forward; however, the inertia reel will automatically lock if an impact force of 2 or 3g's in the fore-and-aft direction is encountered. When this occurs, the inertia reel will remain locked until the lever is moved to the locked position and then returned to the unlocked position. When the lever is placed in the locked (forward) position, the shoulder harness cable is locked so that the occupant is prevented from leaning forward. The locked position is used to provide an added safety precaution over that of the automatic lock on the inertia reel during takeoff and landing, or when a ditching is anticipated.

2.20.4 Variable-Load Energy Absorber Control Dial. The VLEA control dial is mounted on the right side of each seat. The weight of the crewmember (crewmember plus equipment) is set into the dial to adjust each energy absorber and provide maximum protection for the crewmember.

WARNING

Adjustments either higher or lower than actual crewmember weight will increase the probability of injury in a crash.

2.21 TROOP-CARRYING EQUIPMENT

2.21.1 Troop Seats. A three-man nylon webbed troop seat with safety belts is installed in the cabin opposite the cabin door. Some models are capable of utility configuration in which five three-man troop seats (Figure 2-54) are installed. The seats may be removed or folded up against the bulkhead to provide cargo space.

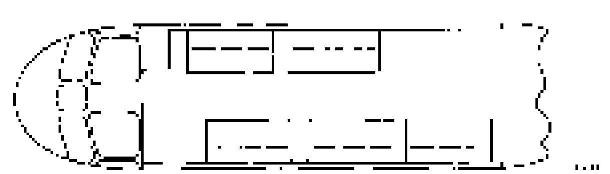


Figure 2-54. Utility Troop Seats

2.21.2 Crewmen Safety Belts. The crewmen safety belt shall be worn at all times when crewmembers unstrap and leave their seats. Attachment points for the safety belt are the single hardpoint located on the port bulkhead under the aft troopseat, troopseat seatbelt rings and the cargo deck tiedown fittings. It shall not be worn in conjunction with the lap belt/shoulder harnesses. No two crewmen safety belts shall occupy the same hookup point. Nor shall they be attached to the shoulder harness straps or lap belts on the crewmember seats.

WARNING

Crewman shall inspect all cargo deck tie-down fittings for excessive corrosion and proper installation before attaching their crewman safety belt to them. Do not use corroded or improperly installed tiedown fittings.

2.21.3 (ET) PASSENGER ACCOMMODATIONS

2.21.3.1 (ET) General. Accommodations for the crew include the pilot's and copilot's seats, which are identical to those installed on UH-3H helicopters, a crew chief's seat, and a forward-facing crew member's seat installed at station 425. Accommodations for passengers include three executive chairs and inward-facing passenger (troop) seats mounted along the sides of the cabin.

2.21.3.2 (ET) Executive Seat. Three executive seats are installed in the forward passenger compartment; one on the right side, and two on the left side. The executive seats are crashworthy seats consisting of a graphite-fiber bucket with metal structural members, four-point restraint system, foam-padded seat cushions and headrest, and swiveling base. The seat base is secured to tracks, mounted on a seat pallet. The guided-stroke seat design provides maximum retention of the seat to the floor structure when subjected to loads that are created during crash conditions. A Variable-Load Energy Absorber (VLEA) system limits vertical deceleration in a hard landing situation to acceptable limits. When the total weight of the passenger (weight of passenger plus equipment) is dialed into the system by means of the VLEA control dial mounted on the backside of the seat, the limit load of each energy absorber is adjusted to provide maximum protection for the passenger.

WARNING

Adjustment either higher or lower than actual passenger weight will increase crash hazards.

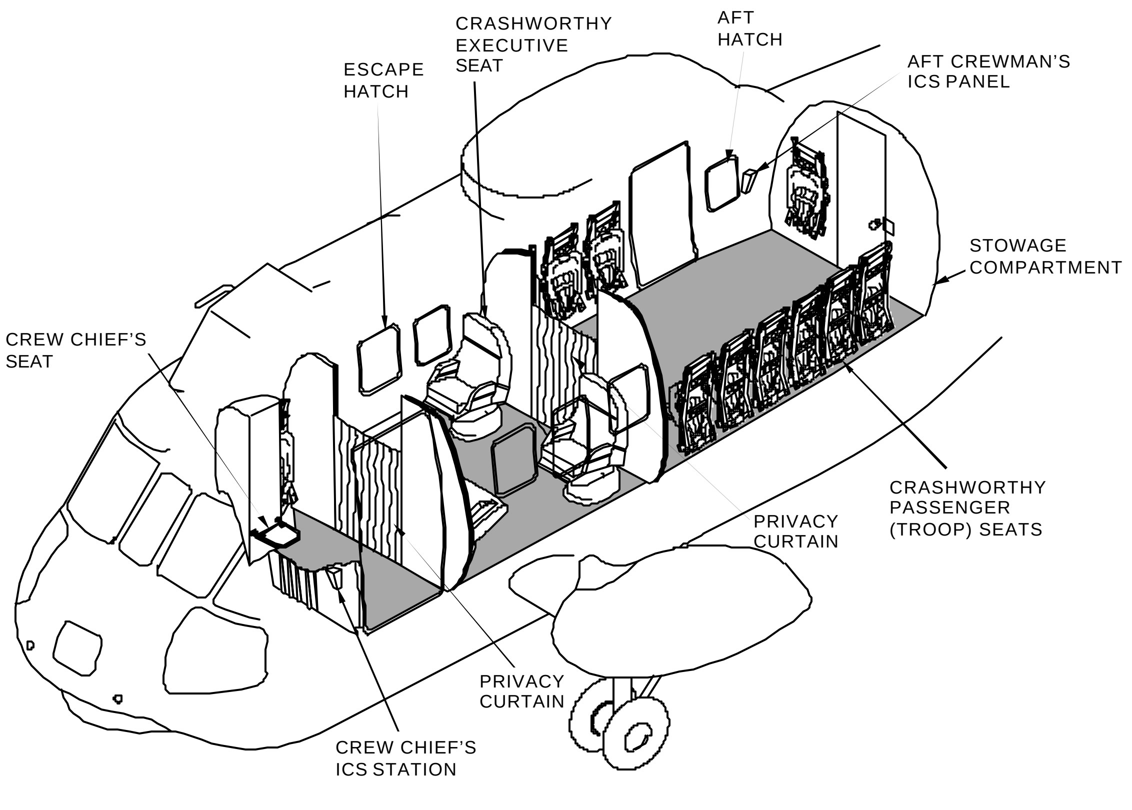


Figure 2-54.1 (ET) Passenger Accommodations

2.21.3.3 (ET) Crew Chief's Seat. The folding crew chief's seat consists of a seat, panel, strut, and seat cushion. The seat panel is constructed of aluminum honeycomb sandwiched between aluminum sheets. Hinge fittings are bolted to the top surface of the panel, and channel for the strut wheels is secured to the bottom surface. The supporting strut is an aluminum alloy tube with fitting at each end. The lower end of the strut is secured to an angle fitting secured in the corner formed by the floor and the ASE controls compartment bulkhead. The fitting is a hinged point that allows the strut and seat to fold against the bulkhead. Wheels on the upper end of the strut ride in the channel under the seat when the seat is being folded up against the bulkhead. A strap under the seat is used to store the seat against the bulkhead when not in use. Seat cushions cover the top and bottom surfaces of the seat panel to provide comfort when the seat is in use and protection against personal injury when the seat is folded against the ASE controls compartment bulkhead. The top cushion of polyurethane foam is held in place by the cover. The bottom cushion of Spongex is bonded to the seat panel and protected by the cover. The cover is secured with Velcro tape. Seat belt attachment fittings are secured to the hinge fittings on the ASE controls compartment bulkhead.

WARNING

The crew chief's seat is not a crashworthy seat. Do not occupy this seat during takeoff or landing.

2.21.3.4(ET) Passenger MATA (Troop) Seat. There are twelve passenger seats installed in the cabin area. Six seats are installed on the left side between stations 295 and 414; five seats are installed on the right side, one between stations 178 and 197, one between stations 224 and 243, and three between stations 295 and 354; one seat is installed on the aft bulkhead at station 425. The passenger seat is a side-facing, energy-attenuating, crashworthy type seat mounted to T-fitting and held in place by locking pins. This allows rapid removal of the seat when necessary for maintenance. The T-fittings are mounted on supports on the left and right sides of the cabin. The seat consists of a back panel and a seat pan. The back panel contains the structural attachment of the seat to the aircraft, the energy absorption system, the attachments of the restraint system, and a nylon duck fabric backrest, which can be adjusted to accommodate each occupant individually. The restraint system is a three-point, single release system with the shoulder strap across the aircraft-forward shoulder. The seat consists of a tubular frame with nylon duck fabric attached to the frame to support the occupant. Attachment of the seat pan to the back panel is done with pivoting fasteners that connect the back of the seat pan to the bottom of the back panel, and nylon webbing connecting the middle sides of the seat pan. This allows the seat to be folded up into a stowed position.

2.21.3.5 (ET) Soundproofing. Soundproofing consists of self-adhesive acoustic material and a thermal barrier. The acoustic material panels are thin, self-adhesive sheets of aluminum that are applied to the inside surfaces of the skin of the helicopter in the cockpit, cabin, and aft compartment. The material is cut to fit between stringers and frames. The thermal barrier is installed between the cabin and the aft fuselage to muffle sounds from the pylon. Access to the aft fuselage is through a zippered opening in the thermal barrier.

2.21.3.6 (ET) Removable Bulkheads. The removable bulkheads consist of sound-absorbing panels that divide the cabin interior into compartments. The bulkhead panels are constructed of two face sheets of fiberglass cloth-reinforced phenolic laminate over phenolic-coated, polyamide paper base honeycomb core. The panels match or complement the cabin furnishings. A wood laminate applied over a formed composite material provides a divider between the carpeting on the lower surface and the upper surface of each interior side panel. The wood strip is secured to the side panels with hook and loop tape. The left forward bulkhead of the forward entrance compartment contains passenger instruction lights and the forward ICS station. A curtain between the removable bulkheads at station 198 separates the forward entrance compartment from the forward passenger compartment providing privacy for the passengers occupying the executive seats. Removable bulkheads and a curtain at station 293 provide additional privacy for the passengers in the forward passenger compartment. Arch assemblies are installed at stations 356 and 390 to support the passenger support unit, and the removable aft bulkhead installed at station 425 divides the aft passenger compartment from the stowage compartment. Instruction lights and fittings for the installation of a passenger seat are installed on the aft bulkhead and a hinged door on the aft bulkhead provides for entrance to the stowage compartment.

2.21.3.7(ET) Overhead Panels. Overhead panels are installed throughout the cabin area. They are hinged panels that are secured by quick release fasteners. The overhead panels are constructed of two face sheets of fiberglass cloth-reinforced phenolic laminate over phenolic-coated, polyamide paper base honeycomb core.

1.21.3.8 (ET) Carpet. The cabin floor is covered with carpet that is installed in two sections. One section covers the floor in the forward entrance compartment, and another, larger section covers the cabin floor from station 201 through 425. The carpet is made of flame resistant nylon secured around its edges with hook and pile tape. If necessary to replace the carpet, remove the rubber backing from the carpet in those areas where the self-adhesive Velcro tape (hook) will be installed. Install the self-adhesive Velcro tape (pile) in a corresponding location on the aircraft floor.

2.22 (NON ET) RESCUE HOIST

A 600-pound lifting and 300-pound lowering capacity hydraulic hoist winch, enclosed by a fairing with about 100 feet of usable cable, is suspended on a fixed truss over the cabin door. The winch motor is powered by the utility pump mounted on and driven by the accessory section of the main gearbox. Hydraulic fluid for the rescue hoist (Figure 2-55) is supplied from the utility hydraulic system at 1,250 psi. The hoist winch incorporates a load-holding brake that locks automatically whenever the winch stops, and a level wind mechanism that prevents snarling if the cable is wound rapidly with no load attached to it. Microswitches turn off the hoist winch either when the cable is reeled completely in or when it is completely unwound. An electrically operated cartridge-type guillotine, controlled by switches in the pilot compartment and the cabin, will cut the cable at the hoist winch if the hook becomes entangled in an obstruction on the ground and cannot be released. A double-throat hook is incorporated that may be used for cargo and/or rescue operations. Both throats have a positive locking feature that may be opened manually. The hook incorporates a ring-type handhold as an aid to rescued personnel and is self-stowing when the cable is reeled completely in. The rescue hoist winch may be controlled from either the pilot compartment or from the cabin by switches that use dc power to operate solenoid valves in the hydraulic lines. The rescue hoist control circuit and cable guillotine circuit are protected by two circuit breakers on the center circuit breaker panel (Figures 2-23 and 2-23.1.1) marked HOIST CABLE and HOIST CONT.

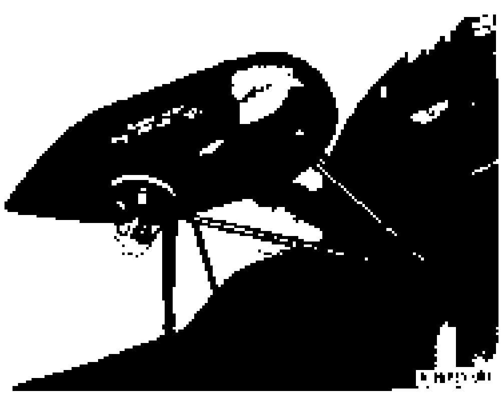


Figure 2-55. Rescue Hoist

2.22.1 (NON ET) Rescue Hoist Master Switch. A switch marked HOIST with marked positions CREW-OFF-PILOT is on the overhead switch panel (Figure 2-9) in the pilot compartment. When the switch is placed to CREW, the rescue hoist is operated by the hoist operator, using the switches near the cabin door. When the switch is placed to PILOT, the rescue hoist is operated by the pilot, using the switch on the pilot collective pitch lever grip. When placed OFF, both the pilot and cabin rescue hoist switches are inoperative. A switch marked HOIST-UP-DN on the bottom of the pilot collective pitch lever grip (Figure 2-30) controls the rescue hoist. The switch is depressed in the direction indicated by the arrows and UP or DN to raise or lower the hoist. When released, the switch is turned off and the hoist winch stops and locks. The switch is inoperative for hoist operations unless the rescue hoist master switch is placed to PILOT.

2.22.2 (NON ET) Rescue Hoist Switch Panel. This panel is on the panel marked HOIST on the cabin wall above the cabin door (Figure 2-56). The two-position switch is of the momentary-contact type with marked positions UP and DOWN. The switch is pushed in the direction indicated, UP or DOWN, to raise or lower the hoist. When released, the switch returns to the center position and the hoist stops and locks automatically. The switch is operative only if the hoist master switch on the overhead switch panel in the pilot compartment is placed to CREW.

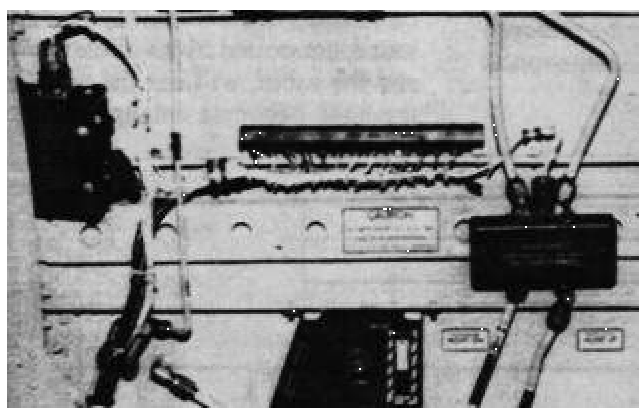


Figure 2-56. Hoist Switches and Override Valve

2.22.3 (NON ET) Crew-Portable Hoist and Microphone Switch. The pistol-grip or bracket-mounted type hoist/ICS assembly is connected to the hoist operator's station to enhance the capability of that station. The portable hoist switch is OFF when in the center position.

To operate the hydraulic hoist, move the switch to either of the extreme momentary positions marked UP and DOWN. When released, the switch returns to the OFF center position. The portable hoist control can be operated only when the hoist master switch on the pilot main switch panel is placed to CREW.

2.22.4 (NON ET) Normal Operation. To prevent exceeding the thermal limits of the utility hydraulic system, rescue hoist operations should be made by using between 25 and 50 feet of cable, and limiting the number of duty cycles as outlined in Figure 2-57.

Note

Visual signals between pilot, crewmen and ground or deck personnel shall be as outlined in NAVAIR 00-80T-113 and used as advisory signals only, as when cargo personnel are ready to be winched up.

1. Rescue hoist master switch - CREW OR PILOT.

2. Pilot rescue hoist switch (collective pitch lever grip) or either of the cabin rescue hoist switches DN, UP.

3. At completion of hoist operations, hold either rescue hoist switch at UP until only a few inches of cable remain, and then beep the hook into the stowed position.

4. Crewman should check for about 1/8- to 1/2-inch hook bumper compression. In conjunction with the hook bumper compression requirements, the hook should be seated to ensure perpendicularity of the cable with respect to the cable drum axle. This should be done by positioning the hook ring in a horizontal plane.

WARNING

Completely compressing the hook bumper may damage the hoist cable and cause an inadvertent hook separation when hoisting passengers or cargo.

2.22.5 (NON ET) Rescue Hoist Cable Shear Switches. If the hoist becomes entangled in an obstruction on the ground, a guillotine may be used to cut the cable at the winch. The guillotine is actuated by an electrically fired cartridge that may be fired from the pilot compartment or the cabin. The circuit breakers on the center circuit breaker panel must be set or the hoist cable cannot be guillotined. The cable is guillotined from the pilot compartment by use of switches on the jettison control panel on the cockpit console (Figure 2-5). To guillotine the cable from the pilot compartment place the jettison selector knob to HOIST and depress the individual RELEASE button. The cable may be guillotined from the pilot compartment regardless of the position of the hoist master switch. The hoist may be guillotined from the cabin only when the hoist master switch is placed to CREW.

HEIGHT	LOAD DOWN	LOAD UP	NO. OF CONTINUOUS CYCLES WITH AMBIENT TEMPERATURE 40 °C	PERIOD FOR ADDITIONAL CYCLES WITHOUT EXCEEDING 121.1 °C	NO. OF CONTINUOUS CYCLES WITH AMBIENT TEMPERATURE 18 °C
25 ft	0	200 lb	4	0.4 min.	UNLIMITED
25 ft	0	600lb	6 (est.)		UNLIMITED
35ft	300 lb	600lb	2		UNLIMITED
50ft	0	200lb	1	1.65 min.	4+
50ft	0	600 lb	2 (est.)		6 (est.)
50ft	300 lb	600lb	2	l0.0min.	1

- Lowering loads shall not exceed 300 pounds due to brake limitations.
- The utility hydraulic system is a variable displacement system; therefore, more work reduces fluid temperature and subsequently more cycles are permitted with greater loads.
- Cycling the landing gear will help prevent overheating during prolonged hoist operations.

System Thermal Limits of 121.1 °C

Figure 2-57. Rescue Hoist Duty Cycles Without Exceeding Utility Hydraulic

2.22.6 (NON ET) Rescue Hoist Shear Circuit Test Panel. A hoist shear circuit test panel (Figure 2-58) marked HOIST SHEAR CIRCUIT is mounted on the cabin wall above the cargo door. A light marked TEST is on the top center of the panel and a guarded switch with marked positions TEST and FIRE is on the bottom center of the panel. A decal is on the side of the panel. Testing of the rescue hoist shear circuit should be accomplished by qualified maintenance personnel in accordance with the appropriate maintenance instruction.

2.22.7 (NON ET) Rescue Hoist Manual Override Valve. A rescue hoist manual override valve (Figure 2-56) will lower or raise the hoist in case of electrical failures and should be used for emergency situations only. The valve operates from the utility hydraulic system.

2.22.7.1 (NON ET) Rescue Hoist Manual Override Valve Buttons

WARNING

Whenever using HOIST DN button during manual operation, do not pay out the last 10 feet of cable, as 10 feet of cable is needed on the hoist drum to support the design load of the hoist. During manual operation, there is no down-limit protection. As an aid in preventing too much payout, the last 10 feet of cable is painted red.

CAUTION

Do not operate the HOIST UP button continuously to its full-up position, because during manual operation there is no up-limit protection and severe damage to the hoist may result. When nearing the full-up position, stop hook assembly about 2 feet short of the up-limit switch and attach large hook to aft upper hoist assembly stanchion.

Two rescue hoist manual override valve buttons are used to actuate the rescue hoist if electrical failure occurs. The buttons are spring loaded and marked to indicate direction of hoist. The left button is marked HOIST DN and the right button is marked HOIST UP.

Figure 2-58. Hoist Shear Circuit Test Panel

2.22.8 (NON ET) Rescue Hoist Assist Handles. These handles (Figure 2-56) marked HANDHOLD are above the cabin door to aid the crewmen during rescue hoist operations.

2.23 EMERGENCY EQUIPMENT

2.23.1 Fire Extinguishing System. A liquid bromotrifluoromethane (CF_3B_r) fire extinguisher system is installed to enable the pilot to put out an engine fire in either engine compartment during flight. The liquid is stored under pressure in two fire extinguisher liquid spherical containers mounted in the aft section of the transmission compartment. Each spherical container has two valves that contain a disc that, when broken by an explosive cartridge actuated by the engine fire extinguisher switch, empties its contents into the preselected engine compartment. Choice of engine compartments is made by pulling one of the engine fire emergency selector handles. Tubing extends from one valve on each container to the No. 1 engine compartment and from the other valve on each container to the No. 2 engine compartment. Within each engine compartment, the tubing divides into four nozzles that extend along the inboard side of the engine.
The extinguishing liquid, when released through the nozzles, turns into a vapor that smothers the fire. The spherical containers have a pressure gauge and a thermal discharge valve that will discharge overboard outside of the helicopter if the temperature of the sphere reaches 96 to 104°C. The engine fire extinguishing system operates on dc power through the circuit breakers marked 1 ENG 2 under the general heading FIRE EXTINGUISHER on the center circuit breaker panel. Although designed primarily

for combating an engine fire during flight, the fire extinguishing system may be used on the ground if other firefighting equipment is ineffectual or not available. Be sure all ground personnel are clear before using the system.

2.23.1.1 Thermal Discharge Indicator. A safety outlet in each engine fire extinguisher container is connected to a red THERMAL DISCHARGE INDICATOR on the outside of the fuselage to the rear of the left cabin window. If pressure becomes excessive within the container, a safety outlet opens, the THERMAL DISCHARGE INDICATOR seal is ejected, and the container's contents are discharged overboard. The thermal discharge indicator is common to both fire extinguisher containers.

On preflight, check the pressure of the container in relation to the pressure/temperature chart on the inside of the inspection plate.

WARNING

CF_3B_r is very volatile but is not easily detected by odor. It is nontoxic and can be considered to be about the same as other freons and carbon dioxide, causing danger primarily by reduction of oxygen. The liquid should not be allowed to contact the skin, as it may cause frostbite or low temperature burns because of its low boiling point.

2.23.1.2 Engine Fire Emergency Shutoff Selector Handles (Engine T-Handles). Two T-shaped handles marked FIRE EMER SHUTOFF SELECTOR are on the overhead switch panel (Figure 2-9). The handle marked NO. 1 ENGINE is for the No. 1 engine compartment and the handle marked NO. 2 ENGINE is for the No. 2 engine compartment. When either handle is pulled down, 28-vdc power actuated the fuel shutoff valve. This closes the fuel lines to the respective engine and selects the engine compartment to which the fire extinguisher fluid is to be directed. It also energizes the circuit to the fire extinguisher switch. The ends of the handles house fire detector warning lights.

2.23.1.3 Engine Fire Extinguisher Switch. This switch marked FIRE EXT on the overheard switch panel (Figure 2-9) in the pilot compartment has three marked positions: RESERVE, OFF, and MAIN. The guarded switch is operative only after one of the fire emergency shutoff selector handles has been pulled. When the engine fire extinguisher switch is held in MAIN, after the fire emergency shutoff selector handle has been pulled, the contents of the fire extinguisher sphere are discharged into the corresponding engine compartment. When the engine fire extinguisher switch is held in at RESERVE, after the fire emergency shutoff selector handle has been pulled and the switch has returned from MAIN, the contents of the opposite fire extinguisher sphere are also discharged into the selected engine compartment. Pulling both engine fire emergency shutoff selector handles and placing the fire extinguisher switch to MAIN discharges the contents of each fire extinguisher sphere into the corresponding engine compartments. When this occurs, there is no reserve of fire extinguishing fluid. The switch will return to OFF when released.

2.23.2 Portable Fire Extinguisher. A portable fire extinguisher (Figure 2-1) is on the bulkhead at the entrance to the pilot compartment. The CF_3B_r fog-type extinguisher is held in place by a bracket with a tight-fitting, quick-release, spring steel clamp. When using the extinguisher, the nozzle must be held close to the source of the fire, as the charge has a short duration of about 30 seconds.

2.23.3 (NON-ET) Helicopter Emergency Egress Lighting System. This emergency lighting system is installed in UH-3H helicopters modified by AFC 417. The HEEL system automatically provides emergency lighting of the cabin exits to enable location by personnel inside the helicopter during an emergency (Figure 2-24). The system (Figure 2-59) consists of six light tube assemblies, five control unit assemblies, a PMG control box, and an arming switch. A light tube assembly is installed around the upper portion of the cabin hatch (left personnel door), right cargo door, and the three separate windows. Each light has a control unit containing a battery pack, function/disable switch, press-to-test switch, and indicator light. The battery pack provides power to the light tube during emergency operation.

CAUTION

HEELS is intended for emergency operation only and should not be used for non-emergency lighting.

The function/disable switch inside the control unit marked FUNCTION-DISABLE must be at FUNCTION for the light to operate.

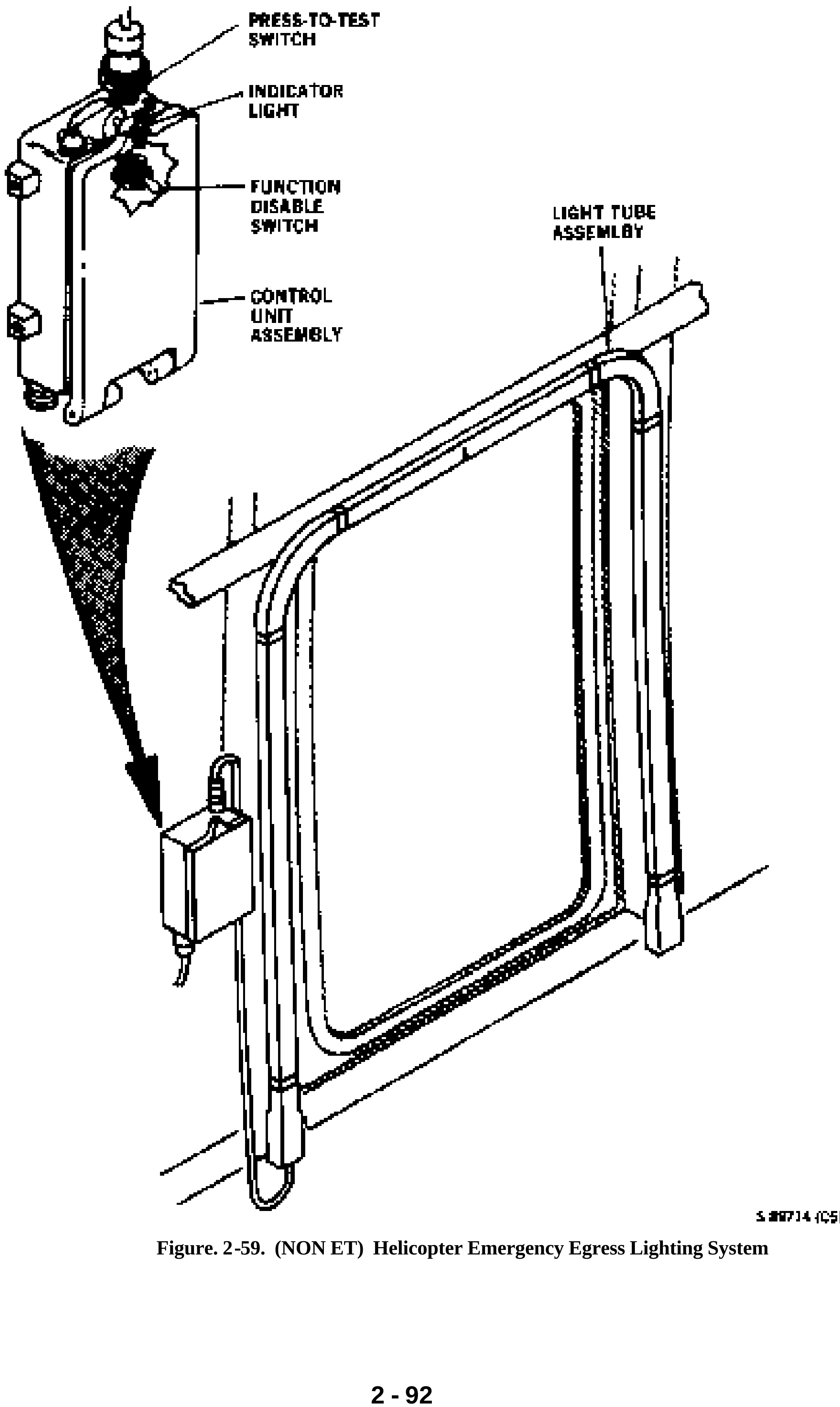


Figure. 2-59. (NON ET) Helicopter Emergency Egress Lighting System

Note

> A single light tube may be deactivated (switch placed to DISABLE) prior to flight should a hatch be unavailable for emergency use because of equipment or cargo obstruction.

The press-to-test switch tests the charge of the battery pack. The indicator light will light green when the press-to-test switch is pressed to indicate the battery pack has sufficient charge to operate for a minimum of 10 minutes and that the FUNCTION/DISABLE switch is at FUNCTION.

The arming switch on the overhead switch panel (Figure 2-9) is marked HEEL SYSTEM and has positions OFF-ARM. The PMG control box on the left cabin wall senses via signal from the ac generators when the generators are turning, provides dc power to the control unit assemblies when the arming switch is at ARM, and creates a light inhibit signal. If the PMG senses that the generators have stopped, the light inhibit signal is removed. The control unit battery packs activate, and the light tube assemblies illuminate. The PMG control box has two switches marked GEN 1 and GEN 2 for test functions of HEELS when ac generators are turning. With the arming switch at OFF, HEEL is disabled. Power for the system is provided through a primary dc circuit breaker marked HEEL on the pilot circuit breaker panel.

2.23.4 Flotation Gear System. The emergency flotation gear system provides the helicopter with stability on the water with the rotor stopped. The system consists of two inflatable bags, four air cylinders, and a control panel. The system operates on 28-vdc current and is protected by a circuit breaker marked AUX FLOAT on the center circuit breaker panel.

2.23.4.1 Emergency Flotation Gear Bags. The emergency flotation gear bags (Figure 2-1) are on the outboard chine of each sponson stowed in a bungee cord laced canvas enclosure. Each bag is subdivided into two chambers having a combined displacement of 35 cubic feet. The chambers are inflated by individual air cylinders. Although each chamber is inflated by a single air cylinder, all chambers will inflate simultaneously upon actuation of the INFLATE switch. The floats are made of neoprene-coated nylon and are scuff-resistant for durability during adverse conditions. The two chamber airbags provide a fail-safe function in that one chamber per side inflated will provide considerably improved stability.

2.23.4.2 Emergency Flotation Air Cylinders. There are two emergency flotation compressed air cylinders mounted horizontally inside each sponson. These cylinders are reached through the inspection ports on the top of the sponson. The cylinders are electrically discharged through solenoid-operated valves. A pressure gauge is also mounted on each valve. The gauge is marked from 0 to 3,500 psi in 100 psi units. The gauge is green-lined for 2,650 to 3,000 psi. If the pressure is not within the minimum and maximum limits, service the air cylinders.

2.23.4.3 Auxiliary Flotation Control Panel. This panel (Figure 2-60) marked AUXILIARY FLOTATION is on the lower right side of the cockpit console. The panel consists of a rotary selector test switch, indicating light, a two-position lever-lock-type switch, and a guarded pushbutton. The rotary selector test switch with marked positions OFF -L1 -L2 -R1 -R2 checks the respective circuit continuity to the air cylinders. When the switch is placed to either L1, L2, R1, or R2, the green light will go on if the circuit is functioning properly. The lever-lock switch has marked positions OFF and ARMED. When the switch is placed to ARMED, dc electrical power is supplied to the system. When the switch is placed OFF, all electrical power to the inflation portion of the system is removed. The pushbutton-type switch is marked INFLATE. When the switch is pressed, all four air cylinders simultaneously discharge air into the float chambers if the OFF-ARMED switch is ARMED. Normally, the bags will take about 6 to 7 seconds to inflate. After the system has been activated, the bags can be deflated only by maintenance personnel on the ground.

2.23.5 Liferaft. Liferafts of sufficient number and capacity to accommodate all occupants of the helicopter shall be carried on overwater flights. Rafts shall be securely stowed or worn as squadron policy dictates.

2.23.6 Aldis Lamp. An Aldis lamp is provided primarily for signaling but may be used for emergency lighting. The lamp is powered by the 28-vdc utility receptacle in the cockpit or after cabin.

2.23.7 First-Aid Kits. One kit is mounted in the pilot compartment on the control enclosure (broom closet). A second first-aid kit is in the cabin behind the pilot seat.

2.24 MISCELLANEOUS

2.24.1 Canteen. Provisions for two 1-quart canteens are on the cabin wall.

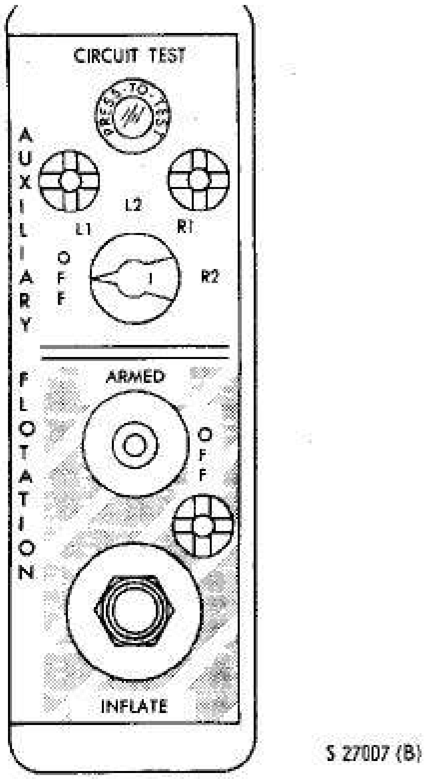


Figure 2-60. Auxiliary Floatation Control Panel

2.24.2 Engine Trim Checker (H219). The engine trim checker assists in more efficiently adjusting the engines by providing remote readings for the gas generator rpm and the power turbine inlet temperature and rpm. The checker is a portable hand-carried unit, equipped with connecting cables to connect the unit to the engine trim checker panel, that simultaneously displays T_5 and either N_f or N_g readings on digital displays for individual engines.

The engine trim checker receptacle panel (Figure 2-61) is mounted overhead in the area of the pilot compartment entrance. The receptacles marked NO. 1 and NO. 2 under the general heading ENGINE TRIM CHECK are associated with respectively numbered engines. These receptacles are each equipped with a jumper plug that is removed and stowed in the adjacent dummy receptacle where the signal input connecting cable to the engine trim checker is connected. The power input cable is connected to the ac utility receptacle on the right side of the cabin. The engine trim checker operates on 115 vac from the helicopter electrical system through connecting power input cable and is protected by a fuse on the engine trim checker control panel.

2.24.2.1 ENGINE TRIM CHECKER Control Panel. This panel (Figure 2-62) contains the receptacles, controls, and digital displays necessary for system operation. The SIGNAL INPUT and POWER INPUT receptacles will accommodate only the correct cable for the function required

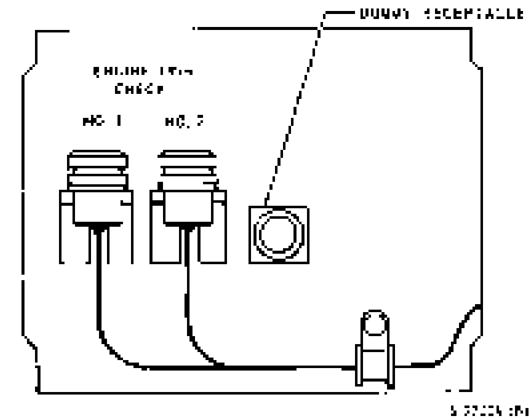


Figure 2-61. Engine Trim Checker Receptical Panel

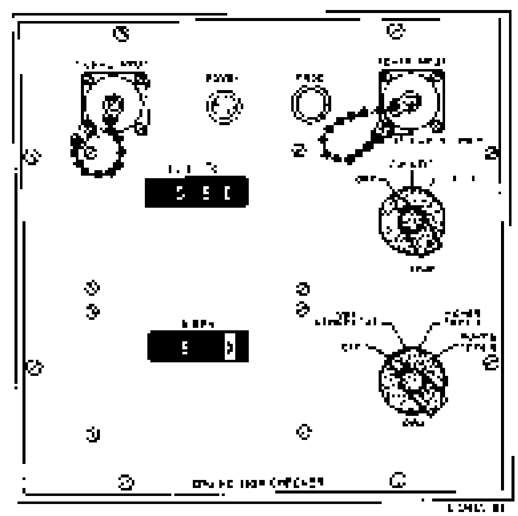


Figure 2-62. Engine Trim Checker Control Panel

The panel has a POWER light that will go on henever operating power is delivered to the engine m checker. A FUSE is incorporated in the control ınel to protect the circuit. The panel has a T_5 digital display marked T.I.T-^{o}C that displays turbine inlet temperature. A three-position rotary switch marked TEMP is associated with the T.I.T ^{o}C digital display. In the OFF position, the digital display is not usable. In the COCKPIT position, the digital display is not usable and the instrument panel T_5 indicator is usable; however, a slight calibration shift will be noted because of the incorporation of the engine trim checker in the circuit. In the T.I.T position, the digital display will display the applicable engine T_5 and the instrument panel power turbine inlet temperature indicator is disabled. An N_f/N_g digital display marked % RPM displays N_f or N_g as selected. The panel has a four-position rotary switch marked RPM that is associated with the % RPM digital display. In the OFF position, the digital display is not usable. The GAS GENERATOR position displays the N_g of the applicable engine on the digital display.

The POWER TURB A position has no function. The POWER TURB B position will display N_f of the applicable engine on the digital display.

2.24.2.2 Engine Trim Checker Operating Procedures.

To turn equipment on:

1. TEMP and RPM switches - OFF.

2. Connect the signal input and power input cables to the SIGNAL INPUT and POWER INPUT receptacles on the ENGINE TRIM CHECKER control panel.

3. Connect the power input cable to the utility receptacle and check that the POWER light on the ENGINE TRIM CHECKER control panel goes on.

4. Remove jumper plug from NO. 1 ENGINE TRIM CHECK receptacle on ENGINE TRIM CHECKER receptacle panel and stow on dummy receptacle.

Note

Until step 5 is completed, the No. 1 engine power turbine inlet temperature indicator on the instrument panel will be disabled.

5. Connect the signal input cable to NO. 1 ENGINE TRIM CHECK receptacle.

6. Turn RPM switch on ENGINE TRIM CHECKER panel to GAS GENERATOR. N_g for No. 1 engine is indicated on % RPM digital display.

7. Turn RPM switch on ENGINE TRIM CHECKER control panel to POWER TURB B. N_f for No. 1 engine is now indicated on % RPM digital display.

8. Turn TEMP switch on ENGINE TRIM CHECKER control panel to COCKPIT. A slight calibration shift will be noted on the instrument panel No. 1 engine T_5 gauge. The T.I.T ^oC digital display is not usable.

9. Turn TEMP switch on ENGINE TRIM CHECKER control panel to. T.I.T ^oC digital display will read No. 1 engine T_5, and instrument panel No. 1 engine T_5 gauge will be disabled.

10. Disconnect signal input cable from NO. 1 ENGINE TRIM CHECK receptacle.

Note

Until step 11 is completed, the No. 1 engine power turbine inlet temperature indicator on the instrument panel will be disabled.

11. Remove jumper plug from dummy receptacle on ENGINE TRIM CHECKER panel and plug into NO. 1 ENGINE TRIM CHECK receptacle.

12. No. 2 engine is checked as No. 1 is with signal input cable connected to NO. 2 ENGINE TRIM CHECK receptacle.

To turn equipment off:

1. Disconnect signal input cable from NO. 2 ENGINE TRIM CHECK receptacle on ENGINE TRIM CHECKER receptacle panel.

Note

Until step 2 is completed, No. 2 engine power turbine inlet temperature indicator on the instrument panel will be disabled.

2. Remove jumper plug from dummy receptacle and plug into NO. 2 ENGINE TRIM CHECK receptacle on ENGINE TRIM CHECKER receptacle panel.

3. Disconnect power input cable from utility receptacle.

4. TEMP and RPM switches - OFF.

5. Disconnect signal input and power input cables from SIGNAL INPUT and POWER INPUT receptacles on ENGINE TRIM CHECKER control panel and stow.

2.24.3 Map Case and Chart Board. A map case (Figure 2-1) is on the side of the controls enclosure at the entrance to the pilot compartment. A chart board can be stowed behind the map case.

2.24.4 Mooring Rings. Nine mooring rings are on the helicopter. Each main landing gear trunnion assembly has a mooring (Figure 2-2) on the inboard and outboard sides. A mooring ring is at the tailwheel housing; four fuselage tiedown rings are below the transmission service platform.

2.24.4.1 (ET) Mooring. Five mooring rings are installed on the helicopter. Each main landing gear trunnion assembly has a mooring ring on the inboard and outboard sides. Another mooring ring is located on the tail wheel housing. There are two fuselage mooring ring fittings installed on the aft cabin, below the transmission service platform. If required, rings may be installed on the aft cabin mooring ring fittings.

2.24.5 Relief Tube. A relief tube (Figure 2-1) is on the side of the controls enclosure at the entrance to the pilot compartment.

2.24.6 Mirrors Rearview. Manually adjustable external rearview mirrors are installed on the pilot and copilot sides of the cockpit canopy. The dual rearview mirrors provide the pilots with a means of viewing the engine and transmission areas during flight or ground operations. The mirrors are mounted so that mirror viewing will require the viewer to lean his head slightly toward the mirror side. This is considered desirable as it prevents mirror reflections from the rotary lights on the helicopter from distracting the pilots while seated in the normal flight position during night operations.

2.24.7 Windshield Wiper System

CAUTION

To prevent scratching windshields, do not operate wipers on dry glass.

The electrically operated system consists of a two-speed motor, two converters, and a rotary control switch. The windshield wipers are on the pilot and copilot windshields. The system is controlled by a rotary-type switch with marked positions PARK-OFF-LOW-HIGH on the overhead switch panel (Figure 2-9) marked WINDSHIELD WIPERS. When the switch is placed to LOW or HIGH, the system is actuated and the desired speed range is selected. When the switch is turned to PARK, the wipers automatically position to the inboard edge of the windshields. The wiper arms have high tension springs installed to increase visibility by reducing wiper blade buffeting and lifting at high speeds. The windshield wiper system receives electrical power from the No. 1 ac primary bus through a circuit breaker marked WSHLD WIPER MOTOR on the copilot circuit breaker panel.

2.24.8 Windshield Washer. The system consists of a reservoir, windshield washer motor/pump, and a control switch. The reservoir behind the pilot seat holds 4.8 quarts. The windshield washer motor pumps the fluid through tubing to the spray bars in the windshield wiper blades. The windshield washer motor is controlled by a switch with marked positions OFF-ON on the overhead switch panel (Figure 2-9). Placing the switch to ON causes the windshield washer motor to pump fluid through the wiper spray bars to the windshield. The windshield washer system is powered from the dc primary bus through a circuit breaker marked WSHLD WASHER on the center circuit breaker panel.

2.25 (NON ET) CARGO SLING

WARNING

Any static electricity that may have been generated by the helicopter should be dissipated prior to attempting a hookup by ground personnel.

A cargo sling with a 6,000-pound capacity (Figure 2-63) is attached below the fuselage at four points. Four cables extend from the fuselage attaching points to the cargo hook. The cargo hook is designed so that external loads may normally be released electrically by depressing buttons on the pilot and copilot cyclic stick grips. Loads can be released manually by the manual release foot pedal, on the pilot right side of the pilot compartment, or automatically when loads less than 100 pounds are sensed at the hook. Direct current from the primary bus supplies operating and control power to the cargo release circuit that is protected by a circuit breaker marked CARGO SLING on the overhead dc circuit breaker panel. Ground personnel may open the hook by actuating the manual release lever on the side of the cargo hook. The load beam of the cargo hook will automatically return to the closed position after the load is released. A light, marked HOOK UNLOCKED, on the CARGO SLING control panel will illuminate anytime the cargo hook is open. On UH-3H helicopters an additional light marked CARGO SLING HOOK UNLOCKED is mounted on the copilot side of the instrument panel. This light will illuminate anytime the cargo hook is open. The lights receive electrical power from the primary bus through a circuit breaker marked PWR under the general heading WARN LTS on the overhead dc circuit breaker panel. For a pickup, the load may be attached to the hook from outside the helicopter while in a hover, or the pilot may attach the load by flying the hook through a ring attached to the load. When the cargo sling is attached, but not in use, it is stowed under the fuselage by means of a nylon stowage line.

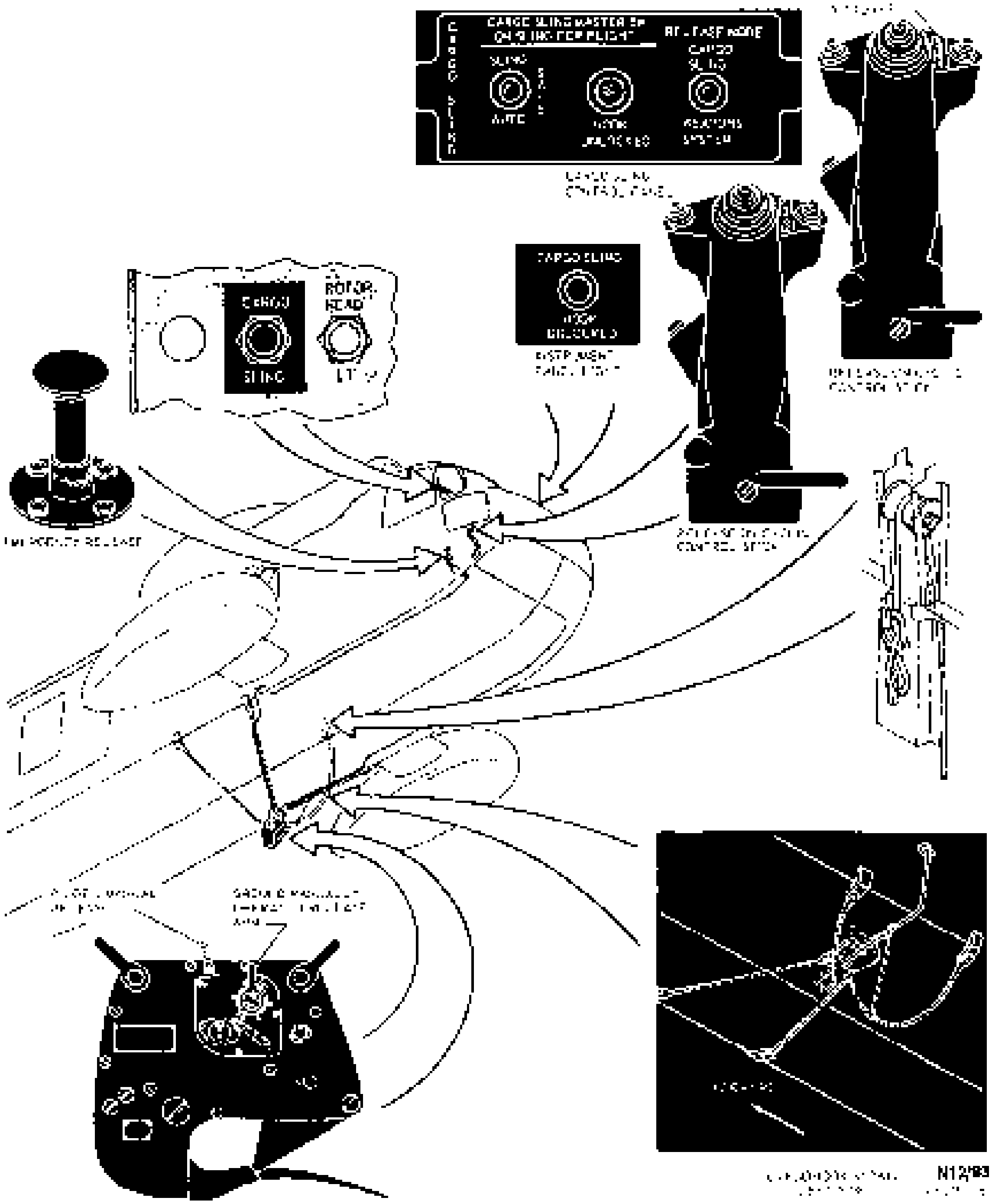


Figure 2-63. (NON-ET) Cargo Sling

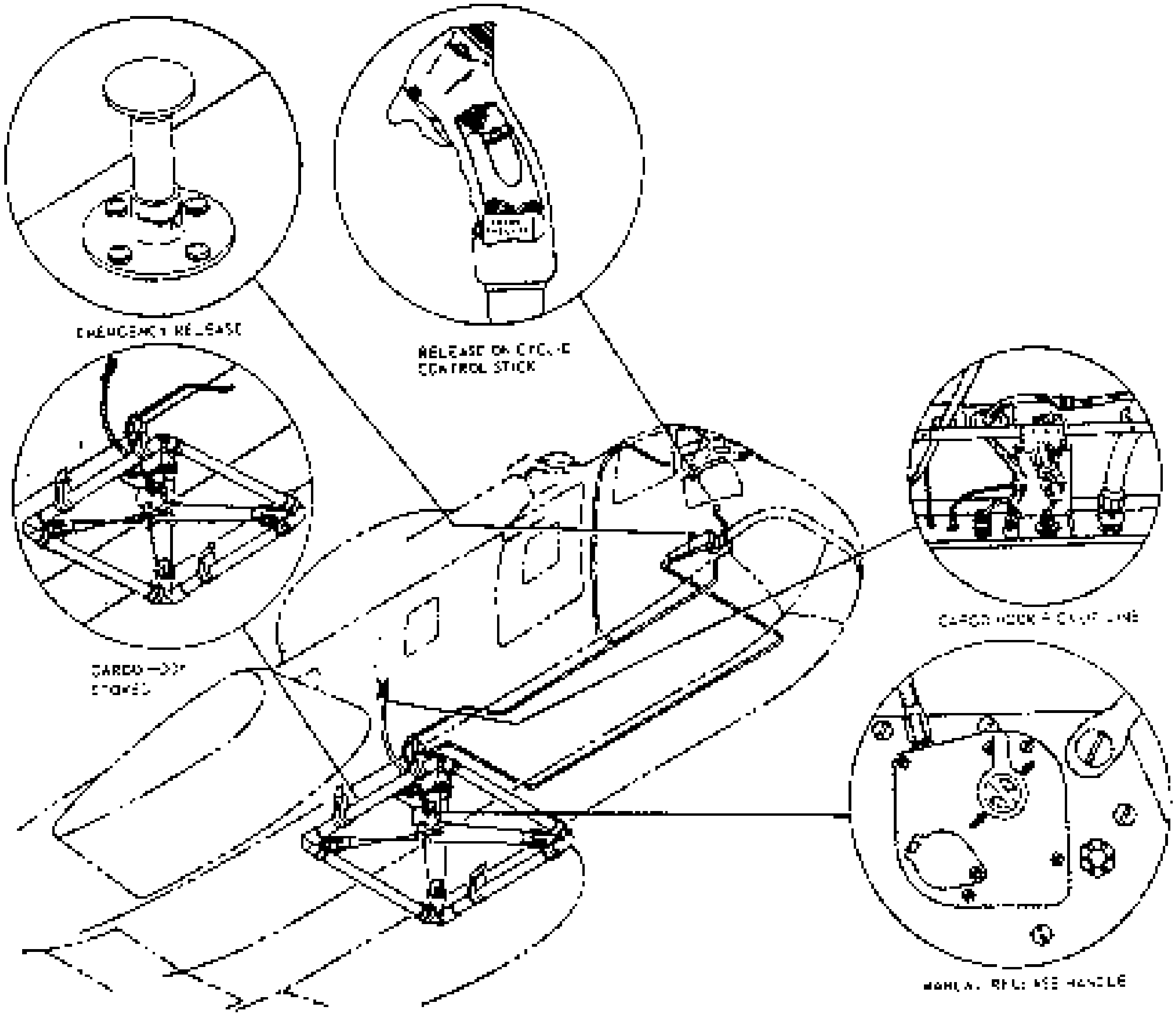


Figure 2-64. Low-Response Cargo Sling System

WARNING

External loads may have aerodynamic characteristics that cause oscillations to the extent that the load may oscillate into the rotor blades and/or fuselage.

CAUTION

The cargo sling should be stowed before landing to prevent the hook from striking the ground. Striking the hook on the ground can cause damage and subsequent failure of the hook.

2.25.1 Cargo Sling Control Panel. The CARGO SLING control panel is located on the pilot's control console. The panel contains a HOOK UNLOCKED advisory light and a three-position CARGO SLING MASTER SWITCH for the following functions:

1. SLING - for normal operation, energizes the CARGO thumb switches on the pilot and copilot cyclic grips that enable the pilot to electrically release the load.

2. SAFE - disables the system and should be used when loading or during flight to prevent inadvertent discharge of the cargo.

3. AUTO - this position energizes the cyclic CARGO switches and the touchdown switch on the cargo hook. In this mode loads will automatically release when a force of 100 pounds or less is sensed.

CAUTION

When carrying loads of less than 200 pounds, the cargo sling master switch should never be in the AUTO position. The cargo sling hook would open immediately if a gust of air momentarily lightens the load.

The switch should always be returned to the SAFE position and the sling stowed after the load has been released.

On UH-3H helicopters the CARGO SLING control contains an additional switch labeled RELEASE MODE. This switch has two marked positions, CARGO SLING and WEAPONS SYSTEM. This switch must be in the CARGO SLING position before the EX STORES buttons on the pilot cyclic grips will open the cargo sling hook when depressed.

2.25.2 Cargo Hook Release Buttons. A cargo hook release button marked EX STORES is on the pilot and copilot cyclic stick grips. Either release button may be depressed to open the cargo sling hook when the CARGO SLING MASTER SWITCH is in either the AUTO or SLING position. The RELEASE MODE switch must be in the CARGO SLING position as well as having the CARGO SLING MASTER SWITCH in either the AUTO or SLING position before EX STORES buttons will open the cargo sling hook when depressed.

2.25.3 Cargo Release Foot Pedal. A cargo release foot pedal on the right side of the pilot compartment is connected mechanically by cable to the manual release lever on the cargo hook. The pedal may be depressed to mechanically open the cargo sling hook when the electrical release circuit is inoperative. The load will be released in the air or on the ground regardless of the position of the cargo sling master switch.

2.25.4 Cargo Hook Stowage Line. The cargo hook stowage line runs from the cargo hook into the fuselage on the left-hand compartment side panel. The cargo hook is stowed by pulling up on the nylon line, from inside the compartment and securing. To release the cargo hook from the stowed position, untie the nylon line and slowly lower the cargo hook. A bungee cord, attached from the cargo hook cables to the fuselage, removes the slack from the cables when the hook is stowed.

2.25.5 Cargo Hook Manual Release Arm. The cargo hook may be manually released by ground personnel by operating the manual release arm on the cargo hook. A force of 15 to 22 pounds is required to move the release arm in any upward direction to release a load beam of 8,000 pounds. With no load, 10 pounds is maximum required to open load beam.

CAUTION

The cargo hook should be stowed before landing to prevent the hook from striking the ground, which can cause damage and subsequent failure of the hook. Landing on water with an unstowed hook can cause damage by denting or puncturing the hull.

2.25.6 Cargo Deck (UH-3H). In this configuration the helicopter is used as a logistical support vehicle for the transportation of personnel and light cargo. For load planning, cargo size and weight limitations, weight and balance factors and formulas, formula for determining center of gravity of a load, shoring requirements, and restraint criteria, and the Cargo Aircraft Loading and Offloading Technical Manual (NAVAIR 01-20HLC-9) shall be used.

The cargo deck (Figure 2-65) is constructed of honeycomb floor panels supported by traverse bulkheads and beams and is divided into eight compartments. The cargo deck strength limits for the various compartments are as follows:

Compartment D 8.	station 160	186,	200 LBS/SQ FT.
Compartment D 9.	station 186	221,	200 LBS/SQ FT.
Compartment D10	station 221	243.5,	120 LBS/SQ FT.
Compartment D11	station 243.5	290,	135 LBS/SQ FT.
Compartment D12	station 290	323,	105 LBS/SQ FT.
Compartment D13	station 323	346.5,	200 LBS/SQ FT.
Compartment D14	station 346.5	391,	145 LBS/SQ FT.
Compartment D15	station 391	425,	200 LBS/SQ FT.

Fifty-eight combination troopseat studs and cargo tiedown fittings are recessed into the floor. Tiedown fittings are rated at 1,500 pounds of pull in any direction.

WARNING

Crewman shall inspect all cargo tiedown fittings for excessive corrosion and proper installation before attaching cargo restraint devices to them. Do not use corroded or improperly installed tiedown fittings.

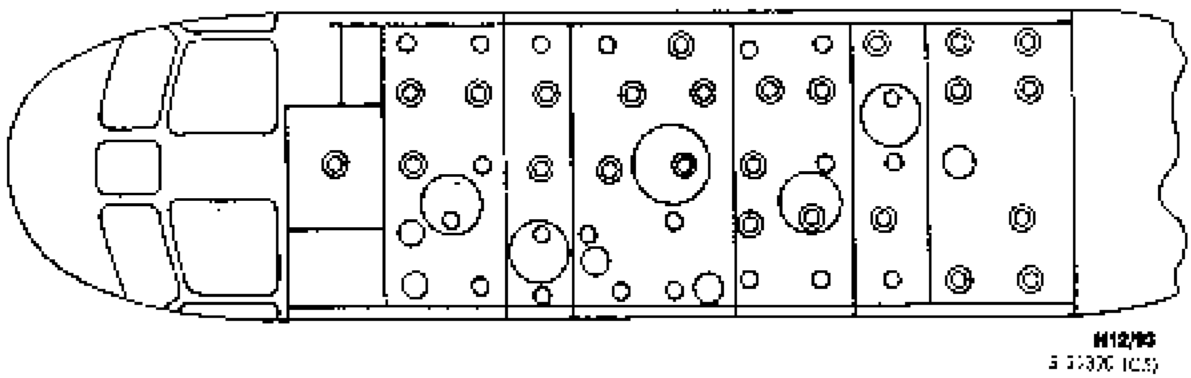


Figure 2-65. Cargo Deck

CHAPTER 3

Servicing

3.1 EXTERNAL POWER REQUIREMENTS

The external power requirements are direct current 28 vdc, 300 amps continuous, and 750 amps intermittent (current limited). The alternating current requirements are 115/200 VAC, and a three-phase rotation 400 Hz, utilizing a standard square six pin lug (wye connection) with a minimum capacity of 20 kVA.

3.1.1 External Electrical Power Connections (See Figure 3-1).

WARNING

To avoid possible injury to personnel, damage to helicopter, excessive hydrogen gas, and damage to battery through overcharging, turn battery switch OFF when using external power.

Note

On the UH-3H Executive Transport helicopters, the BRIGHT/DIM switch on the CABIN LIGHTS panel should remain in the DIM position while operating on external power.

In the H-3, the AC external electrical power receptacle is on the left side of the helicopter in the aft cabin at station 359 (approximate), and the dc external electrical power receptacle is on the right side under the pilot sliding window at station 124 (approximate). When 115-/200-volt, three-phase, 400-cycle, ac power is applied at the EXT POWER 115-VOLTS AC receptacle on Group E helicopters, power is automatically applied to all ac and dc buses. When 115-/200-volt, three-phase, 400-HZ, AC power is applied at the EXT POWER 115 VOLTS AC receptacle on Group F and subsequent helicopters, power is supplied to the EXTERNAL POWER MONITOR PANEL located in the electrical compartment, and to the EXT PWR switch located on the overhead control panel. To apply power to the ac and dc buses, position the EXT PWR switch ON. The #1 GENERATOR and #2 GENERATOR warning lights on the CAUTION PANEL go on, indicating neither generator is in the circuit. When 28-vdc power is applied to the EXT POWER 28 VOLTS DC receptacle, all dc buses, certain necessary ac instruments, and the fire detector system are automatically energized. The #1 RECTIFIER and #2 RECTIFIER warning lights on the CAUTION PANEL remain on.

Note

- If dc starts are expected and maintenance has been done on the fuel system, use AC external power to operate the boost pumps to prime air-locked fuel lines.
- Either AC or DC power may be used for engine starts; however, ac power is better because of its load-carrying capability.

3.1.2 USAF Ground Power Units. When using USAF ground power units, always place the ac control selector switch, if incorporated as in the MD-3 and MD-3A generator sets, to the AIRCRAFT position before engaging the cable plug to Navy aircraft ac external power receptacle. If there is no ac control selector switch, request the operator to observe the warning below and then temporarily modify the cable wiring of the ground power unit as in the procedures below or a connector adapter may be used, if available. The cable adapter, in effect, removes E and F cable wires from the terminal block of the ground power unit and ties them together to complete the control circuit. A Navy cable may be used, if available, negating the need to modify the USAF cable.

To modify the cable wiring proceed as follows:

1 Disconnect the cable terminals E and F from the terminal block of the external power source.

2. Connect cable terminals E and F together and cover the connection with insulation to prevent grounding the circuit.

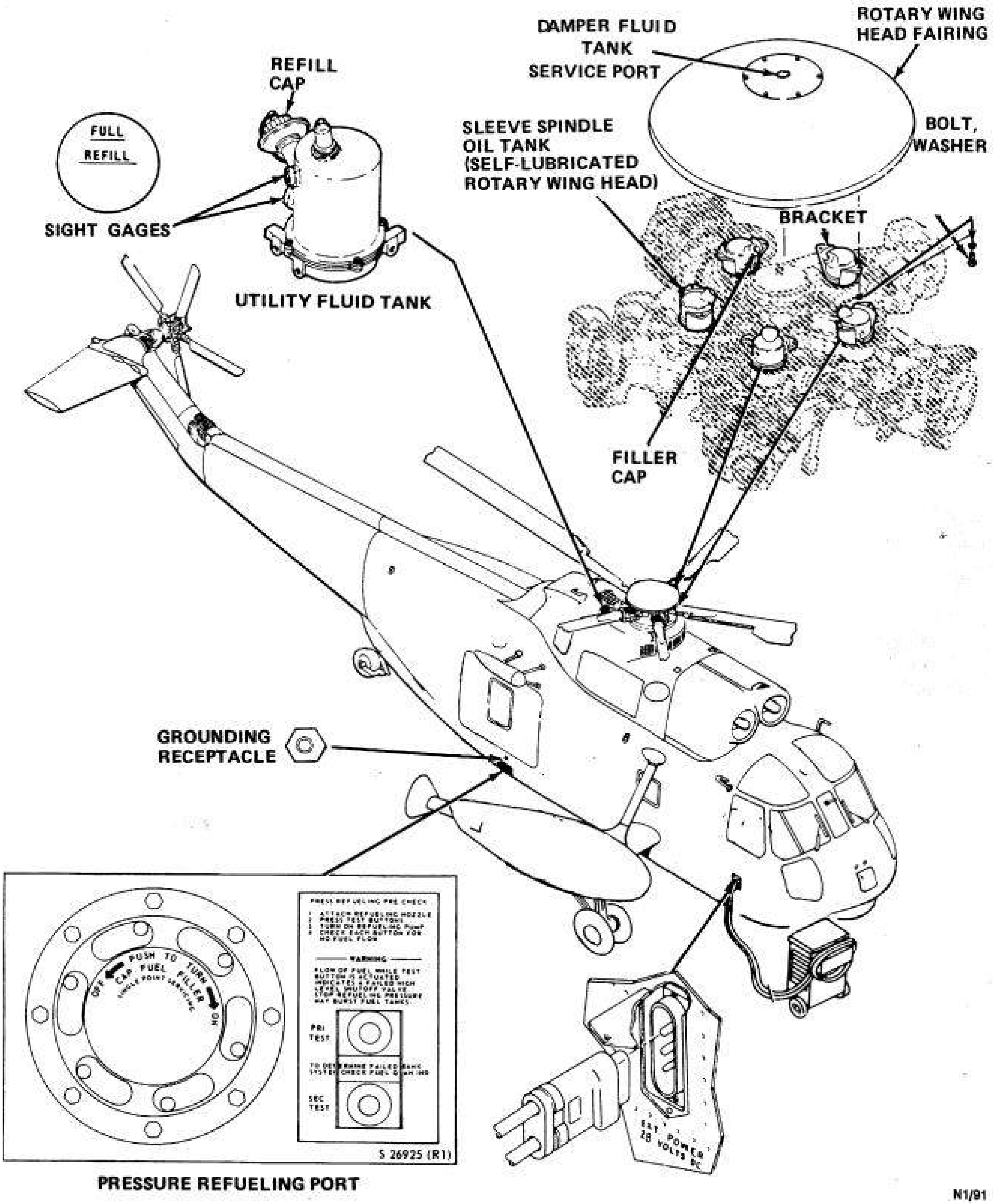


Figure 3-1. Helicopter Servicing Points (Sheet 1 of 2)

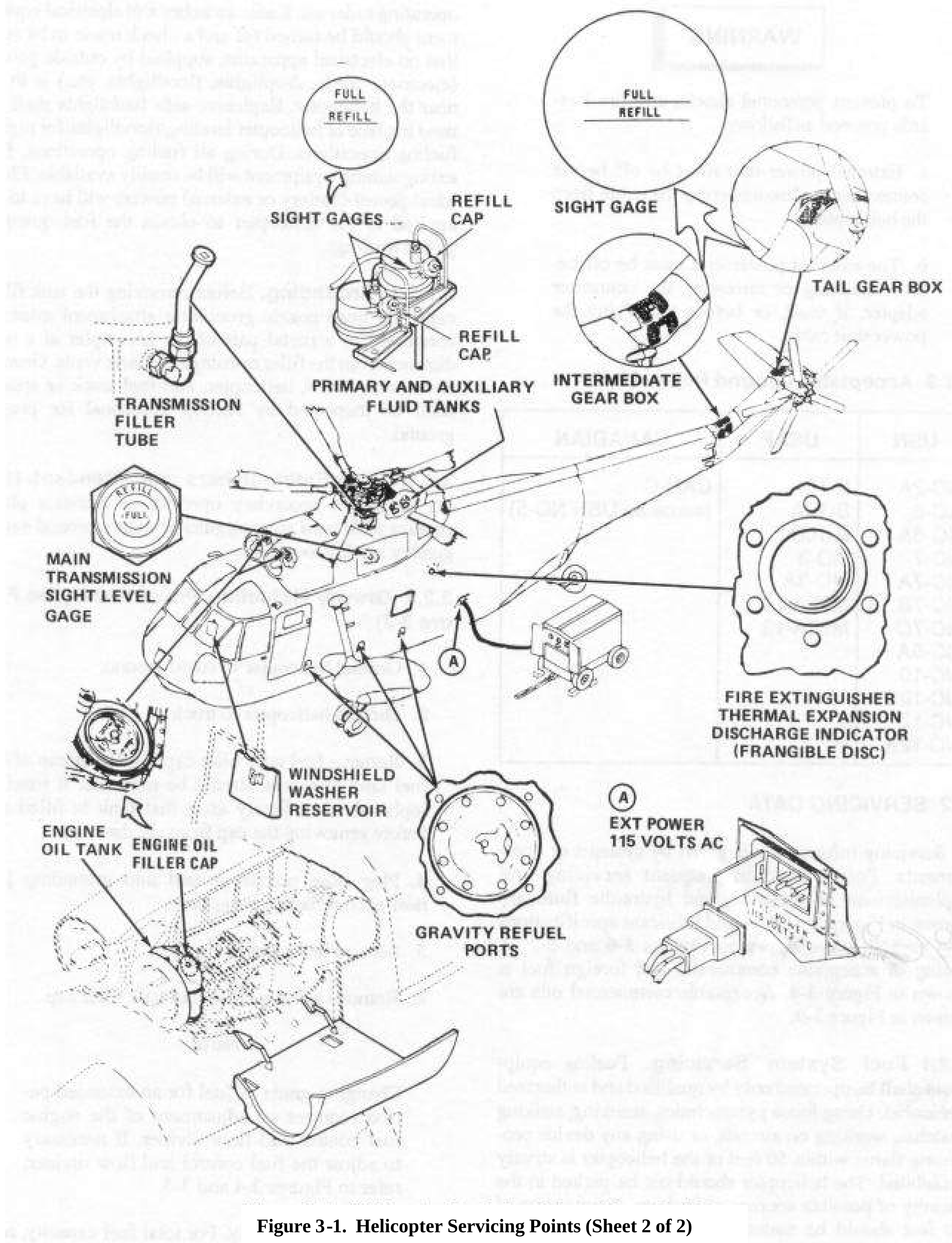


Figure 3-1. Helicopter Servicing Points (Sheet 2 of 2)

3. Service helicopter using normal procedures.

WARNING

To prevent personnel shocks and fire hazards proceed as follows:

a. External power unit must be off before connecting or disconnecting the cable from the helicopter.

b. The external power unit must be off before installing or removing the connector adapter, if used, or before modifying the power unit cable.

3.1.3 Acceptable Ground Power Units.

USN	USAF	CANADIAN
NC-2A	B-10	CAN-C (same as USN NC-5)
NC-5	B-10A	
NC-6A	B-10B	
NC-7	MD-3	
NC-7A	MD-3A	
NC-7B	M32A-10	
NC-7C	M32A-13	
NC-8A		
NC-10		
NC-10B		
NC-12		
NC-12A		

3.2 SERVICING DATA

Servicing information is given by systems or components. Points used in frequent servicing and replenishment of fuel, oil, and hydraulic fluid are shown in Figure 3-1. Fuel and lubricant specifications and capacities are shown in Figures 3-6 and 3-7. A listing of acceptable commercial and foreign fuel is shown in Figure 3-8. Acceptable commercial oils are shown in Figure 3-9.

3.2.1 Fuel System Servicing. Fueling equipment shall be operated only by qualified and authorized personnel. Using loose pyrotechnics, smoking, striking matches, working on aircraft, or using any device producing flame within 50 feet of the helicopter is strictly prohibited. The helicopter should not be parked in the vicinity of possible sources of ignition. A minimum of 50 feet should be maintained from other aircraft or structures, and 75 feet should be maintained from any operating radar set. Radio switches and electrical equipment should be turned off and a check made to be sure that no electrical apparatus, supplied by outside power (electrical cords, droplights, floodlights, etc.) is in or near the helicopter. Explosive-safe flashlights shall be used in place of helicopter landing/floodlights for night-fueling operations. During all fueling operations, fire extinguishing equipment will be readily available. Electrical power (battery or external power) will have to be applied to the helicopter to obtain the fuel quantity gauge readings.

3.2.1.1 Grounding. Before removing the tank filler caps, the hose nozzle grounding attachment must be connected to a metal part of the helicopter at a safe distance from the filter openings and tank vents. Ground devices on hoses, helicopter, and fuel truck or station shall be inspected by fueling personnel for proper ground.

3.2.1.2 Fire Extinguishers and Attendant. During fueling, a secondary operator or assistant plane captain shall man an extinguisher with a second extinguisher readily available.

3.2.2 Gravity Refueling Procedures (See Figure 3-2).

1. Ground helicopter to static ground.

2. Ground truck to static ground.

3. Ground helicopter to truck.

4. Remove fuel tank filler cap. The filler cap of one fuel tank at a time should be removed. It must be replaced immediately after that tank is filled and before removing the cap from another tank.

5. Plug hose nozzle ground into grounding jack near each refueling receptacle.

6. Service helicopter.

7. Remove nozzle; close fuel tank filler cap.

Note

Changing grade of fuel for an extended period requires an adjustment of the engine fuel control and flow divider. If necessary to adjust the fuel control and flow divider, refer to Figures 3-4 and 3-5.

3.2.2.1 Fuel Capacity. For total fuel capacity, refer to Figure 2-22.

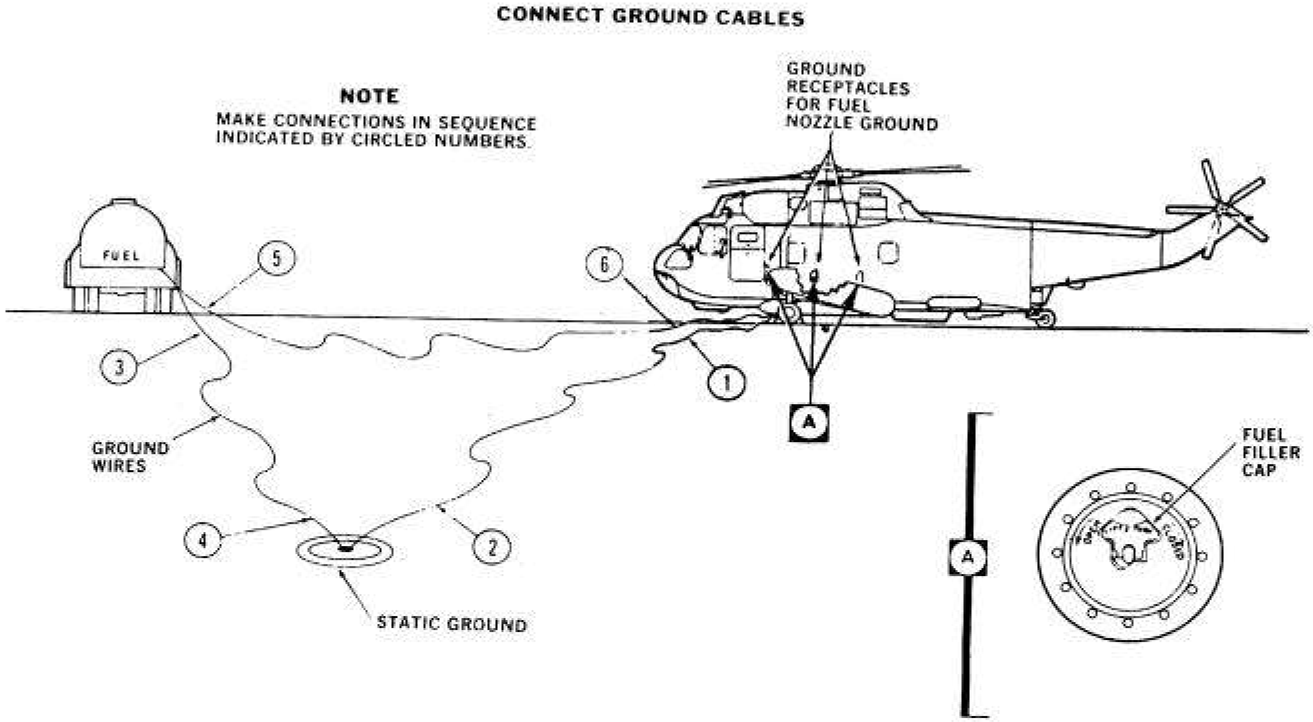


Figure 3-2. Fuel System – Gravity Refueling

3.2.3 Pressure-Refueling Procedures (See Figure 3-3).

Note

During pressure fueling, gravity filler caps may be loosened to prevent damage to tanks in case of failure of the high-level shutoff valves. As fuel flow commences, test the primary and secondary high-level shutoff switches to be sure they will secure the fuel flow within 30 seconds.

1. Ground helicopter to static ground.

2. Ground truck to static ground.

3. Ground helicopter to truck.

4. Turn on battery and note fuel quantity.

5. Loosen gravity-fuel filler caps.

6. Plug hose nozzle ground into grounding jack above receptacle.

7. Remove dust cover from fueling adapter and connect nozzle.

CAUTION

To prevent damage to fuel tanks, cease fueling operations immediately if neither PRI TEST or SEC TEST switch shuts off fuel flow. If only one switch is operative, pressure fueling may continue with caution.

8. Turn on fueling pump. Press and hold PRI TEST switch. Fuel should stop within 30 seconds. Release switch.

9. Press and hold SEC TEST switch. Fuel should stop within 30 seconds. Release switch.

WARNING

Do not let fuel pressure go over 55 psi or flow go over 140 gpm because of fuel cell rupture and possible injury to personnel.

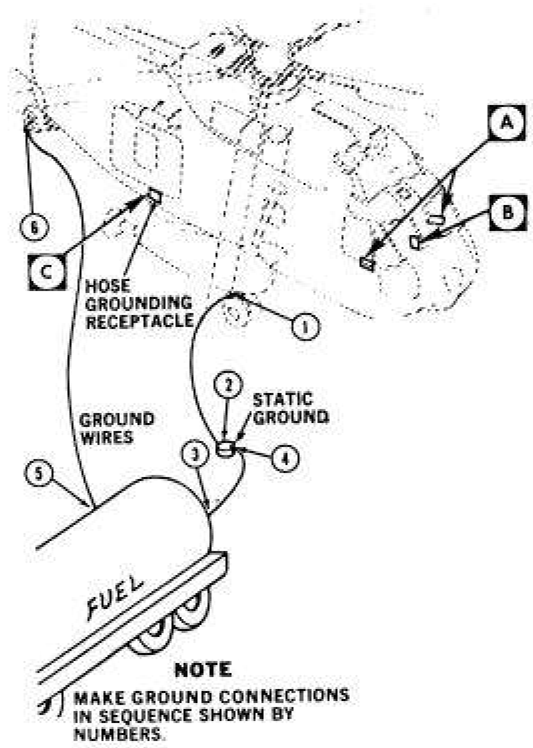


Figure 3-3. Fuel System – Pressure Refueling

10. Service helicopter to desired level or until fuel shuts off automatically.

11. Turn off fuel pump.

12. Remove electrical power from helicopter.

13. Tighten gravity-filler caps.

14. Remove nozzle and replace dust cover.

Note

Changing grade of fuel for an extended period requires an adjustment of the engine fuel control and flow divider. If necessary to adjust the fuel control and flow divider, refer to Figures 3-4 and 3-5.

3.2.3.1 Fuel Capacity. For total fuel capacity, refer to Figure 2-22.

3.2.4 Adjustment of Fuel System for Different Fuels. During off-base helicopter operations, it may be necessary to refuel with different fuel types than were used during the prior flight. Operation with a fuel or a fuel mixture that differs from the fuel type set on the flow divider or fuel control can affect starting and performance characteristics and should be monitored closely for possible overtemperature indications. The auxiliary start fuel shutoff valve can be used to control starting temperature. If prolonged operations are anticipated with fuel other than which is set on the flow divider and fuel control, adjustments should be reset to the type fuel being used as shown in Figures 3-4 and 3-5.

3.2.4.1 Fuel Effect on Engine Start. Fuel in the engine system will not change after refueling with a different density fuel and a normal start can be expected for the first start after refueling unless the engine fuel system has been drained. Subsequent starts may have the following characteristics indicated:

Fuel in Engine System	Flow Divider Setting	Fuel Control Setting	Probable Effect On Start
JP-4	JP-5	JP-4	Hot Start
JP-4	JP-4	JP-5	Cold Hangup
JP-4	JP-5	JP-5	Hot Start
JP-5	JP-5	JP-4	Warm Start
JP-5	JP-4	JP-5	Cold Hangup
JP-5	JP-4	JP-4	Cold Hangup

3.2.4.2 Adjustment of Fuel Flow Divider (See Figure 3-4).

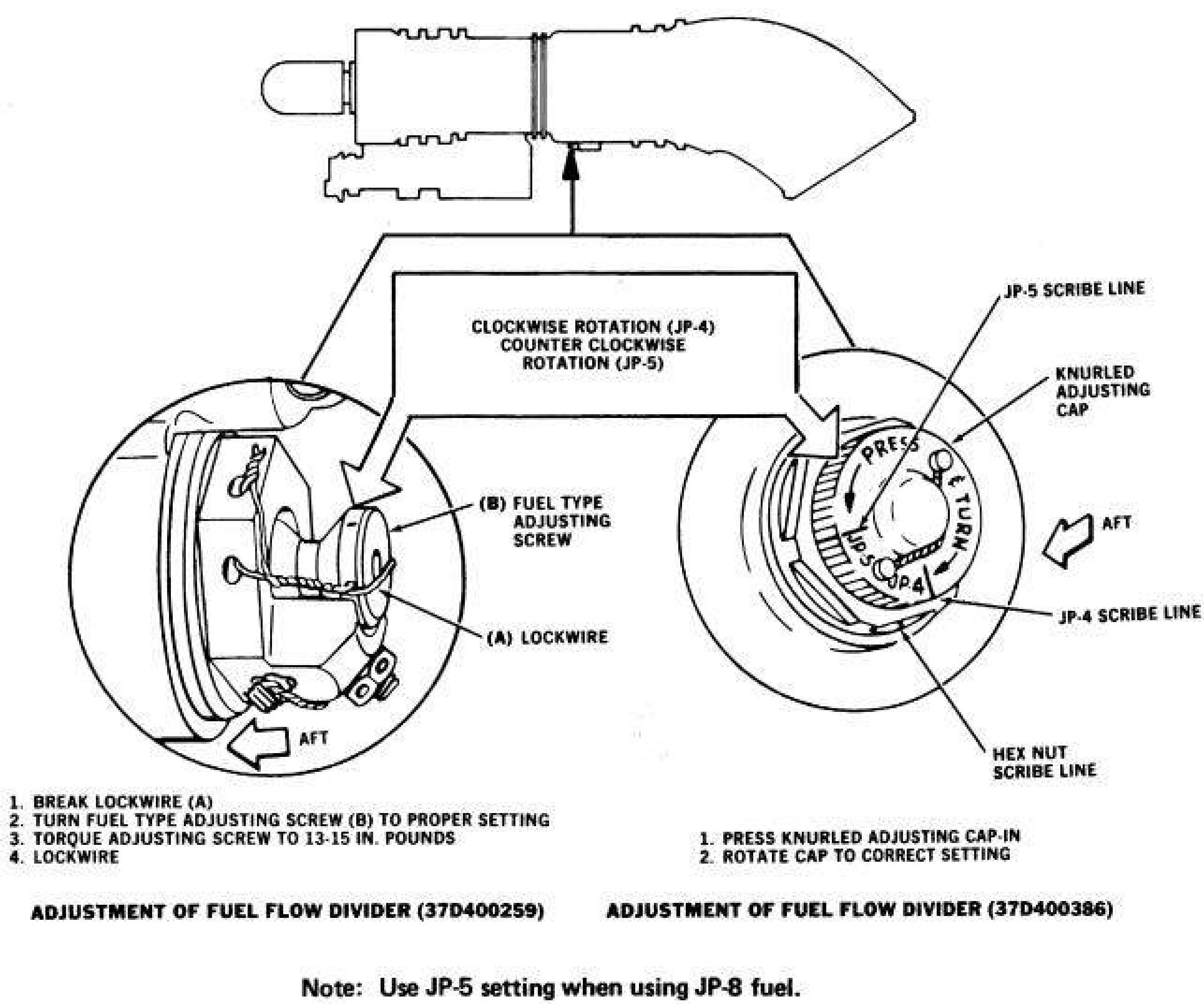
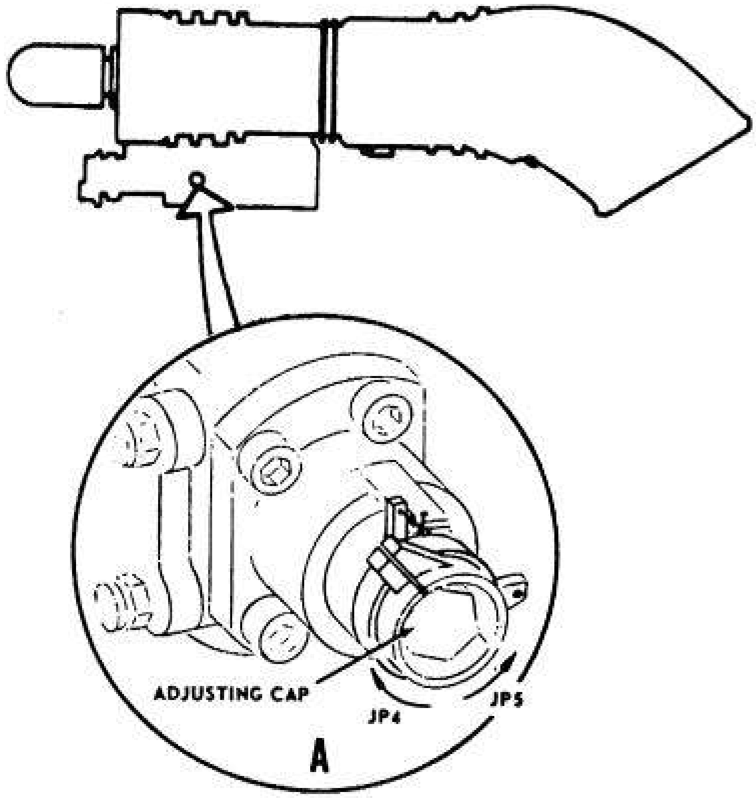


Figure 3-4. Fuel Flow Dividers, 37D400259 and 37D400386

3.2.4.3 Adjustment of Fuel Control (See Figure 3-5).



1. Break lockwire from arm to stop.
2. For JP4, rotate cap clockwise.
   For JP-5 and JP-8, rotate cap counterclockwise.
3. Lockwire arm to stop.

Note

- The fuel control on the T58-GE-402 has only two settings, JP-4 (full clockwise) and JP-5 (full counterclockwise). Use JP-5 fuel control and flow divider settings when using JP-8.
- Changing the setting of the flow divider will have a greater effect on engine start than when changing the setting of the fuel control.

N8/97

Figure 3-5. Fuel Control

3.2.5 Engine Oil Servicing (See Figure 3-1).

1. Open and remove oil filler caps.

2. Oil tank is filled to capacity when oil covering bottom of filler screen is about 5/8-inch diameter (size of dime). Service oil tanks.

3. Install oil filler caps.

CAUTION

To prevent scoring of oil filler cap, causing metal chips to drop into oil tank, manually position hook attaching chain to tab when closing oil filler cap.

3.2.6 Hydraulic System Fluid Servicing (See Figure 3-1).

1. Remove hydraulic tank refill cap.

2. Service primary and auxiliary tanks until FULL on sight gauge. Service utility tank until FULL on upper sight gauge if blades are spread and to FULL on lower sight gauge if blades are folded.

3. Install fluid refill caps.

3.2.7 Main Gearbox Oil Servicing (See Figure 3-1).

1. Lift spring-loaded filler cap and insert filler hose.

2. Main gearbox is full when oil level is anywhere within yellow circle. Refill when oil is at bottom of outer red circle. Service main gearbox to FULL mark on sight gauge on lower left side of gearbox lower housing.

3. Remove filler hose, ensure that spring-loaded filler cap closes.

3.2.8 Damper Fluid Tank Servicing (See Figure 3-1).

1. Lift spring-loaded filler cap and insert filler hose.

2. Damper tank is full when oil level is within the FULL circle. Service damper tank to FULL mark.

3. Remove filler hose and ensure that spring-loaded filler cap closes.

3.2.9 Sleeve-Spindle Oil Tanks, Self-Lubricated Rotary Wing Head Servicing (See Figure 3-1).

1. If servicing unit has a flexible neck, it is not necessary to remove rotary wing head fairing; otherwise, unbolt and remove rotary wing head fairing.

2. Lift spring-loaded filler cap and insert filler hose.

3. Service tanks (5) as necessary to FULL line on tank.

4. Remove filler hose and ensure that spring-loaded filler caps close.

5. Install rotary wing head fairing.

3.2.10 Intermediate Gearbox Servicing (See Figure 3-1).

1. Remove intermediate gearbox oil filler plug.

2. Intermediate gearbox is full when oil level reaches FULL mark on sight gauge on lower left side of gearbox center housing. Service intermediate gearbox to FULL mark.

3. Install intermediate gearbox oil filler plug.

4. Safety wire oil filler plug.

3.2.11 Tail Gearbox Servicing (See Figure 3-1).

1. Remove tail gearbox oil filler plug.

2. Tail gearbox is full when oil level reaches FULL mark on sight gauge on lower left side of gearbox center housing. Service tail gearbox to FULL mark.

3. Install tail gearbox oil filler plug.

4. Safety wire oil filler plug.

3.2.12 Windshield Washer Reservoir Servicing (See Figure 3-1).

1. If OAT is less than 0 ºC (32 ºF), mix 50-percent isopropyl alcohol and 50-percent water. If OAT is above 0 ºC (32 ºF), use unmixed water.

2. Remove filler cap and fill as necessary.

3. Replace filler cap.

3.2.13 Tire Servicing.

1. Remove valve stem cap from tire.

WARNING

- To prevent injury, do not use high-pressure air source or an unregulated air pressure source.
- Never stand beside tire being serviced. Stand forward or aft of tire.

2. Connect source of pressure.

3. Service tires to proper pressure with nitrogen.

Note

- Clean dry compressed air may be substituted if nitrogen is not available, but reservice with nitrogen as soon as practical.
- Pressure ranges are adequate for all helicopter loadings and for all anticipated climatic conditions.

4. Remove source of pressure.

5. Install valve stem cap.

3.2.14 (ET) APU Servicing (See applicable MIMS).

1. Hinge up APU access door.

CAUTION

Do not exceed full line on oil fill cap dipstick. Overfilling will create an overheat condition resulting in damage to the APU.

2. Remove fill-to-spill plug.

3. Remove oil fill cap and dipstick and fill gearbox until oil comes out fill-to-spill plug opening.

4. Check dipstick to ensure normal oil level.

5. Lubricate packing on fill-to-spill plug and install plug in gearbox. Torque plug 80 to 90 inch-pounds. Lockwire plug with lockwire (MS20995NC20).

6. Close APU access door.

3.2.15 Fluid Servicing and Capacities (See figure 3-6).

SYSTEM	TANK CAPACITY (GALLON)	SERVICE LIMIT (GALLON)
ENGINES	2.7	--
MAIN GEARBOX W/ELS	16.6	12.6
INTERMEDIATE GEARBOX	--	0.2
TAIL GEARBOX	--	0.4
PRIMARY HYDRAULIC SYSTEM	--	0.45
AUXILIARY HYDRAULIC SYSTEM	--	0.45
UTILITY HYDRAULIC SYSTEM	--	1.09
DAMPER SYSTEM	38.38 OUNCES	0.14
SLEEVE-SPINDLE WET HEAD	--	8.2 OUNCES
LEFT WHEEL BRAKE SYSTEM	--	5.8 OUNCES
RIGHT WHEEL BRAKE SYSTEM	--	
* WINDSHIELD WASHER		
ELECTRICAL SYSTEM (RESERVIOR)	4.8 QUARTS	4.8 QUARTS
NITROGEN SERVICING		
MAINMOUNT WHEELS		90 TO 95 PSI
TAILWHEEL		70 TO 75 PSI
TAILWHEEL CENTERING CYLINDER		425 ±25 PSI
FLOTATION BAG CYLINDERS		2,650 TO 3,000 PSI
LANDING GEAR EMERGENCY BLOWDOWN BOTTLES		2,500 TO 3,000 PSI
BLADE FOLD ACCUMULATOR		1,500 PSI MINIMUM BLADES SPREAD
(ET) AUXILIARY POWER UNIT	--	.5
*WEATHER WARMER THAN 0 ºC: WATER. WEATHER COLDER THAN 0 ºC. 50-PERCENT ISOPROPYL ALCOHOL/50-PERCENT WATER.		

Figure 3-6. Fluid Capacities

3.3 OILS, GREASES, HYDRAULIC FLUIDS LISTING (See Figure 3-7).

Item	Primary Product		Acceptable Substitute			Emergency Substitute		
	MIL SPEC	NATO	MIL SPEC	NATO	Note	MIL SPEC	NATO	NOTE
Main Gearbox	DOD-L-85734		MILPRF 23699F MIL-L-7808G	0-156 0-148	1,2		0-149	3
Intermediate	DOD-L-85734		MILPRF 23699F MIL-L-7808G	0-156 0-148	1,2		0-149	3
Tail Gearbox	DOD-L-85734		MILPRF 23699F MIL-L-7808G	0-156 0-148			0-149	3
Engines	MILPRF 23699F	0-156	MIL-L-7808G	0-148	2		0-149	5
Self-Lubricating Reservoir	MIL-L-21260 Grade 50	C-642	IL-L-2104 Grade 30		4			7
Hydraulic Fluid System	MILPRF 83282		*MIL-H-5606	H-515	6			
Rotor Head	MIL-G-25537	G-366	MIL-G-81322	G-395				
Rudder Head	MIL-G-25537	G-366						
Damper	MILPRF 83282							
Damper Trunnion AFC 262 INC.	MIL-G-25537	G-366	MIL-G-81322	G-395			G-366	
Sleeve and hinge Mating Lug Surface		0-190	MIL-L-7870A	0-142			0-134	
Sector Gears, Blade Lock and Control Lock pins	MIL-G-81827					MIL-G-21164		8
Bifilar	Lubricated 630AA							
Disconnect Jaws	MIL-G-81827					MIL-G-21164		8
Rescue Hoist	VV-L-800	0-190	MIL-L-7870A	0-142			0-134 0-135	

Notes

1. Primary Product MILPRF 23699F for non 24,000 series MGB.
2. To be used in extreme low temperature (-40^0 C).
3. Up to 50% of 0-149 may be used with 0-148.
4. Does not have corrosive-prevention characteristics of C-642.
5. Any SAE 30 weight non-detergent lubricating oil.
6. Preferred in damp areas or helicopter is idle for long periods.
7. Any fuild of the same viscosity.
8. MIL-G-81827 shall not be mixed. Surfaces to be lubricated must be thoroughly cleaned prior to substitution.

* Degrades the fire resistant properties of MILPRF 83282.

Figure 3-7. Acceptable Fluids

3.4 FUEL CROSS REFERENCE (See Figure 3-8)

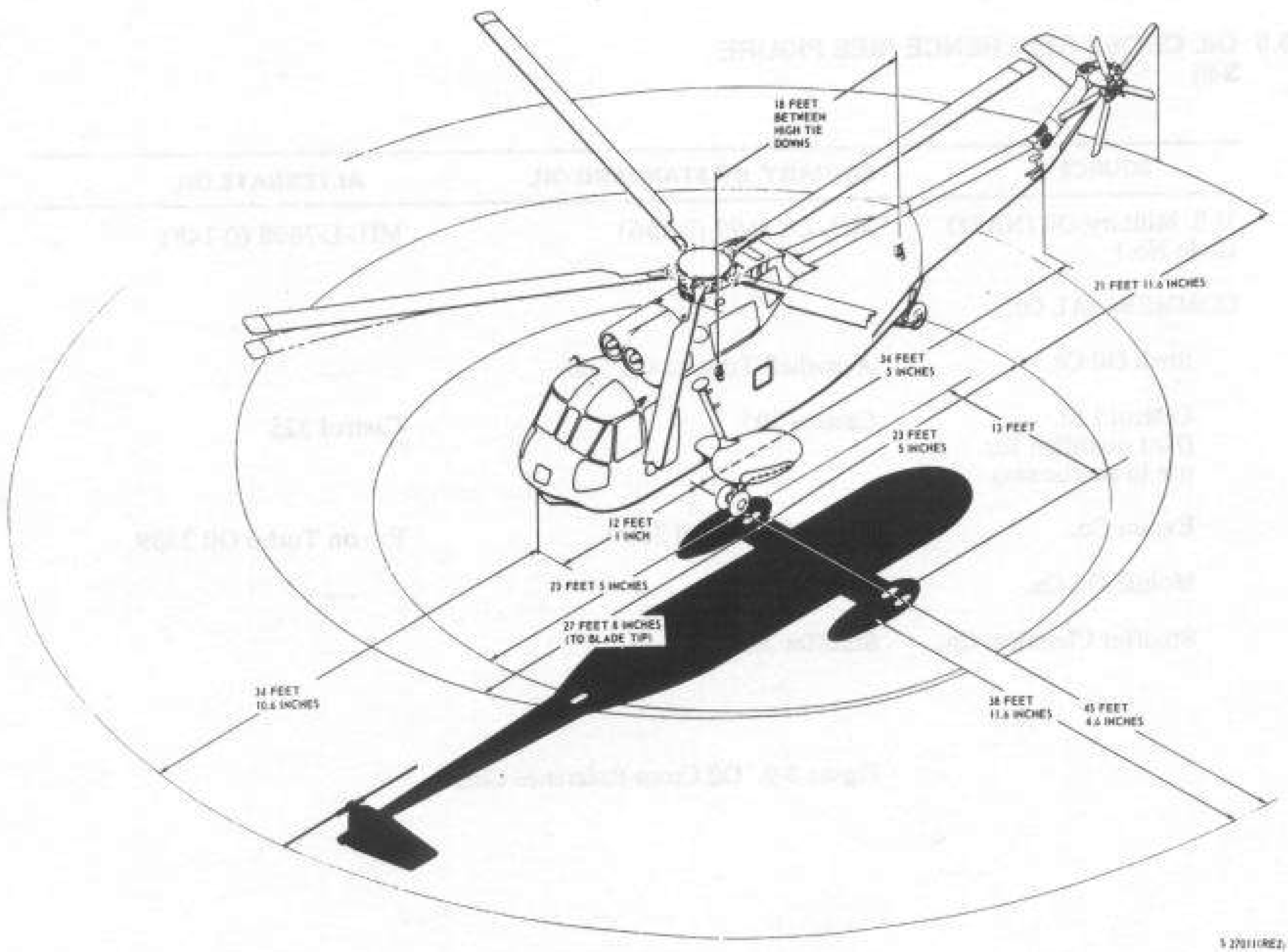
SOURCE	PRIMARY FUEL	ALTERNATE FUEL
U.S. Military Fuel (MIL-SPEC NUMBER) (NATO Code No.)	JP-5 (MIL-T-5624) (F-44)	JP-4 (MIL-T-5624) (F-40, F-4 JP-8 (MIL-T-83133) (F-34)
COMMERCIAL FUEL (ASTM-D-1655)	JET A/JET A-1	JET B
American Oil Co.	American Type A	American JP-4
Atlantic Richfield Richfield Div.	Arcojet A/Richfield A/Arcojet A-1 Richfield A-1	Arcojet B
Continental Oil Co.	Conoco Jet-50 Conoco Jet-60	Conoco JP-4
Exxon Co. U.S.A.	Exxon A Exxon A-1	Exxon Turbo Fuel B
Gulf Oil	Gulf Jet A/Gulf Jet A-1	Gulf Jet B
Mobil Oil	Mobil Jet A/Mobil Jet A-1	Mobile Jet B
Texaco	Avjet A/Avjet A-1	Texaco Avjet B
FOREIGN FUEL:	NATO F-44:	NATO F-40:
Belgium	3-6P-24c	BA-PF-2B
Canada		3GP-22F
Denmark		JP-4 MIL-T-5624
France		AIR 3407A
Germany	UTL-9130-007 UTL-9130-010	VTL-9130-006
Greece		JP-4 MIL-T-5624
Italy	AMC-143	AA-M-C-1421
Netherlands	D. Eng RD 2493	JP-4 MIL-T-5624
Norway		JP-4 MIL-T-5624
Portugal		JP-4 MIL-T-5624
Turkey		JP-4 MIL-T-5624
United Kingdom (Britain)	D. Eng RD 2498	D. Eng RD 2454

Figure 3-8. Fuel Cross-Reference Chart

3.5 OIL CROSS-REFERENCE (See Figure 3-9).

SOURCE	PRIMARY OR STANDARD OIL	ALTERNATE OIL
U.S. Military Oil (NATO Code No.)	MIL-L-23699 (0-156)	MIL-L-7808 (0-148)
COMMERCIAL OIL:		
Shell Oil Co.	Aeroshell Turbine Oil 500	--
Castrol Ltd. (Not qualified for use in gearboxes)	Castrol 205	Castrol 325
Exxon Co.	Exxon Turbo Oil 2380	Exxon Turbo Oil 2389
Mobile Oil Co.	Mobil Jet II	--
Stauffer Chemical Co.	Stauffer Jet II	--

Figure 3-9. Oil Cross-Reference Chart



Note

Minimum Ground Clearances:

Rotary Wing Blades (Stationary):	9 feet	
Rotary Wing Blades (Head Engaged):	11 feet	10 inches
Collective Pitch – Minimum		
Cyclic Pitch – Neutral		
Rotary Rudder Blades (Stationary or Engaged)	6 feet	6 inches
Bottom of Fuselage	1 foot	6 inches
Outside Width at Sponsons	16 feet	4 inches

Figure 3-10. Minimum Turning Radius and Ground Clearance

3.6 HELICOPTER TOWING (SEE FIGURE 3-11)

3.6.1 Safety Precautions

CAUTION

Towing speeds shall not be over 5 mph, and sudden starts and stops shall be avoided.

Because of the top-heavy configuration of the helicopter, precautions must be observed during all helicopter movements to prevent possible damage and dangerous conditions.

Towing equipment (Figure 3-11) shall be operated only by qualified personnel who will be responsible for checking the approved towing coupling before towing. Towing shall not begin until a qualified individual is in the cockpit and ready to operate the brakes. When towing a helicopter, three wing walkers shall be used. A wingwalker shall be stationed on each side of the helicopter, and one will be located near the front of the helicopter to assure adequate clearance. In addition, towing shall be supervised by a director, equipped with a whistle. During night towing operations, wing walkers shall carry a flashlight or a luminous wand and the helicopter position lights shall be turned on. All stop signals shall be given by a whistle or hand signals. Whistle signals should be supplemented by hand signals whenever possible. Wheelbrakes shall be applied as soon as a stop signal is received from the director.

3.6.1.1 Safety Checks Prior to Towing.

1. Check main landing gear lockpins installed.

2. Check operation of brakes. Do not release parking brake or remove chocks until tow bar is installed and attached to tow vehicle.

3. Disconnect grounding wire.

4. Station personnel.

3.6.2 Towing Procedures

1. Install tow bar and tighten chain.

2. Release tailwheel locking handle and move tailwheel back and forth with bar to remove any side load on lockpin and to make sure lockpin is released.

3. Connect tow bar to tow vehicle.

4. Release parking brake by depressing left toe pedal.

5. Pull chocks.

6. Tow helicopter.

7. Lock tailwheel, lock brakes, insert chocks, remove tow bar from helicopter, and install grounding wire.

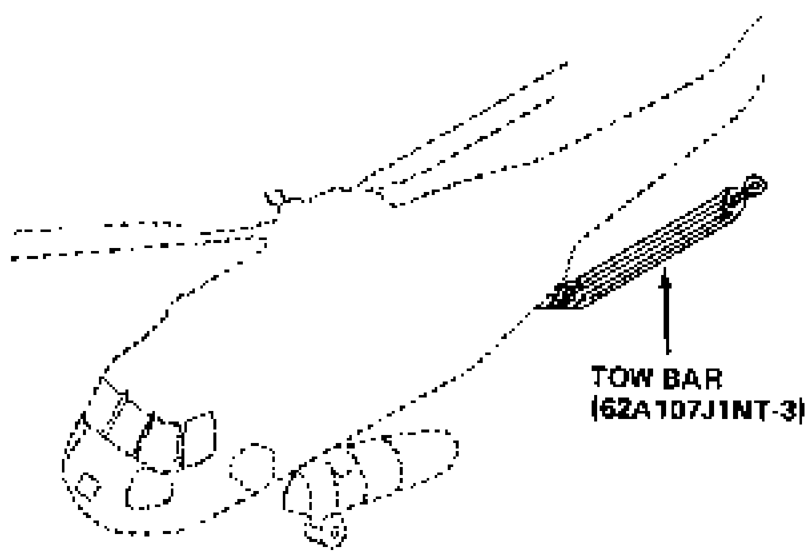


Figure 3-11. Towing Equipment

3.7 PARKING

3.7.1 Short-Term Parking. During short-term parking, helicopter should be attended or monitored at all times.

1. Locate helicopter more than one rotor blade's distance from other helicopters or objects, and face helicopter into the wind if possible.

2. Lock tailwheel, lock brakes, insert chocks, and install grounding wire.

3. Install protective covers. Secure windows and doors.

3.7.2 Long-Term Parking. During long-term parking, helicopter will not be attended or monitored.

1. Park helicopter and secure as in short-term parking.

2. Tie down main rotor blades.

3. If winds of 45 knots are expected, fold and secure main rotor blades. Attach tail rotor gustlock.

4. Moor helicopter (Figures 3-12 and 3-13) as necessary.

3.8 HELICOPTER TIEDOWN AND SECURING

Tiedown fittings are installed at points on the helicopter shown in Figure 3-12 and 3-13. There are four fittings located on the fuselage, two on each main landing gear strut and one on the tailwheel strut. These fittings are used to tie down the helicopter when parked and when wind conditions require it. The lower tiedown fittings located on the landing gear struts are also used for securing the main rotor blades. On the ET the two forward fuselage tiedown fittings/rings, and the two aft tiedown rings have been removed.

3.8.1 Tiedown Procedures (Shore Based)

1. When possible, head helicopter into wind. Fold main rotor blades if wind is expected to reach 45 knots or above.

2. Chock both main landing gear wheels.

3. Fasten chains to tiedown fittings as shown in Figures 3-12 and 3-13 and extend outward to ground mooring points at 45º angles.

4. Install main rotor blade tiedowns and tail rotor gustlock.

3.8.2 Main Rotor Blade Tiedown. Tiedown of the main rotor blades should be done anytime the helicopter will be parked for a period of time or when actual or projected wind conditions warrant.

1. Rotate rotor head to position the forward blades to about a 45° angle to centerline of helicopter and engage rotor brake.

2. Attach blade boots to each blade tip and secure to the closest tiedown fitting (main landing gear or tailwheel strut), but not to the ground mooring point.

3. Place tension in the tiedown lines, but do not pull the blade tips more than 4 feet from original position.

3.8.3 Helicopter Tiedown and Securing Diagram (See Figures 3-12 and 3-13)

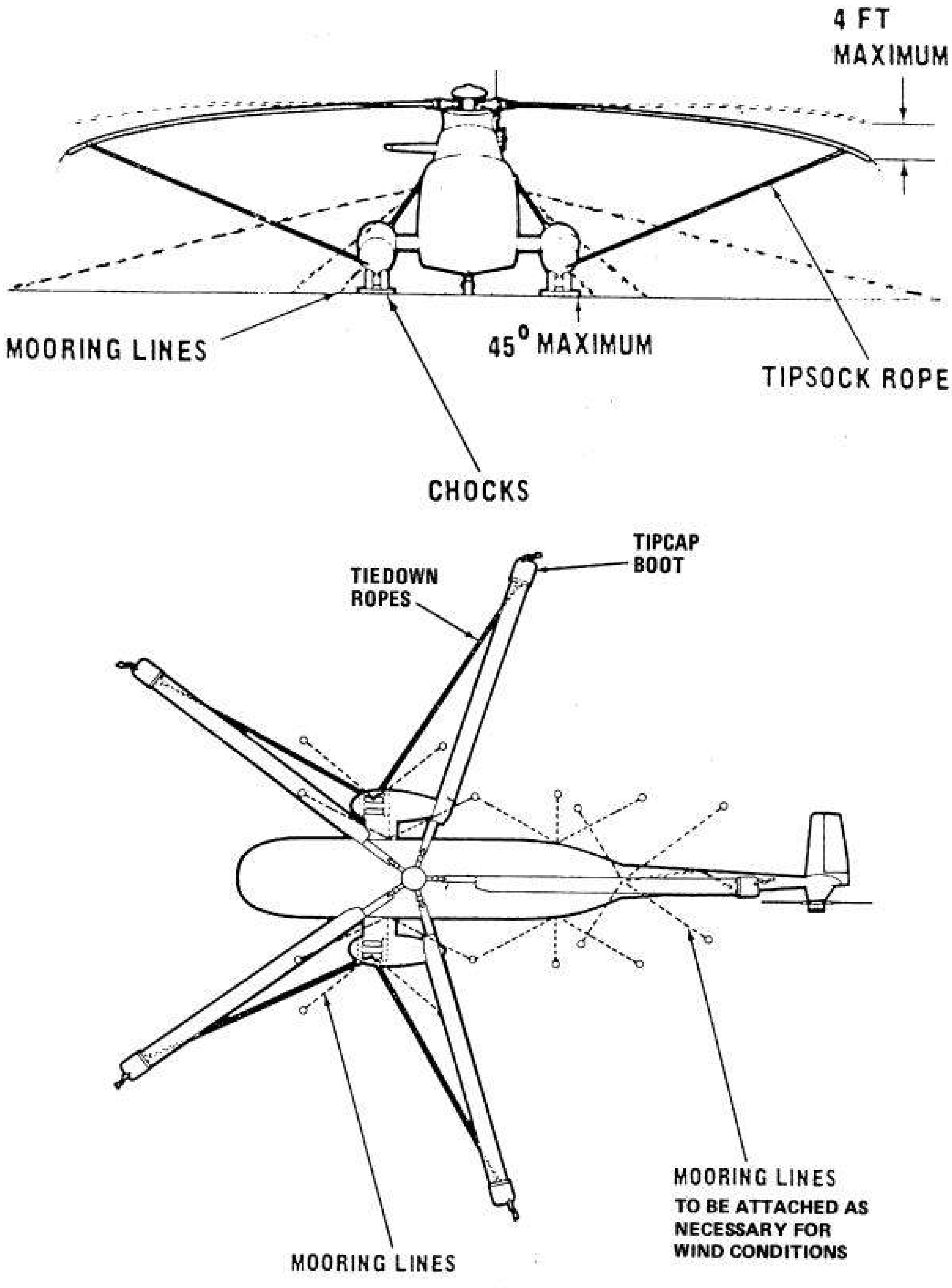


Figure 3-12. Mooring – Blades Spread

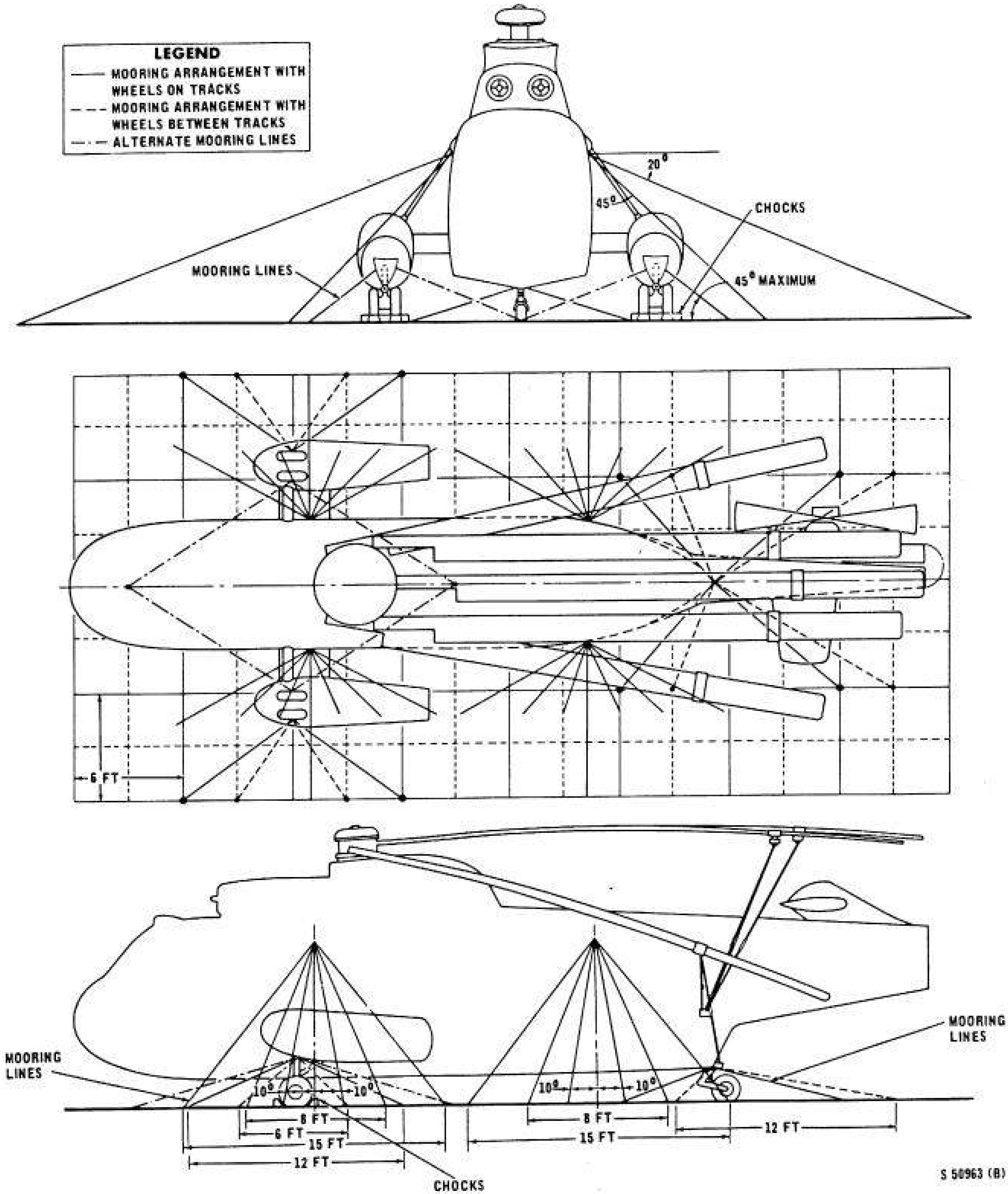


Figure 3-13. Mooring – Blades Folded

3.9 DANGER AREAS (See Figures 3-14 and 3-15)

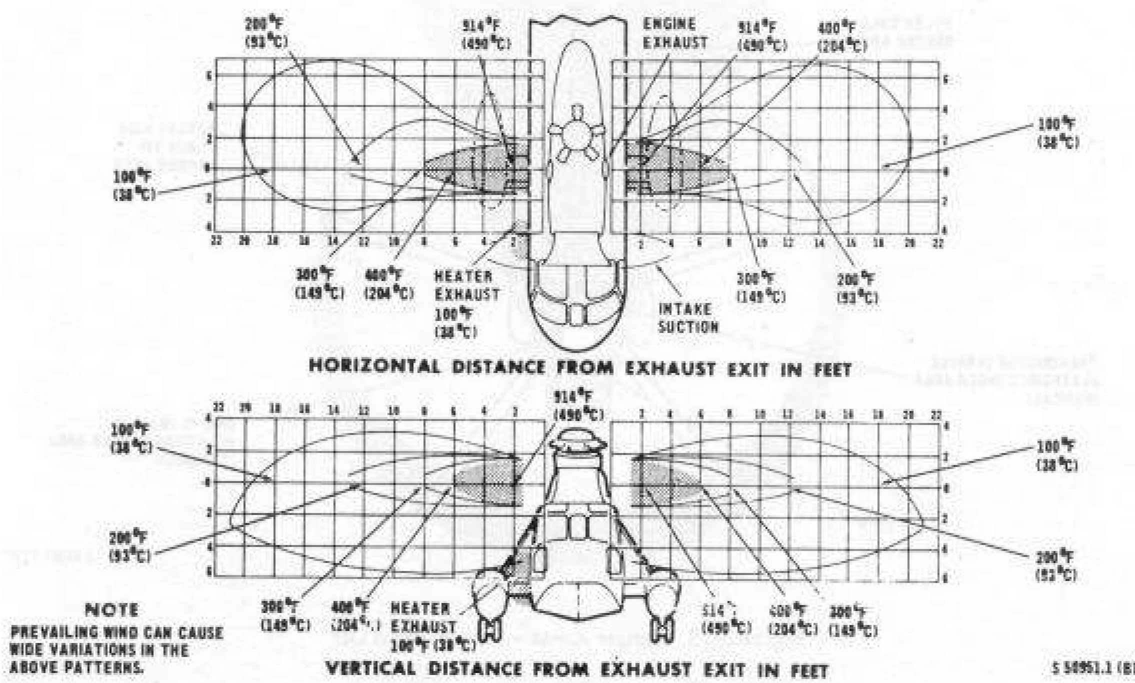


Figure 3-14. Danger Areas – Helicopter Exhaust

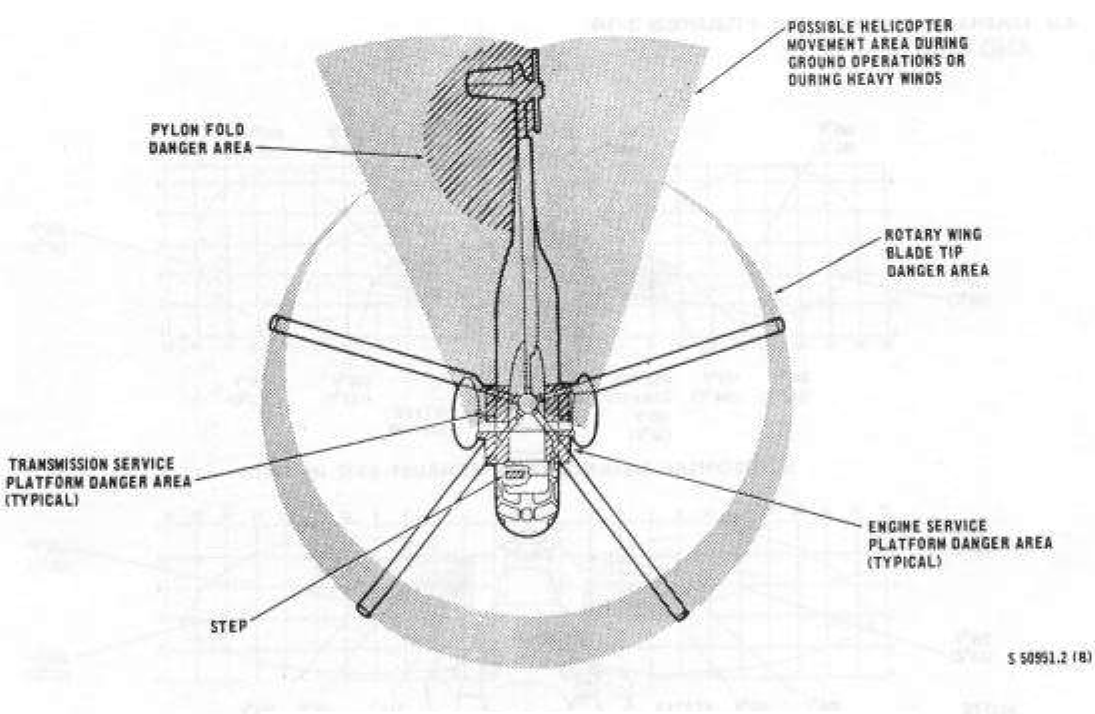


Figure 3-15. Danger Areas – Rotor Stand Off

CHAPTER 4

Operating Limits

4.1 LIMITATIONS

These limitations ensure your safety and help to obtain maximum utilization from the helicopter and its equipment. The instruments are marked as shown in Figure 4-2 to serve as a constant reminder of airspeed and engine limitations; however, additional limitations on operational procedures, maneuvers, and loading are given in the following paragraphs.

4.1.1 Minimum Crew Requirements. The minimum crew required to operate the helicopter under normal nontactical conditions is a pilot, copilot, and a crewman. Additional crewmembers, as required, may be added at the discretion of the commanding officer. For specific crew requirements, refer to Chapter 5.

4.1.2 Engine Limitations (T58-GE-402). All normal engine limitations are shown for T58-GE-402 engines in Figure 4-1. Record all speeds above 106- percent Ng and duration on a VIDS/MAF.

The maximum oil consumption rate during engine operation is 12 ounces per hour.

Engine operation from 691º to 727º is limited to 30 minutes (military power) in duration and 727º to 750º for 10 minutes (topping power) for unscheduled use and maintenance verification of engine performance.

4.1.3 Fuel System Limitations. One boost pump on each tank during all flights. All boost pumps shall be operating:

1. Above 4,000 feet PA.

2. Over 43 ºC OAT.

3. Less than 600 pounds fuel per tank.

With the fuel low level caution lights illuminated, do not exceed 6º noseup attitude.

Minimum planned fuel on final landing shall not be less than 450 pounds total.

Maximum for pressure refueling is 55 psi.

During HIFR operations while using the Wiggins Fitting, a slow pumping rate of less than 100 pounds per minute may indicate a clogged filter in the receiving system. All five filters shall be replaced when this indication occurs.

4.1.4 Starter Limitations

30 seconds operating per start.
3 minutes between starts.
3 starts during any 30-minute period.

4.1.5 Transmission Limitations. Operating limitations of the transmission system are governed by the main gearbox oil pressure and temperature.

4.1.5.1 Temperature

1. Main gearboxes may operate between 135 to 145 ºC for up to 60 minutes.

2. Operation above 145 ºC is an overtemperature.

CAUTION

The transmission oil cooler was designed for maximum cooling efficiency during sea level operations. Higher than normal main gearbox oil temperatures can be anticipated when operating at altitudes above sea level and when combined with high ambient temperatures and high power settings. The reduced pressure/density of air passing through the radiator causes a loss in cooling efficiency of the main gearbox oil cooler.

POWER LIMITATIONS FOR T58-GE-402			
RATING	GAS GEN SPEED — N_g	POWER TURBINE INLET TEMP °C — T_5	TIME LIMIT
MAX TOPPING POWER	<103.7	750°	10 MINUTES
MILITARY POWER	103.7%	727°	30 MINUTES
MAX CONTINUOUS OR NORMAL	101.8%	691°	NONE
OVERSPEED LIMITS	108%	—	NO MORE THAN 15 SECONDS. IF LESS THAN 15 SECONDS, CORRECTIVE ACTION NECESSARY TO BRING RPM WITHIN LIMITS. IF MORE THAN 15 SECONDS, OVERSPEED INSPECTION REQUIRED.
OSCILLATIONS	1%		MAXIMUM ALLOWABLE AT ALL POWER LEVELS (±1%). OSCILLATIONS MAY BE HIGHER IN ACCESS DRIVE MODE. LIMITS DO NOT APPLY DURING AUTOROTATIONS.
STARTING	21% NORMAL 19% MIN FOR NORMAL START 14% FOR BATTERY START	950°	*MOMENTARY
ACCELERATION OR COMPRESSOR STALL	—	950°	*MOMENTARY
STABILIZED OR SLOW TRANSIENT	—	780°	20 SECONDS
GROUND IDLE	56 ±3%	575°	—

*A TRANSIENT HIGH-TEMPERATURE CONDITION IS ONE OF BRIEF DURATION IN WHICH THE TEMPERATURE PEAKS AND FALLS OFF, EITHER AUTOMATICALLY OR THROUGH THE CORRECTIVE ACTION OF THE PILOT.

CAUTION

DEPENDENT UPON FREE AIR TEMPERATURE AND PRESSURE ALTITUDE, THE N_G, T_5, OR Q POWER LIMITS MAY BE REACHED FIRST. FOR VARIATION OF POWER AVAILABLE WITH TEMPERATURE AND ALTITUDE, REFER TO THE PERFORMANCE CHARTS.

Note

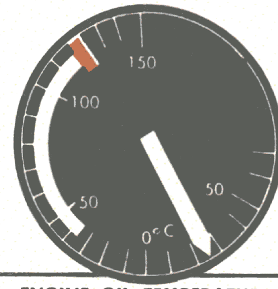
- TORQUE MAY EXCEED 103-PERCENT Q ON ONE ENGINE TO A MAXIMUM OF 123 PERCENT, PROVIDED THAT THE POWER OF THE OTHER IS REDUCED SO THAT TOTAL TORQUE FOR BOTH ENGINES IS NOT OVER 206 PERCENT Q FOR 30 MINUTES OR 172 PERCENT CONTINUOUSLY, AND THAT THE SINGLE-ENGINE NG, T5, AND Q LIMITS ARE NOT EXCEEDED. THAT GOVERNING PARAMETER IS THE LIMIT WHICH OCCURS FIRST.
- THE 86-PERCENT TORQUE LIMIT IS DUE TO THE MAXIMUM CONTINUOUS MAIN GEAR BOX RATING.

M8/97

Figure 4-1. Power Limitations

GAS GENERATOR TACHOMETER
(T58-GE-402)
Ng

- ☐ 70% TO101.8% NORMAL
- ■ <103.7 % MAXIMUM 30 MINUTES

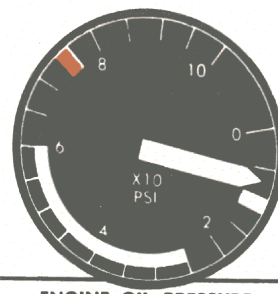


ENGINE OIL TEMPERATURE

- ☐ NORMAL 35° TO 121°C
- ■ MAXIMUM 121°C

POWER TURBINE INLET TEMPERATURE (T58-GE-402)
T5

- ■ 691°C MAXIMUM CONTINUOUS
- ■ 727°C MAXIMUM 30 MINUTES
- ■ 750°C MAXIMUM 10 MINUTES

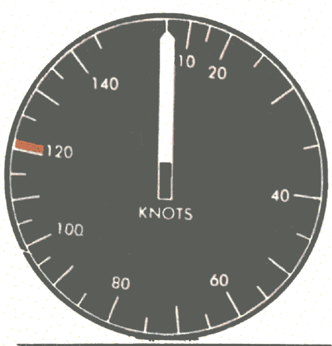


ENGINE OIL PRESSURE

- ☐ NORMAL 25 TO 60 PSI
- ■ MINIMUM 10 PSI AT GROUND IDLE
- ■ MAXIMUM 75 PSI MAXIMUM ENGINE OIL PRESSURE FLUCTUATIONS AT STEADY STATE - ± 3 PSI (6 PSI DIFFERENTIAL)

NOTE

MINIMUM ENGINE OIL PRESSURE FOR NO. 1 ENGINE @ 104% Nf IN ACC DR-19 PSI.



AIRSPEED

- ■ 120 KNOTS IAS - MAXIMUM

Figure 4-2. Instrument Markings (Sheet 1 of 2)

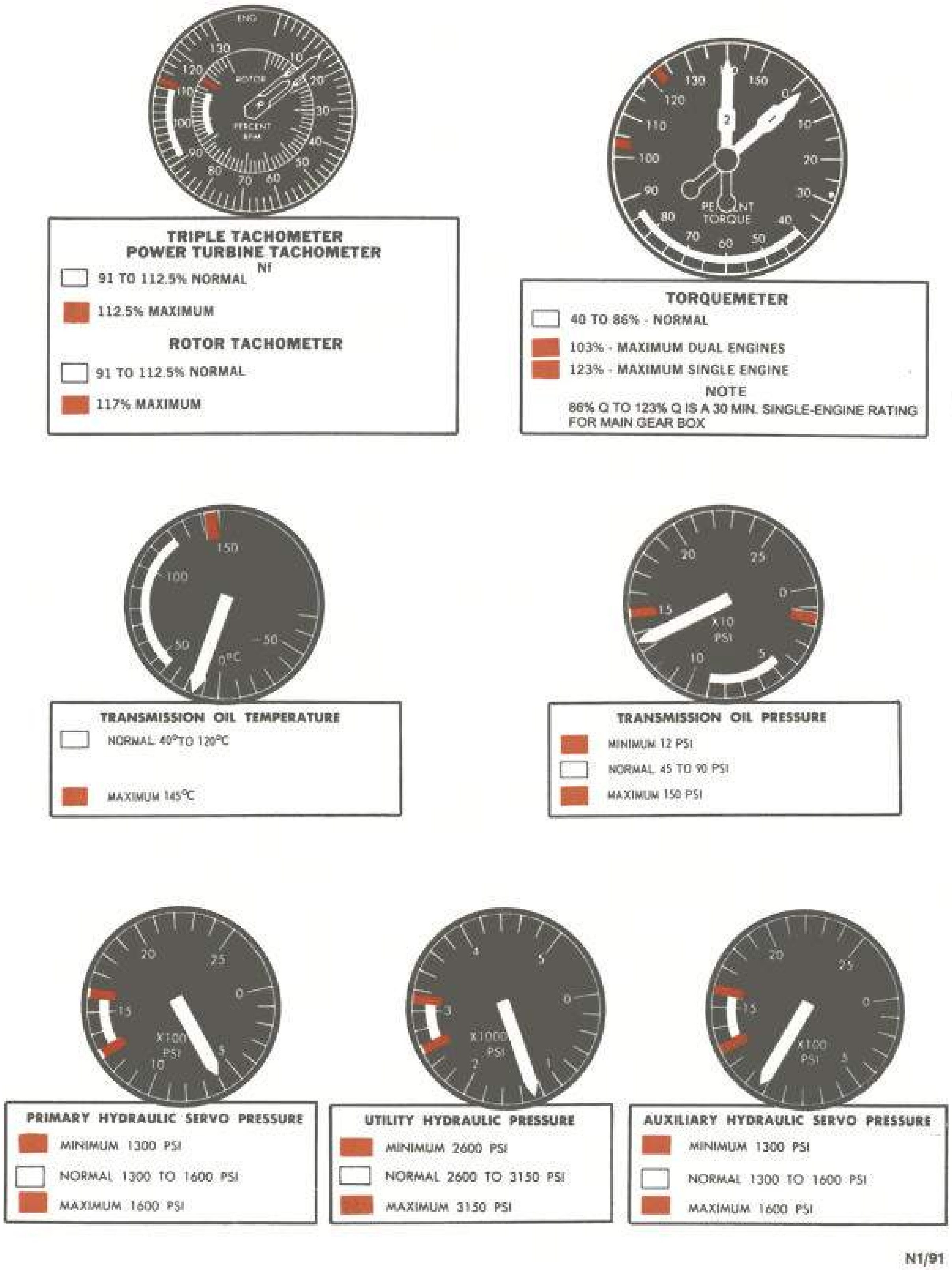


Figure 4-2. Instrument Markings (Sheet 2 of 2)

CAUTION

If emergency rotor engagement is made when the ambient temperature is -29ºC or less, a VIDS/MAF shall be submitted. The gearbox may be damaged from lack of lubrication at these low temperatures.

4.1.6 Gearbox Allowable Oil Leakage. Leakage of main, intermediate, and tail gearboxes may be caused by faulty seals, gaskets, packings, or shims. Total leakage from all sources during a period of 10 flight hours should not be over half the distance from the full to the refill line for each gearbox.

4.1.7 Maximum Continuous Operating Time

4.1.7.1 Servicing. Maximum safe continuous operating time with hot refuelings can vary considerably with individual aircraft, crew fatigue, and specific operations. Medium frequency vibrations can be expected after 8 to 10 hours of continuous operation. Ten hours should be considered as the maximum continuous operating time with hot refueling until the helicopter is shut down and a maintenance daily/turnaround conducted.

4.1.7.2 Rotor System Limitation. Maximum allowable rotor speed is 117-percent N_r.

WARNING

If a blade spar pressure indicator shows black at any time, further flight shall not be attempted until qualified personnel check the integrity of the blade in accordance with applicable maintenance manuals.

(For aircraft without IBIS installed.) For early detection of rotor blade cracks and to preclude crack propagation to hazardous levels, the operation intervals between BIM inspections shall not be over 4.5 hours. If more than 1.0 hour is spent between 20 to 40 KIAS, the operating limit between BIM inspections shall not be over 3.0 hours. If during flight the maximum airspeed is between 101 to 110 KIAS, the operating interval between BIM inspections shall not be over 3.0 hours. If during flight the maximum airspeed is over 110 KIAS, the operating interval between BIM inspections shall not be over 2.0 hours. For these restrictions, operating interval is defined as the elapsed time from lift-off to landing.

Nine hours shall be considered the maximum continuous operating time between rotor system lubrications.

4.1.8 Main Gearbox Torque Limitations. Main gearbox torque limitations for maximum service life under steady-state conditions are indicated by the range markings on the torquemeter. However, transient conditions in excess of the red line may occur during normal operations. Main gearboxes operated in excess of limits must be inspected by an overhaul facility. The following items define allowable operating conditions:

1. During single-engine operation, transient torquemeter readings between 123 and 150 percent are permissible for periods of no more than 5 seconds.

2. During single-engine operation, transient torquemeter readings above 150 percent are not permissible.

3. During single-engine operation, the main gearbox has a 30-minute rating at 1,500 shp (123-percent torque) at 100-percent N_f.

4. During dual-engine operation, transient torquemeter readings between 103 and 120 percent are permissible for periods of no more than 5 seconds.

5. During dual-engine operation, transient torquemeter readings above 120 percent are not permissible.

6. During dual-engine operation, the main gearbox has a 30-minute rating at 2,500 shp (103-percent torque) at 100-percent N_f.

4.1.9 Airspeed Limitations. The combination of airspeed and rotor speed at which blade stall is encountered as shown in the blade stall chart in Part XI should be avoided. The maximum permissible indicated airspeeds are as follows:

Forward flight	120 knots
Sideward flight	30 knots
Rearward flight	20 knots

Note

For altitude operation, decrease maximum permissible airspeed (120 KIAS) by 6 KIAS for each additional 1,000 feet above 4,000-foot MSL.

4.1.10 Additional Speed Limits

Condition	Maximum
Run-on landings	40 knots groundspeed
Flotation bags inflated	60 knots
Rescue hoist below stowed position uncontrolled	60 knots
Maximum water entry/taxi	15 knots groundspeed
Opening cargo doors	90 knots
Shorthauling Personnel	40 knots
External Cargo	
Forward	100 knots
Sideward and Rearward	20 knots

4.1.11 Maneuvers. The following maneuvers are permitted:

1. Angles of bank up to but not exceeding 45º.

2. Hovering turns not beyond a rate of 360º in 15 seconds.

4.1.12 Hovering Limitations. Refer to the hover charts in Part XI. The helicopter shall not be hovered crosswind when wind velocity is over 30 knots nor downwind when wind velocity is over 20 knots.

4.1.13 Altitude Limitations

Practice live hoisting over hard surface unless using safety belay line procedures listed in NWP 3-50. 1.	10 feet max. AGL
Normal hover altitude	15 feet AGL
Flotation bags inflated	3,000 feet PA

4.1.14 Acceleration Limitations. The maximum permissible acceleration shall not be over 1.5g's positive and 0.5g negative.

4.1.15 Center of Gravity Limitations

Fuselage station 258.0	Most forward cg
Fuselage station 276.0	Most aft cg

Note

With ASE off and with cg aft of station 272, reduce the airspeed limits as determined from the blade stall chart in Part XI by 25 knots.

The center of gravity moves aft about one-half inch when landing gear is raised. Proper loading shall be determined by use of the Handbook of Weight and Balance, NAVAIR 01-1B-40.

4.1.16 Weight Limitations. The maximum operating gross weight is 21,000 pounds.

4.1.17 (NON-ET) Rescue Hoist Limitations. The hoist has a lifting capacity of 600 pounds and a lowering capacity of 300 pounds.

Note

Refer to rescue hoist duty cycles without exceeding utility hydraulic system thermal limits of 121.1 ºC (Figure 2-57).

4.1.18 Flotation Bag Limitations

Air bottle serviced 2,650 to 3,000 psi.
Airspeed (deployed) 60 knots.
Altitude (deployed) 3,000 feet PA.

4.1.19 Flood/Hover Lights. Maximum time for flood/hover lights is 15 minutes. Allow 10 minutes cooling cycle after 15 minutes of use.

4.1.20 (NON-ET) Cargo Door. Opening the cargo door at speeds in excess of 90 knots may result in inadvertent loss of escape window.

4.1.21 Stores. Unless authorized by the Naval Air Systems Command (NAVAIR), only the stores shown in Figure 4-3 may be carried and released singly or in combination. Basic helicopter operating limitations without such stores apply unless otherwise noted. Authorized variations in stores loading shall not exceed established launching rack capabilities.

4.1.22 Shipboard Wind Limits. See Chapter 8 for shipboard wind limits.

4.1.23 Taxi Limitations. Aircraft shall not be taxied within 25 feet of an obstruction unless taxi lines/spots or other clearance guides are available for adequate separation.

4.1.24 Cargo Sling Limitations. Maximum allowable external load is 6,000 pounds. Maximum gross weight is not to be exceeded (see weight limitations above). Maximum angle of bank is 30º.

CAUTION

Flight above 60 knots with the cargo hook lowered without an external load may result in damage to the underside of the fuselage

4.1.25 Tipover Limitations

Dynamic tipover angle is 15º.
Static tipover angle is 37º.

WARNING

If lateral cyclic control becomes sluggish or ineffectual or contacts the lateral stop, or if bank angle becomes excessive (8º to 10º) with one wheel on the ground and thrust about equal to the weight, the helicopter will roll over on its side. Use full cyclic control and reduce collective to stop the roll and then correct the bank angle to wings level.

4.1.26 Marine Markers Deployment Limitations

WARNING

Mk 25 marine markers should not be launched in a hover because of the possibility of upward ejection of initial plug.

4.1.27 WEAPON RECOVERY LIMITATIONS

4.1.27.1 MK 146 MOD 0 TARGET LAUNCH SYSTEM

NAVAIR flight clearance limitations for the target launcher are as follows:

1. Maximum airspeed loaded - 90 KIAS.
   Maximum airspeed empty -80 KIAS.

2. Maximum angle of bank - 30°.

3. Maximum acceleration – LBA.

CAUTION

At high airspeed with the empty launcher, full collective lowering rates of 3 seconds or less will cause the launcher to approach and possibly contact the aircraft near the tailwheel.

4. ASE - ON.

4.1.27.2 MK 4 MOD 0 HELICOPTER DEPLOYED LIGHTWEIGHT TORPEDO RECOVERY SYSTEM

1. Carriage

   a. Airspeed -100 KIAS maximum with Mk 46/50
   - 90 KIAS maximum empty.

   b. Angle of bank - 30°.

   c. ASE – ON.

   d. VMC-ONLY.

   e. Climb/descent rate - LBA.

   f. To ensure adequate tail rotor to cage clearance, avoid full collective reduction in less than 2 seconds. A modified flare technique should be used to decelerate by simultaneously reducing collective and bringing cyclic aft.

2. Jettison

   a. Emergency only - level flight if time/emergency permits.

4.1.27.3 MK 2 MOD 0/1 HELICOPTER WEAPON RECOVERY SYSTEM

1. Bank angle-30^0 maximum.

2. Acceleration - LBA (without stores).

3. Climb/descent-LBA.

4. ASE-ON.

5. Maximum airspeed - see Figure 4-3.

4.1.27.3.1 Weight and Balance Information. See Figure 4-4.

4.1.27.4 MQM-74C/BQM-74C/E/E(ERT)/BQM-34 RECOVERY AND FLIGHT LIMITATIONS

4.1.27.4.1 Maximum Sea States Authorized for Recovery by Pole Devices

LENGTH (Feet)	SEA STATE (Beaufort Scale)
15	3 (3-5 foot waves)
20	4 (6 foot waves)

4.1.27.4.2 Drone Retrieval Not Authorized Under Following Conditions

1. Sea states greater than 4 (waves greater than 6 feet).
2. Air temperature less than 4 C.
3. Weather minimum less than 500 foot ceiling and 1 mile visibility.
4. IMC at recovery altitude.
5. Wind gusts greater than 25 knots.

4.1.27.4.3 Airspeed Limitations with Drones

DRONE	AIRSPEED (KIAS)	BANK ANGLE (degrees)
MQM-74/	90 knots	15
BQM-74C/E	90 knots	15
BQM-34	80 knots	15
BQM74E(ERT)	80 knots	15

Note

- Rate of climb is restricted to 500fpm.
- When carrying a BQM-74E(ERT) at altitudes above 1000ft AGL, an unreliable Rad Alt indication will be present with a constant RAWS tone.

4.1.27.4.4 Drone Weights

TYPE	WEIGHT LAUNCH / RECOVERY
BQM-34	2,300 POUNDS / 1,600 POUNDS
BQM-74C/E/E(ERT)	650 POUNDS / 250 POUNDS
MQM-74	450 POUNDS / 286 POUNDS

4.1.27.4.5 Mk 30 Snare/ Pole Recovery and Flight

Sea State:	4 (8 foot seas maximum)
Airspeed:	90 knots maximum
Angle of Bank:	30 maximum
Autorotation entry:	2 seconds minimum collective lowering

Vehicle	Empty Cage/MCRR*	Loaded Cage/MCRR	Cage Configuration
	Forward Lifting Point		
Mk 48/Mk 48 ADCAP/ Mk 30	80 KIAS/2 seconds	100 KIAS	Mod 0, standard
	70 KIAS/2 seconds	90 KIAS/3 seconds	Mod 0, Web barrier
Mk 46 TOTEM	80 KIAS/3 seconds	80 KIAS	Mod 1, long barrel
	AFT Lifting Point		
Mk 48/Mk 48 ADCAP/ Mk 30/EHCTV	70 KIAS/3 seconds	80 KIAS	Mod 0, standard
Mk 46	70 KIAS/3 seconds	80 KIAS	Mod 0, Web barrier

*Minimum collective reduction rate during autorotation entry. Full collective reduction in less than MCRR should be avoided because of minimum cage-to-tail clearance with rapid closure rate.

Figure 4-3. Mk 2 Mod 0/1 HWRS Airspeed Limitations

	NONRUNNER		
	WEIGHT (LB)	C.G. (IN)	BUOYANCY (LB)
Torpedo Mk 48	2,382	114.0	173
Mk 48 Extended Range	2,462	115.0	95
Mk 48 ADCAP	2,458	118.7	97
	FULL RUNNER		
	WEIGHT (LB)	C.G. (IN)	BUOYANCY (LB)
Torpedo Mk 48	2,346	115	209
Mk 48 Extended Range	2,409	116	155
Mk 48 ADCAP	2,415	116.9	140
ASW Target Mk 30	2,685	113	30 to 45
TOMAHAWK Test Missile	2,600	134.5	70

Encapsulated HARPOON CATV:

FLOODED WEIGHT: 2,585, BUOYANCY: 266, CG: 131.4, FLOAT ATTITUDE: VERTICAL
DRAINED WEIGHT: 2,319 Pounds, CG: 123 Inches, FLOAT ATTITUDE: HORIZONTAL
LANYARD LENGTH: 40 Feet

Figure 4-4. Weight and Balance

This Page Left Blank Intentionally

PART II

Indoctrination

This Page Left Blank Intentionally

CHAPTER 5

Indoctrination

5.1 GROUND TRAINING REQUIREMENTS

The following minimum requirements are established for qualification in a nontactical category.

5.1.1 Pilot Ground Training

1. Complete initial or refresher aircrew coordination training in accordance with OPNAVINST 3710.7 and 1542.7.

2. FT/WST (if available) - 6 hours.

3. H-3 flight operation lectures - 6 hours.

4. Helicopter safety and survival equipment – 2 hours.

5.1.2 Crewman Minimum Ground Training Before Flight

1. H-3 familiarization lectures - 2 hours.

2. Complete initial or refresher aircrew coordination training in accordance with OPNAVINST 3710.7 and 1542.7.

3. Helicopter safety and survival equipment - 2 hours.

5.2 FLIGHTCREW QUALIFICATIONS

5.2.1 Pilot Qualifications. The HAC, H2P, PQM, and pilot in command shall be designated in accordance with OPNAVINST 3710.7, type commander instructions, and pertinent sections of this manual.

1. Shipboard qualification and proficiency requirements.

a. Definitions.

(1) Single Spot (SS)

(2) Multi-spot (MS)

b. Qualification in SS does confer qualification in MS. Initial qualification in one category does not confer qualification in the other category.

c. A requalification shall be required when currency has elapsed.

d. Commanding officers may waive qualification requirements in the case of experienced pilots where continuing operation is not planned.

e. Qualifications - SS require at least a PQM qualification.

(1) Initial Qualification.

(a) Day - Six landings.

(b) Night.

1) Day qualified within 10 days.

2) Six night landings.

(2) Currency.

(a) Day- Two day landings within:

MS	SS
6 months	6 months

(b) Night.

1) Day Current.

2) Three night landings within:

MS	SS
4 months	2 months

(3) Requalifications.

(a) Day - Two day landings.

(b) Night.

1) Day qualified and 1 day landing within 10 days.

2) Four night landings.

2. Instrument qualification.

a. In accordance with current OPNAVINST 3710.7.

3. Waivers - In accordance with OPNAVINST 3710.7, unit commanders are authorized to waive in writing minimum flight hours or training requirements.

5.2.2 Crewman Qualification. Helicopter aircrewman shall be designated in accordance with OPNAVINST 3710.7, NAVMILPERS instructions, type/wing commander instructions, and pertinent sections of this manual. The qualifications utility aircrewman and crew chief, as appropriate, will be assigned by squadron commanding officers. These designations are a one-time occurrence (per command tour) and remain in effect until removed for cause. Annual NATOPS evaluations should not be confused with or combined with these designations. NATOPS evaluation flights and crew designation flights should be conducted on separate flights. Crew designation flights evaluate material that is beyond the scope of NATOPS (i.e., information from NWP 3-50.1, survival and first-aid techniques, unit mission and tactics, applicable FXPs/ATPs, PQS, and various maintenance publications). Qualification and entitlement to wear aircrew wings for all H-3 air crewmen shall be in accordance with applicable NAVMILPERS and OPNAV instructions. In accordance with OPNAVINST 3710.7, unit commanders are authorized to waive in writing minimum flight hours, training and/or plane captain requirements.

5.2.2.1 Helicopter Utility Aircrewman. The designation granted by the commanding officer to those aircrewmen who have demonstrated an excellent level of knowledge and performance in the appropriate operations sufficient to meet the unit's requirements. The following minimum requirements are established for designation as helicopter utility aircrewman:

1. Completed H-3 FRS aircrew training syllabus and/or parent unit syllabus.

2. Current in Basic first-aid and CPR qualifications.

3. NATOPS qualified.

4. Designated by unit commanding officer.

5.2.2.2 Helicopter Crew Chief. The designation granted by the commanding officer to those utility air-crewmen who have demonstrated a superior level of knowledge and performance in the operation and required missions of the H-3. The following minimum requirements are established for designation as helicopter crew chief.

1. Designated helicopter utility aircrewman by unit commanding officer.

2. Complete parent unit's aircrew training syllabus and be fully qualified in the following:

a. Current in Basic first-aid and CPR qualifications.

b. Can demonstrate extensive knowledge and usage of SAR equipment and procedures.

3. Log a minimum of the following:

a. Fifty hours flight time in model.

b. Twenty successful practice rescues, five of which must be simulated rescues using the litter with trail line, and six of which must be live hoists.

4. Helicopter rescue swimmers shall be currently qualified in accordance with OPNAVINST 3710.7 and 3130.6.

5. Be a qualified plane captain.

6. Designated by unit commanding officer.

5.2.2.3 SAR Medical Technician. The designation granted by the commanding officer of SAR units that have hospital corpsman assigned under aircrew orders. These personnel perform emergency medical care functions in flight and act as the medical attendant when transporting patients in the MEDEVAC role. These personnel also assist other members of the crew in search and rescue procedures and are trained in aircraft operating and emergency procedures. The following minimum requirements are established for designation as a SAR medical technician:

1. Successful completion of the H-3 FRS aircrew training syllabus and/or parent unit syllabus.

2. Designated helicopter utility aircrewman by unit commanding officer.

3. Fifty hours of flight time in model.

4. NATOPS qualified.

5. Qualified in accordance with OPNAVINST 3130.6 and BUMEDINST 1510.17.

6. Designated SAR medical technician by unit commanding officer.

NOTE

SAR Medical Technicians are required to apply for Naval Aviation Observer IAW MILPERS Manual.

5.2.2.3.1 Waiver of Requirements. In accordance with OPNAVINST 3710.7, commanding officers are authorized to grant waivers in writing for flight hours, specific training, and crew minimums when the situation or crewman's experience warrants such action.

5.2.2.4 Minimum Crew Requirements for Specific Operations. Only those personnel considered necessary to perform the specific mission shall be carried on flights that are determined to be hazardous. Such other personnel as can be accommodated with approved seats and securing devices may be carried during normal operating conditions when authorized by competent authority. To qualify for specific operations and flight categories listed below, pilots/crewmen must meet listed qualifications. Additional or more stringent requirements may be set forth by the reporting custodian officer.

1. Search and rescue, support, utility missions, and passenger transport.

   a. Two helicopter pilots, one of whom is designated HAC.

   b. One designated helicopter crew chief.

   c. One qualified rescue wet swimmer (SAR missions).

2. Familiarization flights and cross-country flights.

   a. Two helicopter pilots.

Note

The requirement may be waived by the commanding officer for indoctrination flights provided the pilot in command holds at least an H2P designation.

   b. One designated aircrewman (FAM flights).

   c. One designated crewman (cross-country).

3. Functional checkflights.

   a. Two helicopter pilots, one of whom is a functional check flight pilot designated by the unit commanding officer.

   b. One crewman designated as a functional checkflight aircrewman by the commanding officer.

5.2.2.5 Minimum Requirements for Combat Search and Rescue

1. Combat search and rescue shall be designated in writing and attend the appropriate CNO-approved strike rescue school prior to assuming a crew position on strike rescue missions.

   a. Day qualifications - Ten hours of flight training emphasizing crewman responsibilities during low level terrain navigation and obstacle avoidance and verbal positioning techniques during confined area landings to unprepared sites.

   b. Currency - Day currency will be maintained with 1-day terrain flight (including CALS) within 45 days.

5.2.2.6 Flight Attendant/Crew Chief. The designation granted by the commanding officer to those aircrew candidates who have demonstrated a superior level of knowledge and performance in the operation and employment of all required missions of the UH-3H Executive Transport. The following minimum requirements are established for designation as flight attendant/Crew Chief.

1. Complete FRS aircrew training syllabus and/or parent unit aircrew training syllabus in accordance with OPNAVINST 3710.7.

2. Log a minimum of 50 hours flight time as an aircrew candidate.

3. **Current in Basic first-aid and CPR qualifications**.

4. Be a qualified plane captain.

5. Demonstrate an expert knowledge of all survival equipment in assigned aircraft.

6. Designated by unit commanding officer.

7. NATOPS qualified.

5.3 NATOPS FLIGHT EVALUATION

5.3.1 Pilot Evaluation. All pilots meeting the below listed minimum qualifications shall be liable for a NATOPS evaluation check. The ground evaluation will be successfully completed in accordance with Chapter 19 before the flight evaluation. Training requirements, checkout procedures, evaluation procedures, and weather minimums for ferry squadrons are governed by the provisions contained in OPNAVINST 371076.

1. Initial flight evaluation criteria. Successfully complete the FRS syllabus, or its equivalent. Flight hour minimum previous 6 months):

   a. Total in model - 35 hours or 25 hours using CNO approved 2F64C trainer syllabus.

   b. Night time in model - 6 hours or 5 hours using CNO approved 2F64C trainer syllabus.

   c. Instrument time in model - 4 hours.

2. Minimum requirements for annual NATOPS evaluation.

   a. Flight hours in model previous 12 months -60 hours (30 of which were in the previous 6 months).

   b. NAMTD if available or refresher at squadron level.

3. Waiver of requirements - In accordance with OPNAVINST 3710.7, commanding officers are authorized to grant waivers in writing for flight hours and NAMTG training when the situation/pilot experience warrants such action.

5.3.2 Crewman Evaluation

1. Initial flight evaluation criteria - Initial NATOPS evaluations will be satisfactorily completed prior to designation as a naval aircrewman.

2. Minimum requirements for annual NATOPS evaluation - Crewmembers meeting the following requirements will be considered current in all respects and shall be given NATOPS evaluations annually.

   a. Complete a minimum of six live hoists and six simulated rescue operations within last year (if applicable).

   b. Complete the squadron approved training syllabus in the preceding year.

   c. Current in Basic first-aid and CPR qualifications.

3. Waiver of requirements - In accordance with OPNAVINST 3710.7, commanding officers are authorized to grant waivers in writing for rescue hoist operation requirements when the crewman experience warrants such action.

5.4 PERSONAL FLYING EQUIPMENT

The pilot in command shall ensure that the following equipment is worn by all crewmembers of the helicopter in accordance with OPNAVINST 3710.7. Consult this instruction for information on passenger flight equipment. Items marked with an asterisk (*) are waived for executive transport missions not over water.

1. Protective helmet.

2. Flight safety boots.

3. Flight gloves.

4. Fire-resistant flight suit.

5. Identification tags.

*6. Survival knife.

*7. Personal survival kit.

*8. Signal devices.

9. Flashlight – required for night flights.

*10. Anti-exposure suit as required by OPNAVTNST 3710.7

*11. Personal survival radio (if available).

*12. Flotation gear (as required).

*13. HEEDS bottle or HABD (as required).

14. Pocket checklist.

5.5 CREW REST REQUIREMENTS

The following crewmember rest requirements are considered to be the minimum criteria that will provide an optimum level of physical and mental performance during flight operations:

1. Crews should not be scheduled for more than 9 hours of operational flying time per day. This is normally interpreted to be two operational sorties per day. This limit is raised to 12 hours per day per 24-hour period for non-operational missions such as cross-country flights.

2. A minimum of 8 hours of uninterrupted crew rest should be provided per 24-hour period.

3. Crews should not be scheduled for continuous alert and/or flight duty (required awake) beyond 18 hours.

For waiver to the above requirements commanding officers shall refer to OPNAVINST 3710.7 for specific guidance.

5.6 FLIGHT TIME SUMMARY

An annual flight time summary shall be compiled for naval aircrewmen at the end of each fiscal year and entered into the appropriate section of the NATOPS flight training jacket (OPNAV 3760/32). An Enlisted Service Record (page 13) entry shall then be made indicating this total.

5.7 WEAPON RECOVERY INDOCTRINATION

5.7.1 Flight Crew Qualifications

5.7.1.1 Pilot Qualifications. HAC shall be designated in accordance with the current OPNAVINST 3710.7, type commander instructions, and pertinent sections of this manual prior to being designated in writing as mission commander for launch/recovery of tar-gets/torpedoes.

5.7.1.2 Aircrew Qualifications. Helicopter air crewman shall be designated in accordance with current OPNAVINST 3710.7, BUPERS/NAVPERS instructions, type/wing commander instructions and pertinent sections of this manual prior to being designated in writing as crew chief for launch/recovery of targets/torpedoes.

5.7.1.3 Crew Requirements

1. Two helicopter pilots, one of whom is a mission designated HAC.

2. One crewman who is a mission designated crew chief.

3. Two crewmen as mission requires.

5.7.1.3.1 Qualification. The incorporation of these procedures into this manual does not constitute authorization for commands to qualify and train aircrews in them nor to perform them operationally. Specific authorization will come from the appropriate type commander, through the operational chain of command.

5.7.1.4 Initial Mission Qualification

1. Ground training shall include:

   a. Training lectures and hands-on equipment training conducted by personnel from cognizant torpedo/drone custodian for all ground personnel.

   b. Ground training conducted by mission qualified personnel for all flightcrews. This training shall include:

      (1) Equipment:

         (a) Torpedo/drone familiarization.

         (b) Recovery system familiarization.

         (c) Recovery system/aircraft Setup.

      (2) Recovery procedures

      (3) Load oscillation recovery

      (4) Emergency procedures

      (5) Safety considerations

      (6) Flight clearances

5.7.1.4.1 Flight Training

1. Pilots

   a. Observation of aircrew duties for each tar-get/torpedo (optional)

   b. Recovery from load oscillation in flight/ hover

   c. Launch/recovery

      (1) System hookup

      (2) Transit

      (3) Launch/recovery:

         (a) Launch - flight as copilot prior to performing maneuvers pilot at controls.

         (b) Recovery - initial qualification; six recoveries (using certified dummy shapes if available).

      (4) Transit/drop off

2. Aircrewmen

   a. For each type of torpedo/target:

      (1) Observation of two launches and two recoveries.

      (2) Conduct six recoveries. (Using certified dummy shapes if available).

5.7.1.5 Proficiency Qualification

1. Ground training to be incorporated into the unit's annual training plan.

2. Requalification/currency: Two launches or two recoveries in the last 6 months.

5.7.1.5.1 Waivers. In accordance with OPNAVINST 3710.7, commanding officers may waive in writing minimum flight hours and training requirements for one time or short-term operations where pilot/aircrew experience warrants.

PART III

Normal Procedures

This Page Left Blank Intentionally

CHAPTER 6

Flight Preparation

6.1 Mission Planning

Helicopter Combat Support mission planning involves consideration of an ever changing variety of situations. Missions of other types must be similarly coordinated based on the requirements of original mission authorization. Ultimate success of mission planning is dependent upon liaison between controlling authority and proper scheduling at squadron level.

The rules applicable to range for the helicopter are the same as those rules applicable to multiengine aircraft. Variables affecting helicopter range are onboard fuel, wind direction, and velocity. No restrictions should be imposed on the helicopter that would limit its range other than those factors that apply to multiengine aircraft (i.e., NAVAIDs, fuel, wind, etc.).

6.1.1 Factors Affecting Range and Endurance

6.1.1.1 Weight. As the weight decreases, the power required to maintain constant airspeed decreases. Heavily loaded helicopters must fly at a greater power setting than similar helicopters lightly loaded and flying at the same speed.

6.1.1.2 Temperature. High inlet air temperature (T_2) has a serious adverse effect on gas turbine engines. Temperature at 38°C reduces the available output power of a gas turbine engine about 20 percent from that obtained under standard conditions of 15°C. High ambient air temperature will also increase density altitude that will increase power required to accomplish the mission.

6.1.1.3 Humidity. High humidity increases the density altitude and effectively reduces the efficiency of the rotor system. For every 10 percent increase in relative humidity, the density altitude increases approximately 100 feet. Thus, a high relative humidity, close to 100 percent, can effectively increase the density altitude by as much as 1,000 feet.

6.1.1.4 Altitude. Altitude has a marked effect on the performance of all airflow engines. Air density and temperature decrease as altitude increases. As the density of the air decreases, the mass flow of air through a gas turbine decreases and the efficiency drops off. However, the gas turbine operates more efficiently at lower temperatures encountered at high altitudes with the result that the thrust delivered per pound of air consumed is higher at high altitudes. Since power output decreases and efficiency increases, specific fuel consumption decreases with increased altitude. Thus, a definite advantage is gained with gas turbines when operated at high altitudes since with reduced air density, higher true airspeed will result from a given power output. The helicopter, however; is limited in using the gas turbines for fullest efficiency at altitude. This is not because of the engines but due to the lift capability of the rotor system at high altitudes. For flight planning purposes, consult appropriate charts in Part XI.

6.1.1.5 Maximum Range. If there is not enough fuel remaining aboard to reach a practicable landing site on two engines, best range may be gained by flying single engine at maximum speed for the single-engine configuration (100 percent N_r). This situation constitutes an emergency.

6.1.1.6 Minimum Requirements. In no case shall the planned fuel reserve after final landing at destination, or alternate airport if one is required, be less than the minimum fuel requirement of 450 pounds total.

6.2 NAVIGATION

6.2.1 Tactical Navigation System. The TACNAV system is used to perform navigation computations and furnish helicopter steering information.

6.3 WEIGHT AND BALANCE

Weight and balance control is necessary for cg location and weight distribution. For safe and efficient flight operations, the following weight and balance requirements are established:

1. Proper loading shall be determined by the use of the Cargo Aircraft Loading and Unloading Technical Manual (NAVAIR 0l-230HLC-9) and Handbook of Weight and Balance (NAVAIR 01-lB-40).

2. During flight, care should be taken to be sure of equal burning of fuel from the forward and aft tanks to maintain an essentially constant cg throughout the flight. This is done by use of the crossfeed switch and fuel boost pumps.

3. Responsibility - Refer to OPNAVINST 3710.7.

6.4 BRIEFING/DEBRIEFING RESPONSIBILITIES

6.4.1 Formation Leader. The formation leader shall make sure that all members of his flight have received an adequate and proper briefing. He shall supplement each briefing as necessary.

6.4.2 Pilot in Command. The pilot in command shall make sure that his flightcrew is equipped with proper flight clothing, navigational kits, flight packets, flight plans, and survival equipment, and shall know their ditching procedures as necessary. He shall also make sure that his crew is fully briefed and prepared for the scheduled mission. It will be the responsibility of the pilot in command to make sure that all passengers are adequately briefed before any flight as to the proper ditching and evacuation procedures on land or water as applicable, and that passengers are instructed on the use of land and water survival equipment.

6.4.3 Command Responsibility. The general responsibilities of pilots in command of naval aircraft are contained in OPNAVINST 3710.7 (current edition). These responsibilities shall be reviewed and understood by all pilots and controlling authorities.

Note

The instructor/evaluator on flights in which contour or NOE terrain flying, unusual attitudes, or simulated emergencies are being conducted should be considered the pilot in command (HAC) and sign for acceptance of the aircraft at the discretion of the commanding officer.

6.4.4 Non-operational Briefing. The formation leader may brief training, familiarization, and other similar flights where only NOTAMs, weather, and communications information are required. Air intelligence, navigation, communication, and other cognizant officers will make sure that information for each briefing is current and readily available to the formation leader. Functional checkflights shall be briefed according to OPNAVINST 4790.2 series.

6.4.4.1 Passenger Briefing. The transfer of personnel aboard the helicopter requires careful and complete passenger briefings on action to be taken during emergency operations and operation of emergency exits and survival equipment. It is recommended that pre-cruise liaison between shipboard personnel and the air department/parent helicopter squadron be established and helicopter indoctrination and briefings be given before actual deployment. Preflight briefings should be made by the designated shipboard air transfer officer in accordance with the CV NATOPS manual. Pre-takeoff briefings shall be the responsibility of the pilot in command and shall be given by the helicopter air crewman prior to or upon entry of the passenger(s) into the helicopter. The following items shall be included in the brief:

1. Check for fit and adequacy of safety and survival equipment. The minimum equipment for each individual shall be according to OPNAVINST 3710.7. Any passenger not equipped with the minimum required survival equipment shall not be carried aboard the helicopter. All passengers shall be required to wear eye protection while embarking and disembarking the helicopter, with rotors turning.

WARNING

The UH-3H ET, crew chief's seat is not a crashworthy seat. Do not occupy this seat during takeoff or landing.

2. Each occupant of the executive seats will be directed to swivel the seat to its normal forward or aft facing position during takeoff, landing, or emergency conditions.

3. Each passenger will be directed to take a seat, and the proper operation of the seatbelt and shoulder release shall be demonstrated by the helicopter air crewman. The crewman shall further make sure that each passenger is correctly seated and that his harness is locked before takeoff or hover departure.

4. Each passenger shall be shown an information placard (see Figure 6-1) with normal, ditching, and emergency egress routes/exits illustrated. The crewman shall make sure that each passenger knows the location of his nearest emergency exit and the proper operation of the exit release handle.

6.4.5 Briefing Format. Briefs should be conducted as assigned prior to launch and should cover the following items, as applicable.

6.4.5.1 Mission

*1. Primary.

*2. Secondary.

*3. Operating Area.

*4. Control agency.

6.4.5.2 Communications

1. Channels, frequencies, call signs, and controlling authority.

2. Navigational aids.

3. Lost Communications.

4. Authenticators, codes, and IFF/SIF.

5. EMCON conditions.

6.4.5.3 Participating Units

1. Call signs and side numbers.

2. Disposition.

3. Utilization.

6.4.5.4 Weather

1. Wind direction/velocity.

2. Ceiling.

3. Visibility.

4. Sea state and direction.

5. Water temperature.

6. Air temperature.

7. Density altitude.

6.4.5.5 (NON-ET) Ordnance

*1. Loading.

*2. Restrictions on employment.

3. Safety.

4. Arming/dearming.

5. Jettison/bomb safe line.

6.4.5.6 Datum

* 1. Bearing (magnetic).

*2. Distance.

*3. Time.

*4 Current situation.

6.4.5.7 Flight Planning

1. Formation.

2. Climb out.

3. Mission planning.

4. CATCC.

5. Recovery.

6.4.5.8 Passenger Briefing

1. Normal and emergency egress routes and exits.

2. Operation of emergency exit releases.

3. Operation of flotation equipment and use of survival gear.

4. Action to be taken during controlled and uncontrolled ditching.

6.4.5.9 Performance Data

1. Weight and Balance, Form F, or substitute form as required.

2. Performance calculations. Use minimum acceptable indicated torque chart (750 °C) located in Functional Flight Chapter 10.

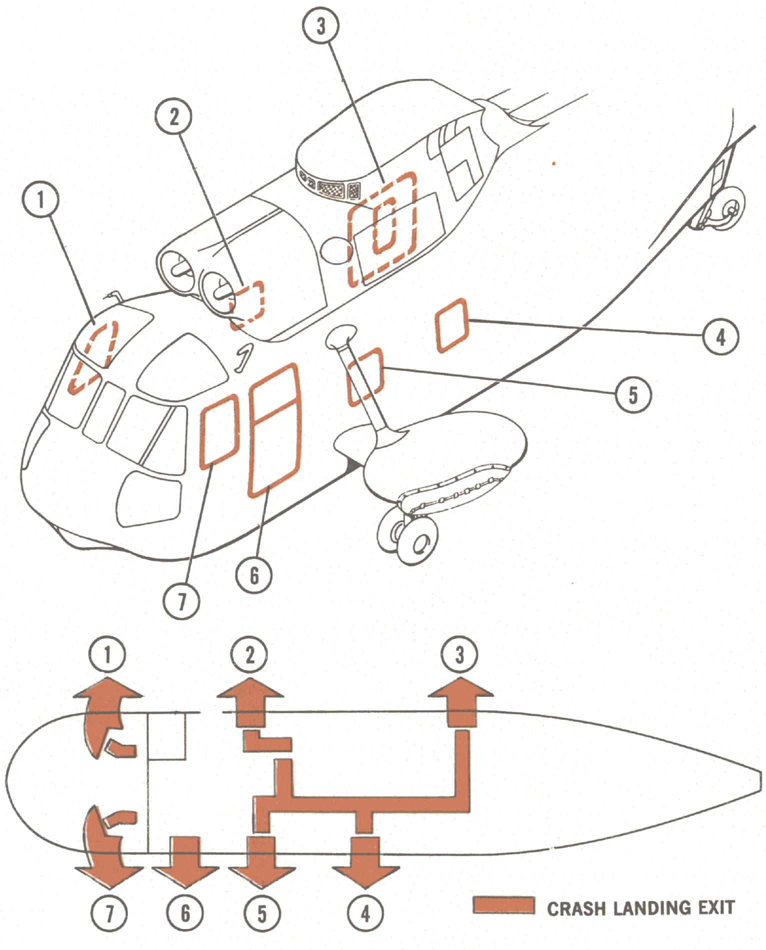
6.4.5.10 Emergencies. Standard lost plane, downed aircraft, and lost communication procedures can be found in NWP 3-04.lM, NWP 3-50.1, and the FLIP Flight Information Handbook.

6.4.6 Debriefing Format. Each flight should be thoroughly debriefed immediately upon its return, normally by the formation leader or pilot in command, covering the following:

1. The success of the mission, including contacts, action taken, tactics employs, and results.

2. Recommendations for improvement of tactics, procedures, and techniques, flight and radio discipline, etc.

3. Completion of syllabus flights, attainment of crew qualifications, and results of competitive exercises.



1. PILOT'S JETTISONABLE WINDOW ASSEMBLY
2. CABIN WINDOW, STARBOARD SIDE
3. CABIN DOOR
4. CABIN WINDOW, PORT SIDE
5. CABIN WINDOW, PORT SIDE
6. PERSONNEL DOOR
7. COPILOT'S JETTISONABLE WINDOW ASSEMBLY

1. KEEP YOUR SEAT BELT FASTENED TIGHTLY UNTIL READY TO DEPART THE AIRCRAFT. STAY STRAPPED IN UNTIL DIRECTED BY THE CREWMAN.
2. KEEP YOUR HEAD PROTECTION AND LIFE VEST ON AT ALL TIMES.
3. ON THE REVERSE SIDE OF THIS CARD IS AN AIRCRAFT DIAGRAM. ORIENT YOURSELF WITH RESPECT TO THE EMERGENCY EXITS. EXITS WITH YELLOW HANDLES CAN BE JETTISONED BY TURNING THE HANDLES. THE WINDOWS CAN BE PUSHED OUT BY SHARPLY STRIKING THE CORNERS.

NOTE

CABIN DOORS AND WINDOWS (EXCEPT FOR CARGO DOOR WINDOW) ARE LINED WITH THE HELICOPTER EMERGENCY EGRESS LIGHTING SYSTEM (HEELS). HEELS WILL ILLUMINATE IN THE ADVENT OF AN EMERGENCY DITCHING.

4. IN CASE OF DITCHING:
   a. IF THE AIRCRAFT REMAINS UPRIGHT REMAIN STRAPPED IN AND WAIT FOR INSTRUCTIONS FROM THE CREW (LAND OR SEA).
   b. IF THE AIRCRAFT ROLLS OVER IN THE WATER, WAIT FOR ALL MOTION TO STOP AND INITIAL INRUSH OF WATER. THEN UNSTRAP AND PROCEED TO PREDETERMINED EXITS, USING HAND OVER HAND METHOD. DO NOT INFLATE FLOTATION UNTIL CLEAR OF THE AIRCRAFT. MUSTER WITH FLIGHT CREW MEMBERS.

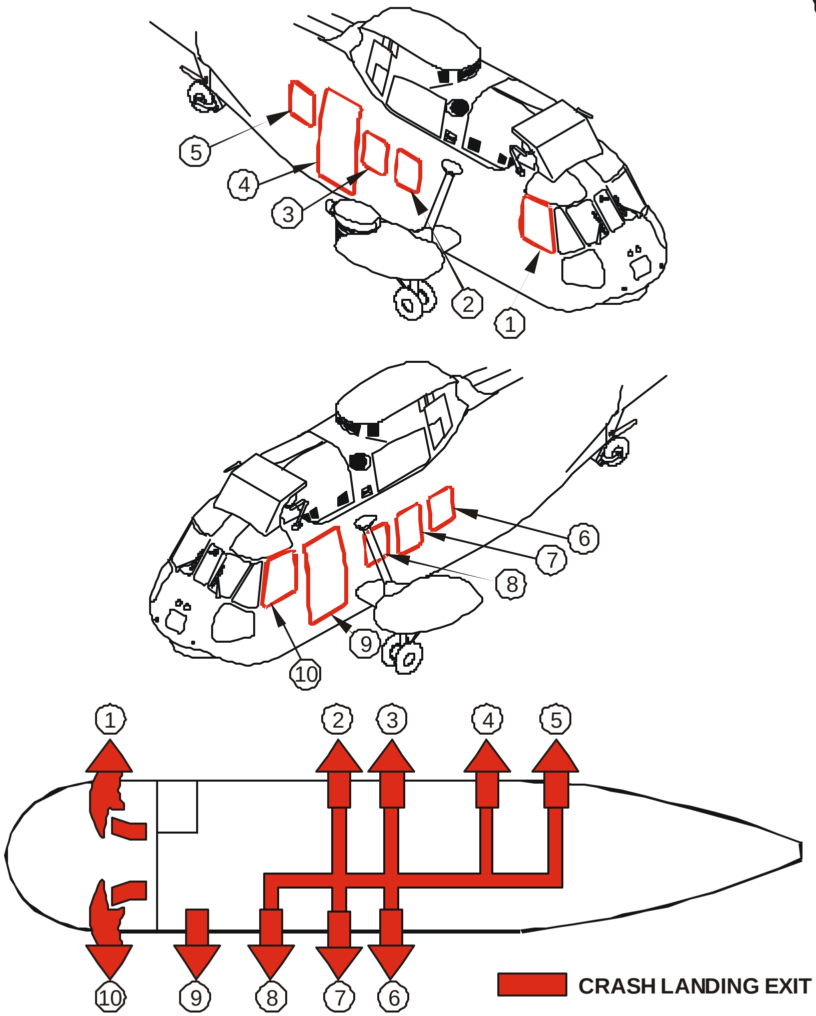
CAUTION

DO NOT REENTER THE AIRCRAFT FOR ANY REASON.

   c. IF THE AIRCRAFT CRASHES ON LAND, EXIT THE AIRCRAFT IMMEDIATELY AFTER ALL MOTION HAS STOPPED AND GET WELL CLEAR.

S 34337 (C8)

Figure 6-1. (NON-ET) Passenger Brief Card



1. PILOT'S JETTISONABLE WINDOW ASSEMBLY
2. CABIN EMERGENCY ESCAPE HATCH, STARBOARD SIDE
3. CABIN WINDOW, STARBOARD SIDE
4. AFT PASSENGER DOOR
5. AFT CABIN EMERGENCY ESCAPE HATCH, STARBOARD SIDE
6. CABIN WINDOW, PORT SIDE
7. CABIN EMERGENCY ESCAPE HATCH, PORT SIDE
8. CABIN WINDOW, PORT SIDE
9. FORWARD PASSENGER DOOR
10. COPILOT'S JETTISONABLE WINDOW ASSEMBLY

01771011

1. KEEP YOUR SEAT BELT FASTENED TIGHTLY UNTIL READY TO DEPART THE AIRCRAFT. STAY STRAPPED IN UNTIL DIRECTED BY THE CREWMAN.

2. KEEP YOUR HEAD PROTECTION AND LIFE VEST ON AT ALL TIMES.

3. ON THE REVERSE SIDE OF THIS CARD IS AN AIRCRAFT DIAGRAM. ORIENT YOURSELF WITH RESPECT TO THE EMERGENCY EXITS. EXITS WITH YELLOW HANDLES CAN BE JETTISONED BY TURNING THE HANDLES. THE WINDOWS CAN BE PUSHED OUT BY SHARPLY STRIKING THE CORNERS.

NOTE

EMERGENCY EXIT LIGHTS ARE LOCATED ABOVE THE EMERGENCY ESCAPE HATCHES

4. IN CASE OF DITCHING:

   a. IF THE AIRCRAFT REMAINS UPRIGHT REMAIN STRAPPED IN AND WAIT FOR INSTRUCTIONS FROM THE CREW (LAND OR SEA).

   b. IF AIRCRAFT ROLLS OVER IN THE WATER , WAIT FOR ALL MOTION TO STOP AND INITIAL INRUSH OF WATER. THEN UNSTRAP AN PROCEED TO PREDETERMINED EXITS, USING HAND OVER HAND METHOD. DO NOT INFLATE FLOTATION UNTIL CLEAR OF THE AIRCRAFT. MUSTER WITH FLIGHT CREW MEMBERS.

CAUTION

DO NOT REENTER THE AIRCRAFT FOR ANY REASON.

   c. IF THE AIRCRAFT CRASHES ON LAND, EXIT THE AIRCRAFT IMMEDIATELY AFTER ALL MOTION HAS STOPPED AND GET WELL CLEAR.

Figure 6-1.1 (ET) Passenger Briefing Card

This Page Left Blank Intentionally

CHAPTER 7

Shore-Based Procedures

7.1 GENERAL

Shore-based operations may vary from indoctrination of new pilots to full-scale around-the-clock operations. Many of the procedures required in shore-based operations are identical with those used in shipboard operations, while others vary in major aspects. In this connection, attention is directed to Flight Preparation, Chapter 6, and Flight Characteristics, Chapter 11. In this section, shore-based procedures are discussed to cover as many operational situations as possible. Mission planning and briefing/debriefing should be done in accordance with Chapter 6.

7.2 LINE OPERATIONS

7.2.1 Line Safety. In accordance with OPNAV Notice 5100 series.

7.2.2 Ground Operation of Helicopter Engines and Rotors

7.2.2.1 Preflight Inspection. Before engaged turn or engine turn, the pilot or nonpilot maintenance personnel shall conduct a complete visual check of the helicopter.

7.2.2.2 Fireguard. Before starting a helicopter engine, a qualified fireguard shall be stationed near the engine and remain in readiness with the fire bottle until the engine is operating.

Note

The standard fire bottle without the 8-foot extension must be elevated in order to reach the engine fire access door.

7.2.2.3 Starting of Engine. A qualified pilot or person designated by the commanding officer shall be in the pilot seat whenever an engine is started. Starting personnel shall receive and acknowledge plane captain and fireguard all-clear signals before starting the engine. Helicopter engines shall not be started until the helicopter is properly secured with approved chocks, parking brakes on, and tailwheel locked. Engines shall not be started in a hangar unless an emergency situation exists. Chocks and tiedowns will be removed with utmost caution when engines and/or rotors are operating, and then only upon the proper signal.

7.2.2.4 Rotor Engagement. A qualified helicopter pilot shall be in the pilot seat at all times when the rotors are engaged. Goggles that provide adequate peripheral vision shall be worn by ground personnel. Before rotor engagement is effected, it shall be mandatory that the surrounding area be clear of unnecessary personnel, equipment, and obstructions. The pilot must receive and acknowledge all-clear signals from ground personnel. Rotor engagement and disengagement shall not be attempted in wind velocities in excess of those shown in Figure 8-1 except in an emergency.

7.2.3 Taxiing

7.2.3.1 Taxi Signals. Only standard taxi signals will be used.

7.2.3.2 Taxi Pilots. No one shall be permitted to taxi a helicopter except those persons authorized to fly it.

7.2.3.3 Taxi Director. Enough ground control personnel must be available for the safe taxiing of helicopters in the vicinity of obstructions or other aircraft.

Note

The taxi director shall position himself in front of and to the right of the helicopter centerline. He shall maintain visual contact with the pilot in the right seat at all times. He shall further maintain this position relative to the helicopter whenever the helicopter is in motion and under his supervision.

7.2.3.4 Taxiing. All taxiing shall be done at a safe, slow speed. Extreme caution during night operation must be observed. Air taxiing may be authorized during high-wind conditions.

CAUTION

Helicopters shall not be ground taxied within 25 feet (rotor tip clearance) of buildings, aircraft, or other obstacles unless taxi lines/spots or other clearance guides are available for adequate separation.

7.2.4 Towing

7.2.4.1 Operation of Equipment. Only qualified personnel shall operate towing equipment. Towing couplings shall be inspected before towing. Only approved attachment devices shall be used. Towing shall not begin until a qualified pilot or qualified brake rider is in the cockpit and ready to operate the brakes.

7.2.4.2 Towing Speed. Towing speed shall not be over 5 miles per hour. Sudden stops and starts should be avoided. Extreme caution should be taken when towing in a congested area.

7.2.4.3 Wingwalker. When towing a helicopter near hangars, obstructions, or other aircraft, a wingwalker equipped with a whistle shall be stationed on each side of the helicopter to be sure of adequate clearance. When helicopters are being pushed backward, a man shall be stationed at the tail to be sure of clearance at the rear of the helicopter. At night the wingwalker shall carry a flashlight or luminous wand and the helicopter position lights shall be turned on.

7.2.4.4 Movement. Helicopters may be pushed from the tail, provided adequate clearance is available and the helicopter is under positive control of a towing director. A towing director equipped with a whistle should be positioned to supervise towing.

7.2.5 Helicopter Acceptance. The pilot in command shall not accept the helicopter for flight until he is assured that the helicopter is satisfactory for safe flight and accomplishment of the assigned mission. The major steps to be taken before acceptance of the helicopter are the following:

1. Careful examination of the helicopter's recent discrepancies contained in the Aircraft Discrepancy Book.

2. Careful examination of discrepancies listed on the maintenance turnaround and daily cards.

3. A thorough preflight inspection in accordance with the items listed in Preflight Inspection, paragraph 7.2.7.

4. If a crew change is required while the helicopter is engaged or engine running, the requirement for a preflight in accordance with Preflight Inspection, paragraph 7.2.7, by the relieving crew is waived. The relieving crew shall inspect the helicopter as thoroughly as possible under existing conditions. Additionally, the crew being relieved shall thoroughly brief the oncoming crew on all aspects of the helicopter that could influence the conduct of the flight.

5. Crew change with rotor disengaged, No. 1 engine in accessory drive.

   a. Pilots shall pick up checklist under NORMAL STARTING PROCEDURES, paragraph 7.4 with Compass system. Console switches – AS REQUIRED.

   b. Complete remainder of checklist.

6. Crew change with rotor engaged, No. 1 engine in flight position.

   a. Pilots shall pick up checklist under STARTING NO. 2 ENGINE AND ROTOR ENGAGEMENT, paragraph 7.6 with N_f/N_r -104 percent.

   b. Complete remainder of checklist.

When a crew change is conducted with the rotors engaged, the landing gear lockpins shall not be installed unless directed by the pilot. If pins are installed, remove before flight.

7.2.6 Aircraft Discrepancy Book. The discrepancies of at least the last 10 flights shall be made available to the aircrew for their examination. Any additional discrepancies should also be brought to their attention in the form of written notations on appropriate forms.

1. The pilot in command shall ensure that all applicable inspections have been completed and that the post-flight documentation is completed and in accordance with OPNAVINST 3710.7 and 4790.2 series.

2. The pilot in command, when satisfied with the Aircraft Discrepancy Book, shall sign applicable portions of the aircraft inspection and acceptance record (OPNAV Form 4790/141) Part A before flight and shall complete the necessary postflight sections upon completion of the postflight inspection.

7.2.7 Preflight inspection. The pilot in command shall ensure that the preflight inspection is accomplished in accordance with the following.

7.2.7.1 General Walk around Inspection.

1. Wheel chocks in place.

2. Number and proper adjustment of tiedowns, if attached.

3. Fuel, oil, and hydraulic fluid leakage.

4. Port stores and/or stores attachment points for condition and security (NON-ET); gravity fuel caps secure.

5. Intermediate gearbox/tail gearbox oil levels, tail rotor area, pylon hinge, and disconnect jaw teeth for wear/excessive grease (if folded).

6. Tail drive shaft covers secured; pressure-fueling cap secure; check cargo door/tracks (NON-ET) or the forward air stair passenger door (ET) for security.

7. Fuel, oil, and hydraulic fluid leakage.

8. Starboard stores and/or stores attachment points for condition and security (NON-ET).

7.2.7.2 Interior Inspection.

1. Battery on.

2. Landing gear handle down; indicators indicate gear down.

3. Fuel quantity.

4. Tailwheel locking handle locked.

5. Parking brake set and advisory light on.

6. Rotor brake on, pressure up, and caution light on.

7. Battery off.

8. Cockpit windows secure.

9. ASE compartment for hydraulic leaks, security of control rods, and auxiliary filter indicator.

10. Condition of overhead fuel lines, wires, and tail rotor cables.

11. Aft cabin/tail cone security; tail rotor cables.

12. Fuel dump valves closed.

7.2.7.3 Left Engine.

1. Pitot cover and intake cover removed.

2. Ice shield and pitot tube airspeed adapter (if installed).

3. Starter for security; bellmouth area free of FOD

4. Oil tank for leakage, fluid level, and filler cap for security.

5. Engine mounts for delamination and cracks.

6. Stator vane actuator for alignment/security.

7. Exhaust casing for cracks, dents, hot spots, and security.

8. Engine door secure; J-hooks/suitcase latch fastened (if installed).

7.2.7.4 Left Transmission, Rotary Wing Head.

1. Input shaft area for wear/leaks, freedom of movement.

2. Rotary wing head fairing for condition and security.

3. Damper reservoir for proper level.

4. Rotary wing head self-lube oil reservoirs for proper level.

5. Antiflapping and droop restrainers for broken springs.

6. Check Bifilar weights and mount for integrity and lubrication.

7. BIM indicators for normal indications.

8. Blades for cracks, dents, and bonding separations.

9. Servo cylinders for hydraulic leaks; boot strap springs (left lateral servo) present.

10. Transmission mounts for cracks and corrosion.

11. Main gearbox oil level.

12. Check lube pump filter and torque pump filter PDIs for proper indication.

13. Accessory section, links, and wiring for condition, leaks, and security.

14. Transmission oil cooler, fan, fan belts, and brackets for condition, leaks, and security.

15. Aux manifold hydraulic filter for proper indication.

15. Primary/auxiliary reservoir fluid levels.

16. Fire bottle for proper pressure.

17. Tail rotor drive shaft housing for condition and security.

18. Engine and transmission access doors secure.

CAUTION

On main gearboxes modified by DCC 43, a bypass indicator on the torquemeter pump filter will pop out giving a visible indication of impending system bypass (filter clogged). If the red button pops out, the filter must be changed. Do not reset the red button without first changing the filter.

7.2.7.5. Right Engine.

1. Pitot cover and intake cover removed.

2. Ice shield and pitot tube airspeed adapter for security and proper installation.

3. Starter for security; bellmouth area for FOD.

4. Oil tank for leakage, proper level, and security of filler cap.

5. Engine mounts for delamination and cracks.

6. Stator vane actuators for alignment and security.

7. Exhaust casing for cracks, dents, hot spots, and security.

8. Engine door secure; 3-hooks/suitcase latch fastened.

7.2.7.6 Right Transmission Rotary Wing Head.

1. Input shaft area for wear/leaks, freedom of movement.

2. Rotor head fairing for condition and security.

3. Damper reservoir for proper level.

4. Rotary wing head self-lube oil reservoirs for proper levels.

5. Antiflapping and droop restrainers for broken springs.

6. Check bifilar weights and mount for integrity and lubrication.

7. BIM indicators for normal indications.

8. Blades for cracks, dents, and bonding separations.

9. Servo cylinders for hydraulic leaks, and bootstrap springs (right lateral servo) present.

10. Transmission mounts for cracks and corrosion.

11. Utility Manifold/Primary Manifold Hydraulic filter PDIs for proper indication. (3 inlines, 2 manifolds)

12. No. 2 transmission oil pump filter PDI button.

13. Accessory section, lines, and wiring for condition, leaks, and security.

14. Transmission oil cooler, fan, fan belt, and brackets for condition, leaks, and security.

15. Utility reservoir fluid level.

Note

An overfilled utility reservoir may indicate internal leakage between the damper reservoir and the utility system.

16. Fire bottle for proper pressure.

17. Rotary rudder drive shaft housing for condition and security.

18. Rescue hoist mounts and housing for condition and security (NON-ET).

19. Engine and transmission access doors secure.

7.2.7.7 Nose Section.

1. Personnel door and towline for security.

2. All protective covers removed.

3. Condition of windows, windshields, and windshield wipers.

4. Battery connected and shearwired, door secured, and vents clear.

5. Electronics compartment for security; circuit breakers/switches (L.F. stores switch off for overland flights); leaks; door closed, locked, and water tight; floodlights for condition.

6. Condition of UHF, OTPI/ADF.

7. Bottom skin for cracks, corrosion, distortion, and damaged rivets or screws.

8. Condition of radar-altimeter antennas.

7.2.7.8 Right Front of Fuselage.

1. External power receptacle for cleanliness.

2. Heater air intake and heater exhaust clear.

3. Condition and cleanliness of Doppler TACAN and IFF antennas (NON-ET).

4. Condition and cleanliness of TACAN and IFF antennas (ET).

5. Fuel, oil, and hydraulic leakage.

7.2.7.9 Right Sponson Area.

1. Tires for cuts, blisters, uneven wear, and proper inflation.

2. Landing gear system for leaks and loose connections.

3. Sponson attachment points for loose bolts/missing hardware/cracks.

4. Sponson panels for security; drain screws installed; and flotation bags secure.

5. APU exhaust clear, free from obstruction (ET).

6. APU fuel lines for leaks and loose connectors (ET).

7. Hover light bracket security.

8. Bottom skin for cracks, corrosion, distortion, and damaged rivets and screws.

9. Stores and/or stores attachment points for condition and security (NON-ET).

10. Cargo hook attachment for security and damage, condition of manual release cable (NON-ET).

7.2.7.10 Right Bottom Hull, Side of Aircraft.

1. Fuel tank sump drains for leakage.

2. Fuel tank filter drain for leakage.

3. Access panels for security.

4. Bottom skin for cracks, corrosion, distortion, and damaged rivets or screws.

5. Cargo door for condition and security of stop, slide rail, and door (NON-ET).

6. Aft passenger door for security and damage (ET).

7. Blades for cracks, dents, and tears.

8. UHF/COMM antenna for condition and cleanliness.

9. Pressure-refueling cap for security.

7.2.7.11 Right Side of Tail Cone and Pylon.

1. Tail rotor drive shaft housing for condition and security.

2. Check cotter pin on rotary rudder pitch control rod

3. Pylon hinge for cracks and security.

4. Intermediate and tail rotor gearboxes, cooling air intakes and exhaust openings for condition, overheating, obstructions, and leakage.

5. LF/ADF loop and sense antennas for security.

6. Stabilizer and static wicks for condition and security.

7. Skin for cracks, corrosion, distortions, and damaged rivets/screws.

7.2.7.12 Aft Observation.

1. Helicopter attitude/condition, as observed from behind.

2. Screened area aft of transmission for FOD.

3. Anticollision light and clearance lights for condition.

4. Screened area around the tail rotor gearbox.

5. Pylon folded – Inspect tail rotor drive pylon connector jaws for teeth wear/excessive grease.

7.2.7.13 Left Side of Tail Cone and Pylon.

1. Intermediate and tail rotor gearbox and openings for leakage and obstructions.

2. Rotary rudder head components secure.

3. Rotary rudder blades for dents or cracks and direction of rotation.

4. Gust lock removed.

5. Skin for cracks, corrosion, distortions, and damaged rivets/screws.

6. Pylon spread, lockpins for positive locking and ratchet stowed.

7.2.7.14 Left Rear of Fuselage.

1. External ac power receptacle for cleanliness (UH-3H).

2. Bottom skin for cracks, corrosion, distortions, and damaged rivets/screws.

3. Condition of UHF/COMM and HF antennas (removed by AFC 418).

4. Top of tail oleo strut for damage; tailwheel bonding wire for condition.

5. Tailwheel locking pin in place (locked) and cable for condition.

6. Tailwheel oleo strut for leaks and proper extension.

7. Tailwheel tire for cuts, blisters, and proper inflation; ground wire for condition and security.

8. Fuselage for dents or tears in skin.

9. Blades for cracks, dents, and tears.

10. Thermal discharge indicator for red seal.

7.2.7.15 Left Bottom Hull.

1. Bottom skin for cracks, corrosion, distortions, and damaged rivets or screws.

2. Access panels for security.

3. Bilge drain plugs and flapper valves for security.

4. Fuel tank filter drains for leakage.

7.2.7.16 Left Sponson Area.

1. Tires for cuts, blisters, uneven wear, and proper inflation.

2. Landing gear system for leaks and loose connections.

3. Sponson attachment points for loose bolts, missing hardware, cracks.

4. Sponson panels for security, drain screws installed, flotation bags, and hover light.

5. Cargo hook attachment for condition, damage, and security of cable; gap on manual release cable one-eighth inch or greater in sight gate on hook body after pilot completes foot plunger release, and condition of hook rubber bumper pad.

7.2.7.17 Left Front of Fuselage.

1. Bottom skin for cracks, corrosion, distortion, and damaged rivets or screws.

2. Doppler, TACAN, IFF, and VHF antennas for condition and cleanliness.

3. Fuel filler caps for security.

4. Fuel, oil, and hydraulic leakage.

7.2.7.18 Cabin Interior.

1. NATOPS manual, fire extinguisher, and first aid kits installed/current.

2. Gyro tilt table secure/bonding strap.

3. Emergency air bottle, charged (2,500 to 3,000 psi).

4. ASE compartment for hydraulic leaks, security of control rods, and auxiliary filter indicator.

5. Cabin escape hatches/windows secure.

6. HEELS (AFC 417) secure, and press-to-test switches checked (NON-ET).

7. Transmission area for leaks.

8. Aft cabin for security of SAR/survival gear, electronic equipment, and gear stowage.

9. Condition of overhead fuel lines, wires, and tail rotor cables.

10. Condition of ET seats, MATA troop seats, interior executive package. (ET)

11. Tail cone for rudder cables/bellcrank condition and corrosion.

7.3 BATTERY/DC EXTERNAL POWER START NO. 1 ENGINE

1. Circuit breakers and switches - CHECKED.

2. Fuel dump switches - OFF.

3. Brakes and tailwheel - LOCKED.

4. Beeper trim switch - ON.

5. Ignition switches - NORMAL.

6. HEELS switch – ARMED (NON-ET).

7. Manual throttles and speed selectors - FREE AND OFF.

8. Emergency start switches – OFF.

9. Rotor brake - CHECKED (320 psi minimum).

WARNING

The rotor brake will not prevent rotor movement with the No. 1 engine in flight position above ground idle or with the No. 2 engine above ground idle. Personnel injury and/or helicopter damage may occur as a result of inadvertent rotor engagement.

CAUTION

If low rotor brake pressure requires recycling manual rotor brake with blades folded, personnel should be placed on either side of the helicopter holding the blades in order to prevent shifting of head while the manual rotor brake is off.

10. No. 1 firewall valve - OPEN.

11. Start mode switch - MANUAL (Normal for 28 VDC external power).

12. Battery switch – ON.

13. DC External Power Connected – As Required.

CAUTION

Maximum continuous/peak current, for 28-vdc external power is 300/750 Amps. When 28-VDC power is applied to the EXT POWER 28 VOLTS DC receptacle, all dc buses, certain necessary ac instruments, and the fire detector system are automatically energized. The EXT PWR switch does not control 28-vdc power.

Note

Momentarily cycling the battery switch will verify DC EXT Power is properly applied to the aircraft.

14. Landing gear - CHECK.

15. Fire warning, caution, and advisory panels - CHECK.

16. Accessory drive switch - FORWARD, LIGHT ON.

17. No. 1 engine - START.

To start the engine, hold the speed selector at SHUTOFF and momentarily press the starter button. When the engine has accelerated to 14-percent N_g (19 percent with external dc power), T_5 below 100 °C, and positive indication of oil pressure is noted, advance the speed selector to the idle detent.

a. ENG ST switch - DEPRESS AS NECESSARY TO CONTROL T_5. When engine light-off is evident, press the ENG ST switch on the cyclic stick grip. Hold the switch pressed as necessary until T_5 stabilizes.

Note

Compressor stalls may occur if N_g is allowed to decelerate.

18. At 45-percent N_g, starter - DISENGAGE AS REQUIRED.

Disengage starter by pulling down on the speed selector lever.

19. All gauges – CHECK.

20. Speed selector - 104-percent N_f.

21. Generator switches - ON.

22. Lights - AS REQUIRED.

23. Blade panel, hoist, crew ICS - CHECK.

Note

The normal light indications on the blade fold panel when the blades are folded are safety valve warning light, control lockpins advance light, and blades folded light. When the blades are spread, normal light indications are blade spread light and flight position light on. Abnormal indications must be noted or corrected, as appropriate.

24. No. 1 overspeed system - CHECK.

a. An overspeed may be simulated with the No. 1 engine in accessory drive by advancing the No. 1 speed selector to achieve approximately 108-percent N_f. The N_f will then begin to cycle about ±2-percent N_f.

b. Retard the No. 1 speed selector to 104-percent N_f.

25. DC External Power – Disconnect As Required.

26. Anti-ice - CHECK.

27. Fuel quantity - CHECK.

28. Compass system, console switches - AS REQUIRED.

29. RAD ALT, BAR ALT, RAWS - SET AND TEST.

30. Start mode switch - NORMAL.

31. Servo sensor - CHECK (only required the first flight of the day).

a. Servo switch - AUX OFF.

If auxiliary servo pressure drops, the primary servo sensor is malfunctioning.

Note

Proceed with systems checklist.

7.4 NORMAL STARTING PROCEDURES

The No. 1 engine is started first to provide power for accessory drive section. The No. 1 engine may be started using either ac or dc external power, APU (ET) or if neither is available, by using the battery. After the No. 1 engine is started and run up above generator cut-in speed, generator power can be used to start the No. 2 engine. A fireguard shall be standing by when starting engines.

1. Circuit breakers and switches - CHECK.

2. Fuel dump switches - OFF.

3. Brakes and tailwheel - LOCKED.

4. External power - CONNECTED.

WARNING

(ET) The APU is intended for ground operations only (minimal lighting, instrumentation, and air conditioner operation). It does not have a fire warning or suppression system and therefore should not be used in flight.

Note

- On the executive transport helicopters (ET), the BRIGHT/DIM switch on the CABIN LIGHTS panel should remain in the DIM position while operating on external power.
- On executive transport helicopters, if the APU is used instead of external power; omit steps 4 and 6.

5. APU — START (ET).

a. APU ON switch — ON.

(1) FUEL PUMP ON light — ON.

(2) STARTER ON light — ON (OFF after starter drops out).

(3) OIL TEMP HI light — OFF.

(4) APU FAIL light — OFF.

(5) APU ON light — ON.

b. APU generator switch — RESET THEN ON (after APU engine comes to operating speed).

(1) GEN FAIL light — OFF.

(2) GEN ON light — ON.

a. Cabin heater/air-conditioner (ET) – On as Desired.

Note

If the No. 1 or No. 2 engine/inlet anti-ice switches are in the ON position, the air-conditioner will not operate.

a. HEATER/AIR COND SELECTOR — AS REQUIRED.

b. CABIN AIR TEMPERATURE — AS REQUIRED.

6. External power switch - RESET, THEN ON.

7. Landing gear - CHECK.

a. Indicators - DOWN.

b. Landing gear actuating lever - DOWN.

c. Landing gear warning light - PRESS TO TEST.

d. Emergency landing gear extension handle - DOWN, FORE, AND AFT; AND SHEAR-WIRED.

e. Emergency landing gear release lever – AFT AND SHEARWIRED.

8. Start mode switch - AS REQUIRED.

9. Blade panel, hoist, beeper trim, and crew ICS CHECK.

Note

The normal light indications on the blade fold panel when the blades are folded are safety valve warning light, control lockpins advance light, and blades folded light. When the blades are spread, normal light indications are blade spread light and flight position light on. Abnormal indications must be noted or corrected, as appropriate.

10. Anti-ice switch - AS REQUIRED.

Note

No. 1 engine anti-ice switch on (below 10 °C OAT if visible moisture is present).

11. Ignition switches - NORMAL.

12. HEELS switch – ARMED (NON-ET).

13. Accessory drive switch - FORWARD, LIGHT ON.

14. Manual throttles and speed selectors – FREE AND OFF.

15. Emergency start switches. – OFF.

16. Rotor brake - CHECKED (320 psi minimum).

WARNING

The rotor brake will not prevent rotor movement with the No. 1 engine in flight position above ground idle or with the No. 2 engine above ground idle. Personnel injury and/or helicopter damage may occur as a result of inadvertent rotor engagement.

CAUTION

If low rotor brake pressure requires recycling manual rotor brake with blades folded, personnel should be placed on either side of the helicopter, holding the blades in order to prevent shifting of head while the manual rotor brake is off.

17. Fire warning, caution, and advisory panels – CHECK.

18. No. 1 firewall valve – OPEN.

19. Fuel quantity - TEST.

Depress fuel gauge test button. Verify all fuel gauges drop to zero and then return to original position when the button is released.

20. Battery switch - ON.

CAUTION

Failure to have battery switch on with No. 1 engine running and blades folded may result in damage to the swashplate and rotary wing head with inadvertent loss of external power.

21. Lights - AS REQUIRED.

22. No. 1 engine - START.

To start the No. 1 engine, hold the speed selector SHUTOFF position and momentarily depress the starter button. As the engine accelerates to 19-percent N_g, T_5 is below 100 °C, and positive indication of oil pressure is noted, turn boost pumps ON and advance the speed selector to GRD IDLE. When the engine lights off and accelerates to about 45-percent N_g and the normal start mode is being used, the current sensitive holding coil in the automatic dropout relay automatically cuts off electrical power to the starter, the ignition systems, and the auxiliary start fuel shutoff valve switch. Do not pull down on the speed selector since this will cut out the starter. If start is aborted inadvertently, return speed selector to SHUTOFF. Normal starts are characterized by 700 to 750 °C T_5 in 3 seconds. (Use of ENG ST switch will aid in limiting excessive T_5.) Abort start if T_5 reaches 840 °C. Power turbine overtemperature during start is T_5 is in excess of 950 °C.

CAUTION

Power turbine inlet temperature (T_5) should be less than 100 °C before advancing the engine speed selector to GRD IDLE. If engine light-off does not occur within 10 seconds after the engine speed selector has been advanced to GRD IDLE, abort the start by pulling the speed selector down and returning it to SHUTOFF. Move the boost pump switches to OFF. Do not operate starter continuously for more than 30 seconds except in an emergency. Do not attempt more than three starts in any 30-minute period. In the event of starter hangup, comply with procedures in Part V. Before attempting another start, allow the engine to stop rotating and wait 3 minutes for fuel to drain from the manifolds, combustion chambers, and exhaust hood before repeating starting procedures. The starter should be capable of motoring the engine to 19-percent N_g. Failure to do so may result in hot starts. If power turbine inlet temperature (T_5) rises abnormally or reaches 840 °C, immediately shut down the engine. If T_5 continues to rise above 840 °C, note time above 840 °C and indicated maximum temperature. If engine fire follows, as may be indicated by a continuous temperature in excess of 300 °C, engage the starter without ignition and motor it until the temperature drops to acceptable limits. Refer to Part V, POSTSHUTDOWN ENGINE FIRE.

23. All gauges - CHECKED.

CAUTION

Upon initial indication of a lack of accessory drive when operating in accessory, the engine should be shut down immediately and not restarted. Continued operation could cause severe damage to the main transmission. Lack of accessory drive is indicated by the loss of hydraulic (primary, auxiliary, and utility) pressure, and transmission oil pressure.

24. Boost pumps - OFF.

Note

Boost pumps should be off to check for engine flameout because of possible air leak in a fuel line. If airframe fuel filters have been changed just before the flight, the boost pumps should be left on for about 1 minute after starting engine to purge air from fuel lines, to preclude engine flameout.

25. Speed selector - 104-percent N_f.

26. Generators - ON.

27. APU -. SECURE (UH-3H Executive Transport).
    a. APU generator switch – OFF.
    b. APU ON switch – OFF.
    c. If APU used, omit step 29.

28. No 1. Overspeed System - CHECK

a. On aircraft modified by AFC 399, an overspeed may be simulated with the No. 1 engine in accessory drive by advancing the No. 1 speed selector to achieve approximately 108-percent Nf. The Nf will then begin to cycle about ±2-percent Nf.

29. External power - DISCONNECTED.

(Initiate checklist here for crew change with rotor disengaged, No. 1 engine in accessory drive.)

30. Compass system. Console switches - AS REQUIRED. (On aircraft with the A/A24G-39 AHRS, set the latitude and hemisphere switches to the local latitude.)

31. RAD ALT, BAR ALT, RAWS - SET AND TEST.

32. Servo sensor - CHECK (only required the first flight of the day).

a. Blades spread.

(1) Safety switch - OPEN.

(2) Blade fold MASTER switch - ON.

(3) Servo switch - AUX OFF, ON.

If servo pressure drops, the primary servo sensor is malfunctioning.

(4) Safety Switch - CLOSED.

(5) Blade fold MASTER switch – OFF.

b. Blades folded.

(1) Servo switch - AUX OFF, ON.

If servo pressure drops, the primary servo sensor is malfunctioning.

CAUTION

Operating time in accessory drive should not exceed 30 minutes. With rotors disengaged, the oil cooler blower does not operate and a rapid rise in main gearbox oil temperature to above the red line is possible.

7.5 SYSTEMS CHECKLIST

1. Area clear - CHECKED.

2. Blades - SPREAD.

CAUTION

The primary servo is not normally pressurized when the blades are folded but will pressurize if all electrical power to the helicopter is lost or secured, or if an open circuit develops in the safety valve switch. Pressurization of the primary servo when the blades are folded will put undue stress on control linkages and may damage the control lockpins.

Note

- Spread/fold power will not be available if the No. 2 engine fuel firewall valve switch is open.
- The ASE should be off during blade spreading to prevent inadvertent control inputs.

a. SAFETY VALVE switch - OPEN.

b. Blade fold MASTER switch – ON.

(1) Fold power indicator light – ON.

(2) No. 1 blade position light – ON.

c. BLADES FOLD-SPREAD switch – SPREAD.

(1) BLADES FOLDED light - OFF.

When first blade moves.

(2) Control lockpins advance light - OFF.

When pins are disengaged.

(3) BLADES spread light - ON.

d. SAFETY VALVE switch - CLOSED.

(1) SAFETY VALVE warning light - OFF.

(2) Fold power indicator light - OFF.

(3) Primary servo hydraulic pressure - 1,500 PSI.

e. Rotor brake - 320 PSI MINIMUM.

f. Blade fold MASTER switch - OFF.

(1) No. 1 blade position light - OFF.

(2) Flight position light - ON.

g. BLADES FOLD-SPREAD switch - OFF.

h. Lights and servo pressure - CHECKED.

CAUTION

Check with ground crewman to be sure that blades are in proper spread position and that the blade lockpins are securing the blades in place.

3. Hoist, hoist ICS, HEELS, and IBIS (NON-ET) - CHECKED.

4. Flotation gear - CHECKED.

a. Arming switch - OFF.

b. Rotary selector test switch – L1, L2, R1, and R2.

c. Indicating light - ON, IN EACH POSITION.

d. Rotary selector test switch - OFF.

5. Head check - AS REQUIRED.

WARNING

Personnel injury may occur if controls are moved without knowledge of the man on the rotor head.

6. Servos - CHECKED.

a. Auxiliary and primary servo hydraulic pressure indicators - NORMAL RANGE.

b. Flight control servo switch - PRI OFF. Primary servo pressure indicator should indicate a drop to zero and caution light should go on.

c. Trim release button (on cyclic stick) - DEPRESS.

Collective pitch lever - ACTUATE FULL UP.

d. Actuate cyclic stick from one extreme to the other in lateral, then fore-and-aft directions. Repeat cyclic stick movements with collective down.

e. Flight control servo switch - ON.

f. Flight control servo switch - AUX OFF.

Auxiliary servo hydraulic pressure indicator should indicate a drop to zero and caution light should go on.

Note

When turning auxiliary servo off, note that stick jump does not exceed one-eighth of an inch in cyclic and one-sixteenth of an inch in rudder and collective to be sure of proper rigging of auxiliary servo pilot valve. Collective should be at midposition (approximately 4 inches off bottom stop) and rotary rudder pedals positioned right pedal slightly forward of left when making this check. If excessive reactions are encountered, repeat the check when hydraulic temperatures are normal (about 12 to 15 minutes).

g. Trim release button (on cyclic stick) - PRESS.

Collective pitch lever - ACTUATE FULL UP.

Actuate cyclic stick from one extreme to the other in lateral, then fore-and-aft directions. Repeat cyclic stick movements with collective down.

h. Press left rudder pedal and lift collective to full-up position. Note left rudder pedal rearward movement of about 2 inches because of collective to yaw coupling. Press right rudder pedal and lower collective to full-down position. Note right rudder pedal rearward movement of about 2 inches because of collective to yaw coupling.

Note

- Full actuation of flight controls can be made in any one direction in 1 second with no evidence of binding. Should binding in the controls be encountered, maintain that control position where the binding occurred until the system can be checked by maintenance personnel.

- If cyclic drives excessively during collective/pedal checks, primary servos could be incorrectly timed.

i. Flight control servo switch - ON.

Auxiliary servo hydraulic pressure indicator should indicate normal pressure, and caution light should go off.

7. Basic ASE - CHECKED.

a. Initial warmup time is 3 minutes ±30 seconds.

b. ASE - ENGAGE.

c. Hover indicator - A MODE(NON-ET) or flight director (ET) A MODE.

d. CG TRIM - Move CG TRIM knob and note that the pitch bar on the hover indicator (NON-ET) or flight director (ET) can be moved full travel in each extreme and follows movement of trim knob. Reposition pitch bar to center, cyclic stick centered.

e. Pitch and roll valve check - Move cyclic stick to forward left quadrant. Recenter the cyclic and note that the pitch bar precedes the roll bar to the center. Repeat step to aft right quadrant. Normal deflection of the pitch bar with cg bar centered should be 2-1/2 ±l/2 divisions. In each case, observe that the pitch bar precedes the roll bar to the center of the hover indicator (NON ET) or flight director (ET). This assures proper operation of the dual-channel lag amplifier.

f. Yaw trim - CHECK PROPORTIONAL BAND. Raise collective to midposition and position pedals left pedal slightly forward of right. Slowly turn yaw trim knob. At initial movement of pedals, note point on hover indicator (UH-3H) or flight director (UH-3H Executive Transport) at which pedals start to move. This should be between 3/4 and 1-1/2 divisions from center. Press either pedal switch and observe that the yaw piper returns to center. Repeat for opposite rudder and note that the breakout should be approximately equal in both directions.

Note

If the above check is unsatisfactory, repeat the check when hydraulic temperatures are normal (about 12 to 15 minutes).

g. ASE engage/disengage check.

WARNING

Use of the hardover switches on the ASE channel monitor panel shall not be made with the blades folded to preclude damage to the rotary wing and control linkages. In addition, ASE hardovers shall not be induced in flight. Repeated use of the hardover switches may cause ASE valve failure. If an induced hardover should cause an ASE valve failure, a hydraulic hardover may occur and can be eliminated only by securing of the auxiliary servo hydraulic system.

(1) ASE, BAR ALT, CPLR, and HOVER TRIM engage buttons (CYC CPLR switch must be in DOPP to engage hover trim) - PRESS.

(2) Pilot CPLR, BAR ALT, and ASE release buttons (collective, cyclic stick) - PRESS INDIVDUALLY AND IN ORDER. Check that all release buttons function and all engage button lights go off.

(3) ASE, BAR ALT, CPLR, and HOVER TRIM engage buttons - PRESS.

(4) Copilot CPLR, BAR ALT, and ASE release buttons (collective, cyclic stick) - PRESS INDIVIDUALLY AND IN ORDER. Check that all release buttons function and all engage button lights go off.

8. Coupler/Doppler checks (if desired) (NON-ET).

a. Altitude channel test.

(1) Radar altimeters - ON AND RELIABLE.

(2) Collective friction - OFF.

(3) ALTITUDE set knob - 100 FEET.

(4) Altitude coupler switch - RAD ALT.

(5) ASE and CPLR buttons - DEPRESS; CHECK FOR COLLECTIVE RISE.

(6) Altitude coupler switch – WHEN COLLECTIVE STARTS TO RISE, SWITCH TO VA. COLLECTIVE SHOULD CONTINUE TO RISE IN EACH POSITION. (On helicopters with AFC 396, disregard mention of CABLE ALT position.)

(7) Collective pitch lever - UP.

(8) CPLR REL and BAR REL buttons -DEPRESS; CHECK VERT POINTER NULL ±3/4 DIVISIONS.

(9) ALTITUDE set knob - ZERO.

(10) SPEED set knob - 100 KNOTS.

(11) CPLR button - DEPRESS; CHECK FOR COLLECTIVE DROP.

(12) Altitude coupler switch – WHEN COLLECTIVE STARTS TO DROP, SWITCH TO VA, THEN RAD ALT. COLLECTIVE SHOULD CONTINUE TO DROP IN EACH POSITION.

(13) Collective pitch lever - DOWN.

(14) CPLR REL and BAR REL buttons - DEPRESS; CHECK VERTICAL POINTER NULL ±3/4 DIVISION.

(15) BAR OFF button - DEPRESS.

b. VA/Doppler V_h, V_d, and V_z nulls.

(1) Doppler - STBY.

(2) METER SELECTOR knob - CPLR.

(3) Hover indicator - A MODE.

(4) CYC CPLR switch - OFF.

(5) ASE - ENGAGED.

(6) SPEED set knob - CENTER HORIZONTAL BAR (±2 knots on knob).

(7) DRIFT set knob - CENTER VERTICAL BAR (between D and T on knob).

(8) Hover indicator vertical pointer - 1 ±l/4 divisions up.

(9) Altitude coupler switch - RAD ALT.

(10) CPLR - ENGAGED.

(11) Hover indicator pointer - 0 ±l/4 division.

Note

The accelerometer nulls cannot be checked adequately aboard ship because of the accelerations generated by ship movement. When setting nulls aboard ship, center DRIFT and SPEED knobs as approximate settings during first hover. Speed and drift settings can be effectively nulled during a cyclic coupled hover. With the meter selector switch in coupler, monitor A mode to center both bars with the speed and drift pots while the copilot monitors aircraft hover stability.

c. Hover trim check - IF DESIRED.

(1) ASE, BAR ALT, coupler - ENGAGE.

(2) CYC CPLR switch - DOPP.

(3) HOVER TRIM - ENGAGE.

(4) Crewman at the aft station - REPORT RED LIGHT ON.

(5) Pilot - RELAY INFORMATION TO CREWMAN TO ALLOW HIM TO CENTER BARS ON HOVER INDICATOR WITH HIS PITCH AND ROLL BIAS KNOBS.

(6) Crewman - MOVE CONTROL STICK FORWARD.

(7) Pilot - CHECK THAT HORIZONTAL BAR MOVES UP AND THAT CYCLIC STICK BEEPS FORWARD.

(8) Repeat steps (6) and (7) for back, right, and left.

(9) CYC CPLR switch - OFF, CHECK THAT HOVER TRIM LIGHT ON ASE PANEL GOES OFF.

d. Cyclic channel tests.

(1) Pilot hover indicator - D MODE.

(2) Copilot hover indicator - A MODE.

(3) Doppler selector switch - TEST.

(4) CYC CPLR switch - DOPP.

(5) Pilot hover indicator - 1 TO 1-1/2 DIVISIONS UP AND RIGHT, VERTICAL POINTER 1-1/2 TO 2-1/2 DIVISIONS UP.

(6) Copilot hover indicator - 2-1/2 TO 3-1/2 DIVISIONS UP AND RIGHT, VERTICAL POINTER 3 TO 3-1/2 DIVISIONS DOWN FROM V_Z NULL.

Step 11 of accelerometer nulls.

(7) Groundspeed indicator - 17 ±2 KNOTS and 225° ±5°.

(8) Cyclic stick - CHECK BEEPING FORWARD AND RIGHT.

(9) Doppler selector switch - RESET TO STBY.

(10) Hover indicators - RESET.

(11) METER SELECTOR knob - ASE.

(12) ASE - OFF.

9. TACNAV equipment check (if desired).

10. Cargo hook releases - CHECKED (as desired) (NON-ET).

a. Crewman should check for activation of cargo hook release for both pilot and copilot electrical release button.

b. Check for activation of cargo hook release for pilot manual release foot plunger.

CAUTION

If foot plunger does not return to the full up position after manual activation, subsequent inadvertent release of an external load is possible.

7.6 STARTING NO. 2 ENGINE AND ROTOR ENGAGEMENT

1. Start mode switch - NORMAL.

2. Fuel panel - No. 2 FIREWALL VALVE OPEN.

3. Rotor brake - ON.

4. Anti-ice switch - AS REQUIRED.

Note

No. 2 engine anti-ice switch on (below 10 °C OAT if visible moisture is present).

5. No. 2 engine - START.

Note

Engine start limitations are the same as No. 1 engine.

6. All gauges - CHECKED.

7. Boost pumps - OFF.

8 ASE - OFF.

9. Shoulder harness (all stations) - LOCKED.

10. Collective - MINIMUM.

Copilot monitor until taxi.

11. Area clear, engage signal - CHECK.

WARNING

Before rotor engagement, be sure personnel are clear of the rotary wing and the rotary rudder blades. For ground clearances, see Figure 3-10.

12. Rotor - ENGAGE.

Advance No. 2 speed selector for a 2-percent N_g increase, place rotor brake in detent, checks rotor brake pressure zero, caution light off, and ensure that N_f and N_r are advancing together. Maintain torque values between 40 and 60 percent. Antiflapping restrainers should release at about 25- to 30-percent N_r. Droop stops should release at about 65- to 75-percent N_r.

CAUTION

The rotors should not be engaged in winds above 45 knots because of excessive rotary wing blade flapping. When engaging the rotor in high or gusty winds, the rotor should be accelerated as rapidly as possible without exceeding torque limits of 60 percent. Refer to FIG. 8-1 for Engagement Wind Limits

13. Cyclic stick - CHECK RESPONSE AT 100 PERCENT.

Actuate cyclic stick a slight amount in all directions and cheek for proper response by observing tip-path plane of rotary wing blades.

14. No. 2 engine flat pitch - CHECKED.

Normally power turbine speed (N_f) is 108 to 112.5 percent for single engine with maximum travel on the speed selector. Normal deterioration of engine performance may result in flat pitch readings below 108-percent N_f. If this flat pitch is the result of normal deterioration of engine performance, the engine may be accepted for flight provided the reading is not below 105-percent N_f. If the pilot is unable to determine that a reading between 105 and 108 percent is the result of normal deterioration of engine performance, the engine shall be checked for serious fuel control malfunction before flight.

Note

With AFC 399 and Nr above 104 percent, No. 1 engine will sense an overspeed condition and drop to 60- to 70-percent N_f.

15. No. 1 speed selector - GRD IDLE.

CAUTION

If the generator caution lights and/or tail takeoff caution light go on when the No. 1 engine is retarded to ground idle, do not switch from ACCESS DR to FLIGHT. Immediately return the No. 1 speed selector to 104-percent N_f and go through a normal shutdown. This condition indicates a possible failure of the tail takeoff freewheeling unit. Under these conditions, loss of No. 1 engine will result in loss of all accessories.

CAUTION

Before switching accessory drive switch to FLIGHT, a verbal challenge and reply exchange shall be made between the pilots to be sure the No. 1 engine is at GRD IDLE and No. 2 engine is at 102-percent Nf/Nr or above. Selecting FLIGHT when No. 1 engine N_f is greater than No. 2 engine N_f can damage main gearbox because of suddenly applied loading.

16. Accessory drive switch - AFT, ACCESSORY DRIVE AND BLADE PANEL LIGHTS OFF.

CAUTION

- After placing the accessory drive switch to the aft position, if the accessory drive light remains on or there is any other indication that the transmission did not actually shift to the flight mode, return the accessory drive switch to the forward position before moving the No. 1 engine speed selector from the GRD IDLE position.

- If the input freewheeling unit fails to engage despite positive indications of a successful shift from accessory drive to flight position, the accessory drive switch should be returned to the accessory drive position, and a normal shutdown performed.

- Lack of electrical overspeed protection may result in destructive overspeed in the event of a flex drive shaft failure while on the deck with the main gearbox accessory drive switch in the flight position.

- Rapid movement of No. 1 Speed selector to the maximum position can cause premature Failure/damage to the main gearbox No. 1 freewheeling unit. Gradually bring the No. 1 engine N_f up to approximately 90 to 95 percent, pause momentarily, then smoothly marry No. 1 N_f to N_r without any "clunking" of the input freewheeling unit or N_f overshoot. If "clunking" or overshoot does occur during normal engagement of the No. 1 engine, it may indicate a worn freewheeling unit that should be further investigated.

- On helicopters modified by AFC 401, if the speed selectors are in the proper position (No. 1 - GRD IDLE, No. 2 - 102-percent N_f or above) but the linear actuator will not transfer from accessory drive to flight, you can bypass the speed selector microswitches by placing the accessory drive override switch to OVRD. Selecting OVRD when No. 1 engine N_f is greater than No. 2 engine N_f can damage main gearbox because of suddenly applied loading. A verbal challenge and reply exchange shall be made between the pilots to be sure the No. 1 engine is at GRD IDLE and No. 2 engine is at 102-percent N_f prior to selecting OVRD. The accessory drive light will remain on 6 to 7 seconds after selecting OVRD.

17. No. 1 engine flat pitch - CHECKED.

a. No. 1 speed selector - MAXIMUM.

b. No. 2 speed selector - 100-percent N_f, ZERO TORQUE.

18. N_f and N_r - 104 PERCENT.

(Initiate checklist here for crew change with rotor engaged).

19. NAVAIDs - CHECKED.

20. Landing gear lockpins/safety pins - SIGHTED.

21. HEEDS bottle - ON.

22. VLEA control dial (helicopters modified by AFC 407) - SET.

7.7 TAXIING

WARNING

The tip-path height forward of the helicopter must be monitored to prevent endangering taxi directors and line personnel.

7.7.1 Taxiing Procedure. Taxiing is a coordinated maneuver utilizing collective to control taxi speed and rotary rudder thrust to control heading. In addition, the toe brakes are utilized for slowing/stopping the aircraft. The toe brakes shall only be applied with collective in the full-down position. Cyclic is normally displaced slightly forward and into the wind.

All ground taxiing in congested areas shall be done under positive control of a qualified taxi director. Use his signals as an aid; however, remember that the pilot and not the lineman is responsible for the safety of the helicopter.

The copilot shall give the lineman the pull-chocks sign. The pilot and copilot shall then check their respective sides of the helicopter for removal of chocks, tiedowns, obstructions, and loose gear. The copilot shall report his side clear, and the pilot shall acknowledge and report his side clear. All stations should report shoulder harness locked. The copilot shall monitor the collective while the pilot unlocks the tailwheel.

7.7.1.1 Taxi Checklist.

1. Area - CLEAR.

2. Lights - AS REQUIRED.

3. Chocks/tiedowns - REMOVED.

4. Tailwheel locking handle - UNLOCKED.

5. Shoulder harness (all stations) - LOCKED.

WARNING

The crew chief's seat is not a crashworthy seat. Do not occupy this seat during takeoff or landing.

6. Parking brake - OFF.

7. Brakes – CHECKED.

WARNING

If the wheelbrakes bind or lock up, or helicopter is inadvertently taxied into a hole or obstruction, the nose will pitch down and an immediate lift-off may be required to prevent damage to the helicopter. During all phases of ground taxi, pilots must be constantly alert for the necessity of lift-off and all occupants must remain securely strapped in until cleared to leave their seats by the pilot.

8. Tailwheel - CHECKED.

CAUTION

Do not place tailwheel lock handle to LOCKED during ground turns. Helicopter must be rolling in a relatively straight line when tailwheel is LOCKED to prevent shearing of lockpin.

Note

To allow the tailwheel lockpin to release, do this:

a. Allow helicopter to taxi forward a few feet to relieve possible binding of the lockpin because of tailwheel tire side loading.

b. Exert rotary rudder pedal pressure (normally left) in varying amounts to balance inherent torque that may prohibit disengagement of tail-wheel lockpin during step 4.

Use rotary rudder pedals cautiously to prevent swerving. Maintain 104-percent N_r so that an immediate takeoff can be accomplished if a crosswind should tilt helicopter. When taxiing crosswind, hold cyclic stick slightly into wind.

CAUTION

Taxi speed is controlled with coordinated use of cyclic, collective, and toe brakes. Rapid application of excessive aft cyclic without enough load on the rotor system may cause the retreating blade to strike the tail cone.

9. RMI/BDHIs/wet compass – CHECK.

10. Turn-slip-Indicator – CHECK.

7.7.2 Air Taxiing. Air taxiing should not be used in the vicinity of parked aircraft or debris that will be displaced by rotor wash. Extreme care shall be taken when air taxiing. The pilot, copilot, and crewman shall act as vigilant lookouts. Taxiing altitude shall be high enough to clear all obstructions and to prevent dust, dirt, and debris from blowing into the helicopter.

7.8 PRETAKEOFF

1. Radar and barometric altimeters, VGI - TEST, SET, AND CHECKED.

2. N_r - 104 PERCENT AS REQUIRED.

3. OAT - CHECKED.

Check OAT and turn on pitot heat if required. Engine anti-ice switches on at 10 °C OAT or below if visible moisture is present.

WARNING

If windshield anti-ice is to be used, the LOW position should be selected before selecting NORMAL. Personnel in the vicinity of the helicopter should be warned of a possible missile hazard in case of damaged or arcing heating elements.

4. Boost pumps - AS REQUIRED.

5. Rotor brake - CHECKED.

Rotor brake handle is in detent, the rotor brake caution light is off, and that rotor brake pressure is 0 psi.

6. Instruments/warning lights - NORMAL/ CHECK.

7. Lights - AS REQUIRED.

7.9 TAKEOFF CHECKLIST

CAUTION

The crew of the helicopter must maintain constant vigilance outside of the cockpit to avoid the possibility of striking another aircraft or other obstacles.

1. Chock/tiedowns - REMOVED.

2. Shoulder harness - LOCKED.

3. Doppler/tacan/TACNAV - AS REQUIRED (NON-ET).

4. ASE/BAR ALT - ENGAGE/AS REQUIRED.

5. Lights - AS REQUIRED.

6. Emergency start - ON.

7. Tailwheel - LOCKED.

8. Brakes - AS REQUIRED.

9. Crew - READY FOR TAKEOFF.

   a. Heed bottles - ON.

   b. VLEA control dials - SET.

7.9.1 Takeoff Procedures. Because of the versatility of the helicopter and its ability to takeoff from small areas, the governing factors in the type of takeoff to be used are gross weight, density altitude, wind velocity and direction, and size and condition of the takeoff area. The following paragraphs describe the types of takeoff to be made under various conditions. The normal vertical takeoff is the most common type of takeoff and should be used whenever possible. Normal vertical takeoffs can be made at moderate altitudes and with normal gross weight, as shown in Chapter 21. This type of takeoff provides a high safety factor, as the helicopter is lifted vertically to a height of 15 feet where flight and engine instruments and controls may be checked for normal operation before continuing flight. At high altitudes, when a vertical takeoff can be made but hovering out of ground effect is not possible, the helicopter may be accelerated forward in level flight with the wheels clear of the ground until climbing airspeed is obtained. Conditions requiring an accelerating run in level flight are shown in Chapter 21. Maximum performance takeoffs permit the helicopter to take off from restricted areas under high gross weight and high-altitude conditions. Maximum performance takeoffs are used to accelerate the helicopter from a standing position on the ground without hovering into forward flight with a concurrent climb. Running takeoffs are used under certain conditions of high gross weight and high-density altitude where there may not be enough power developed by the engines and lift developed by the rotary wing blades for a vertical takeoff. Conditions requiring a running takeoff are shown in Chapter 21.

WARNING

(ET) The APU is intended for ground operations only (minimal lighting, instrumentation, and air conditioner operation). It does not have a fire warning or suppression system and therefore should not be used in flight.

7.9.1.1 Normal Vertical Takeoff. After the helicopter has been taxied to the takeoff spot and headed into the wind, the takeoff checklist shall be completed including a request for takeoff clearance.

Set pilot hover indicator (NON-ET) or flight director (ET) to A mode (D mode in instrument conditions), check collective pitch lever at minimum pitch setting, set engine speed selectors, and increase collective pitch steadily as helicopter leaves the ground.

Rise vertically to about 15 feet as indicated by the radar altimeter, maintaining hover altitude and steady position with cyclic stick. Check all engine and flight instruments and check for clear area before transition to forward flight.

7.9.1.2 Running Takeoffs. Running takeoffs should never be attempted over rough terrain. Under conditions requiring a running takeoff, it is necessary to increase lift through forward motion before becoming airborne. With the helicopter lined up on desired takeoff heading, smoothly increase collective pitch and at the same time move the cyclic control forward to commence forward motion over the ground. As the helicopter becomes light on the landing gear, the combinations of the nosedown attitude to roll forward and the collective to cyclic coupling may tend to pitch the helicopter forward and possibly bring the ARA-25 antenna and rotating beacon in contact with the ground. As groundspeed increases, sufficient lift will be developed to accomplish a takeoff. Do not attempt to rush the forward movement, as settling into the ground will result. Utilize rotary rudder and wing-down methods of control as necessary to maintain a straight track over the ground with no drift. As the helicopter becomes airborne, establish a shallow climb and gradually displace the cyclic control forward to increase airspeed to 70 knots while maintaining necessary torque to obtain normal acceleration. Do not exceed maximum dual-engine torque. When comfortably airborne, adjust collective as necessary for climbing. Throughout the maneuver, the required torque will be less than that required to hover.

7.9.1.3 Crosswind Takeoffs. Crosswind takeoff procedures are the same as into-the-wind-vertical or running-takeoff procedures with the exception of the required cyclic displacement into the wind. These takeoffs are prohibited in winds exceeding 30 knots.

7.9.1.4 Maximum Performance Takeoff (Restricted Area). The maximum performance takeoff is required when operating from restricted areas where obstructions surround the site. This type of takeoff can usually be accomplished when there is sufficient power to hover out of ground effect. It may be necessary to climb vertically or nearly vertical, as dictated by surrounding obstacles. Set speed selectors full forward. Maximum performance takeoffs are used to take off from restricted areas and to accelerate the helicopter from a standing position on the ground into a climb and forward flight without hovering. Check wind direction and area clear. Increase collective pitch smoothly to maximum power, being careful not to exceed gearbox limitations, and simultaneously increase airspeed to the extent consistent with safely clearing the obstacles until best climb speed can be attained and climbout continued. Every effort should be made to minimize operating time in the avoid sections of the height velocity charts found in Chapter 25.

CAUTION

At high gross weights, it may not be possible to make a safe landing in the event of engine failure. Consequently, this maneuver should only be practiced at low gross weights.

7.9.2 Hovering. Hovering this helicopter is basically the same as hovering any other single rotor helicopter. Proficiency in hovering the helicopter is most important, since this is the maneuver whereby the helicopter has most of its designed missions. Hovering should be done at 100-percent N_r. Height above the deck should be about 15 feet over a paved surface and 40 feet over water or unpaved surfaces. When hovering crosswind, the cyclic control should be displaced into the wind to avoid drifting. Hovering crosswind in winds of over 30 knots shall not be attempted. Downwind hovers are seldom used operationally and should be attempted only under controlled conditions of wind and terrain. This maneuver should only be practiced over terrain suitable for landing. During extended downwind hovering, close cabin and cockpit hatches and turn on the ventilating fan to prevent too much exhaust gas concentrations in the cockpit and cabin. Hovering downwind in winds of over 20 knots is a prohibited maneuver.

7.10 TRANSITION TO CLIMB

When transitioning to forward flight, lower nose approximately 5° to 8° below hover attitude and increase torque approximately 15 percent above hover torque. If engine power, rotary wing rpm, and collective pitch remain constant, a momentary settling will be noted when the cyclic stick is moved forward, tilting the tip-path plane to obtain forward speed. As the helicopter accelerates forward through translational lift, less power is required because of the increased airmass contacted by the rotary wing. At this time, the cyclic stick should be repositioned to maintain the nosedown attitude.

As forward speed is attained, the aircraft will begin to climb; torque values established by the original collective position will decrease with the increase of translational lift but should be maintained above 65 percent. Normally, transition should be programmed to attain 70 knots airspeed between 150 and 200 feet. A normal climb airspeed should be maintained at 70 knots and will result in a near level attitude. For recommended speeds, climb rates, and fuel consumption for climbs refer to Chapter 22.

7.11 POSTTAKEOFF

After a normal vertical takeoff check all engine and flight controls and complete the following:

1. Landing gear - UP.
2. Lights - AS REQUIRED.
3. IFF/NAVAIDs - CHECK.
4. Compass - CHECK.
5. Security check - COMPLETE.
6. N_r -AS REQUIRED.
7. Adjust CG Trim – As Required.

Note

While operating at or above 104-percent N_r, the tail takeoff freewheel unit warning system will not function because of high generator frequency output.

7.12 CRUISE CHECKS/FUEL MANAGEMENT

1. For cruise power settings, refer to Part XI.

Note

The automatic navigation system accuracy and the electronics equipment reliability is dependent upon operation at 100-percent N_r. The vibration absorber also is adjusted for best operation at 100-percent N_r. For optimum electronic and automatic navigation system performance and lowest vibration levels, the helicopter should be flown at 100-percent N_r.

2. Engine anti-ice switches - ON (at 10 °C OAT or below if visible moisture is present).

3. Fuel boost pumps - AS DESIRED.

The four submerged-type, fuel boost pumps installed will not provide enough fuel pressure to operate the engines in case of failure of the engine-driven fuel pump. They will, however, assure a head of fuel is delivered to the centrifugal fuel purifier and counteract any vapor lock that might otherwise form in the helicopter fuel system.

a. During normal operations, at least one boost pump shall be on in the forward and aft tanks.

CAUTION

Use of boost pumps for engine feed is required whenever the center tank is empty. A malfunctioning transfer check valve can result in air being drawn into the fuel system from the empty center tank. The above condition can result in flameout of the engine serviced by the fuel tank, in which case both boost pumps are either inoperative or off.

b. Use of all fuel boost pumps is mandatory during the following conditions:

(1) When flying at pressure altitudes of 4,000 feet and above.

(2) During operations in temperatures of 43 °C, OAT, and above.

(3) When fuel level indicates less than 600 pounds in either the forward or aft tank.

4. BAR ALT engage button - DEPRESS if automatic altitude control is desired after leveling off and stabilizing airspeed.

7.12.1 Fuel Crossfeed. Fuel crossfeed may be utilized during normal operations to assist in fuel management. To accomplish fuel crossfeed, do the following:

1. Crossfeeding tank - BOTH BOOST PUMPS ON.

2. Noncrossfeeding tank - ONE PUMP ON.

3. Crossfeed switch - OPEN.

Note

It is possible that differential fuel pressure may prevent the system from crossfeeding. If no evidence of crossfeeding is noted, change pump usage in the noncrossfeeding tank.

7.12.2 To Secure Crossfeed

1. Crossfeed switch - CLOSED.

2. Boost pumps - AS DESIRED.

7.12.3 Fuel Dumping in Flight. If fuel dumping is necessary to reduce gross weight for hovering or landing, perform the following procedures:

1. All fuel boost pumps - ON.

2. Crossfeed switch - CLOSED.

WARNING

To preclude possible flameout, do not open the crossfeed valve. Fuel dumping should be done utilizing the failed engine's fuel dump system. Cg trim should not be affected seriously from fuel imbalance.

3. Fuel dump switch - AS REQUIRED.

4. Fuel dump switch - OFF.

5. Boost pumps - AS REQUIRED.

Note

Under certain extreme conditions, other equipment should be removed in conjunction with the fuel.

7.12.4 Turns Using Automatic Stabilization Equipment. By using the yaw trim knob for turns while hovering, turn the knob left or right slowly and smoothly to produce the turn desired. With forward speed, this control will be very convenient for small turns of from 1° to 5°. Large turns can be made but will cause the helicopter to skid unless they are made very slowly or the pilot banks the helicopter while the knob is turned.

7.13 BEFORE LANDING CHECK

1. Landing gear - DOWN AND LOCKED.

Check landing gear position indicators. Warning light in lever knob should go on and then go out when landing gear is down and locked. Landing gear should extend in about 5 seconds.

2. Speed selectors - CHECKED.

Note

When established in a landing pattern, only item 1 needs to be checked for subsequent touch and go landings. The landing gear shall not be retracted when another landing is intended.

3. Cabin heat/air conditioning (ET)- OFF.

Five minutes before landing to allow heater fan to continue to operate and lower duct air temperature before landing.

4. Jettison, HF (if installed) - SAFE.

5. Lights - SET.

6. Stores load panel switches (NON-ET)- OFF/SAFE.

7. Shoulder harness - LOCKED.

WARNING

The crew chief's seat is not a crashworthy seat. Do not occupy this seat during takeoff or landing.

Check all helicopter stations.

8. Tailwheel - LOCKED.

9. Brakes - CHECKED.

Check for pressure and set as desired.

10. Crew – Crew landing checklist complete/Hook stowed.

7.14 LANDING

7.14.1 Dual-Engine Landing Approach and Transition to a Hover (Figure 7-7). The proper position to begin a normal approach is abeam the landing spot, heading downwind at a recommended 500-foot altitude and 70-knot airspeed. Complete the landing check list before reaching the 180° position. When turning base, check wheels down and locked and notify the tower. Begin approach by reducing collective to about 25-percent torque and establish a rate of descent of 500 to 1,000 fpm while turning toward the landing area. Vary the power as necessary to maintain the desired rate of descent at 70 knots. Increased right rotary rudder pressure will be required to maintain balanced flight. At about 150-foot altitude, apply back cyclic to decelerate. Plan the approach and apply power as necessary so that the helicopter simultaneously arrives at zero groundspeed and zero rate of descent over the landing site in a near level attitude at 15 feet. If excessive groundspeed is present at the end of an approach, come to a hover beyond the spot or take a waveoff. Any tendency to correct this condition by placing the helicopter in an abrupt tail-low attitude near the ground should be avoided.

7.14.2 Landing After Attaining a Hover.

CAUTION

- During landings and ground operations, it is possible by abrupt movement of the collective pitch lever to the down position and the cyclic stick to the aft position to cause the rotary wing blades to strike the tail section. To prevent this, avoid abrupt movements of the collective and cyclic controls while the wheels are in contact with the ground.

- When landing with an extreme aft cg setting and maintaining level attitude with cyclic, the helicopter will move forward on landing. The cyclic should not be moved aft to stop the forward motion, as the rotor blades may strike the tail pylon.

After attaining a hover over the spot of intended landing, decrease the collective pitch to a vertical descent, maintaining position over the ground with cyclic stick and directional control with the rotary rudder pedals. Smooth reduction of collective pitch will limit directional control problems. Under normal wind conditions, the helicopter will touch down tailwheel first, followed in a nearly level attitude by both main landing gears. Upon firm contact with the surface, decrease collective pitch slowly and smoothly, simultaneously applying forward cyclic; stop any forward rolling motion with wheelbrakes, not aft cyclic. A bias in the collective to cyclic pitch (fore and aft) coupling is incorporated in the mixing unit to apply automatic noseup pitching correction when the collective is lowered. The pilot must counteract this automatic aft tilt of the rotor path when the collective is lowered by application of forward cyclic. The technique is imperative to prevent the rotary wing blades from operating in proximity to or flexing downward upon landing impact and possibly striking the tail cone. To aid smooth landings and avoid undue stresses on the landing gear, all sideward or rearward drift should be eliminated before touchdown. When conditions will allow, a smoother landing is sometimes accomplished by moving forward over the deck at 1 or 2 knots on touchdown. Stop the rolling with wheelbrakes, not aft cyclic. If a soft surface is unintentionally encountered and the wheels begin to settle, add collective pitch immediately and become airborne. This helicopter does not have a history of susceptibility to ground resonance; however, if any unusual vibration or unbalanced condition is experienced during landing, execute an immediate takeoff. Normal vertical landings on land should be made with tailwheel locked. Changes in the rotary wing torque may cause a slight swerve if the tailwheel is unlocked.

7.14.3 Run-On Landings. Run-on landings should be practiced to simulate the method of landing a helicopter that cannot be hovered because of a high gross weight or high altitude. Under those conditions, it is necessary to maintain the added lift provided by forward motion until the wheels are on the ground. Practice run-on landings should be made with feet on the rotary rudder pedals, tailwheel locked, wheelbrakes off, and on approved landing sites. The helicopter is flown in a normal approach down to the straightaway position. In the straightaway, cyclic control is used to control descent while maintaining a torque value less than hover power to simulate heavy load conditions; utilize wing-down, top rotary rudder methods of control as necessary to maintain a straight track over the ground with no drift. A normal rolling touchdown will be made in a level attitude (maximum pitch 1° to 2° nose high) at a ground-speed not over 40 knots. Attitude and rate of descent shall be controlled with cyclic and collective pitch, not to exceed preestablished torque values. Following touchdown collective will be gently lowered in conjunction with forward movement of cyclic. Wheelbrakes should be used to slow groundspeed. Run-on landings should not be made with the tailwheel unlocked.

7.14.4 Crosswind Landings. Crosswind landing procedures are the same as into-the-wind vertical landing procedures with the exception of the required cyclic displacement into the wind. This cyclic displacement should not be released upon touchdown, as this will reduce the force holding the helicopter in a vertical position and under extreme conditions could result in the helicopter being overturned. It is most important to have no sideward drift when making crosswind landings. These landings are prohibited in winds above 30 knots.

7.14.5 Practice Single-Engine Approach. This practice maneuver should be initiated by retarding one speed selector to no less than 96-percent N_f. Perform critical memory item steps related to engine loss to keep the aircraft in a safe flight envelope. Upon determination that flight can be maintained, check all gauges to determine which engine has malfunctioned and what action to take. Once it has been determined that the engine has failed, perform a topping check of the good engine to determine single-engine capabilities. Perform topping checks by drooping N_r to 100 percent and noting available torque. Call for checklist as backup. A single-engine approach to a pad or single-engine run-on landing should be made depending on the available landing platform. During a single-engine run-on landing, a normal touchdown should be made in a level attitude (maximum pitch 1° to 2° nose high) at a groundspeed not over 40 knots, ensuring that 1,000-fpm rate of descent during the pattern and 500-fpm rate of descent on final is not exceeded. During a single-engine approach to a pad, fly a normal approach profile ensuring that rate of descent does not exceed 500 fpm on final. At 30 feet and below, avoid nose attitudes in excess of 10° up. At 10-foot AGL, nose attitude should not exceed 5° noseup. Touchdown should be level.

CAUTION

If at any time during the approach unusual engine performance is noted, advance both speed selectors to the full forward position, perform normal landing, and analyze malfunction.

7.15 AUTOROTATIONS

7.15.1 Practice Autorotation.

Note

During practice autorotations, BAR ALT shall be disengaged.

Autorotations should be practiced only at designated areas where there are no obstructions and where crash and firefighting facilities are available. At least one normal approach shall be made before attempting a practice autorotation to determine the required torque, N_g, gross weight, and density altitude conditions. Autorotations may be practiced only with an HAC or an H2P aboard. Pilots should be particularly alert to observe and report any engine or rotor overspeeds and torque values that exceed the limits. Any unusual phenomena encountered during an execution and recovery from an autorotation shall be recorded on a VIDS/MAF.

Practice basic autorotations shall be made using a minimum of 70 knots from a starting point of 500 feet or above for every 90° of turn. Recovery will simulate ground level at about 15 feet with a touchdown groundspeed of about 15 knots. After mastering the basic autorotation, pilots are encouraged to perform various altitude, airspeed, and flare and recovery techniques (i.e., 100 knots maximum glide, confined area, etc).

The sequence of procedures for an autorotation is:

1. Adjust N_f/N_r to 98 percent.

2. Enter autorotation by smoothly lowering collective to full-down position. N_f and N_r should separate and torque will indicate zero percent, both indications of autorotative flight.

3. Establish glide of 70 knots.

4. Adjust collective to maintain 104-percent N_r. Forward cyclic, negative g, up collective, or left rudder application will cause a decrease in N_r, and conversely, aft cyclic, positive g, down collective, or right rudder will cause an increase in N_r.

5. Begin flare based on visual reference, meteorological conditions, aircraft instrumentation, and pilot experience (normally 150 to 200 feet). The purpose of the flare is to reduce the rate of descent and increase N_r while slowing groundspeed to 15 knots or below. Improper choice of initial flare altitude may be compensated for by increasing or decreasing cyclic flare rate. Ensure that N_r does not exceed 117 percent.

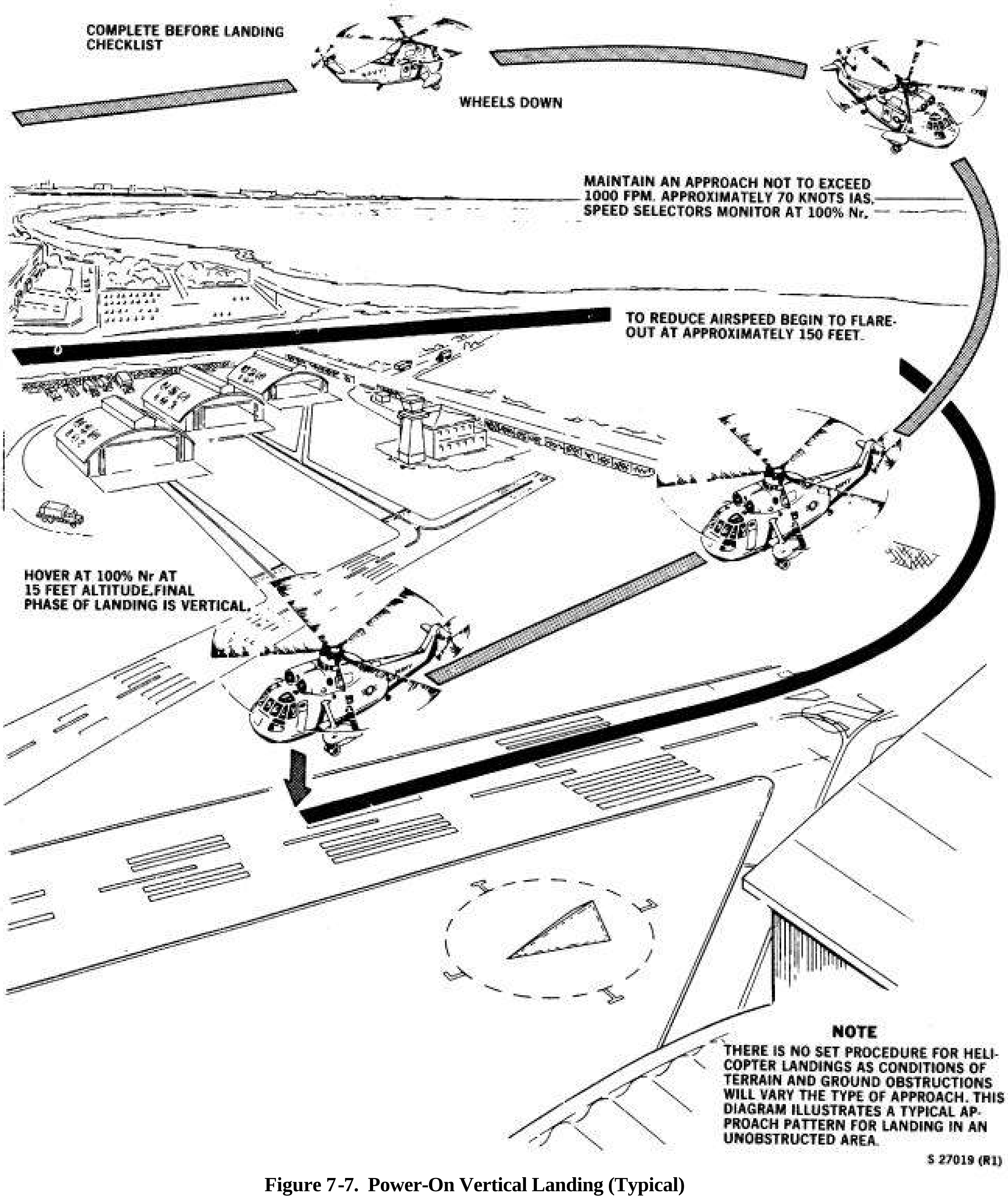


Figure 7-7. Power-On Vertical Landing (Typical)

CAUTION

Rapid application of aft cyclic will result in a premature or excessive decrease in rate of descent resulting in a high recovery or a vertical descent that could result in major damage in the case of actual autorotative landing.

6. Speed selectors full forward - As the flare is commenced, the speed selectors shall be advanced to full forward (maximum 112.5-percent N_f) in response to the command, "FULL POWER."

This step shall be completed prior to simulated touchdown. If speed selectors are advanced too rapidly during the flare, torque will increase and the helicopter will enter the powered flight regime that is of little value in autorotative technique practice.

7. Simulate touchdown at 15 feet/less than 15 knots groundspeed. In approaching the simulated touchdown point, the nose-high attitude shall be reduced so as to arrive at a level to slightly nose-high attitude as the collective is smoothly increased to simulate cushioning the landing.

Note

It is not necessary or desirable to lower the nose attitude to the horizon before collective application, as the normal collective to pitch coupling will tend to bring the nose to the level position as the collective is raised. Level nose attitude will cause the aircraft to accelerate.

Simulated touchdown in excess of 5° noseup should not be made. For successful completion of a safe autorotation, there should be no sideward drift. To compensate for crosswind, the wing-down method is recommended.

WARNING

If at any point it is considered necessary, the autorotation shall be waved off by smoothly adding collective while advancing speed selectors and adjusting nose/wing attitude to commence level off and return to powered flight. The aircraft shall not be allowed to descend below 30 feet with a noseup attitude in excess of 10° and N_f/ N_r not married.

For successful completion of a safe autorotation, it is imperative that the helicopter be flown on a straight heading with no sideward drift. In case of a crosswind, the wing-down method to control helicopter heading and drift should be used. Autorotations may be practiced over water as authorized by the squadron commanding officer for test and standardization flights under the following conditions:

1. VFR with a recovery reference other than water, such as a ship, reef, island, or prominent channel buoy.

2. Recovery must be completed above 50 feet.

Note

Practice full autorotation to a landing shall not be executed in this helicopter. In addition, practice autorotations shall not be executed at night.

7.16 NIGHT FLYING

WARNING

For flight safety, the barometric altitude controller should be kept ON while in the night landing pattern ashore or while embarked and should not be shut off until in visual contact with the desired landing spot; however, intermittent operation may be obtained by pressing the momentary BAR REL button on the collective stick during pattern descents.

7.16.1 Familiarization.

7.16.1.1 General. A night flying briefing folder or its equivalent shall be used before all night operations. In congested areas, all ground taxiing shall be under the supervision of a qualified taxi director equipped with lighted wands. Practice autorotation approaches shall not be executed.

7.16.1.2 Helicopter Operating Equipment Minimums.

1. Flight instruments (pilot and copilot): Attitude and turn-and-slip indicator, airspeed indicator, altimeters (radar and barometric), compass system, standby compass, vertical speed indicator, and clock.

2. All engine and systems instruments.

3. All instrument, navigation, landing, cockpit, and cabin lights.

4. Radio equipment: UHF, ICS, and appropriate navigation equipment.

5. ASE.

6. Low altitude overwater operations, the RAWS and BAR ALT controller shall be operating.

7.16.2 Approaches. The copilot shall go over the landing checklist and report completion to the pilot. Before each approach, the pilot and copilot shall visually check the landing gear as being down. The same type of approach that was used for day operations should be used at night. A recheck of the landing gear between the pilots and aircrewmen shall be made before each touchdown.

7.17 HELICOPTER LIGHTING

7.17.1 Land-Based (Day). For turn-up, launch, and recovery:

1. Ready to start engines - Aft anticollision light on.

2. Ready to engage - Exterior position lights flashing bright.

3. Ready for taxi - Exterior position lights steady bright.

4. After takeoff - Exterior position lights, anticollision light, and beacon as desired.

5. Recovery - Exterior position lights steady bright.

6. Disengage - Exterior position lights flashing bright.

7. Rotor stopped - Exterior position lights off.

7.17.2 Land-Based (Night).

1. After preflight and upon entering the helicopter, have crewman check operation of internal cabin lights.

2. Before starting No. 1 engine (external power required), check the illumination of all lighting. The pilot shall receive an affirmative signal from the plane director indicating that all lights are operative.

3. Pre-position the landing light about 45° below the horizontal and about 5° to the right of the nose of the helicopter, which will provide best lighting in case of an emergency.

4. Turnup, launch, and recovery.

a. Ready to start engines - Aft anticollision light on, signal with red flashlight.

b. Ready to engage - Exterior position lights flashing dim, rotor head light on.

c. Ready for taxi - Exterior position lights steady dim.

d. After takeoff - Exterior position lights, anti-collision light, and beacon as desired.

e. Recovery – Exterior position lights steady dim.

f. Disengage – Exterior position lights flashing dim, rotor head light on.

g. Rotor stopped – Exterior position lights off.

7.17.3 Carrier-Based. Light signals and helicopter lighting shall be as promulgated in NWP 3-04.1 and the CV NATOPS Manual.

7.18 AFTER FINAL LANDING

WARNING

All crewmembers must remain strapped in their seats until the helicopter has been chocked and the rotor systems stopped. If they are required to assist in parking the helicopter or the disengagement of the rotor system, they should unstrap and exit the helicopter only upon command of the pilot. If crewman reenters the helicopter, he shall be strapped in before rotor disengagement.

1. ASE-OFF.

2. Emergency Start Switches – OFF.

3. Lights - AS REQUIRED.

4. IFF-STANDBY.

5. Doppler - STANDBY.

6. Crossfeed – Closed.

7. Boost pumps - OFF.

8 Tailwheel - AS REQUIRED.

7.19 PRESSURE REFUELING WITH ROTORS ENGAGED ASHORE

During shore-based operations, tactical situations may require the helicopter to be refueled with both engines running and the rotors engaged. When performing the evolution, the following procedures will be used.

7.19.1 General Safety Precautions.

1. All fueling personnel must know the contents of NAVAIR 00-80T-109, Ashore Refueling Manual.

2. The helicopter shall be securely chocked.

3. All movement from one side of the helicopter to the other shall be at the nose. No personnel will work in close to the tail rotor.

4. All personnel working within the rotor arc shall exercise extreme caution.

5. Refueling shall be secured when any fuel spillage is noted and shall not be continued until spillage is wiped up.

6. The fueling hose shall be evacuated before connecting it to or disconnecting it from the helicopter.

7. Before entering the hot refueling area:

   a. Secure all unnecessary electrical and avionics equipment. Radio transmissions should be made only in an emergency.

   b. All ordnance shall be safed.

   c. Helicopter and fueling system checks shall be completed, including a fuel sample if required by the aircraft commander or air crewman. Fuel samples shall not be taken while the helicopter is in the refueling station.

   d. The area shall be cleared of loose objects.

   e. Ground crews shall wear proper eye and ear protection.

   f. When taxiing into the refueling station, the helicopter shall be under the guidance of a taxi director.

WARNING

Only pressure refueling is authorized with engine(s) running. Engines shall be secured for gravity refueling.

7.19.2 Duties of Personnel

7.19.2.1 Fueling Station Operator.

1. Energize and deenergize the fueling station upon signal of the LSE.

2. Continuously watch the LSE for signals.

7.19.2.2 Helicopter Director.

1. In charge of the refueling party.

2. Position himself outside of rotor diameter where he can see the pilots, fueling station operator, and the nozzle connect/disconnect man.

3. Make sure that the pressure-refueling nozzle is connected and that all personnel are ready for pressure refueling. He must get a thumbs up from the pilot, nozzleman, and fire extinguisher operator before signaling the fueling station operator to energize the fueling station.

4. Closely monitor the refueling operation and secure refueling upon the first indication that an unsafe condition exists. Refueling will normally be secured when the high-level shutoff valve is actuated or when the prebriefed amount of fuel has been added.

5. Signal the fueling station operator to evacuate the hose and deenergize the fueling station.

6. Upon completion of step 4, signal the nozzleman to unplug the pressure-refueling nozzle.

7. Be sure all refueling personnel, equipment, and chocks are clear before giving the taxi, signal to the pilot.

7.19.2.3 Nozzle Connect/Disconnect Man.

1. Stand by the fueling station to assist the hoseman in pulling the refueling hose to the helicopter.

2. Attach the nozzle to the pressure-refueling connection.

3. When he is ready in all respects to commence the pressure refueling, he will signal the helicopter director.

4. As the hose is pressurized, he activates the flow control handle. As fuel flow commences, he will test the primary and secondary high-level shutoff switches to be sure they will secure the fuel flow. If neither switch will secure the fuel flow, then pressure refueling must be discontinued at once. If one of the switches will secure the fuel flow, then pressure refueling may be continued with caution being exercised.

5. When the refueling is completed, he will close the flow control handle upon signal from the plane director. Secure the helicopter pressure-refueling connection cover and lay the nozzle under the fuselage.

6. He will help the hoseman retrieve the hose and secure it at the fueling station.

7.19.2.4 Fire Extinguisher Operator.

1. Stand by with appropriate firefighting equipment.

2. Attach the grounding wire to the helicopter.

3. When the refueling hose is brought to the aircraft, he will take his station near the pressure refueling panel.

4. Signal to the helicopter director when he is ready for the pressure refueling to commence.

5. At the first sign of a fire, he will activate the fire extinguisher and direct it on the fire.

6. Remain at his station until the hose is disconnected and removed from the vicinity of the helicopter; disconnect the grounding wire from the helicopter and remove the fire extinguisher bottle.

7.19.2.5 Hoseman.

1. Stand by the refueling station to take the hose to the helicopter.

2. Remain at his station until the refueling is completed and, then with the help of the nozzleman, he will remove the hose to the fueling station.

7.19.2.6 Helicopter Crewmembers.

1. Pilot in the left seat:

   a. Monitor the collective and the cyclic.

   b. Monitor engine instruments for any unusual indications. If anything is noticed that would jeopardize the safety of the refueling operation, he will notify the pilot in the right seat.

2. Pilot in the right seat:

   a. When ready for refueling to commence, the pilot shall ensure the window is closed and signal the helicopter director.

   b. Watch the helicopter director for an emergency cut signal.

   c. Signal the helicopter director if the prebriefed amount of fuel has been added.

   d. If he receives an emergency cut signal, he will secure both speed selectors, apply the rotor brake, instruct the crew to abandon the helicopter, and secure all electrical power in the helicopter.

3. Crewmembers:

   a. After chocks are in place and upon order of the helicopter commander, the crewman shall ensure the cabin door is closed and open the personnel door.

   b. When not involved elsewhere in the helicopter (monitoring the refueling evolution, checking equipment, etc.), remain strapped in and ready to abandon the helicopter upon direction.

   c. When refueling is completed, crewman shall check that pressure-refueling cap is secured.

7.20 SHUTDOWN

1. Collective (copilot monitor) - MINIMUM PITCH.

2. Brakes and tailwheel - LOCKED.

3. Landing gear lockpins and chocks - IN.

   a. Safety pins - AS REQUIRED.

   b. Tiedowns - AS REQUIRED.

4. No. 1 speed selector - GRD IDLE.

CAUTION

Before switching the accessory drive switch to ACCESS DR, a verbal challenge and reply exchange shall be made between the pilots to be sure the No. 2 engine is driving the rotors between 102- to 104-percent N_r, the No. 1 speed selector is at GRD IDLE, and No. 1 N_f is less than 70 percent.

5. Accessory drive switch - FORWARD, LIGHT ON.

CAUTION

- On helicopters modified by AFC 401, the accessory drive light may remain off 6 to 7 seconds.
- If accessory drive light does not go on, proceed as follows:

a. No. 2 engine - 104-PERCENT N_f/ N_r.

b. No. 1 engine - GRD IDLE DETENT.

c. Check ACCESS DRIVE circuit breaker,

If out - RESET AND CONTINUE WITH NORMAL CHECKLIST.

If in - RETURN ACCESS DR SWITCH TO FLIGHT.

d. No. 1 engine - SECURE.

e. Rotor disengagement checklist - COMPLETE.

f. No. 2 engine - SECURE.

6. No. 1 speed selector - 104-PERCENT N_f.

Note

On helicopters modified by AFC 401, if after shifting to the accessory drive position the No. 1 N_f does not respond to speed selector advancement, return the No. 1 speed selector to the GROUND IDLE position and retard the No. 2 speed selector back to 102- to 104-percent N_r. This will ensure that the No. 2 engine is in the governing range and allow the No. 1 engine to advance normally.

7.20.1 Rotor Disengagement.

1. Area clear/disengage signal - CHECK.

2. No. 2 speed selector - GRD IDLE.

3. Droop stops - IN (approximately 50- to 60-percent N_r).

CAUTION

- If one or more droop stops fail to go in, reengage the rotor, taking care not to over-torque the main gearbox. Repeat the rotor disengagement procedure, slightly displacing the cyclic in an attempt to dislodge the jammed droop stop. If the droop stop does not go in after repeated disengagement attempts, the area should be cleared of all unnecessary personnel and close coordination should be established between the LSE and the pilot. During disengagement, the rotor system should be allowed to coast down to that N_r at which the rotor blade starts to droop. Maximum rotor brake pressure must be applied when the low blade is seen passing over the tail pylon. To prevent striking the tail pylon, the rotor blades must be stopped immediately.
- In an emergency, the engine may be shut down immediately, observing power turbine inlet temperature (T_5) for indication of postshutdown fire. However, indiscriminate use of emergency shutdown procedure from high-performance conditions will increase the possibility of engine seizure and decrease the useful life of the engine.

Note

To obtain the most efficient cooling of the No. 2 engine, maintain a constant T_5 for 1 minute at minimum collective pitch.

4. No. 2 Speed Selector – Off.

5. Rotor brake below 45-percent N_r - ON.

For normal shutdown, the rotor brake should be applied firmly and smoothly. As rotation nears complete deceleration, rotor brake pressure should be reduced in order to ease rotor blades to a stop, precluding any tendency of whip action.

Note

If the rotor brake is weak, it is necessary to place the handle in the full-up position and then reapply the rotor brake. This may have to be repeated until enough pressure is built up to slow the main rotor.

6. No. 2 fuel switch - CLOSE.

7. No. 2 engine instruments - CHECKED.

8. All electronic equipment - AS REQUIRED.

With the No. 2 engine shut down and the No. 1 engine in accessory drive, proceed as follows:

CAUTION

LSE shall visually check droop stops in prior to commencement of folding sequences.

9. Area - CLEAR.

10. Blades - FOLDED.

a. Collective pitch lever - MINIMUM PITCH.

b. Cyclic stick - NEUTRAL . Depress trim release to center.

c. SAFETY VALVE switch – OPEN. SAFETY VALVE OPEN red warning light – ON and FLIGHT POS green light – OFF.

(1) Blade fold MASTER switch – ON. FOLD PWR red light will go ON, primary servo pressure will drop to zero, and caution panel PRI SERVO PRESS light – ON.

d. Rotor brake lever – OFF.

e. BLADES FOLD-SPREAD switch – FOLD.

Observe this sequence:

(1) ROTOR BRAKE caution light – OFF.

(2) No. 1 blade positions aft.

f. No. 1 BLADE POS indicator light – ON.

(1) ROTOR BRAKE caution light – ON.

g. Rotor brake lever – ON (320 PSI MINIMUM)

(1) Dampers position all blades against their autorotation stops.

Note

Check visually that the two forward blades are positioned an equal distance from the centerline of the helicopter. If the blades are not in the correct position, refer to Manual Folding Procedures, paragraph 7.20.2.

(2) CONT LOCK PINS ADV indicator light – ON. BLADE SPREAD indicator light – OFF as soon as one flight control lockpin advances.

CAUTION

After fold cycle is initiated and until blades are spread, do not move the controls, as damage to control lockpins will result.

Note

It may be necessary to reposition the cyclic stick very slightly to seat all the lockpins.

h. BLADES FOLDED indicator amber light – ON. When all blades are folded.

(1) If folding cycle should stall at any point, proceed as follows:

(a) BLADES FOLD-SPREAD switch – OFF.

(b) BLADES FOLD-SPREAD switch – SPREAD.

Until BLADES SPREAD amber light goes ON.

(c) BLADES FOLD-SPREAD switch – FOLD.

i. SAFETY VALVE switch – CLOSED.

SAFETY VALVE red warning light remains ON, blades fold MASTER switch – OFF, and BLADES FOLD-SPREAD switch – OFF.

7.20.2 Manual Blade Folding Procedures.

7.20.2.1 Improper Blade Positioning. If improper blade positioning is experienced during automatic blade folding and it is necessary to complete blade folding, proceed as follows:

1. Blade fold master switch – OFF.

2. Rotor brake lever – OFF.

3. No. 1 blade – AFT (position manually).

4. Blade fold master switch – ON (proceed with automatic operations).

7.20.2.2 Manual Folding. If necessary to fold the blades manually, proceed as follows:

1. Rotor brake lever – OFF.

2. No.1 blade – DIRECTLY AFT.

3. Rotor brake lever – ON.

4. Servo switch – PRI OFF.

5. Collective pitch lever – MINIMUM PITCH.

6. Cyclic stick – NEUTRAL (HAVE GROUND-CREW CHECK CONTROL LOCKPIN ALIGNMENT).

CAUTION

Tripping the fold manual override will cause the blades to fold, regardless of the position of the No. 1 blade and regardless of whether the rotor brake is on or off. Close coordination is required between personnel in the cockpit, the line director, and the person actuating the FOLD manual override switch.

7. Safety valve switch - OPEN (WARNING LIGHT ON).

8. Trip fold manual override and observe this sequence:

   a. Dampers position.

   b. Control locks engage.

   c. Blade lockpins retract.

   d. Blades fold.

9. Safety valve switch - CLOSED.

7.20.3 No. 1 Engine Secure

1. HEELS system switch (NON-ET) - OFF.

2. Speed selector - GRD IDLE.

3. Speed selector - SHUT OFF, after Ng is less than 60 percent.

4. Fuel switch CLOSE.

5. All engine instruments - CHECK.

6. All switches - OFF.

7. HEEDS bottles - OFF.

7.21 POSTFLIGHT

1. Visually check for external hydraulic/oil leaks.

2. Visually check main and tail rotor blades.

3. Check ground wire to be sure helicopter is properly grounded.

4. Check helicopter for any missing panels.

This Page Left Blank Intentionally

CHAPTER 8

Ship-Based Procedures

8.1 CV OPERATIONS

8.1.1 General. Shipboard procedures in general are explained in the CV NATOPS Manual, NWP 3-04.1M, and NAVAIR 00-80T-113. This chapter deals only with those areas where amplification of or deviation from those procedures is necessary.

8.2 FLIGHT/HANGAR DECK PROCEDURES

Basic operating procedures outlined in Chapter 7, the CV NATOPS Manual, and NWP 3-04.l M shall be adhered to except as modified in this chapter.

8.2.1 Hangar Deck. During periods of prolonged storage, blade racks should be used.

8.2.2 Hangar Flight Deck

8.2.2.1 Movement of Helicopters. Because of the top-heavy configuration of the helicopter precautions must be observed in all movements to preclude possibility of damage to the relatively light structural members and rotor blades. Helicopters shall not be respotted on the deck with the rotors engaged.

8.2.3 Flight Deck

8.2.3.1 Blade Folding/Spreading. Blade folding/spreading should be accomplished with the No. 1 engine operating at 104-percent N_f in accessory drive. The maximum safe non-turbulent wind relative to the helicopter for rotor folding/spreading is limited to 45 knots except in an emergency situation.

CAUTION

At any time blades are to be spread or folded aboard ship, two persons shall act as blade walkers while the Nos. 3 and 4 blades are in motion to prevent excessive blade flapping that could result in the blade tips striking the deck. At night, blades should be spread or folded upon signal from the flight deck director, indicating that the blade walkers are in position and the area is clear. The blade walkers should be equipped with red flashlights.

8.2.3.2 Rotor Engagement. Rotors shall be engaged only on signal from an LSE and under the positive control of primary flight control.

Mandatory requirements for engagement of the rotor consist of the following items:

1. Tail and mainmount tiedowns secured with 2 to 3 inches slack and chocks in place.

2. Flight deck area clear of unnecessary personnel.

3. Tailwheel locked, parking brake on.

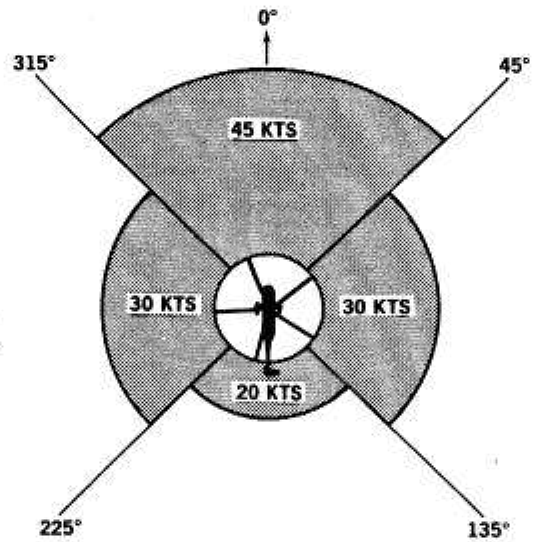
4. Winds for engagement/disengagement in accordance with Figure 8-1.

When gusty winds are involved, the velocities shown in Figure 8-1 should be reduced, depending on the gust magnitude. When directed by primary flight control following an up status signal from the pilot, tiedowns will be removed. It is mandatory that the ship and the squadron establish procedures that will permit the helicopter commander to determine that all tiedowns have been removed. The helicopter aircraft commander is responsible to assure complete removal of tiedowns before takeoff. Helicopters should be launched in order from forward to aft. Helicopters shall not be launched over other aircraft.

CAUTION

With rotors engaged on the flight deck, disengage the ASE. This is extremely important, especially when the carrier is turning, as the turn will be resisted by the automatic stabilization directional channel and cause the helicopter to turn in relation to the deck of the carrier.

ROTOR ENGAGEMENT AND DISENGAGEMENT



NOTES

1. LIMITING VELOCITIES OF THE SHADED AREA REPRESENT MAXIMUMS FOR STEADY STATE, NONTURBULENT WINDS WHEN TURBULENCE OR PITCHING DECK CONDITIONS EXIST WHICH MAY IN ANY WAY JEOPARDIZE THE SAFETY OF THE HELICOPTER OR FLIGHT DECK PERSONNEL. THESE MAXIMUMS WILL BE REDUCED ACCORDINGLY WITH GUSTS OF 10 KNOTS OR MORE. REDUCE THE MAXIMUM WINDS BY 10 KNOTS IN ALL DIRECTIONS.
2. ROTOR ENGAGEMENT IN WIND VELOCITIES NEAR THE LIMITING VALUES SHOULD BE MADE AS RAPIDLY AS POSSIBLE USING APPROXIMATELY 60% TORQUE.
3. ROTOR DISENGAGEMENT IN WIND VELOCITIES NEAR THE LIMITING VALUES SHOULD BE MADE AS RAPIDLY AS POSSIBLE APPLY BRAKE FIRMLY AND SMOOTHLY.

Figure 8-1. Maximum Wind Velocities

8.2.4 Pressure Refueling Aboard Ship With the Rotors Engaged. During shipboard operations, tactical situations may arise that will require the helicopter to be refueled with both engines running and the rotors engaged. The following procedures will be used to accomplish this evolution. Hand signals shall be used in accordance with CV NATOPS Manual and NAVAIR 00-80T-113.

8.2.4.1 General Safety Precautions

1. Secure the helicopter with two chocks and initial four point tiedown. Fueling personnel shall not approach the helicopter until it is properly chocked.

2. All fueling personnel must be thoroughly indoctrinated in the contents of the following procedures, pertinent type commander instructions, and carrier refueling instructions.

3. All movements from one side to the other shall be via the nose. Under no circumstances will any personnel work in close proximity of the rotary rudder.

4. All personnel working under the main rotors are to use extreme caution.

5. Refueling shall be secured when any fuel spillage is noted and not commenced until the spillage is wiped up.

6. The fueling hose shall be connected and disconnected from the helicopter with the hose in an evacuated condition.

8.2.4.2 Duties of Personnel

1. Fueling station operator.

   a. Energize and deenergize the fueling station upon signal of the LSE.

   b. Continuously watch the LSE for signals.

2. LSE.

   a. In charge of the refueling party.

   b. Position himself outside of rotor diameter where he can see the pilots, fueling station operator, and the nozzle connect/disconnect man.

   c. Make sure that the pressure-refueling nozzle is connected and that all personnel are ready for pressure refueling. He must get a thumbs up from the pilot, nozzleman, and fire extinguisher operator before signaling the fueling station operator to energize the fueling station.

   d. Closely monitor the refueling operation and secure refueling upon the first indication that an unsafe condition exists. Refueling will normally be secured when the high-level shutoff valve is actuated or when the prebriefed amount of fuel has been added.

   e. Signal the fueling station operator to evacuate the hose and deenergize the fueling station.

   f. Upon completion of step e above, signal the nozzleman to unplug the pressure-refueling nozzle.

   g. Be sure all refueling personnel, equipment, chocks, and tiedowns are clear before giving the launch signal to the pilot.

3. Nozzle connect/disconnect man.

a. Stand by the fueling station to assist the hoseman in pulling the refueling hose to the helicopter.

b. Attach the nozzle to the pressure-refueling connection.

c. When he is ready in all respects to commence the pressure refueling, he will signal the LSE.

d. As the hose is pressurized, he activates the flow control handle. As fuel flow commences, he will test the primary and secondary high-level shutoff switches to be sure they will secure the fuel flow. If neither switch will secure the fuel flow, then pressure refueling must be discontinued at once. If one of the switches will secure the fuel flow, then pressure refueling may be continued with caution being exercised.

e. When the refueling is completed, he will close the flow control handle upon signal from the LSE, secure the helicopter pressure-refueling connection cover, and lay the nozzle under the fuselage.

f. He will help the hoseman retrieve the hose and secure it at the fueling station.

4. Fire extinguisher operator.

a. Stand by with two 5-pound CO^2 fire extinguishers.

b. Attach the grounding wire from the helicopter to the flight deck.

c. When the refueling hose is brought to the aircraft, he will take his station near the pressure-refueling panel.

d. Signal to the LSE when he is ready for the pressure refueling to commence.

e. At the first sign of a fire, he will activate the fire extinguisher and direct it on the fire.

f. Remain at his station until the hose is disconnected and removed from the vicinity of the helicopter, disconnect the grounding wire between the helicopter and the flight deck, and remove the fire extinguisher bottles.

5. Hoseman.

a. Stand by the refueling station to take the hose to the helicopter.

b. Pass the hose under the fuselage to the nozzleman.

c. Remain at his station until the refueling is completed and then with the help of the nozzleman he will remove the hose to the fueling station.

6. Plane crewmembers.

a. Pilot in the left seat.

(1) Monitor the collective and the cyclic.

(2) Monitor engine instruments for any unusual indications. If anything is noticed that would jeopardize the safety of the refueling operation, he will notify the pilot in the right seat.

b. Pilot in the right seat.

(1) When ready for refueling to commence, the pilot shall ensure the window is closed and signal the LSE.

(2) Watch the LSE for an emergency cut signal.

(3) Signal the LSE if the prebriefed amount of fuel has been added.

(4) If he receives an emergency cut signal, he will secure both speed selectors, apply the rotor brake, instruct the crew to abandon the helicopter, and secure all electrical power in the helicopter.

c. Crewmembers.

(1) After tiedowns are attached and chocks are in place and upon order of the helicopter commander, the crewman shall ensure the cabin door is closed and open the personnel door.

(2) When not involved elsewhere in the aircraft (monitoring the refueling evolution, checking equipment, etc.), remain strapped in and ready to abandon the helicopter upon direction.

(3) When refueling is completed, crewman shall check that pressure-refueling cap is secured.

WARNING

After refueling has been completed and the fuel hose has been removed from the vicinity of the helicopter and before signaling ready for launch, the plane commander shall make sure that all hatches and the personnel door are secure and the Takeoff Checklist has been completed.

8.3 LAUNCHING AND RECOVERY PROCEDURES

WARNING

Power required to hover both in and out of ground effect (Figures 21-1 and 21-2) shall be used to calculate performance for all shipboard launches and landings.

CAUTION

The plane commander shall make sure that the Landing Checklist is completed (including lowering the landing gear) before commencing any approach (HIFR, transfers, etc.) to any ship to preclude a gear-up landing in case of an emergency or other unscheduled landing.

Note

During shipboard operations after becoming airborne, the compass system should be reset when free of local magnetic disturbance. Resetting will provide more accurate readouts sooner than if the system were allowed to slave by itself.

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

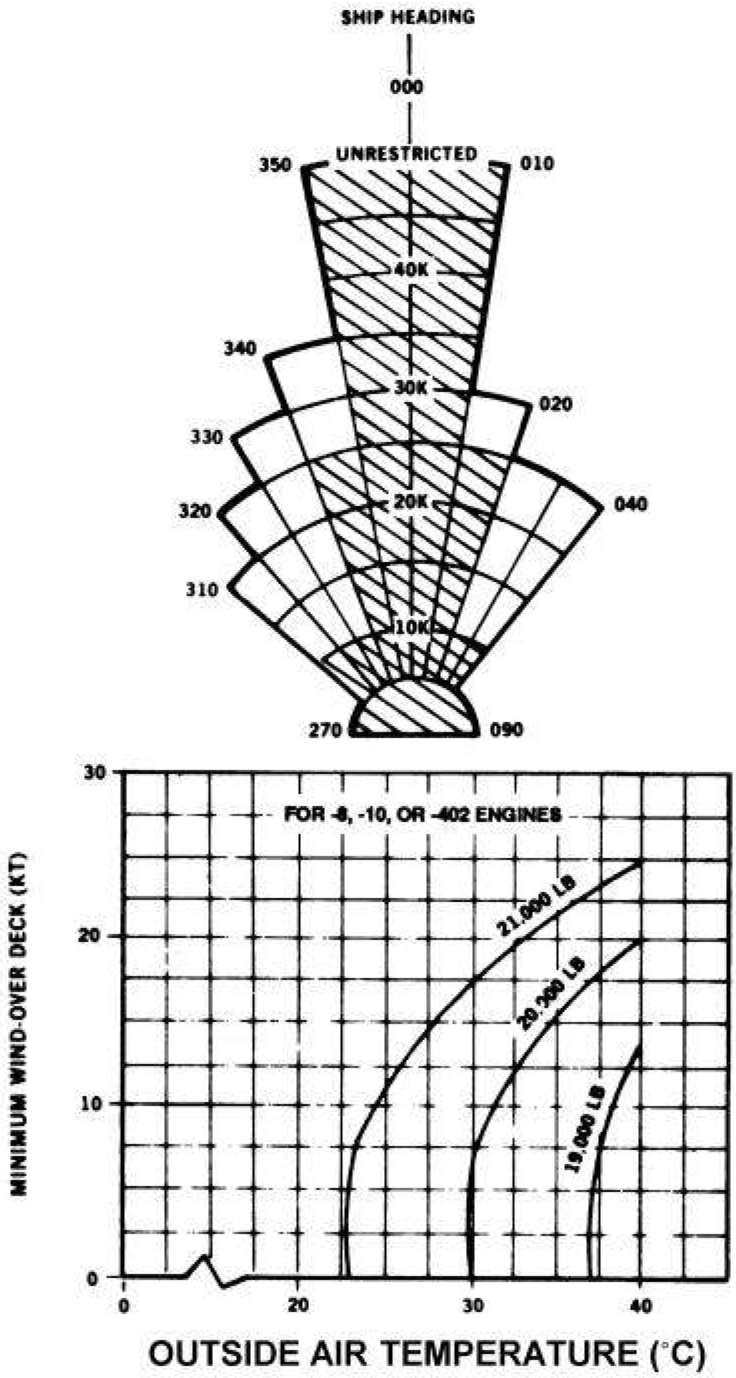
- In crosswind conditions, relative to the carrier fore and aft axis, the indicated winds in primary flight often vary from those winds actually experienced at the flight deck level. This variance will affect velocity, turbulence, and direction, all of which are critical for safe launches and recoveries.

- To avoid the possibility of helicopter damage or personnel injury, the ship should not change course or speed during launch/recovery or during engagement/disengagement. Emergency conditions may preclude adherence to the above, in which case immediate notification to the pilot is mandatory.

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 on all daylight VFR flights within the relative wind limits as prescribed in Figure 8-2 to derive the maximum aerodynamic capability of the rotary wing and rotary rudder and to lessen power required to maintain directional control.

Night and IFR launches and recoveries shall be made with the nose of the helicopter oriented forward and parallel to the centerline of the angle or axial deck. The relative winds shall not exceed the parameters set forth in Figure 8-2. Except in unusual situations, the upwind helicopter shall be launched first.

3. When launching with Doppler in SEA mode, it is normal for the system to be in memory until helicopter speed is above 35 knots. This can be avoided by first selecting LAND/ALT for a few seconds until memory ceases and then selecting SEA before takeoff. During shipboard operation, the compass system must be reset after becoming airborne when free of local magnetic disturbance. Resetting will provide more accurate readouts sooner than if the system were allowed to slave by itself free of local magnetic disturbance.

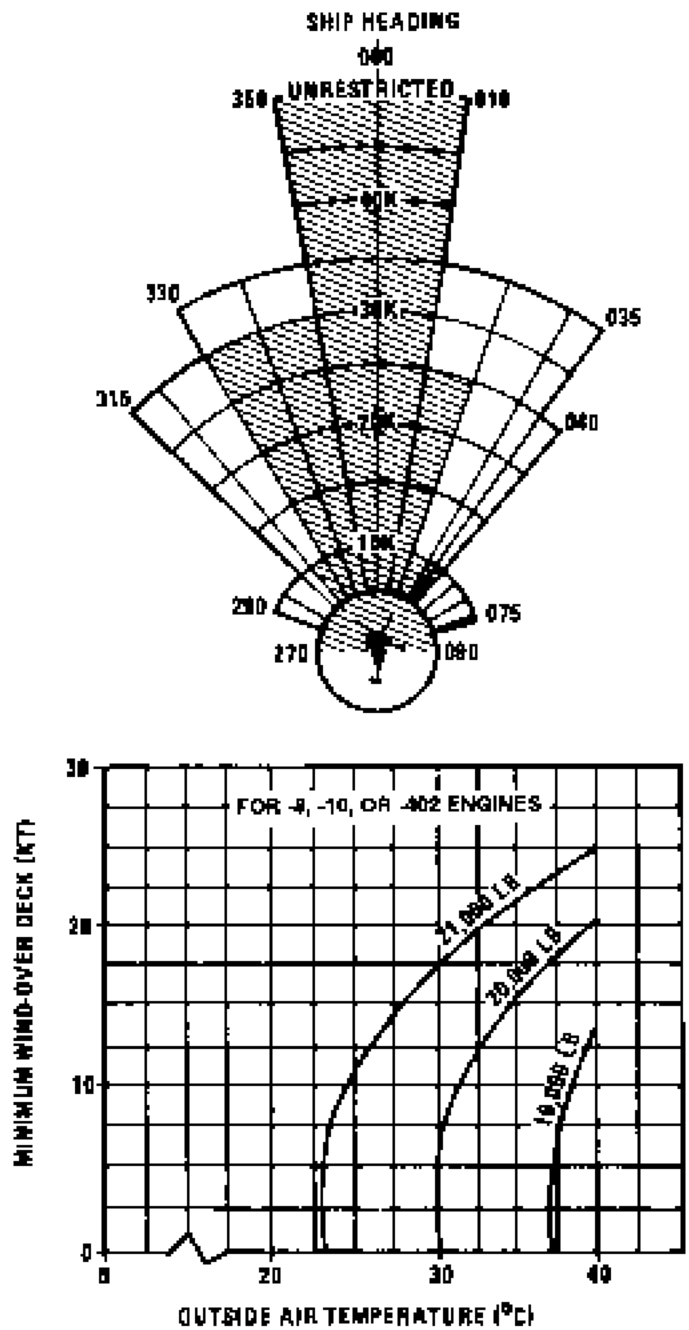


NOTE

- DAY OPS: USE ENTIRE ENVELOPE. ENVELOPE APPLIES TO FIRST TWO BOW SPOTS AND THIRD ANGLE SPOT.

- NIGHT OPS: USE ONLY HATCHED ENVELOPE. HATCHED ENVELOPE APPLIES ONLY TO THIRD ANGLE SPOT.

Figure 8-2. CV/CVN Class Ships Launch and Recovery Wind Limits (Sheet 1 of 5)

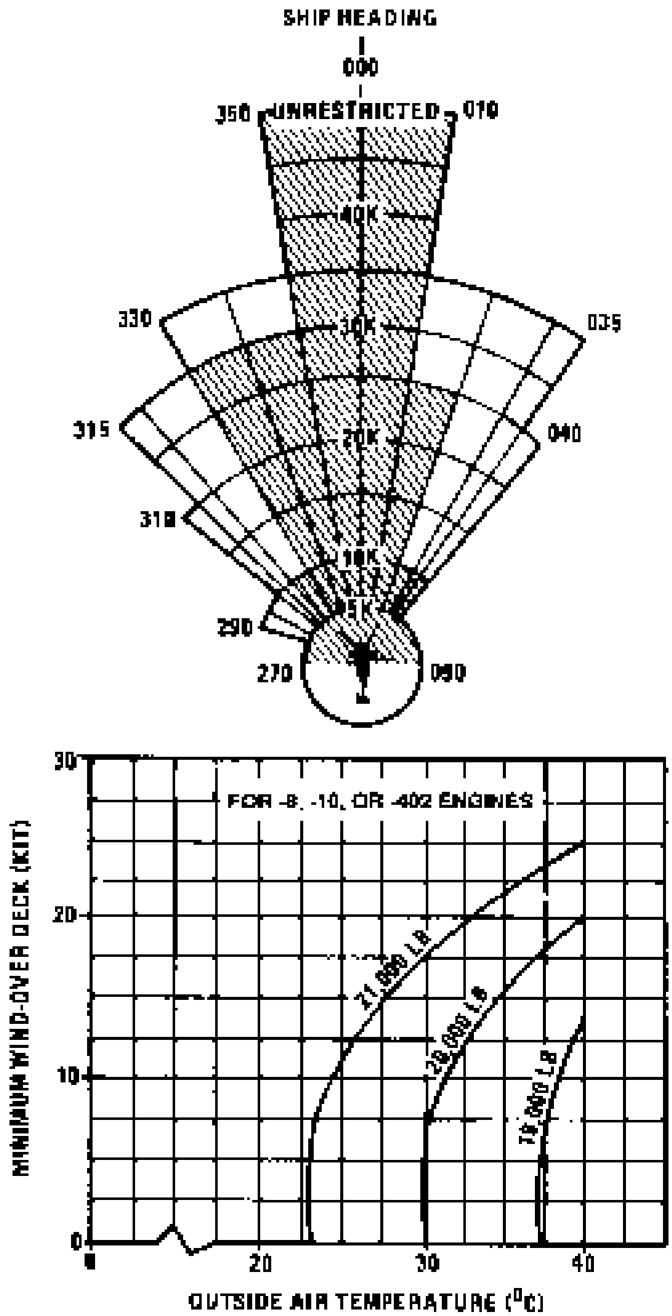


NOTE

- DAY OPS: USE ENTIRE ENVELOPE. ENVELOPE APPLIES TO FIRST ANGLE SPOT, STERN TO BOW APPROACH.
- NIGHT OPS: USE ONLY HATCHED ENVELOPE. HATCHED ENVELOPE APPLIES ONLY TO FIRST ANGLE SPOT.
- WIND-OVER-DECK SHALL BE SUFFICIENT TO PROVIDE HOGE CAPABILITY WHEN WINDS ARE 5 KNOTS AND BELOW FROM 075° TO 290° AZIMUTH ANGLE.

N1/91

Figure 8-2. CV/CVN Class Ships Launch and Recovery Wind Limits (Sheet 2 of 5)

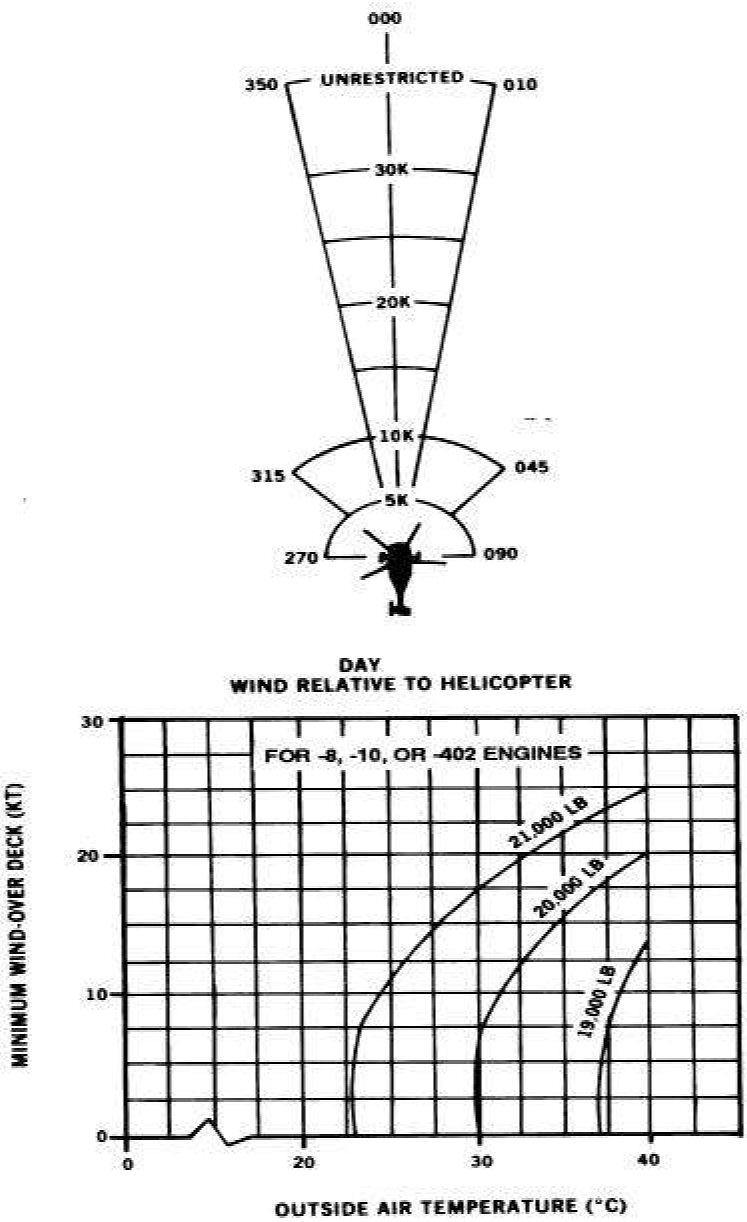


NOTE

- DAY OPS: USE ENTIRE ENVELOPE. ENVELOPE APPLIES TO THE SECOND ANGLE SPOT, STERN TO BOW APPROACH.
- NIGHT OPS: USE ONLY HATCHED ENVELOPE. HATCHED ENVELOPE APPLIES ONLY TO THE SECOND ANGLE SPOT.
- WIND-OVER-DECK SHALL BE SUFFICIENT TO PROVIDE HOGE CAPABILITY WHEN WINDS ARE 5 KNOTS AND BELOW FROM 075° TO 290° AZIMUTH ANGLE.

N1/91

Figure 8-2. CV/CVN Class Ships Launch and Recovery Wind Limits (Sheet 3 of 5)



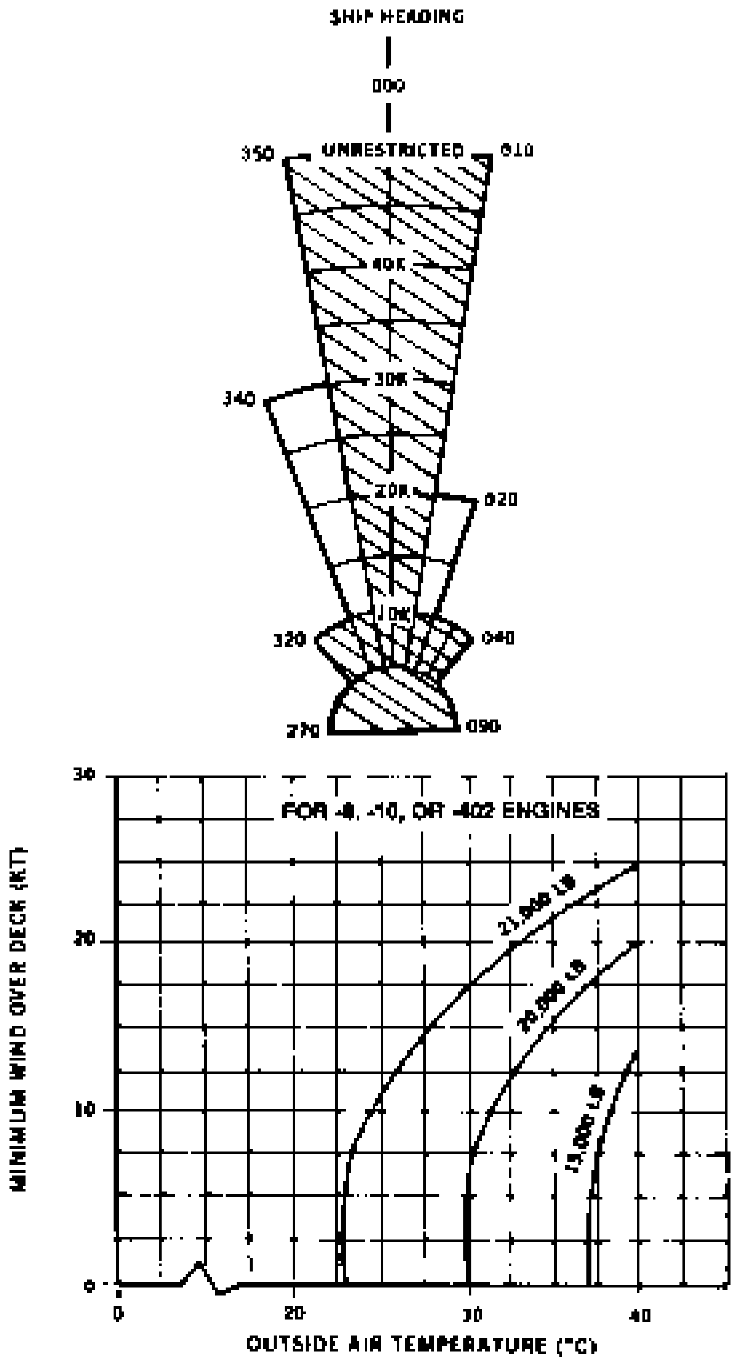
N1/91
S 66556 (C8)

NOTE

DAY OPS ONLY: CROSSDECK USE ENTIRE ENVELOPE. ENVELOPE APPLIES TO FIRST TWO BOW SPOTS AND FIRST THREE ANGLE SPOTS.

ALSO PRESENTS WIND LIMITS FOR AIR CAPABLE SHIPS WHEN NO LIMITS ARE SPECIFIED IN NWP 3-04.1.

Figure 8-2. CV/CVN Class Ships Launch and Recovery Wind Limits (Sheet 4 of 5)



NOTE

- DAY OPS: USE ENTIRE ENVELOPE. ENVELOPE APPLIES TO FIRST TWO BOW SPOTS AND FIRST THREE ANGLE SPOTS. ASE/AUX OFF.
- NIGHT OPS: USE ONLY HATCHED ENVELOPE. HATCHED ENVELOPE APPLIES ONLY TO FIRST THREE ANGLE SPOTS. ASE/AUX OFF.

N1/91
S 66557 (C2)

Figure 8-2. CV/CVN Class Ships Launch and Recovery Wind Limits (Sheet 5 of 5)

4. On launching, the helicopter may be moved forward slightly to make sure chocks/tiedowns are removed. Lift into a hover about 15 feet above the deck and transition to forward flight. Helicopters should clear the ship expeditiously to reduce the hazard to flight deck personnel. Helicopters shall not cross the bow or stern within 1 mile unless specifically directed to do so or in an emergency. VFR departures should be conducted on the search course or departure vector.

CAUTION

Sonic booms are capable of ejecting windows and damaging cargo doors. When notified of an impending sonic boom, all windows and doors shall be open to minimize potential damage.

Note

Pilots should be aware when operating in vicinity of island/bridge structures that airframe vibrations and rumbling noises may be induced throughout the flight controls and airframe by ship foghorns.

5. Downwind approaches shall not be made except under emergency conditions.

6. Helicopters should not cross the deck edge on an approach until cleared to do so by the LSE.

7. Chocks and tiedowns shall not be installed upon landing without pilot knowledge. Normally, this will be done by an exchange of signals between the pilot and LSE.

8.3.1 Shipboard Wind Limits. Figure 8-2 presents the maximum safe launch and recovery wind limits for CV/CVN class ships. The end points for the wind azimuth/velocity envelopes define wind conditions where less than 10-percent tail rotor authority remains or when the pilot workload is unacceptably high. As part of the limits, the figures also present the minimum safe WOD for a particular temperature and gross weight. Use of this minimum WOD chart is mandatory and ensures that the helicopter will have a 10-percent torque margin. The minimum WOD chart is derived entirely from the performance charts in Part XI and is based on HIGE conditions. Launching or recovering through jet exhaust may degrade helicopter performance.

Figure 8-2 (sheets 1, 2, and 3 of 5) presents the normal day/night launch and recovery wind limits for CV/CVN class ships. Winds are relative to ship heading. For first two bow spots, align helicopter with axial deck, nose toward bow. Do not use this figure for crossdeck operations. The proper takeoff technique for this envelope is as follows:

a. Winds within envelope.

b. Lift into 15-foot hover.

c. Transition to forward flight.

d. Maintain helicopter heading from lift-off through transition to forward flight.

Do not lift off outside the envelope and then turn on the spot to obtain winds inside the envelope. Do not lift off inside of envelope and then turn out of the envelope. Ship roll angles beyond 3° were not tested.

Figure 8-2 (sheet 4 of 5) presents crossdeck launch and recovery wind limits for CV/CVN class ships and also presents wind limits for nonaviation ships when no limits are specified in NWP 3-04.1. Winds are relative to helicopter. A lift-off and transition to forward flight in a direction other than forward along the axial or angle deck may at times be required by operational necessity. Under these unusual circumstances, this chart shall be used. Helicopter heading shall remain constant from lift-off through out transition to forward flight. A lift-off out of the envelope with a turn on the spot is not authorized. A lift-off within the envelope with a turn out of the envelope is also not authorized. Operations with the helicopter aligned with the axial or angle deck are preferred over crossdeck operations. Crossdeck operations should only be attempted when axial/angle deck alignment is not feasible or because of operational necessity.

Figure 8-2 (sheet 5 of 5) presents the ASE OFF or AUX OFF recovery wind limits for CV/CVN class ships. All winds are relative to ship heading. Align the helicopter with angle or axial deck. Do not use this figure for crossdeck operations. Wind limits for other emergency conditions (single engine, chip lights, etc.) were not developed. Ship roll angles beyond 3° were not tested.

8.3.2 Traffic Patterns. Traffic patterns and IFR or night approaches shall be conducted in accordance with the CV NATOPS Manual. Marshall points, holding and approach patterns, as well as distance and altitudes shall be as prescribed in the CV NATOPS Manual as modified by the ship CATCC instruction. Holding should be flown at 80 knots.

8.3.2.1 Departures. Instrument flight rule departures shall be executed in accordance with the CV NATOPS Manual as modified by the CATCC procedures. Departure frequencies shall be set in while on deck and this setting should be maintained until departing the carrier control zone. Helicopters shall climb straight ahead to at least 300-foot altitude and 60 KIAS before beginning any turn.

8.3.3 Night and IFR Operations

8.3.3.1 Deck Conditions. Standard deck spotting (centerline only) shall be used. Such spacing shall provide a minimum rotary wing to rotary rudder clearance of 20 feet. Minimum deck lighting should consist of red deck edge or flood lighting. Deck edge and centerline lights of required spacing and brilliance for helicopter operations are required for CV/LHA/LPH class ships. Night and IFR operations from these class ships shall have a minimum of 125 feet of visual reference to the flight deck forward of the cockpit. Centerline and/or deck edge lighting shall be used to assist in providing this required visual reference to the flight deck. When 125 feet of visual reference to the flight deck is not available forward of the cockpit, night and IFR helicopter operations shall not be conducted with less than 175 feet of deck edge lighting forward of the cockpit. Night operations are not authorized from the first two bow spots.

Note

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

8.3.3.2 Minimum Operating Equipment for Night/IFR Shipboard Operations.

1. Flight instruments (pilot and copilot).

   a. Attitude and turn-and-slip indicator.

   b. Airspeed indicator.

   c. Altimeters (barometric and radar).

   d. Compass system.

   e. Standby compass.

   f. Vertical speed indicator.

   g. Clock.

2. All engine and systems instruments.

3. All instrument, navigation, landing, cockpit, and cabin lights.

4. Radio equipment: UHF, ICS, and appropriate navigation equipment.

5. ASE and RAWS.

6. Coupler/Doppler for SAR.

8.3.3.3 Night Launches. The radar altimeter limit should be set at 15 feet above the flight deck height to visually warn of low altitude after takeoff from the flight deck. The BAR ALT hold should be engaged on deck and the temporary release button held from takeoff until reaching the desired altitude to provide the pilot with an altitude hold preselected if disorientation occurs. Following the night takeoff, the pilot should hold cockpit functions to a minimum until the helicopter is established in level cruising flight. Helicopters shall climb straight ahead to at least 300-foot altitude and 60 KIAS before beginning any turn.

WARNING

- With the landing gear down, the RAWS will not provide an indication of an unreliable radar altimeter. Therefore, the landing gear should be raised as soon as practicable after clearing the ship deck edge.

- Because of loss of RAWS aural and visual warning of unreliable radar altimeter and absence of 30-foot aural RAWS, night/IFR overwater operations below 150 feet shall not be conducted with landing gear down.

8.3.3.4 Night and IFR Approaches. Night and IFR approaches should be conducted under control of the ship CATCC and by pilot reference to the mirror/optical landing system, if installed. Marshal points, holding and approach patters, as well as distances and altitudes shall be flown as published in the ship CV NATOPS Manual. The holding pattern, unless briefed otherwise, should be flown at 80 knots. Relative wind for approaches and landings shall not go over the parameters set forth in Figure 8-2.

8.3.4 Mirror/Optical Landing System Approach. The radar altimeter should be set at 15 feet above the flight deck height to visually warn of low altitude prior to crossing the flight deck edge. The helicopter should enter the glidepath about 2 miles astern of the carrier on the landing axis. The helicopter should be flown down the glideslope at 90 to 100 KIAS. At about three-quarters 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 15-foot 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 the LSE.

8.3.5 Recovery Signals. Helicopter recovery signals are as follows:

1. Voice: Charlie (number), meaning length of time in minutes before carrier will be able to take helicopters aboard. Upon receipt of Charlie (number), all helicopters in the holding pattern VFR will establish proper interval for landing. This procedure will reduce the time the carrier must remain into the wind and expedite the recovery.

   Flag: Hotel at the dip.

2. Voice: Charlie, meaning land helicopters.

   Flag: Hotel closeup.

3. Hotel at the dip indicates the ship is preparing to conduct helicopter operations. Hotel closeup indicates the ship is conducting helicopter operations and constitutes a Charlie signal during periods of radio silence. The Charlie signal should also be passed by flashing light to helicopters that are not in a position to observe the flag hoist. Receipt of either signal constitutes pilot authority to commence a landing approach.

Primary flight control should designate numbered deck spots to be used before Charlie. LSE thus will be readily sighted and landing interval may be reduced.

8.3.6 Waveoff Procedures. A waveoff signal is mandatory at all times. Pilots must use extreme caution to avoid overflying other helicopters and fixed-wing aircraft parked or turning up on deck while executing a waveoff. The landing gear should not be retracted. Re-entry into a landing pattern shall be prescribed by the controlling authority.

8.3.7 Landing Considerations. Helicopters should be landed within l0° of the relative wind. The pilot should cross the deck edge at least 15 feet above the flight deck to compensate for the pitch and/or roll of the deck and the ever-present turbulence in this area.

8.3.8 Shutdown. After chocks and tiedowns have been attached, the helicopter will be shut down upon signal from the flight deck director.

8.3.9 Hand Signals. Considering the hazards of FOD ingestion into the T-58 jet engines, paddles, wands, flashlights, or plain hand signals may be substituted for the hand flag signals prescribed in NAVAIR 00-80T-113.

WARNING

Only two hand signals are mandatory: waveoff and hold. All others are advisory in nature.

8.4 AIR-CAPABLE SHIP OPERATIONS

8.4.1 Flight/Hangar Deck Procedures

8.4.1.1 Helicopter Movement

1. OOD approval is required prior to helicopter movement. Timely requests for permission to move the helicopter are necessary so that the OOD can maneuver the ship to achieve the most stable deck.

2. A minimum of 15 men for manual moves is required as follows:

   a. Director (1).

   b. Brake rider (1), strapped in.

   c. Tailwheel steering bar (1).

   d. Mainmount chock/chain men (2).

   e. Tailwheel chain men (2).

   f. Pushers (8).

3. Whenever the officer in charge of the helicopter detachment determines that because of weather and/or ship roll/pitch more personnel are required to move the helicopter, he shall request additional assistance from the ship force. However, additional personnel will significantly increase the supervisory requirements.

4. During high sea states, safety nets may be raised prior to helicopter movement.

5. The director should maneuver the aircraft into/out of the hangar at a slow and controllable rate of speed. When the ship is unstable, consideration should be given to alternately attaching and removing the chains during helicopter movement. A brake check shall be performed immediately after initial helicopter movement. When positioning the helicopter for takeoff, the main landing gear should be in the center of the landing circle and the tailwheel on the desired lineup line.

6. The helicopter should always be properly secured unless it is being positioned for launch, at which time two tiedowns are to be attached to each main landing gear and one tiedown to each side of the tailwheel.

7. The movement is not complete until the director notifies the OOD of helicopter ultimate position and security.

8. At night, all available lighting should be used during helicopter movements.

CAUTION

The tail pylon should be folded/spread in the lee of the hangar to reduce the chances of a runaway tail rotor.

8.4.1.2 Starting the Helicopter

1. Starting will normally be accomplished only upon a signal from the LSE and clearance by the OOD. The helicopter normally uses ac external power for starting. The aircraft may be started with ac or dc power.

2. The rotor blades will be spread, after starting the No.1 engine only upon signal of the LSE. Blade walkers shall be used to prevent the No. 3 or No. 4 blade from striking the flight deck, safety nets, or other obstructions. The safety nets shall be lowered prior to spread/fold evolution.

8.4.1.3 Rotor Engagement

1. Rotors shall be engaged only on signal from the LSE. Mandatory requirements for engagement of rotors shall consist of the following items:

   a. Tail and mainmount tiedowns secured with 2 to 3 inches of slack and with chocks in place.

   b. Flight deck clear of unnecessary personnel.

   c. Tailwheel locked and parking brakes on.

   d. Winds for engagement in accordance with Figure 8-1.

   e. Helicopter rotors shall not be engaged (or disengaged), nor shall the helicopter be launched (or recovered) while the ship is tuning.

CAUTION

When the helicopter is on the flight deck with the rotors engaged, the cyclic stick 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 unnecessary stresses on the droop stops.

8.4.2 Launch and Recovery Procedures

WARNING

Power required to hover both in and out of ground effect (Figures 21-1 and 21-2) shall be used to calculate performance for all shipboard launches and landings.

Note

During shipboard operations, after becoming airborne, the compass system should be reset when free of local magnetic disturbance. Resetting will provide accurate readouts sooner than if the system were allowed to slave by itself.

8.4.2.1 Operating Conditions

1. Air-capable ship flight operations present problems not generally associated with other aviation ships. The small deck area, pitch and roll, obstructions, and wind turbulence combine to make these operations hazardous. Furthermore, ground handling poses an additional hazard to the aircraft and personnel.

2. Launch and recovery operations, signals, and procedures shall be in accordance with NWP 3-04.1 M and NAVAIR 00-80T-113.

3. Wind limitations for launch and recovery operations are defined by ship class in NWP 3-04.1M. The helicopter shall be launched and recovered within the limits of the prescribed wind envelope to preclude damage or loss. Launch and recovery shall not be attempted while the ship is turning.

4. In selecting optimum wind conditions, several factors must be considered: turbulence, pitch and roll, pilot experience, minimum wind over deck for hover out of ground effect, and minimum safe single-engine speed. A turbulent wind is more hazardous than a nonturbulent wind, even though the latter may be of high velocity. Turbulence can result from an otherwise smooth wind flowing over and around the ship superstructure.

8.4.2.2 Day/Night Launches

1. For takeoffs, the helicopter shall be spotted along the lineup to assure maximum obstruction and landing gear clearance. The centerline of the helicopter must be parallel to the lineup line to provide an adequate tailwheel landing area. During takeoff, the pilot nearest the hangar face should be at the controls and the parking brakes shall be set. After the tiedowns have been removed, the pilot should be prepared for an immediate takeoff in case the helicopter starts to slide on deck. Normally, the pilot should wait for a level-ship attitude before lift-off.

2. On launching, the helicopter should be raised to approximately 15 feet above deck and flown laterally, so that the pilot at the controls keeps the flight deck environment in sight to a position at least one rotor diameter clear of all obstacles. The pilot should transition to forward flight on a path parallel to the painted lineup line, ensuring that the helicopter remains well clear of the ship superstructure.

3. During night and IMC, the pilot shall transition to forward flight using instrument takeoff procedures. The wings shall be maintained in a level attitude with reference to the attitude indicator and the nose should be beeped to an attitude approximately 5° nose low as the collective is simultaneously being raised as necessary. Continue to lower the nose to 5° to 8° below the hover attitude and increase collective within transmission torque limits. No turns will be commenced until an altitude of at least 300 feet is reached. The D mode position of the hover indicator should be monitored because at low airspeeds it will be the only cockpit indication of drift. The pilot not on the controls raises the gear when directed; monitors attitude, departure heading, rate of climb, and airspeed; and maintains (if conditions permit) an outside lookout.

Note

During night/IMC operations, landing gear should be raised as soon as possible to enable the RAWS aural warning system.

4. When safely airborne and established on the departure heading, an "OPS normal" report should be given to helicopter control. Unless the urgency of the situation dictates otherwise, the ship should not make radio calls to the helicopter during the departure until this report is received. All other reports will be in accordance with the tactical reference manuals and the prelaunch brief. The ship should remain at flight quarters until the "OPS normal" report has been received.

8.4.3 Approach/Landing Procedures

WARNING

Power required to hover both in and out of ground effect (Figures 21-1 and 21-2) shall be used to calculate performance for all shipboard launches and landings.

8.4.3.1 General. Because of the reduced obstruction clearances and pilot restricted field of view, the pilot nearest the hangar face should be at the controls for landing.

8.4.3.2 Day Visual Meteorological Condition. Inbound to the ship, intercept the approach line at approximately 200 feet and 0.5 nm to achieve a 3° slope. Maintain this approach line and glidepath using the lineup line on the ship deck (and the GSI) as visual cues until in close, at which point the landing phase commences.

8.4.3.3 Landing Phase

1. The pilot should begin to stabilize the helicopter in an air taxi short of the flight deck. A slow and controlled closure rate close to the flight deck is essential to maintain obstruction clearance. The pilot should not necessarily enter a stabilized hover short of the flight deck. The crewman shall report, "deck in sight." The pilot not at the controls shall back up the pilot scan and monitor performance instruments. The crewman should give advisory commands using standard terms found in Chapter 18. The pilot shall monitor LSE signals and verbal advisories from the crewman. The pilot shall receive signals to land from both the LSE and crewman prior to landing the helicopter. Refer to Figure 8-3.

2. After landing, the pilot not at the controls signals for chocks and tiedowns and completes the After Landing Checklist if performing multiple landings, the pilot not at the controls ensures completion of the Takeoff Checklist.

8.4.3.4 Night or IMC.

1. At night or during IMC, the aircraft will marshal as assigned. At the expected approach time or when cleared, complete Landing Checklist and commence the instrument approach. Descent to published minimums should be completed prior to 1 nm in order to see the GSI and deck landing environment.

2. The left-seat pilot should fly the helicopter during the instrument procedure portion of the approach. When the right-seat pilot has visually acquired the lineup light and GSI and is capable of continuing the approach visually, he should notify the left-seat pilot and take control of the aircraft. The left-seat pilot should secure the forward anti-collision light, switch position lights to dim, and resume his instrument scan.

Note

If the ship is below instrument minimums with no available divert field or ship, the aircraft commander may deviate from these procedures. The crew should consider the following options:

a. Use the coupler to descend to VMC.

b. Establish an air taxi at a slow closure rate and continue the approach from directly astern the ship.

c. Request the ship to drop smoke markers astern.

3. The right-seat pilot should utilize the GSI and deck lineup lights as visual cues until in close, at which point the landing phase (see Day Visual Meteorological Condition, paragraph 8.4.3.2) commences.

8.4.4 ASE/AUX OFF Approaches and Landings to Restricted Decks. In the event of a flight control malfunction, the pilot in command should determine if extended flight is feasible that would permit a landing ashore or aboard a larger ship (such as CV, LPH).

	FROM	TO	WHEN	REPORT VISUAL SIGNAL	RESPONSE
1.	PILOT	CREW	After landing checklist is completed	RIG FOR SMALL DECK DLQ LANDING	ROGER. UNSTRAPPING
2.	CREW	PILOT	When crew has visual reference with the deck	I HAVE THE DECK IN SIGHT	ROGER. YOU HAVE VERBAL CONTROL
3.	CREW	PILOT	After hearing from pilot, YOU HAVE VERBAL CONTROL	ROGER. I HAVE VERBAL CONTROL	
4.	CREW	PILOT	Visually sighting deck landing center line	ON CENTER LINE (Crewman reports standard terms for helicopter movement)	ROGER
5.	CREW	PILOT	When approaching deck edge (not deck edge safety nets)	GOOD ALTITUDE	
6.	CREW	PILOT	When main landing gear passes over the deck edge	MAINMOUNTS OVER DECK	
7.	CREW	PILOT	When tailwheel passes over deck edge	TAILWHEEL OVER DECK	

NOTE

Crewman shall monitor the tailwheel position until final touchdown or landing is achieved. The tailwheel may move either left or right and corrections must be made before final landing. The following are recommendations for standard ICS phraseology.

	FROM	TO	WHEN	REPORT VISUAL SIGNAL	RESPONSE
8.	CREW	PILOT	When tailwheel moves excessively to the left of safe landing criteria	TAILWHEEL IS LEFT	
9.	CREW	PILOT	When tailwheel moves excessively to the right of safe landing criteria	TAILWHEEL IS RIGHT	

NOTE

After final landing is achieved, pilot shall ensure that the chocks and chains are properly installed. Two chocks, one on each mainmount, four tiedown chains, one on each mainmount and two on the tailwheel.

	FROM	TO	WHEN	REPORT VISUAL SIGNAL	RESPONSE
10.	CREW	PILOT	When stable hover is achieved and safe landing criteria are met	CLEAR TO LAND	
11.	PILOT	CREW	After takeoff checklist is complete and all chocks and chains are visually sighted as being removed	LIFTING	ROGER
12.	COPILOT	PILOT	After a stable hover is achieved and safe altitude is obtained	CLEAR TO MOVE LEFT/RIGHT	COMING LEFT/RIGHT
13.	CREW	PILOT	After helicopter is visually clear	When clear of all obstructions—READY FOR FORWARD FLIGHT	POST TAKEOFF CHECKLIST

Figure 8-3. SS or MS Communications Brief

CHAPTER 9

Special Procedures

9.1 FORMATION/TACTICS

Helicopter formation flight is conducted to provide improved operational capability, mutual safety and accountability, and esprit de corps. When properly executed, the formation 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 delay while intentions are passed via signal or radio. The danger of midair collision is greatly reduced when every flight member knows where he is supposed to be and remains in his designated space. The formation leader, by checking positions, can account at a glance for any missing aircraft. Few factors can create a greater pride in a unit than a sharp, correctly executed formation doctrine. Few factors can destroy unit pride more thoroughly than a poor formation capability. Certain helicopter characteristics that should be considered in formation flight are the following: (1) Formation flying is done in a step-up position to avoid rotor wash and improve visibility and to provide a greater safety margin between the rotary wing and the helicopter ahead; (2) there is no wing to observe to indicate movement and changes of direction (at night it is difficult to ascertain when the lead helicopter changes direction and altitude) (refer to Night Formation, paragraph 9.1.7); and (3) loss of both helicopters in case of midair collision is probable.

Section and division leaders must endeavor to fly as smoothly and as steadily as possible. It is imperative that their power settings remain as near constant as possible. Constancy of heading and altitude should be a rule of flight insofar as considered practical and within the mission requirements. Quick stops in any formation or rendezvous are strictly forbidden. Illustrations of free cruise and parade formations can be found in Figures 9-1 and 9-3. In judging altitude separation between helicopters, the horizon is considered level with the eye.

9.1.1 Formation Composition.

See Figures 9-1, 9-2, and 9-3.

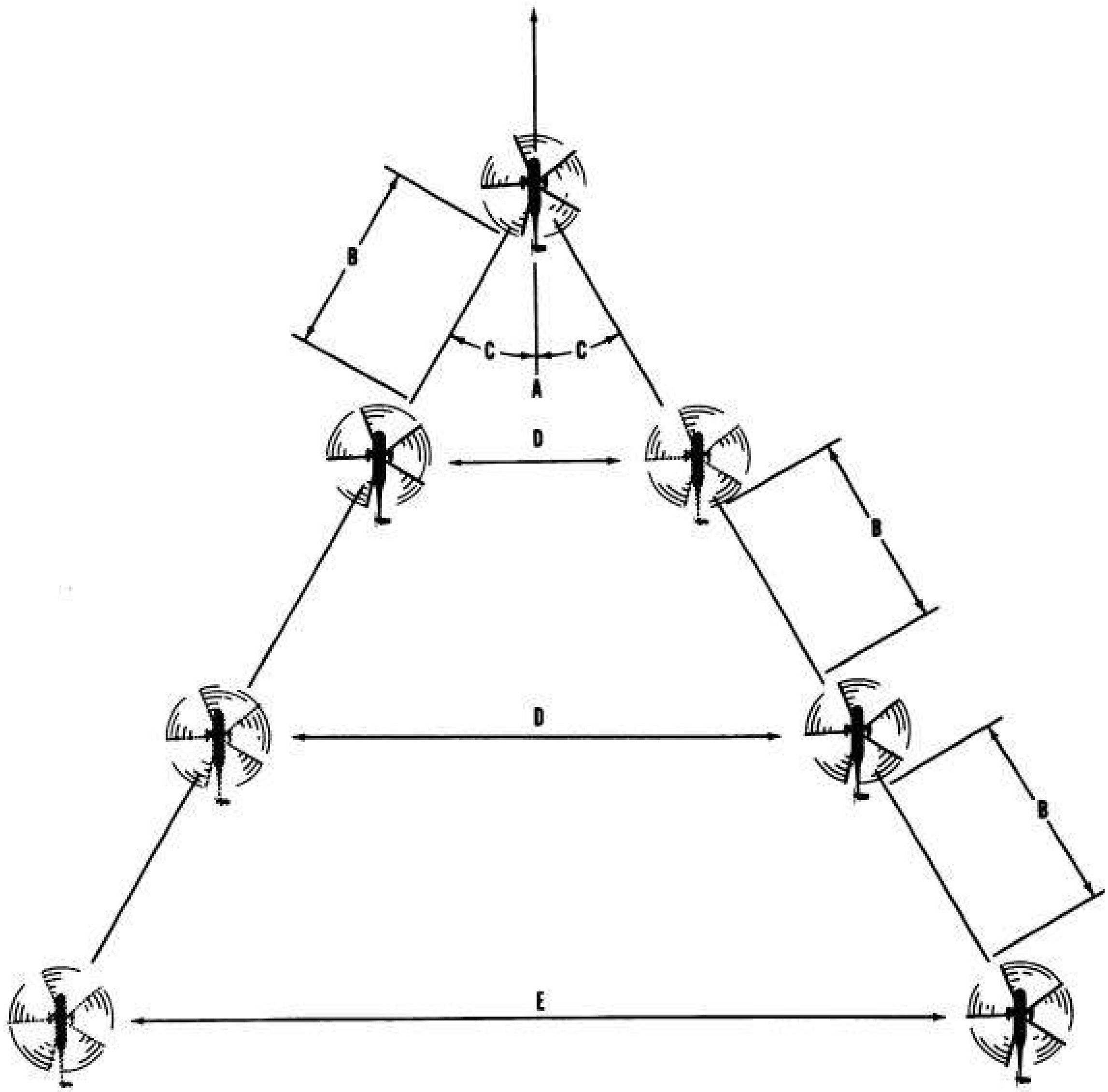
9.1.1.1 Section. The section will consist of two helicopters and will constitute the basic unit of a formation.

9.1.1.1.1 Parade. The wingman will fly at a 45° bearing abaft the beam on the appropriate side of the section leader. The horizontal helicopter-to-helicopter separation will be one rotor diameter minimum between rotor tips. The vertical separation (step-up) will be 10 feet between closest components of helicopters. The wingman position in the parade section is fixed.

9.1.1.1.2 Free Cruise. The wingman will fly within bearings about 60° abaft the beam of the section leader. The horizontal helicopter-to-helicopter separation will be about two to three rotor diameters. The vertical separation (step-up) will be 10 feet between closest components of helicopters. Normally, the free cruise wingman maintains a position 30° off the axis of the lead helicopter during straight and level flight. During turns, he crosses over from one side of the section leader to the other to maintain position with minimum changes of power. Normally, when straight and level, a position on the outward extremity of this segment is assumed in order that the leader may have ready visual accountability and for avoidance of turbulence or downwash problems.

9.1.1.2 Division. A division will consist of two sections and be considered the main unit of a formation.

9.1.1.2.1 Parade. The second section leader is the number three man in the division. His position is opposite of the wingman of section one. Section two wingman always views both his section leader and division leader in line from his position. Normally, the number two helicopter flies on the leader's starboard side.



LEGEND

A — LEAD (FORMATION AXIS)
B — DISTANCE BETWEEN HELICOPTERS: APPROXIMATELY TWO TO THREE ROTOR DIAMETERS
C — BEARING EXTREMITY: 30° EITHER SIDE OF LEAD AXIS
D — DIRECTION AND DISTANCE OF ALLOWABLE TRAVEL OF EACH HELICOPTER
E — NO. 4 HELICOPTER LIMITED TO 30 DEGREES OF EITHER SIDE OF SECOND SECTION LEADERS AXIS

Figure 9-1. Free Cruise – Straight and Level

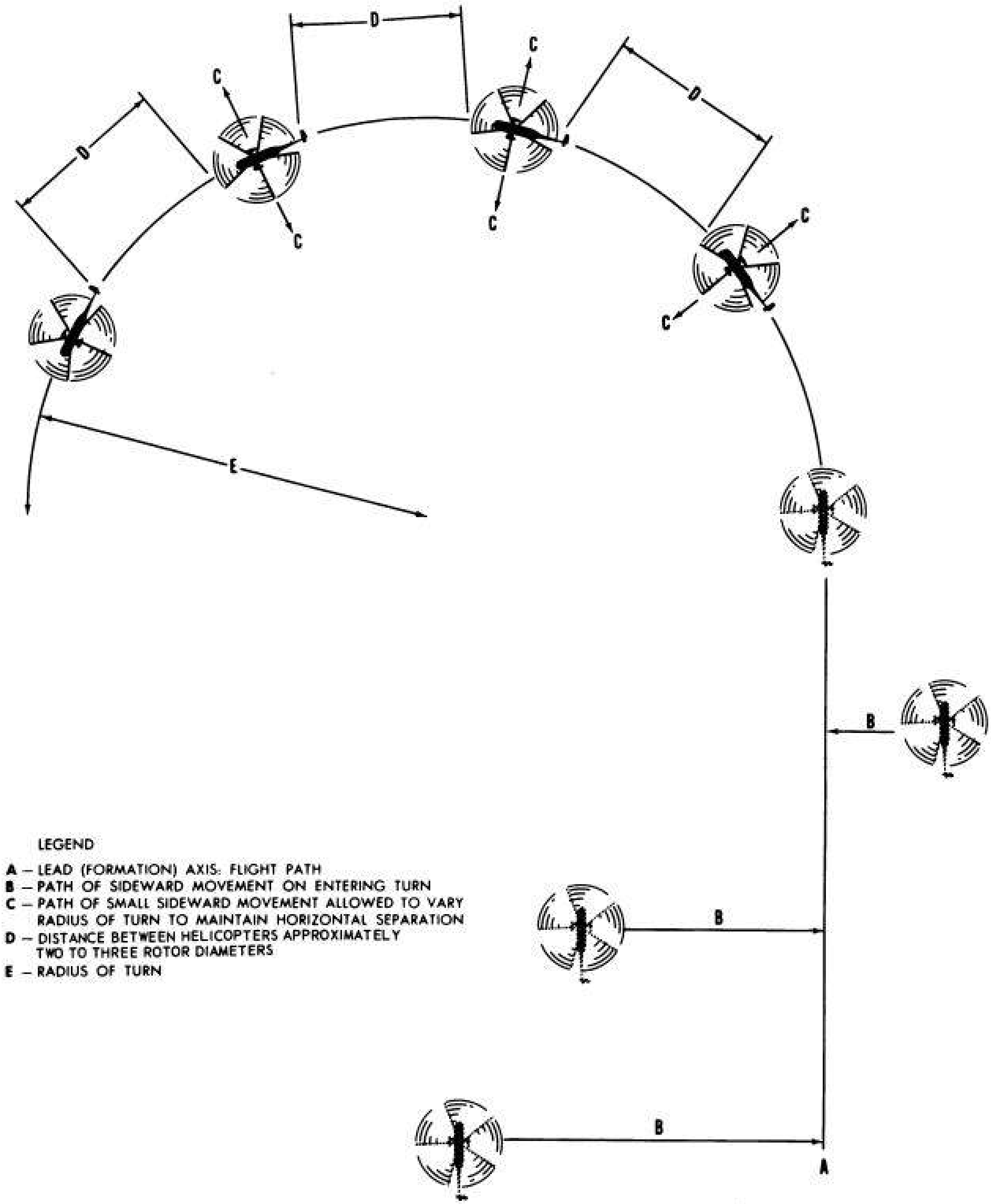


Figure 9-2. Free Cruise Turn

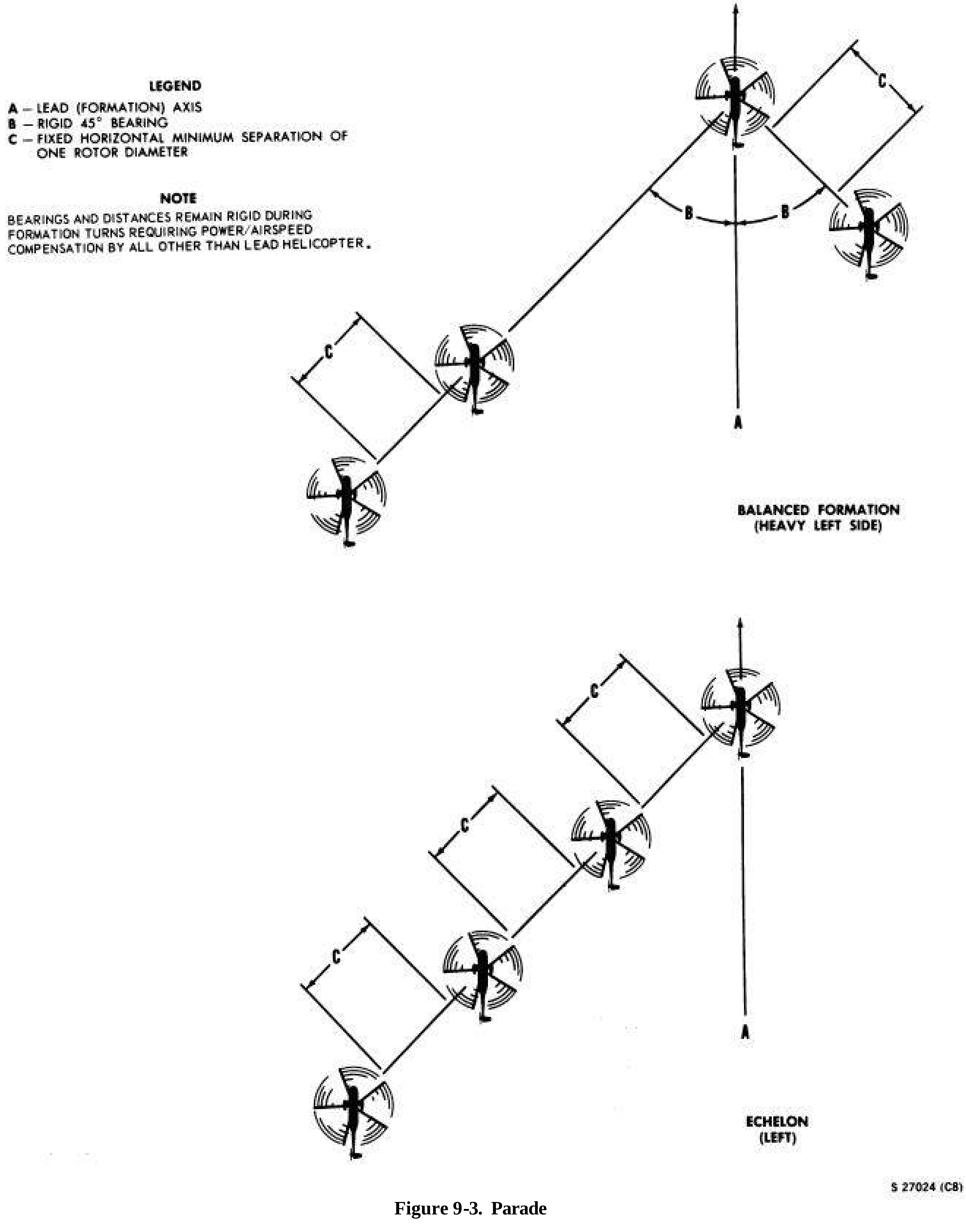


Figure 9-3. Parade

9.1.1.2.2 Free Cruise. The section leader will fly a bearing about 60° abaft the beam of the division leader when in straight-and-level flight. The horizontal and vertical clearance will be about two to three rotor diameters and 10 feet between closest components of helicopters respectively, from the section one wingman. During turns, the second section leader is free to cross over his section from side to side of the division leader to maintain horizontal clearance with minimum changes of power. The second section leader's wingman will conform to the requirements in the preceding paragraph. 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. The general rules applying to individual helicopters in formation may be expanded to apply to divisions of helicopters 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, and the side of the leader's wingman the light side.

9.1.1.3 Scouting Line. The scouting line formation is normally used, day or night, for flights proceeding to and from datum and for VFR cross-country navigation. This formation provides the best means for all helicopters in the flight to conduct visual search and navigation en route, while still affording the formation leader the means to control the flight. The formation leader must always be aware that relative motion is difficult to immediately discern at these distances and any course changes, especially at night, must be preceded by a radio call or other prearranged signal.

9.1.1.4 Other. Variations from the standard two-plane section and four-plane division are authorized.

9.1.2 Rendezvous. Normally, the running rendezvous should be employed. The leader should fly on course at slow cruise and the flight should take positions as briefed. When the flight is joined, the leader should proceed at cruise speed. An orbiting rendezvous may be used. The leader should 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 should join in column formation using the free cruise principle until the leader rolls out. On departure heading. All rendezvousing helicopters should pass across the designated point, pickup altitude separation, and join on the helicopter ahead. Any overshoot tendency should be taken to the outside of the turn. There after, the flight should continue to maintain free cruise formation at cruise speed unless otherwise directed by the formation leader. The flight positions are as briefed. Extreme caution should be taken during night rendezvous because of reduction of perception of relative motion.

9.1.3 Conduct of Flight. Formation flight should be practiced in accordance with this doctrine during all normal multiple helicopter movements in order to improve proficiency. Free cruise formation should be used for most operations. Parade formation is normally used only for flyover of ships or base. Unless otherwise specified, the formation leader should fly the lead from number one position. A change of lead should be passed only when the flight is in echelon and when positive change of lead is indicated by visual or radio communications.

9.1.4 Responsibility. The formation leader is responsible for flight briefing, conduct, and discipline of flight. He should normally handle radio transmissions for the flight, including takeoff and landing clearances. Division and section leaders are, responsible for maintaining position and should be prepared to assist the lead when required. All pilots are responsible for maintaining positions as outlined, bearing in mind the necessity for being in view of lead plane when not maneuvering in free cruise formation. No deviation of position, such as change of lead, shall be made until appropriate signals have been given and acknowledged. When changes of lead are made, the lead helicopter shall drift slightly away from the echelon until safely clear, and then assume position on the new formation. Safety shall govern all actions. Wingmen must avoid flying behind leaders in straight-and-level flight.

9.1.5 Briefing. Briefing for a formation flight is the responsibility of the formation leader. The briefing shall include the following information:

1. Rendezvous (type, area, altitude, positions, speed, and other pertinent data).

2. Position of each helicopter in the flight.

3. Communications (whether by radio or hand signals).

4. Review of signals.

5. Conduct of flight (what maneuvers will be accomplished, whether there will be changes of lead within the section or within the division, etc.).

9.1.6 Signals. The following signals shall be used in formation flying:

MANEUVER	SIGNAL	
	DAY	NIGHT
Join up	Radio and/or zoom (fore-and-aft movement of cyclic)	Radio
Right echelon (wingman)	Right arm up	Radio or R (.---.) on lights.
Left echelon (wingman)	Left arm up	Radio or K (---,---) on lights.
Echelon	Pumping arm signal or radio	Radio
Break-up	Vertical rotary motion on hand, pass leads, and kiss off. Radio.	Blink lights, then switch lights to bright to bright Radio.

9.1.7 Night Formation. Night formation should be flown in the same manner as day formation only when complete visual reference between the helicopters can be maintained. Separation between helicopters may be adjusted as deemed prudent by members of the flight and as directed by visibility conditions. Caution shall be taken 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. At any time firm and complete visual contact, cannot be maintained between helicopters, or silhouette definition is lost, discontinue the formation flight. Helicopters in formation at night should have position lights on STEADY, DIM, or BRIGHT (as required) with the rotating Grimes light OFF, with the exception of the last helicopter in each division turning lights on STEADY BRIGHT and actuating its rotating beacon.

9.2 INSTRUMENT FLIGHT CONDITIONS IN FORMATION (Figure 9-4)

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. Flight conditions permitting, the formation should be maintained intact, return to a clear area, and either land or file an IFR flight plan.

9.2.1 Lost Sight During IFR Flight Procedures. The reversal base course will be the reciprocal of the flight's present heading.

Upon signal, the helicopters will acknowledge and take the following action:

1. Helicopters 1 and 4 will commence a standard rate level turn away from the flight. They will call passing 90^{o} of turn and turn 170^{o}.

2. Helicopter 2 will maintain heading and altitude; upon call from helicopter 1 passing through the 90^{o} position, it will reverse course 170^{o} toward helicopter 1.

3. Helicopter 3 will maintain heading and immediately climb 500 feet; upon receiving the radio call from helicopter 4 passing through the 90^{o} position, it will reverse course 170^{o} toward helicopter 4.

It is essential that all helicopters maintain the airspeed of the flight when the dispersal was commenced. The flight will regroup when in a clear area.

9.3 ADVANCED INSTRUMENT FLYING

9.3.1 Instrument Check. Before leaving the ground or deck on an instrument flight, all instruments must be checked for proper operation. In addition, special emphasis must be placed on checking for instrument calibration, standby compass, gyro-stabilized compass, and all receivers and navigational equipment for proper operation. Check proper settings for attitude indicators, altimeters, etc. The following airspeeds for the various conditions of flight are designated as standard for the helicopter:

MANEUVER	SPEED
Slow cruise	70 knots
Normal cruise	100 knots
Fast cruise	120 knots

9.3.2 Straight-and-Level Flight With Power Changes. Straight-and-level flight is said to be the easiest to master for only one reason. It is a steady-state maneuver and requires a minimum of cross-checking or scanning. However, in order to sustain this regime of flight, a pilot must be quick to recognize any deviation of his aircraft through the primary instruments, in this case, airspeed, altitude, and slaved compass. The attitude indicator, if cross-checked properly, will greatly reduce the normal scan time. When holding a steady airspeed with constant altitude and heading, the end result can only be straight-and-level flight. At any given airspeed, the power setting determines whether the helicopter is in level flight,

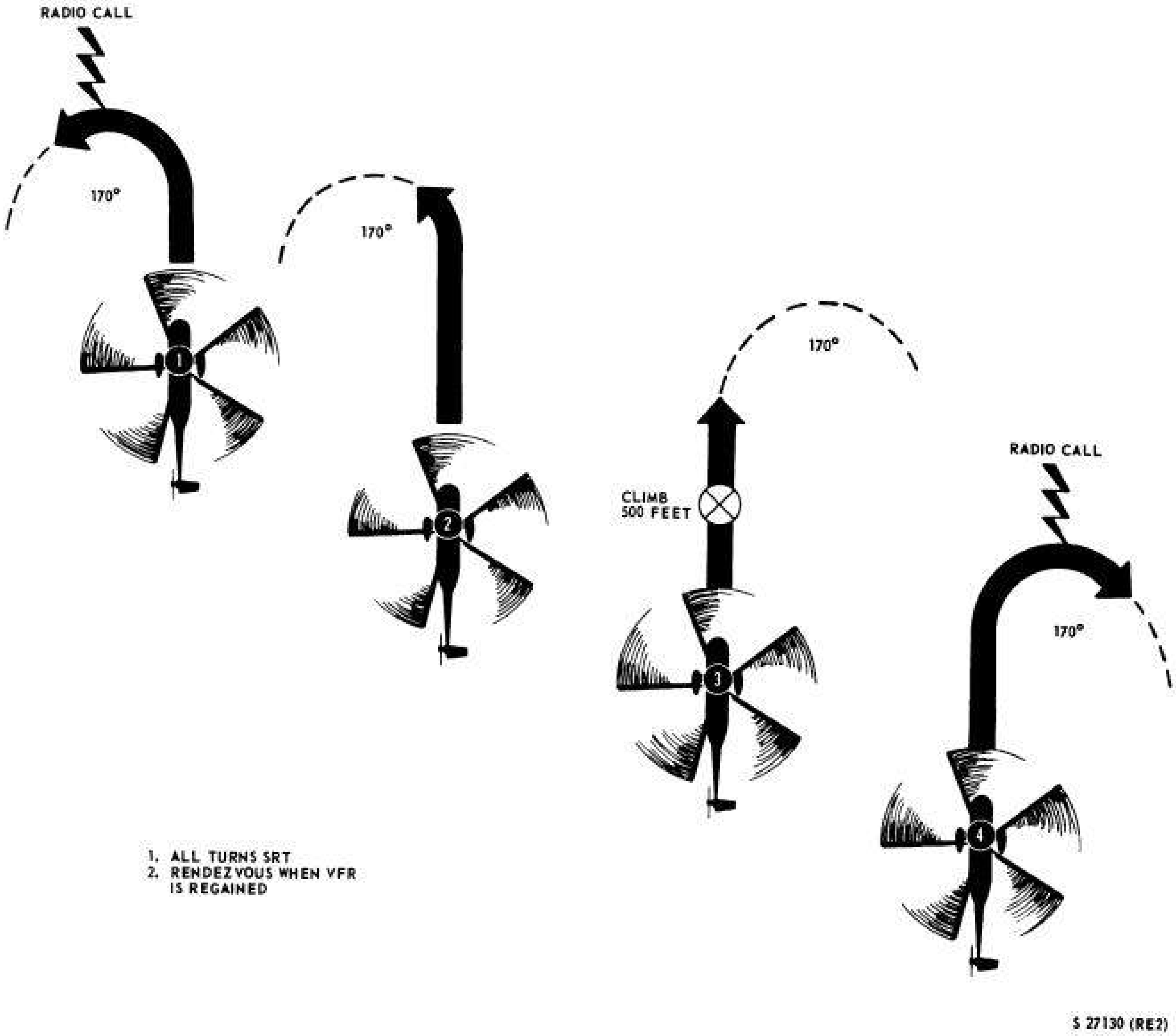


Figure 9-4. Four Plane Echelon IFR Dispersal

a climb, or descent. Airspeed shall be maintained during climb and descent with very little movement of the cyclic control. Because of collective cyclic coupling, minor cyclic adjustments must be made to maintain constant airspeed. When there is a reduction in power at low airspeeds, the helicopter tends to pitch noseup; the response is less noticeable at higher airspeeds. It will be noted in single rotor configured helicopters that when increasing power, the nose will yaw to the right Rudder changes are less necessary in this helicopter with power changes because of the collective yaw coupling.

9.3.3 Turns. A turn made by reference to instruments should be made at a definite rate. Except for practicing basic attitude maneuvers, a 3º per-second turn is usually used in programming precision instrument turns, as indicated by the turn-and-bank and attitude indicator. Airspeed determines the angle of bank necessary to maintain a standard rate turn. The standard rate turn is a single needle width turn. Combining bank and pitch control requires a more rapid cross-check, and interpretation must be accurate. This rapid cross-check should be practiced until it has become second nature to the pilot, and as a result will allow him to direct more attention to the other matters in the more advanced phase. In entering a level turn, the attitude indicator is the primary pitch attitude instrument, and the airspeed indicator is the primary power control instrument. During entry into the turn, increase power to compensate for loss of vertical lift caused by the banking of the helicopter. Remember not to apply any corrective action until the flight instruments indicate a deviation from the desired condition of flight. Only experience in the helicopter can teach the pilot to anticipate certain conditions. Although there is no lag in the slaved compass system, a lead should be established in rolling out of a turn. The amount of lead is determined by the individual pilot technique. A good rule of thumb is one-third the degree of bank used in the turn; for example, if you are using a 12º bank, then your rollout should commence at a 4º lead. This lead will serve as an aid in keeping the rollout smooth with less chance of an over-shoot.

9.3.4 Constant Airspeed Climbs - Descents and Level-Offs. For any power setting and load condition, there is only one airspeed that will give the most efficient rate of climb. In a climb at any predetermined constant airspeed and power setting, the pilot must accept whatever vertical velocity results. The entry to either is made by first adjusting the collective pitch and power to the desired power setting. The pitch attitude may be changed momentarily to hold the desired airspeed during the entry or level-off; however, once the descent or climb has been established and the airspeed stabilized, the pitch attitude will remain constant. Use the vertical speed indicator only after it is stabilized to maintain a standard rate of climb or descent. By continuous cross-check, you will be able to conduct a good programmed descent with small power changes. The level off from a climb must be started before reaching the desired altitude. Although the necessary amount of lead varies with the helicopter and pilot technique, the most important factor is the vertical velocity. Normally, the lead for each 500 foot-per-minute rate of climb will be 40 to 50 feet.

9.3.5 Unusual Attitudes. The importance of cross checking the attitude indicator must be stressed. The attitude indicator is a nontumbling attitude indicator. If the pilot uses the information presented by it correctly, he can execute a recovery very easily. Airspeed should be checked simultaneously with the attitude indicator. Checking the airspeed will also give an instant indication of pitch attitude. As soon as the airspeed is adjusted, the altimeter becomes the primary pitch instrument. The angle of bank and power should then be corrected. When a diving spiral is experienced, too much aft cyclic may aggravate the maneuver, will tighten the turn, and may result in a blade stall. It must be emphasized that when flying at mission altitude (150 feet and below) and at low speeds, the attitude indicator will only give attitude and rate of turn and will not present any information on rate of descent or accent. High sink rate can be experienced with no change in attitude; therefore, radar altitude and rate instruments should be given strong emphasis. While reducing speed, the only possible way to expedite the recovery is to level the wing attitude or at least decrease the angle of bank while simultaneously applying back cyclic. Do not chase the vertical speed indication on recovery from any maneuver. This is a rate instrument and is fairly reliable in a steady-state but should be disregarded after a pitch change is made. Abrupt right and left inputs in yaw will cause static instruments to indicate climb or dive, respectively.

9.4 HELICOPTER IN-FLIGHT REFUELING PROCEDURES (HIFR)

9.4.1 General. HIFR is done to extend the on-station time and should be initiated with enough fuel remaining to "bingo" to the nearest land base or carrier, if it is not possible to in-flight refuel.

Daylight VFR refueling operations can be executed in the same manner as normal utility transfers of mail, cargo, or personnel. Night in-flight refueling is an extremely demanding operation and should be scheduled only as operational necessity requires. Hot refueling while rotors are turning) is preferable to night in-flight refueling.

9.4.2 HIFR Systems. All HIFR-capable ships are equipped with one of two different rigs for HIFR:

1. Wiggins/North Island HIFR Rig - This rig has a ship's hose (> l00 feet in length and all HIFR assembly that is a 10-foot section of 1-1/2 inch hose outfitted with a saddle for hoisting the HIFR assembly and hose to the aircraft. Both ends of the HIFR assembly are equipped with female CCR fittings (also referred to as Wiggins fittings). A manual emergency disconnect lanyard (emergency release "T" handle) is located near the Wiggins fitting on the HIFR assembly that connects to the male Wiggins fitting in the helicopter. The second Wiggins fitting connects the HIFR Assembly to the ships hose.

Note

The Wiggins rig incorporates a manual breakaway that requires a helicopter crew member to pull an emergency disconnect lanyard to effect breakaway.

2. NATO Compatible High Capacity (HIFR -This new rig features a 100-foot long 2-inch lightweight hose, unisex couplings, automatic emergency breakaway and facilitates the use of either a CCR nozzle or a D-1 nozzle (SPR) for HIFR operations. The NHC also has two major assemblies - the 100-foot HIFR hose and the l0-foot HIFR assembly. During routine HIFR operations, H-3 aircraft will receive the CCR nozzle attached to the HIFR assembly. This nozzle has a built-in 45-psi pressure regulator and an on/off flow control handle that allows the crewman to turn on and off the fuel flow. Emergency breakaway is initiated when 450 ±50 pounds of straight tensile pull is extended on the automatic breakaway coupling. The mount for the hoist cable has been designed for self-alignment between the winch and deck tiedown to assure straight pull.

Note

- Emergency breakaway is accomplished automatically as the pilot pulls the helicopter away from the ship. No action by an air crewman is necessary.

- Most U.S. helicopters are configured with a CCR-type connection for HIFR refueling while all other NATO countries with HIFR capability use an SPR connection. Therefore, if a U.S. helicopter is HIFR'ed by another member country's ship, it will be given an SPR nozzle and must carry an adapter to convert it to a CCR-type connection.

Further information on both HIFR rigs can found in NWP 3-04.1.

9.4.3 Normal Operation. For day and night HIFR operations, the helicopter shall be positioned into the relative wind over the HIFR deck marking. The wind should be 330° to 355° relative to the ship heading at a velocity of 15 to 20 knots. Density altitude and true wind velocity will dictate whether a higher relative wind velocity will be required to hover. During high true wind conditions, the most stable hover with the least amount of turbulence is normally encountered when the ship is at a speed slightly above that required to maintain steerageway. The ship speed should be adjusted to minimize the pitching and rolling of the transferring ship in high seas.

WARNING

The plane commander should ensure that a fuel sample is taken and is visually inspected by a crewmember before fueling is commenced.

CAUTION

The plane commander shall make sure that the Landing Checklist (including lowering the landing gear) is completed before beginning any approach (HIFR, transfer, etc.) to any ship to preclude a gear-up landing in case of an emergency or other unscheduled landing.

To request in-flight refueling, the pilots shall contact the refueling ship and request HI-DRINK, specifying type nozzle, and the amount of fuel in pounds required. Two types of refueling nozzles are used:

1. The Parker nozzle (also referred to as the Dl/SPR nozzle) that is attached to the normal pressure-refueling receptacle on the starboard side of the helicopter.

2. The Wiggins fitting (also referred to as the CCR nozzle) is attached to a receptacle in the aft cabin floor, or starboard side, aft of the cargo door, behind the thermal barrier. When equipped with a Wiggins fitting, any member of the crew may give the command, "Break away." The crewman will immediately pull the emergency disconnect lanyard and report, "Hose clear."

Note

- If the Wiggins fitting is not properly seated, it will unseal when the fueling hose is pressurized. The fueling hose must be depressurized and partially sucked back before it can be properly resealed.
- When equipped with a Wiggins fitting, a slow pumping rate of less than 100 pounds per minute total for both tanks may indicate a clogged fuel filter in the helicopter receiving system. All five filters should be replaced with this indication. Before attempting to replace the filters, ensure that adjustments in the aircraft altitude and sufficient fueling hose pressure do not correct the problem.
- A light should be connected to the hoist hook during night operations to give visual reference to hook position at all times.

9.4.4 Communications. Signals to start and stop pumping shall be exchanged between the helicopter crewman and the ship director with the radios as the backup means of communication. In addition to the normal hover positioning reports, refer to Figure 9-5 for Standard Terms.

9.4.5 HIFR Procedures

1. Lower the hoist and obtain fuel sample taken from nozzle of HIFR rig and confirm fuel is acceptable.
2. Lower hoist cable for pick up of refueling rig.

Note

Should waveoff be required before either HIFR rig is connected, the hoist cable should be cut immediately.

3. Disconnect nozzle from hoist (or saddle).
4. Connect the grounding wire.
5. Connect CCR nozzle (NHC rig) or Wiggins fitting (NI rig) to the receptacle in the aircraft. When using the NI rig, crewman shall place one hand on the emergency release "T" handle and keep it there until fueling is complete and the NI Wiggins nozzle has been disconnected from the aircraft receptacle.

Note

The NI rig incorporates a manual emergency breakaway system. An aircrewman must pull the emergency release "T" handle to effect safe breakaway.

6. Raise hoist to near seat position.

Note

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.

7. Signal ship to pressurize hose.
8. Depress locking tab on the NHC rig's CCR nozzle and slowly move the flow control handle into the on or forward position.

Note

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

9. Monitor fueling. Signal ship to shut off fuel before exceeding maximum gross weight or internal weight limits (or when pilot commands).

Note

Crewman has ability to stop fueling with flow control handle on the NHC rig's CCR nozzle. In addition, this CCR nozzle will automatically stop flow and the red pin behind the flow control handle will extend under the following conditions: Pressure has exceeded 45 psi; tanks are full.

10. Move NHC CCR nozzle flow control handle into closed or off position.
11. Signal ship to turn off pump.
12. Disconnect NHC CCR nozzle or NI Wiggins fittings from aircraft fuel fitting.
13. Remove grounding wire.
14. Signal to move over flight deck and lower rig once over deck.
15. Raise hoist after confirming HIFR disconnected and report to pilot, "Clear for forward flight."

FROM	TO	WHEN	REPORT/VISUAL SIGNAL	RESPONSE
CREW	PILOT	Hose connected to hoist hook.	HOSE COMING UP.	ROGER.
CREW	PILOT	Hose is in the aft station	Hose is in aft station, CLEARED TO MOVE LEFT.	ROGER, MOVING LEFT.
CREW	PILOT	Ready to receive fuel (hose connected)	HOSE CONNECTED.	ROGER, COMMENCE PUMPING.
CREW	SHIP	Directed to commence pumping	CREWMEMBER MAKES CIRCULAR MOTION WITH HAND.	

CAUTION

The copilot must monitor the fuel quantity indicators during the pumping phase to avoid over filling and possibly rupturing the fuel tanks in the event the high-level shutoff valves fail.

FROM	TO	WHEN	REPORT/VISUAL SIGNAL	RESPONSE
PILOT	CREW	Desired quantity of fuel has been received.	STOP PUMPING.	ROGER, STOP PUMPING.
CREW	SHIP	Stop fueling.	CREWMEMBER MAKES CUTTING MOTION ACROSS THROAT.	
CREW	PILOT	Fueling has stopped.	FUELING STOPPED, HOSE DISCONNECTED CLEAR TO MOVE RIGHT.	ROGER, MOVING RIGHT.
CREW	PILOT	Ready to lower hose.	HOSE GOING DOWN.	ROGER.
CREW	PILOT	Hose disconnected from hoist hook and hoist is being raised.	HOIST HOOK CLEAR.	

NOTES

- At the pilot's discretion and when hoist is reported clear of ship deck, move left, retrieve hoist, and depart area
- The visual signals will be the same at night except a red lens flashlight shall be used.

Figure 9-5. HIFR Communications

9.4.5.1 HIFR Emergency Procedures. During HIFR, when an emergency conditions is observed, or when the command "Breakaway" is received the following emergency breakaway procedures should be followed depending on the type of HIFR rig being used:

1. NI HIFR Rig - The crewman, with his hand on the emergency release "T" handle, must pull the device, thus, releasing the HIFR hose and letting it fall back to the ship. The pilot then flies away from the ship.

2. NHC HIFR - This rig incorporates an automatic emergency breakaway. No crewman action is necessary to disconnect system. Once the NHC rig has been attached, the pilot can effect emergency breakaway at anytime by flying away from the ship.

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.

CAUTION

If the hoist cable is cut with either HIFR rig connected to the aircraft fitting, the possibility exits that the HIFR rig or aircraft fitting could rupture, causing pressurized fuel to leak into the cabin.

9.4.6 Night/Low Visibility HIFR Approach

1. The Approach/Landing Procedures, paragraph 8.4.3, described for night or IMC approaches to air-capable ships shall be used for HIFR. Hose pickup will be accomplished instead of landing.

2. Prior to commencing the approach, complete the Alternate Approach Checklist. When a green deck signal is received from the ship and the helicopter is ready to come over the stern, the copilot will secure the forward rotating anticollision light about 100 yards astern of the ship. The pilot takes control of the aircraft and completes the approach visually. The pilot in the left seat should adjust the ALTITUDE set pot as directed by the pilot in the right seat to maintain minimum safe altitude for desired obstruction clearance.

Note

Be prepared for collective jumps when the radar altimeter coupler acquires or loses the height of the ship fantail.

3. Once the HIFR hose has been picked up, the aircraft should be positioned to receive fuel. Recommended position for HIFR is rotors clear of the ship and a hover altitude of 40 feet. While hovering alongside the ship, the coupler system should be used. On pilot command "Coupler," the copilot engages the coupler, reports, "Engaged," and makes adjustments as directed by the pilot.

4. Once refueling is completed, the coupler should be disengaged prior to recrossing the deck. Departure from the HIFR ship shall be conducted using the procedures for night launches from air-capable ships.

5. Upon completion of the refueling evolution, make a 20° turn to the left and after receiving a "ready for forward flight" report from the crewman, slide clear of the ship to port. Use standard automatic hover departure procedures to climb to 150 feet. The anticollision light and exterior position lights reset as desired either before the departure or upon completion of the climbout.

9.5 ENGINE GASPATH PROCEDURES

Engine gaspath is a procedure designed to reduce corrosion of the engines because of the saltwater environment in which the helicopter is operated. This procedure is normally carried out after flights over water during which hovering was conducted, or as required.

CAUTION

If conditions prevent spreading the rotor blades for No. 2 engine start, ensure a minimum of 400 psi rotor brake pressure. If rotor brake must be pumped up, make sure that ground personnel are available to hold the blades.

9.5.1 Freshwater Wash

Note

- Allow engine to cool for 10 minutes after shutdown.
- If ambient temperature is below 5 °C (40°F), P3 line shall be disconnected from fuel control.

1. Preflight helicopter.
2. Circuit breakers and switches - CHECKED.
3. Brakes and tailwheel - CHECKED.
4. FUEL DUMP switches - OFF.
5. External power - CONNECTED.
6. External power switch - RESET, THEN ON.
7. Landing gear - CHECKED.
8. Start mode switch - NORMAL.
9. Blade panel, hoist, and trim, CREW ICS - CHECKED/ON.
10. Anti-ice - CHECKED AS REQUIRED.
11. Ignition switches - OFF.
12. Accessory drive switch - FORWARD, LIGHT ON.
13. Manual throttles and speed selectors -FREE, OFF.
14. Emergency start switches - OFF
15. Rotor brake - CHECKED (320 PSI MINIMUM).
16. Fire warning, caution, and advisory panels - CHECKED.
17. Fuel panel/quantity – OFF/CHECKED.
18. Lights - AS REQUIRED.
19. No.1 engine - ENGAGE STARTER.

Motor until N_g peaks (19-percent minimum), open wash cart valve, and introduce water. When N_g decreases to 15 percent, close valve. Wait until N_g accelerates to 19 percent before reopening water valve. As wash cycle continues, do not allow N_g to decrease below 15 percent with water valve open. Secure water wash 5 seconds before securing starter. Do not exceed 30-second starter limitation.

20. No. 2 engine emergency start - ON.
21. No. 2 engine - ENGAGE STARTER.

Motor until N_g peaks (19-percent minimum), open wash cart valve, and introduce water. When N_g decreases to 15 percent, close valve. Wait until N_g accelerates to 19 percent before reopening water valve. As wash cycle continues, do not allow N_g to decrease below 15 percent with water valve open. Secure water wash 5 seconds before securing starter. Do not exceed 30-second starter limitation.

22. No. 2 engine emergency start - OFF.

9.5.2 No. 1 Engine. Burnout. Operate engines for 3 to 5 minutes to dry out residual water.

Note

If engines cannot be started, go to Engines Gaspath Procedures, paragraph 9.5.7.

1. Ignition switches - NORMAL.
2. Emergency start switches - OFF.
3. Rotor brake - 320 PSI MINIMUM.
4. No. 1 firewall valve - OPEN.
5. Battery - ON.
6. No. 1 engine - START.
7. All gauges - CHECKED.
8. Speed selector - 104-percent N_f.
9. Boost pumps - OFF.
10. Generators - ON.
11. External power - DISCONNECTED.

9.5.3 Blade Spread. Only required ashore.

1. Servo sensor - CHECKED.
2. Area clear - CHECKED.

3. SAFETY VALVE switch - OPEN.

4. Blade fold MASTER switch - ON.

5. BLADES FOLD-SPREAD switch - SPREAD.

6. BLADE SPREAD light - ON.

7. SAFETY VALVE switch - CLOSED.

8. Rotor brake - 320 PSI MINIMUM.

9. Blade fold MASTER switch - OFF.

10. BLADES FOLD SPREAD switch - OFF.

11. Blade fold panel lights - CHECKED.

12. Servo pressure - CHECKED.

9.5.4 No. 2 Engine Burnout

1. Start mode switch - NORMAL.

2. No. 2 firewall valve - OPEN.

3. Anti-ice - AS REQUIRED.

4. Rotor brake - CHECKED (400 psi minimum).

5. No. 2 engine - START.

6. All gauges - CHECKED.

7. Boost pumps - OFF.

8. Allow both engines to operate for 3 to 5 minutes (No. 1 at 104-percent N_f, No. 2 at GRD IDLE).

WARNING

The rotor brake will not prevent rotor movement with the No. 1 engine in flight position above ground idle or with the No. 2 engine above ground idle. Personnel injury and/or helicopter damage may occur as a result of inadvertent rotor engagement.

9. No. 2 speed selector - SHUTOFF.

10. No. 2 fuel switch - CLOSED.

11. No. 2 engine instruments - CHECKED.

9.5.5 Automatic Blade Fold

1. Droop and flap restrainers - IN PLACE.

2. No. 1 blade position - CHECKED.

3. No. 1 engine speed selector - 104-percent N_f.

4. Rotor brake lever - ON.

5. No. 2 engine fuel firewall valve - CLOSE.

6. Automatic stabilization equipment (ASE) - OFF.

7. Area – CLEAR.

8. Collective pitch lever - MINIMUM PITCH.

9. Cyclic stick - NEUTRAL.

10. SAFETY VALVE switch - OPEN.

11. Blade fold MASTER switch – ON.

12. Rotor brake lever OFF.

13. BLADES FOLD-SPREAD switch - FOLD.

14. Rotor brake lever (No. 1 position light on) - ON.

15. BLADE FOLD light - ON.

16. SAFETY VALVE switch - CLOSED.

17. Blade fold MASTER switch - OFF.

18. BLADES FOLD-SPREAD switch - OFF.

9.5.6 No.1 Engine Secure

1. Speed selector - GRD IDLE.

2. Speed selector (less than 60-percent N_g) - SHUT OFF.

3. Fuel switch - CLOSE.

4. All engine instruments - CHECKED.

5. All switches - OFF.

9.5.7 Engine Gaspath Procedures

Note

- Allow engine to cool for 10 minutes after shutdown.
- P3 line shall be disconnected at the 2-o'clock position on the compressor rear frame at all temperatures whenever soap or solvent is sprayed into the engine. Whenever water is sprayed into the engine, the P3 line shall, be disconnected at the 2-o'clock position on the compressor rear frame if ambient temperature is below 5 ^{0}C (40 ^{0}F).

1. Preflight helicopter.
2. Circuit breakers and switches - CHECKED.
3. Brakes and tailwheel - CHECKED.
4. FUEL DUMP switches - OFF.
5. External power - CONNECTED.
6. External power switch - RESET, THEN ON.
7. Landing gear - CHECKED.
8. Start mode switch - NORMAL.
9. Blade panel, hoist, trim, and crew ICS - CHECKED/ON.
10. Anti-ice - CHECKED AS REQUIRED.
11. Ignition switches - OFF.
12. Accessory drive switch - FORWARD, LIGHT ON.
13. Manual throttles and speed selectors -FREE, OFF.
14. Emergency start switches - OFF.
15. Rotor brake - CHECKED (320 PSI MINIMUM).
16. Fire warning, caution, and advisory panels - CHECKED.
17. Fuel panel/quantity - OFF CHECKED.
18. Lights - AS REQUIRED.
19. No. 1 engine - ENGAGE STARTER.

Motor engine until N_g peaks (19-percent minimum). Introduce gaspath mixture while continuing to motor starter until N_g drops to 15 percent or 30-second starter limitation is reached, whichever comes first. Secure gaspath injection and starter simultaneously.

20. No. 2 engine emergency start - ON.
21. No. 2 engine - ENGAGE STARTER.

Motor engine until N_g peaks (19-percent minimum). Introduce gaspath mixture while continuing to motor starter until N_g drops to 15 percent or 30-second starter limitation is reached, whichever comes first. Secure gaspath injection and starter simultaneously.

22. No. 2 engine emergency start – OFF.

Note

Allow cleaner to soak for 15 to 20 minutes. Rinse within 30 minutes.

9.5.8 Gaspath Engine Rinse

1. Do steps 1 to 25 of Freshwater Wash procedures checklist.

9.5.9 Gaspath Engine Burnout

Note

- Allow engine to air dry 5 minutes before burnout.
- If engine cannot be started, motor starter for 30 seconds.

1. Do steps 1 to 12 of No. 1 Engine Burnout Checklist and steps 1 to 10 of No. 2 Engine Burn-out Checklist.
2. Blades must be spread ashore.

Note

Reconnect P3 line to fuel control if necessary.

9.6 ADDITIONAL MISSIONS/STATIC DISPLAYS

The helicopter can be used for the following utility missions: personnel and mail transfers, plane guard for carrier air operations, SAR, torpedo/rocket firing spotting and drop evaluation, and other support operations.

9.6.1 Static Displays. The following safety procedures shall be closely adhered to when displaying UH-3 helicopters to the general public:

1. Helicopter shall be chocked and all safety pins installed.

2. Battery shall be disconnected and door secured.

3. All marine smoke markers PDCs shall be removed from interior of the helicopter.

4. CADs shall be removed from rescue hoist.

5. Thermal barrier will be secured.

6. Blades should be spread; however, if folded, boots shall be attached.

7. A rope-type barrier should be used around the helicopter to control entry and exit point.

8. Visitors will enter and depart from personnel door unless an appropriate platform is available for cargo door use.

9. No more than four visitors should be allowed in the helicopter at one time.

10. All visitors shall be escorted while inside the helicopter, and a watch shall be posted to observe visitors around the exterior of the helicopter.

11. No visitors shall be allowed on the engine or transmission deck.

12. Upon completion of static display, the helicopter shall receive a thorough inspection, paying particular attention to the following areas:

a. Interior.

(1) Switches/control positions.

(2) Foreign objects.

(3) Rudder control cable security.

(4) Cleanliness.

b. Exterior.

(1) Antennas.

(2) Panels.

(3) Foreign objects.

(4) Refueling and defueling systems.

(5) Areas around helicopter for clearance and cleanliness.

9.7 SPECIAL CHECKLISTS (ET)

9.7.1 Mission Checklist. The Mission Checklist is designed to safely shut down the main rotor head and reduce noise levels when the executive transport mission requires expeditious arrival and departure with minimal noise and rotor wash. Its use is at the discretion of the helicopter commander.

9.7.1.1 Shutdown.

After Landing:

1. APU — START.
2. APU generator — ON.
3. ASE — OFF.
4. Tailwheel — LOCKED.
5. Brakes — ON.
6. No. 1 speed selector — GROUND IDLE.
7. Accessory drive switch — FWD, LIGHT ON.
8. No. 2 speed selector — GROUND IDLE.
9. Droop stops — IN.
10. No. 2 speed selector — SHUT OFF.
11. Rotor brake — ON (less than 45-percent N_r).
12. No. 2 engine instruments — CHECKED.

9.7.1.2 Start.

1. Rotor brake — CHECKED.
2. No. 2 engine — START.
3. All gauges — CHECKED.
4. Boost pumps — OFF.
5. ASE — OFF.
6. Shoulder harness (all stations) — LOCKED.
7. Collective — MINIMUM, COPILOT MONITOR.
8. Area — CHECK CLEAR.
9. Rotor — ENGAGE.
10. N_r — 102 PERCENT.
11. No. 1 speed selector — GROUND IDLE.

12. Accessory drive switch — AFT, LIGHT OUT.

13. N_r and torques — 104 PERCENT MATCHED.

14. Generators — RESET.

15. APU — SECURE.

9.7.2 Alert Checklist. The Alert Checklist may be used when a mission requirement exists to expeditiously start, engage, and prepare for takeoff. The Alert Checklist shall not be used on a routine basis to avoid system checks. The Normal Checklist, through systems checks, shall be completed prior to using the Alert Checklist.

9.7.2.1 Cockpit Setup.

1. Anticollision light switch — ON.

2. Other light switches — AS DESIRED.

3. Radio masters — ON.

4. Beeper trim — ON.

5. Ignition switches — ON.

6. Accessory drive switch — ACCESS DR.

7. Engine speed selectors — SHUT OFF.

8. Emergency start switches — OFF.

9. Start mode switch — NORMAL.

10. Rotor brake lever — CHECKED (320 psi minimum).

11. Fuel shutoff valves — CLOSED.

12. Crossfeed — OFF.

13. Boost pumps — OFF.

14. UHF, VHF, ICS, RAD ALT, NAVAIDS — AS DESIRED.

15. All other switches — OFF.

9.4.7.2.2 Start.

1. Battery — ON.

2. APU — START.

3. APU generator — ON.

4. Fuel valves (both) — OPEN.

5. No. 1 engine — START.

6. All gauges — CHECK.

7. Rotor brake lever — CHECKED (320 psi minimum).

8. No. 2 engine — START.

9. All gauges — CHECK.

9.7.2.3 Engagement.

1. Area — CLEAR.

2. Collective — MINIMUM (copilot monitor).

3. Rotor — ENGAGE, SET 102-PERCENT N_r.

4. Accessory drive switch — AFT, LIGHT OUT.

5. No. 1 engine — ADVANCE 104-PERCENT Nr. TORQUES MATCHED.

6. Generators — ON.

7. APU — SECURE.

8. Landing gear lockpins, chocks — REMOVED.

This Page Left Blank Intentionally

CHAPTER 10

Functional Checkflight Procedures

10.1 FUNCTIONAL CHECKFLIGHT PROCEDURES

The functional checkflight procedures listed herein are for the purpose of promulgating standard criteria for ground and flight functional checks for this helicopter. All functional checkflights shall be flown by qualified functional checkpilots designated in writing by the unit commander. The pilot seat shall be occupied by a functional check pilot designated by the squadron commander. The copilot seat shall be occupied by a qualified helicopter pilot. The flight shall be conducted with the minimum crew necessary, and the crew shall be fully equipped for flight. Functional checkflights shall he in accordance with OPNAVINST 3710.7 and 4790.2.

10.1.1 Designation of Pilots. The helicopter maintenance officer shall recommend designated helicopter commanders who have completed the indoctrination program to the commanding officer, via the operations officer, for designation as functional checkflight pilots. The operations officer shall forward such recommendations with appropriate comments to the commanding officer.

10.1.2 Functional Checkflight Pilot Qualification. The following shall be considered minimum for functional checkflight pilot qualification:

1. Functional checkflight pilot ground and flight checkout.

2. Read and initial functional checkflight pilot folder.

3. Read pertinent sections of the Maintenance Instruction Manuals.

4. Read applicable general engine bulletins.

5. Maintain familiarity with this flight manual (particularly Chapter 10).

6. Completion of a locally prepared ground training syllabus for prospective functional check-flight pilots.

10.1.3 Designation of Functional Checkflight Aircrewman. The unit's aircrew training and qualification instruction shall dictate the requirements as developed by the quality assurance officer and/or the crewchief recommendation board.

10.1.4 Qualifications for Functional Checkflight Aircrewman. The following shall be considered the minimum requirement for qualification as a functional checkflight aircrewman:

1. Designated utility aircrewman or special mission crewman.

2. Complete NAESU VATS training course.

3. Complete local FCF training syllabus and FCF checkride.

4. Be designated functional checkflight aircrewman by the unit commanding officer.

10.1.5 Conditions Requiring Functional Checkflight. Functional checkflights are required under the following conditions, after the necessary ground check and before release of the helicopter for operational or training flights:

A. Functional checkflights shall be accomplished at the completion of helicopter rework before acceptance and/or transfer of helicopters. All checklist items required are prefixed A.

B. Controllability checkflights shall be accomplished whenever the helicopter has been rerigged. Minimum checklist items required are prefixed B.

C. Engine change and/or fuel control adjustment checkflights shall be done whenever an engine or fuel control has been replaced and/or a stator vane actuator adjustment has been performed and are prefixed C.

D. Gearbox serviceability and/or overhaul check-flights shall be done as required in the Maintenance Instruction Manuals. Minimum checklist items required are prefixed D.

E. To be completed subsequent to the following maintenance actions:

1. Removal and installation/replacement or adjustment of these items:

a. Rotary wing head.

b. Swashplate.

c. Rotary rudder head.

d. Pitch change beam.

e. Any pitch change rod/link.

2. Removal and replacement of main rotary wing blade.

3. Removal and replacement of rotary rudder blade (auto rpm check not required).

Vibration Analysis/Main Rotor Track Balance/Tail Rotor track and balance (VMT). To be completed when vibration analysis is required in conjunction with another profile. (Figure 10-1)

10.1.5.1 General Functional Checkflights. General functional checkflights shall include such items as blade change, tail rotor control cable replacement, dual-gyro change, horizontal stabilizer replacement, and other circumstances as directed by the maintenance officer based on the scope of maintenance accomplished and the effect of such maintenance on safety and reliability of operation. Before such flight a determination shall be made by the maintenance officer along with the quality assurance officer as to which items on the functional checkflight card shall be done for the proper and safe functioning of the helicopter.

10.1.6 Blade Tracking. Whenever a track is required and there is no intent to fly, the cockpit shall be manned by a designated HAC. If there is intent to fly, then the cockpit shall be manned by a designated functional checkflight pilot

Note

All personnel in the helicopter shall be strapped in securely during each engagement.

10.1.7 Vibration Troubleshooting. 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 result of the amplitudes of all the frequencies. It would be difficult for the pilot to completely separate all the types of vibrations encountered. Generally, these are divided into 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. Figure 10-1 is a reference for post maintenance vibration analysis.

10.1.7.1 Low-Frequency Vibrations.

10.1.7.1.1 One Times Main Rotor Speed (One Per Revolution). This vibration emanates from the rotary wing system and is generally caused by rotary wing head or blade imbalances. It produces a rotary excitation of the fuselage that feels like a lateral oscillatory roll or wallow to the pilot on deck. In flight, it feels like a vertical bounce. If this vibration is present in all regimes of flight, troubleshoot rotary wing blades. The most probable causes are the following:

1. Rotary wing blades out of track. A blade track adjustment is not warranted even though the blades appear to be slightly out of track if a one-per-revolution vibration is not present. When using the electronic blade tracking equipment, if one or two blades are more than three-fourths inch out of track, as compared to blade No. 1, or if any three blades are not within one-half inch spread, troubleshoot in accordance with the tracking procedures. Out-of-track condition could be caused by damaged rotary wing blade trailing edges, or rotary wing blade static balance beyond tolerances.

2. Worn or loose control rod end bearings. If the vibration is present in a hover only, the cause could be item 1 above as well as rotary wing blade dynamic balance beyond tolerances.

10.1.7.1.2 Ground Roll. This is a one-per-revolution lateral roll of the helicopter that often occurs during rotor engagement and is due to the in-plane misalignment of the rotary wing 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 vibration disappears. If the vibration continues with the rotor up to speed at flat pitch, but disappears when the helicopter is lifted into a hover, then the cause could be static balance of rotary wing blades or the landing gear struts need servicing.

VIBRATION ANALYSIS MATRIX

VIBRATION ANALYSIS MATRIX V-INDICATES VIBRATION ANALYSIS REQUIRED AS PER NOTES M- INDICATES MAIN ROTOR TRACK/BALANCE T-INDICATES TAIL ROTOR TRACK/BALANCE	VIBRATIONS	BLADE TRACK	NOTES
ACCEPTANCE INSPECTION	V	M/T	9
AIRCRAFT NOT FLOWN IN EXCESS OF 30 DAYS	V		10
ENGINE REMOVAL / REPLACEMENT / REINSTALL	V		1
ENGINE H.S.S. REMOVAL / REPLACEMENT / REINSTALL	V		1
ENGINE H.S.S. DISCONNECT / ROTATION	V		1
ENGINE INBD MOUNT REMOVAL / REPLACEMENT / REINSTALL	V		1
ENGINE OUTBD MOUNT REMOVAL / REPLACEMENT / REINSTALL	V		1
MAIN GEAR BOX REMOVAL / REPLACEMENT / REINSTALL	V	M	1,7,8
TAIL GEAR BOX REMOVAL/ REPLACEMENT / REINSTALL	V	T	3
IGB REMOVAL / REPLACEMENT / REINSTALL	V		3
MAIN GEAR BOX INPUT SEAL REPLACEMENT	V		1
TAIL TAKEOFF DRIVE SEAL REPLACEMENT	V		4
IGB INPUT / OUTPUT SEAL REPLACEMENT	V		3
TGB INPUT SEAL REPLACEMENT	V		3
TGB PITCH CONTROL SHAFT SEAL REPLACEMENT	V		3
REPORTED AIRFRAME VIBRATION / SHUFFLE	V	M/T	10
PITCH LINK REPLACEMENT / ADJUSTMENT	V	T	3
PITCH CONTROL ROD REPLACEMENT / ADJUSTMENT		M	
MAIN ROTOR BLADE REMOVAL / REPLACEMENT / REINSTALL		M	
TAIL DRIVE SHAFT / THOMAS COUPLING REMOVAL / REPLACEMENT REINSTALL / DISCONNECT / ADJUSTMENT	V		10
TAIL DRIVE SHAFT #2 BEARING DISCONNECT/ REMOVAL / REPLACEMENT / REINSTALL	V		4
VISCOUS DAMPED BEARING REMOVAL / REPLACEMENT / INSTALL	V		2
MAIN ROTOR HEAD REMOVAL / REPLACEMENT / REINSTALL	V	M	7
TAIL ROTOR HEAD REMOVAL / REPLACEMENT / REINSTALL	V	T	3
TAIL ROTOR PITCH BEAM REPLACEMENT	V	T	3
TAIL ROTOR BLADE REMOVAL / REPLACEMENT	V	T	3
TAIL DISCONNECT JAW REMOVAL / REPLACEMENT / REINSTALL	V		3
MAIN ROTOR FLIGHT CONTROLS RIGGING		M	
TAIL ROTOR FLIGHT CONTROLS RIGGING		T	
PHASE A	V	M/T	3,7,8
PHASE B C D	V		3,7,8

NOTES:

1) HIGH SPEED SHAFT GROUND ONLY
2) STATION 391 GROUND ONLY
3) STATION 649 GROUND ONLY
4) STATIONS 290 AND 391 GROUND ONLY
5) STATIONS 391 AND 649 GROUND ONLY
6) STATIONS 290, 391, AND 649 GROUND ONLY
7) STATION 290 GROUND, HOVER, AND FORWARD FLIGHT
8) STATION 391 GROUND, HOVER, AND FORWARD FLIGHT
9) HIGH SPEED SHAFT, STATION 649 (GROUND ONLY), STATIONS 290 AND 391 GROUND, HOVER AND FORWARD FLIGHT
10) AS APPROPRIATE FOR RELATED MAINTENANCE ACTION REQUIRED / PERFORMED

Figure 10-1. VIBRATION ANALYSIS MATRIX

10.1.7.1.3 Two-Thirds Times Main Rotor Speed (Two-Third Per Revolution). In flight conditions that result in high rotary wing blade flapping angles, a condition of negative pitch lag coupling can occur in which the capability of rotor system damping is exceeded. This condition called pitch lag oscillation is felt as a heavy lateral rotary oscillation that can become increasingly violent if airspeed is allowed to build up or N_r is further decreased. It is not desirable to remain in this condition. Immediate corrective action is to lower the collective, increase rotor speed, and reduce airspeed and/or the severity of the maneuver.

Pitch lag oscillation may be encountered during flight at forward cg helicopter loadings with high forward speeds or right sideward flight or hovering in a right crosswind. It can also be encountered at any cg loading at forward speeds that exceed the allowable limit, high gross weight; low rotor speed; steep, level, or climbing turns; gusty wind conditions; or during abrupt pullup from a dive. If two-thirds-per-revolution vibrations should be experienced within the normal flight envelope, inspect the rotary wing head dampers.

10.1.7.1.4 Tail Shake. Tail shake, sometimes erroneously referred to as two-per-revolution vibration, is an aerodynamic effect of the rotary rudder passing through the disturbed air of the rotary wing system in certain flight regimes. This vibration will be felt in all helicopters to a certain extent as a random impulse around the yaw axis. The trailing position of the rotary rudder relative to the rotary wing head resulting from flying the helicopter in a right slip can induce this vibration in the speed range of 50 to 80 knots, especially with an aft cg loading. The rotary wing beanie-type fairing reduces this vibration considerably. This aerodynamic tail shake should not be confused with ASE yaw kicks that can be observed on the yaw indicator.

10.1.7.2 Medium-Frequency Vibrations.

10.1.7.2.1 Five Times Main Rotor Speed (Five-Per-Revolution). This most common inherent vibration is caused by the dynamic response of the rotary wing blades to asymmetrical aerodynamic blade loading. Its intensity is greatest at high forward speeds and during transition to a hover. It is felt in transition to a hover as a steady vertical shake caused by the rotary wing blades traversing the downwash of preceding blades. This is normal to the helicopter when felt at the point where the collective pitch is increased to sustain the hover, or when hover taxiing the helicopter into and out of translational lift. The effect can be reduced in transition to hover by leveling the helicopter just before applying collective pitch and by planning the approach so that final pitch application at a slow rate will be enough to attain the hover. At high speeds, the difference in the lift distribution between the advancing and retreating rotary wing blades results in heavy vibratory loads on the rotor head as the spanwise center of lift of each blade moves in and out. It is felt as a combination of vertical and lateral shake at the same frequency with the vertical being the most noticeable. The battery vibration absorber is designed to minimize the vertical portion of this vibration. The battery absorber is "tuned" to operate best at 100-percent N_r. If five-per-revolution vibration is excessive at high forward speeds, do this: check the battery mechanical vibration absorber. Check for improper torque on main gearbox tiedown bolts.

10.1.7.2.2 One Times Tall Rotor Speed. This vibration (1,243 cycles per minute at 100-percent N_r) is usually due to rotary rudder blade pattern dissymmetries and is not easily identifiable by the pilot because of its proximity to five times rotary wing frequency. It is evidenced by an increase in overall helicopter vibration. Since this frequency is close to five-per-revolution (1,015 per minute), the two frequencies sometimes modulate (beat) at a frequency of 228 cycles per minute that is felt as a shudder throughout the helicopter hard to distinguish from one-per-revolution (203 cycles per minute). When excessive vibration is suspected in all regimes of flight, check the rotary rudder.

10.1.7.3 High-Frequency Vibrations. These vibrations may be felt as a tingling sensation in the soles of the feet or a tickling in the nose, In extreme cases, the instrument needles will appear to be fuzzy. They will normally emanate from the engine, main gearbox input section, or rotary rudder drive system and are often equally apparent in a ground run as in flight. However, by far the most important cue to high-frequency vibration will be the associated sounds.

10.1.7.3.1 Rotary Rudder Drive Shaft Vibrations. Generally caused by an unbalanced drive shaft or bad bearings, this vibration can be identified during ground run by feeling the tail cone.

10.1.7.3.2 Main Gearbox Vibrations. The main gearbox contains many possible sources of high-frequency vibrations, such as the various gearbox-mounted accessories, the accessory gear train, oil cooler blower and the input bevel gear and freewheeling units that are generally heard rather than felt in the airframe. Combinations of these high frequencies in extreme cases could result in the pilot sensing low or medium frequencies. These would be detected as vibrations that are affected only by variation in rotary wing speed and may be just as apparent in a ground run as in flight. There are also numerous gear clash sounds that occur under various conditions, the acceptability of which can only be determined by experience or measurement by instrumentation.

10.1.7.3.3 Engine Vibrations. The engine gas generator or power turbine will normally beat together at various N_g and N_f combinations or with N_f split off from N_r. To the pilot, the only obvious evidence of excess vibrations will be greatly increased high pitch noise levels. If the magnitude appears abnormal, it is well to check alignment of the power turbine or high-speed main gearbox input shaft and condition of engine mounts. It is often possible to reduce this vibration by turning the engine main drive shaft in relation to the main gearbox input shaft in 90° units until in a ground run the vibration is diminished. If the noise level of one engine seems excessive compared to the other engine at the same power condition and if the excessive noise varies with N_g or N_f changes and is perhaps accompanied by a tingling vibration in the engine control levers, then a bad engine bearing or rubbing compressor blades may be indicated. Listen carefully to that engine during normal shutdown. Any unusual noises during coast-down after the speed control has been shut off might require an engine change. Normal engine coastdown time from idle to stop is 40 to 65 seconds. Troubleshoot the engine.

10.1.8 Definitions

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

10.1.8.2 Functional Checkflights. Functional checkflights are flights performed to determine if the airframe, powerplant, accessories, and items of equipage are functioning in accordance with predetermined requirements while subjected to the intended operating environments. Such flights are conducted when it is not feasible to determine safe and/or required functioning by means of a ground check or shop tests. The following items provide a detailed description of the checks, sequenced in the order in which they should be performed. In order to complete the required checks in the most efficient and logical order, a flight profile has been established. A letter designation has been established for each checkflight condition and prefixes each applicable check item in the following text and the functional checkflight checklist. Items not prefixed by a letter designation are normal procedure checks and will be accomplished on all flights. checkflight personnel will familiarize themselves with these requirements before the flight. NATOPS procedures will apply during the entire checkflight unless specific deviation is required by the checkflight to record data or be sure of proper operation within the approved aircraft envelope. Functional checkflight requirements and applicable minimums are described herein. When a conflict in the limits or procedures occurs between MIMs and NATOPS, the values and procedures specified in MIMs shall apply. A daily inspection is required before the checkflight.

Note

- The functional checkflight pilot shall approach preflight inspections differently than an average pilot. Since he is checking work that directly affects safety of flight, much closer scrutiny must be exercised during inspections.

- A (†) indicates normal checklist items.

PROFILE

10.2 PREFLIGHT CHECKS

ABCDE **10.2.1 Exterior** Perform normal preflight exterior inspection, paying particular attention to those components repaired, reworked, or replaced.

10.2.2 Interior

A 1. Personnel and cabin doors - CHECK FOR PROPER OPERATION.

A 2. Survival equipment - PROPERLY LOCATED, SECURED, AND NOT OVERDUE FOR INSPECTION.

A 3. HEEL system (AFC 417) - LIGHTS SECURE AND PRESS-TO-TEST SWITCHES CHECKED. (UH-3H)

A 4. Ditching bills - INSTALLED AND LEGIBLE.

A 5. Cockpit windows - CHECK FOR PROPER OPERATION.

A 6. Seats, seatbelts, shoulder harnesses, and shoulder harness lock levers - CHECK ALL STATIONS FOR PROPER OPERATION.

A 7. Seat and pedal adjustments - CHECKED.

A 8. Instrument range markings - CHECK ALL INSTRUMENT RANGE MARKINGS IN ACCORDANCE WITH CHAPTER 4, OPERATING LIMITATIONS.

A 9. Compass and airspeed correction cards - CHECK.

10.2.3 Prestart Checks

†1. Circuit breakers and switches - CHECKED.

†2. FUEL DUMP switches - OFF.

†3. Brakes and tailwheel - CHECKED.

WARNING

(ET) The APU is intended for ground operations only (minimal lighting, instrumentation, and air conditioner operation). It does not have a fire warning or suppression system and therefore should not be used in flight.

Note

On UH-3H Executive Transport aircraft, if the APU is used instead of external power; omit steps 5 through 7.

PROFILE

A

†4. (ET) APU – START.

a. Battery switch – ON.
b. APU ON switch - ON.

Observe the following:

(1) FUEL PUMP ON light - ON.

(2) STARTER ON light - ON (OFF after starter drops out).

(3) OIL TEMP HI light- OFF.

(4) APU FAIL light - OFF.

(5) APU ON light - ON.

c. APU generator switch - RESET THEN ON (after APU engine comes to operating speed).

Observe the following:

(2) GEN FAIL light - OFF.

(3) GEN ON light - ON.

†5. External power - CONNECTED.

A

6. External power advisory light - ON.

†7. External power switch - RESET, THEN ON. (with ET APU power as well)

†8. Landing gear - CHECKED.

A

9. Firewall valves - Place firewall valve switches to OPEN, then CLOSE, listening in each case for a clicking sound indicating the valves are opening and closing. If the clicking cannot be heard from the cockpit, have someone listen from a position just aft of the auxiliary servo compartment.

A

10. Engine T-handles - Place firewall valve switches to OPEN, then pull T-handles down and listen for clicking sound in the same manner as when checking firewall valves.

A

11. Crossfeed valve - Place crossfeed switch to OPEN and CLOSE and listen for clicking sound in the same manner as when checking firewall valves.

A

12. Fuel boost pumps/check valves.

a. Speed selectors - SHUTOFF.

b. FIREWALL VALVE switches - OFF.

c. No. 1 fuel boost pump switch - ON. The pump failure light should go on, then go off. If the failure light remains on, have crewman check for sound of boost pump running. If pump is running with light on, it may indicate check valve failure.

PROFILE

d. No. 1 fuel boost pump switch - OFF.

e. Repeat steps c and d for remaining boost pumps.

†13. Start mode switch - NORMAL.

†14. Blade panel, hoist, trim, and crew ICS - CHECKED/ON.

15. Helicopter lighting.

A

a. Exterior - CHECK FOR PROPER OPERATION.

b. Cabin interior - CHECK FOR PROPER OPERATION.

c. Cockpit interior - CHECK FOR PROPER OPERATION.

A C

16. Engine speed selector rigging.

Make sure that the fuel firewall valves are closed. Move the speed selectors through their full travel, checking for freedom of movement. At the full forward position, speed levers should be approximately matched. Check for smooth operation with the vernier controls. At some position above GRD IDLE, check for deadband play in each direction, with a light spring force tending to return the lever to the center of play. Retard the selectors toward GRD IDLE. A high load region that feels like a bind in the speed selector will be noticed just prior to reaching the ground idle detent. Further retard the speed selector to GRD IDLE; it should freely latch in that position. Return the selector to SHUTOFF.

A C

17. Starter and abort microswitches.

a. Be sure that the ignition switches and boost pumps are off and fuel firewall valves closed. Hold the No. 1 speed selector about 3° forward of the SHUTOFF position and depress the starter button; the starter should not energize. Hold the speed selector at SHUTOFF, and momentarily depress the starter button; the starter should energize and remain energized. Pull down on the speed selector; the starter should deenergize. Listen for any unusual coastdown noises.

b. Repeat all of the above on the No. 2 engine with the emergency start switch on. Return emergency start switch to OFF.

CAUTION

Do not motor the engine in the absence of fuel in the fuel control for any prolonged periods.

A

18. Windshield anti-ice.

Check the windshield anti-ice system by placing the ice protection windshield switch to LOW. Feel the windshield to determine that it becomes warm. Place the switch to NORMAL and check the windshield for an increase in temperature. After check, turn off switch.

PROFILE

A 19. Pitot heat.

Turn on pitot heat and check that pitot tubes become hot. Turn off pitot heat after check.

A 20. (NON-ET) Cabin heater.

Place the fan switch ON. Check for airflow through all diffusers. Turn the fan switch off. Place cabin heater switch to LOW. Check all diffusers for warm airflow. Place heater switch to HIGH and check that airflow temperature from diffusers increases. Turn the heater switch off and note that the fan continues to operate until heater cools and then shuts off automatically.

A 21. (ET) Environmental Air System.

a. Place the VENT AIR switch on the AIR COND CONTROL panel in the ON position and check for airflow through the cockpit and cabin floor diffusers. Place the EVAP BLO switch in the ON position and check for airflow through cockpit and cabin gasper outlets. Place both switches in the OFF position.

b. Place the HEAT MODE selector switch to AUTO and the HEATER/AIR COND SELECTOR switch to HEATER. Position the CABIN AIR TEMPERATURE selector on the air crewman control panel to WARM. Check cockpit and cabin floor diffusers for warm air. Place the HEATER/AIR COND SELECTOR switch to OFF.

Note

The heater fan will continue to run until the temperature in the plenum chamber reaches a safe level.

c. Place the HEATER/AIR COND SELECTOR switch on the AIR COND CONTROL panel to the AIR COND position. Rotate the CABIN AIR TEMPERATURE selector on the air crewman control panel to COLD. Check for illumination of the COMPR light on the air crewman receiver selector panel. Check cabin diffusers and cockpit and cabin gasper outlets for cold airflow.

Note

If the No. 1 or No. 2 engine/inlet anti-ice switches are in the ON position, the air-conditioner will not operate.

A 22. Engine/inlet anti-ice system.

Place Nos. 1 and 2 engine anti-ice switches ON. The Nos. 1 and 2 engine anti-ice advisory lights should go on. This indicates that the solenoid valve controls the 10th stage anti-icing bleed air has been deenergized to the open position. In addition, the Nos. 1 and 2 inlet anti-ice cautions lights may go on. The caution lights will remain on until the inlet has heated to 38 °C and the thermal switch opens.

PROFILE

Note

In extremely hot weather, there is a possibility the inlet temperature will be above 38°C before turning on the anti-ice system. In this case, the caution light will not go on and the system will have to be checked when cooler ambient conditions prevail.

†23. Anti-ice - AS REQUIRED.

A 24. AN/AIC-14 interphone (ICS) all stations.

a. Establish communications from the pilot station to all other stations with the AMPL SEL knob in the NORM, ALT-1, and ALT-2 positions. Return the AMPL SEL knob to NORM and place the MIC SEL switch to HOT. Communications should be possible without keying the cyclic mike switch.

b. Turn the VOX knob clockwise and determine that the microphone is energized when the operator talks in a normal tone and deenergized when the operator stops talking. Continue rotating the VOX knob clockwise and note that the sound level necessary to key the microphone decreases. Turn the VOX off.

c. Place the MIC SEL switch to CALL. All stations should be able to communicate without keying their mike buttons. Check operation of ICS volume control knob. Have one station select CALL on the MIC SEL switch and check that the ICS OFF is overridden at all stations. Repeat the above checks at all stations.

d. Place the SONAR INTERCOM switch on the overhead switch panel OFF and have the sonar operator select ICS. The pilot ICS should be isolated from the sonar operator ICS with these conditions set. Check that communications between pilots and crewmen may be established by depressing the SONAR CALL switch on the collective simultaneously with the mike button. Check that the hoist operator can select either pilot or sonar ICS.

10.2.4 No. 1 Engine Checks

A C 1. No. 1 engine start interlocks.

a. Place accessory drive switch to FLIGHT and No. 1 engine ignition switch to TEST; no clicking should be heard. Place No. 1 engine emergency start switch ON and No. 1 engine ignition switch to TEST; clicking should be heard. Return emergency start switch to OFF.

b. Place accessory drive switch to ACCESS DR and the SAFETY VALVE switch on the blade fold panel to OPEN. Release the rotor brake and place No. 1 engine ignition switch to TEST; no clicking should be heard. Reengage the rotor brake and place No. 1 engine ignition switch to TEST; clicking should be heard. Close the SAFETY VALVE switch.

CAUTION

Do not do step b in high or gusty winds.

PROFILE

†2. Ignition switches - NORMAL.

†3. (NON-ET) HEELS switch - ARM.

A CD

4. Accessory drive/ground idle interlock/override test.

Advance No. 1 speed selector forward of the ground idle detent. Move the accessory drive switch to FLIGHT and wait 7 seconds. Note that the shift does not occur (accessory drive red light remains on). Move No. 1 speed selector to GRD IDLE (light remains on). Move No. 2 speed selector forward of MIN GOV. Accessory drive light should extinguish (after approximately 6 to 7 seconds). Move accessory drive switch to ACCESS DR and both speed selectors to SHUTOFF. When the accessory drive light illuminates, move the accessory drive switch back to FLIGHT. The accessory drive light will remain on. Move the override switch to OVRD. The light should extinguish in approximately 6 to 7 seconds. Return the accessory drive switch to ACCESS DR and turn the override switch off.

†5. Accessory drive switch - FORWARD AND LIGHT ON.

†6. Manual throttles and speed selectors - FREE AND OFF.

†7. Emergency start switches - OFF.

†8. Rotor brake - CHECKED (320 PSI MINIMUM).

A

†9. Fire warning caution and advisory panels.

a. Press lamp test button. All caution and advisory lights should go on.

b. Press either PRESS-TO-RESET master caution light capsule; both capsules should go off.

c. Slightly turn the pilot flight instrument lights rheostat. Check that all caution and advisory lights dim, then turn pilot flight instrument lights rheostat off.

d. Fire warning system.

Move the test switch to FIRE TEST. The two warning lights on the pilot instrument panel and all four lights in the two FIRE EMERGENCY SHUTOFF SELECTOR HANDLES should go on.

†10. Fuel panel/ quantity - CHECKED.

Note

Be sure fuel quantity drops to zero and returns to initial quantity in about 10 seconds.

† 11. NO. 1 Firewall valve – OPEN.

†12. Battery switch - ON.

†13. Lights-AS REQUIRED.

A C

14. No. 1 engine alternate start.

a. Start mode switch - MANUAL.

PROFILE

b. Engage starter normally and advance speed selector to GRD IDLE. Engine should accelerate normally to ground idle T_5 within limits. During the transition to ground idle, depress the ENG ST button and note that engine accelerates at a slower rate. Release the ENG ST button and note that engine continues to accelerate normally to ground idle.

c. Pull down on speed selector when N_g reaches 45 percent and note starter dropout.

d. After starter dropout, a decrease of 20 to 40 °C T_5 will be noticed to indicate normal start bleed valve operation.

e. All gauges – Checked.

f. Boost pumps – OFF.

g. No. 1 engine T-handle shutdown - Pull No. 1 engine fuel valve circuit breaker. Shut down No. 1 engine from ground idle using fire emergency shutoff selector (T-handle). Allow engine to operate for at least 1 minute. Reset No. 1 engine fuel valve circuit breaker. Time required from resetting circuit breaker until first definite drop in N_g should be less than 1 minute. When flameout occurs, immediately place the speed selector to shutoff position and reset T-handle to prevent fuel control from running dry. Begin substep "h." below at this time.

h. No. 1 engine coastdown time - The engine shall be stabilized at ground idle before doing this check. Start the clock at the first positive drop of N_g if T-handle shutdown has been made, or at the moment of placing the speed selector in shutoff in a normal shut-down. Engine coastdown time should not be less than 40 seconds to the moment the compressor rotor is stopped, as visually observed at the engine bellmouth. Listen for any unusual noises. After the compressor rotor has stopped, a small amount of kickback in the opposite direction should be noted.

A C

15. No. 1 engine normal start.

a. Start mode switch – NORMAL.

b. Record time to light-off (should be less than 10 seconds).

c. Record time from light-off to ground idle (Figure 10-2).

d. Record N_g at starter drop out.

e. Record maximum T_5.

f. At ground idle, record T_5, N_g, and OAT (Figure 10-2).

OAT (°C)	-15	-10	-5	0	5	10	15	20	25	30	35
*MAX TIME LIGHT – OFF GRD IDLE	29	27	25	23	21	20	20	21	22	24	25
GRD IDLE $N_g \pm 3\%$	52.5	53.0	53.5	54.0	54.5	55.0	56.0	56.5	57.0	57.5	58.0
MAX T_5 °C	450	460	475	485	500	510	525	535	550	565	575
** ENG OIL PRESSURE	8 to 20 PSI					10 to 24 PSI					

* Add 1 second for each 1,000 feet pressure altitude above sea level.
** After oil temperature has stabilized.

Figure 10-2. Light-Off Time – Ground Idle

PROFILE

†16. No. 1 Engine – START

†17. All gauges - CHECKED.

†18. Boost pumps - OFF.

†19. No. 1 speed selector - 104-percent N_f.

†20. Generators - ON.

†21. (ET) APU – SECURE :

a. APU generator switch – OFF.

b. APU ON switch – OFF.

†22. No. 1 overspeed system - CHECK.

†23. External power - DISCONNECT.

†24. Servo sensor - CHECKED.

†25. Area clear - CHECKED.

†26. Blade fold safety, master, and blades fold/spread switches - OPEN, ON, SPREAD.

A C

27. Bladefold interlock test: Open the No. 2 firewall fuel valve and attempt a bladefold/spread (IAW NATOPS Chapter 7.). With the No. 2 firewall valve OPEN, the interlock feature within the bladefold system will interrupt (if in mid-bladefold/spread) or make blade folding/spreading impossible. If blades begin to fold, reverse procedure to return MRH to formerly fully folded or fully spread condition, abort functional check and troubleshoot IAW applicable MIMs. If check is successful, ensure the following:

a. Rotor brake lever - ON.

b. No. 2 engine fuel firewall valve – CLOSED.

AB D

28. Complete blade spread, fold, then spread cycles in accordance with NATOPS Pilot's Pocket Checklist to be sure blade fold system is operating properly.

†29. Blade fold safety, master, and blades fold/spread switches - CLOSED, OFF, OFF.

†30. Lights and servo pressure - CHECKED.

A

31. Electrical system checks.

CAUTION

With the No. 1 engine running, do not secure all electrical power to the helicopter with the blades folded, to preclude pressurizing the primary servo.

Note

Make sure all unnecessary electrical equipment is turned off before doing the following check.

a. With No. 1 engine in accessory drive and operation at 104-percent N_f with the boost pumps on, turn off the No. 1 generator. The No. 1 generator caution light and both No. 2 boost pump lights should go on. Turn No. 1 generator on and observe lights go off.

b. Turn off No. 2 generator. The No. 2 generator and No. 2 boost pump lights should go on. Turn No. 2 generator on and observe lights go off.

c. With the battery switch on, turn both generators off and note that both generator and transformer-rectifier caution lights go on. Also, be sure the pilot VGI does not go off until both generators are turned off. Place both generator switches ON.

d. With No. 1 engine in accessory drive, the tail takeoff warning light will go on at 98.5-percent N_f.

†32. Compass system and IFF console switches - AS REQUIRED.

†33. RAD ALT, BAR ALT, RAWS - TEST, SET, CHECKED.

10.2.5 Systems Checks

†1. (NON-ET) Hoist, hoist ICS, and HEELS - CHECKED. Have the air crewmen simultaneously press and release GEN 1 and GEN 2 switches on PMG control box. All light tubes will illuminate while both switches are pressed. Press and release GEN 1 and GEN 2 switches individually. Light tubes will remain off when each switch is pressed.

†2. Flotation gear - CHECKED.

†3. Head check - AS REQUIRED.

AB D

†4. Servo check - Check freedom of movement of all controls through full travel.

a. Primary servos - Turn off the primary servos; there should be no jump in the controls. The primary pressure gauge should go to zero and the primary servo pressure caution light should go on. Actuate the cyclic stick from one extreme to the other in lateral, then fore-and-aft directions, checking freedom of movement. Turn the primary flight control servo switch on. The primary servo pressure caution light should go off and pressure should read normal.

b. Auxiliary servos - Turn off the auxiliary servo and note zero pressure and caution capsule lighting. Collective should be at midposition (approximately 4 inches off bottom stop) and rotary rudder pedals positioned right pedal slightly forward of left when making this check. The cyclic should not jump more than one-eighth, and no more than one-sixteenth inch jump in rotary rudder pedals or collective should be noticed. With the auxiliary servo off, move the cyclic stick from one extreme to the other in lateral, then fore-and-aft directions, checking freedom of movement. Full actuation of cyclic in any direction should be possible with no evidence of binding.

Press left rotary rudder pedal and lift collective. Left rotary rudder pedal should move aft about 2 inches. Press right rotary rudder pedal and lower collective. Right rotary rudder pedal should move aft about 2 inches. These characteristics are due to the collective to yaw coupling through the auxiliary servos that are no longer irreversible with auxiliary hydraulic pressure off. In addition, the negative force gradient installation in the rotary rudder control system will cause any movement of the pedals from neutral to be aided by a spring force proportional to the pedal displacement. Movement of the rotary rudder pedals toward neutral will be opposed by the same spring force. Turn the auxiliary servo switch on; auxiliary servo hydraulic pressure should indicate normal and the caution light should go off.

c. Stick trim release - With the beeper trim switch on, press the TRIM RELEASE button

PROFILE

on the pilot cyclic stick; the stick should move freely. Release the button and displace the stick fore, aft, left, and then right. When released in each case, it should return to the original position. Check the copilot TRIM RELEASE button in the same manner.

d. Beeper trim - Check that the cyclic stick moves smoothly in the proper direction by pressing the beeper trim buttons on the pilot and copilot sticks in the fore, aft, left, and right positions.

e. Collective friction - Turn the collective friction nut to full increase. It should be possible to move the collective. Turn the collective friction nut to an intermediate point between full increase and off; the collective stick should move smoothly. The force required should be proportional to the amount of friction applied. Turn the collective friction nut to full off; there should be no evidence of friction applied to the collective stick.

AB D

5. ASE.

WARNING

Use of the HARDOVER switches on the ASE CHANNEL MONITOR panel shall not be made with the blades folded, to preclude damage to the rotary wing and control linkages. In addition, ASE hardovers shall not be induced in flight. Repeated use of the HARDOVER switches may cause ASE valve failure. If an induced hardover should cause an ASE valve failure, a hydraulic hardover may occur and can be eliminated only by securing of the auxiliary servo hydraulic system.

Note

All ASE ground checks should be made with the rotary wing blades spread, rotary wing head disengaged, and the No. 1 engine running in accessory drive at 104-percent N_f. The hover indicators should be in the A mode and the METER SELECTOR switch in ASE.

a. CHAN MON TEST switch - TEST.

b. HARDOVER switches - FORWARD.

Note

This check may be done with the ASE engaged or disengaged.

(1) Hover indicator (NON-ET) or Flight director indicator (ET) - Monitor that horizontal bar is up (pitch channel), vertical bar is left (roll channel), vertical arrow is up (collective channel), and horizontal arrow is left (yaw channel).

(2) TRIM RELEASE button - Depress and move the cyclic stick from stop to stop. Control movement aft and right should be slower than movement forward and left; however, it should be possible to move the cyclic from stop to stop in 1 second. Push the collective pitch lever down. A force of 3 to 5 pounds will be required to move the collective. Push the right rotary rudder pedal to its extreme forward position and release. The right pedal will move aft again and a force of 11 to 25 pounds will be required to prevent movement.

PROFILE

c. HARDOVER switches - AFT.

(1) Hover indicator (NON-ET) or Flight director indicator (ET) - Monitor that horizontal bar is down (pitch channel), vertical bar is right (roll channel), vertical arrow is down (collective channel), and horizontal arrow is right (yaw channel).

(2) TRIM RELEASE button - Depress and move the cyclic stick from stop to stop. Control movement forward and left should be slower than movement aft and right; however, it should be possible to move the cyclic from stop to stop in 1 second. Raise the collective pitch lever. A force of 3 to 5 pounds will be required to move the collective. Push left rotary rudder pedal to its extreme forward position and release. The left pedal will move aft again and a force of 11 to 25 pounds will be required to prevent movement.

Note

Any resistance, seizing of controls, or excessive pedal force during the hardover checks indicates improper adjustment of control linkage or auxiliary servo.

d. Channel disengage switches - OFF.

Hover indicators (NON-ET) or Flight director indicator (ET) - Check that all indicators are centered.

e. Channel disengage switches - ON.

f. CHAN MON TEST switch - Turn off and check hover indicator or flight director(ET) for normal indications.

g. All HARDOVER switches - OFF.

h. Collective clutch - Engage BAR ALT. Raise the collective to its full-up position. Note that the vertical pointer on the hover indicator (NON-ET) or the flight director (ET) moves to its full-down position. Press and release the BAR REL button on collective. The arrow should center within ±3/4 division. Lower the collective to the full-down position (the vertical pointer should move to the full-up position). Press and release BAR REL button. The vertical pointer should center with ±3/4 divisions.

PROFILE

†6. Normal ASE check.

a. CG trim - Engage ASE and place the cyclic in approximately neutral position. Turn CG TRIM knob and note that the pitch bar on the hover indicator (NON-ET) or flight director (ET) moves full travel in each extreme and properly follows the movement of the CG TRIM knob. When knob is moved to the F position, the pitch bar moves up. When the knob is moved to the A position, the pitch bar moves down.

b. Yaw proportional band - Raise collective to midposition and position left pedal slightly ahead of right. Slowly turn YAW TRIM knob. At initial movement of pedals, note point on hover indicator (NON-ET) or flight (ET) at which pedals start to move. This should be between 3/4 and 1-1/2 divisions from center. Press either pedal switch and observe that yaw piper returns to center. Repeat for opposite rudder and note that the breakout should be approximately equal in both directions.

c. Yaw cutout switches - Start rotary rudder pedals moving by use of the YAW TRIM knob. Pressing either pedal switch should disengage the yaw system, causing rotary rudder pedal motion to cease and the yaw arrow in the hover indicator to center. Check in the opposite direction. This checks operation of the yaw pedal switches.

d. Pitch and roll response - Move the cyclic forward, aft, left, and right. Note that pitch and roll bars on the hover indicator follow movement of the cyclic stick. Displace cyclic stick forward and to extreme left, then return cyclic to neutral position. Note that the roll bar lags the pitch bar by approximately 1 second. Repeat aft and to right. This checks proper operation of the dual-channel lag amplifier.

A

7. (NON–ET)Coupler/Doppler check (NATOPS) .

a. Cyclic beeping - With the Doppler off, the hover indicator in the A mode, and the CYC CPLR switch in the DOPP position, engage ASE and place cyclic in the neutral position with the roll bar centered. Center pitch bar with the CG TRIM knob. Engage the coupler and slowly increase the SPEED set knob until the cyclic starts to beep forward; this should occur when the pitch bar is within 2 ±l/2 divisions up. Repeat the check decreasing the speed set; the cyclic should beep aft when the pitch bar is within 2 ±l/2 divisions down. Repeat the above check, displacing the DRIFT set knob left and then right. In each case, the cyclic should beep in the proper direction when the roll bar has displaced 2 ±l/2 divisions.

b. Altitude tracking.

(1) Hover indicators - A MODE.

(2) Radar altimeters - ON AND RELIABLE.

(3) Altitude coupler switch - RAD ALT.

(4) Doppler - STBY.

(5) ALTITUDE set knob - ZERO.

(6) ASE - DISENGAGE.

PROFILE

(7) Radar altimeter PRESS-TO-TEST and hold. Radar altimeter indicator should read 100 ±l5 feet and hover indicator vertical pointer should go full down.

(8) ALTITUDE set knob - Turn to null vertical pointer. Altitude indicated by set knob should agree with RAD ALT indicator within ±5 feet.

(9) Radar altimeter- RELEASE PRESS-TO-SET.

c. Altitude channel tests.

(1) Collective pitch lever - FRICTION OFF.

(2) ALTITUDE set knob - 100 FEET.

(3) METER SELECTOR switch - ASE.

(4) SPEED set knob - ZERO.

(5) ASE and CPLR buttons - Depress; check for a collective rise. While the collective is rising, check that the vertical pointer on the hover indicator does not oscillate or exceed one division, indicating collective friction problems. Allow the collective to rise to the full-up stop and note that the vertical pointer on the hover indicator now rises full up. Release ASE, lower the collective, and repeat this step for VA. At the completion of the VA check, do not release ASE, be sure collective pitch lever is full up, and go to step (6).

(6) CPLR and BAR REL buttons - DEPRESS. Check that the vertical pointer nulls ±3/4 division within 8 seconds.

(7) ALTITUDE set knob - ZERO.

(8) SPEED set knob - 100 KNOTS.

(9) Altitude coupler switch - RAD ALT.

(10) CPLR button - Depress; check for collective drop as in step (5), only now pointer will go down. At completion of VA check, do not release ASE. Be sure collective pitch lever is full down and go to step (11).

(11) CPLR and BAR REL - Depress. Check that the vertical pointer nulls ±3/4 division within 8 seconds.

(12) BAR OFF button - Depress.

d. (NON-ET) IVSC test.

(1) METER SELECTOR switch - CPLR.

(2) Altitude coupler switch – RAD ALT.

(3) SPEED and DRIFT set knobs – Center pitch and roll bars.

(4) Doppler – TEST. Copilot sets his hover indicator to D mode and checks that Doppler signals are correct (1 to 1-1/2 divisions up and right, vertical pointer 1-1/2 to 2-1/2 divisions up.) Pilot checks the pitch and roll bars of his hover indicator moving slowly up and right (three divisions in about 22 seconds.)

PROFILE

(5) Doppler – OFF, THEN STBY. Pitch and roll bars on pilot hover indicator should slowly return to center.

e. (NON-ET) Cyclic channel test.

(1) CYC CPLR switch – DOPP.

(2) Doppler - TEST.

(3) Copilot hover indicators - Should read as in step d (5). Pilot hover indicator - Pitch bar 2-1/2 to 3 divisions up, roll bar 3-1/2 ±1/2 divisions right.

(4) Groundspeed indicator – 17 ±2 knots and 225° ±5°.

(5) SPEED and DRIFT set knobs - Null pitch and roll bars on pilot hover indicator. Drift knob should be at or near the I and SPEED knob about -15 knots.

(6) CPLR button - Depress. Pilot hover indicator vertical pointer should move 3 to 3-1/2 divisions down. Null SPEED and DRIFT knobs. Cyclic should now beep forward and right.

(7) ALTITUDE set knob - Null vertical pointer on pilot hover indicator. Knob should indicate 35 to 40 feet. Reset knob to zero.

(8) Doppler - OFF, THEN STBY.

f. (NON-ET) VA/Doppler V_h, V_d, V_z nulls.

(1) Doppler - STBY.

(2) METER SELECTOR knob - CPLR.

(3) Hover indicator - A MODE.

(4) CYCL CPLR switch - OFF.

(5) ASE - ENGAGED.

(6) CPLR and BAR ALT - DISENGAGE.

(7) Hover indicator vertical pointer - 1±1/4 divisions up.

(8) SPEED set knobs - Center horizontal bar (±2 knots on knob).

(9) DRIFT set knob - Center vertical bar (between D and T on knob).

(10) CPLR - ENGAGED.

(11) ALT CPLR switch - RAD ALT.

(12) Hover indicator vertical pointer -0±1/4 divisions.

(13) CYCL CPLR – DOPP.

PROFILE

g. (NON-ET) Hover trim test.

(1) CPLR button - DEPRESS.

(2) HOV TRIM button - DEPRESS; note ASE control panel light on.

(3) Crewman at the aft station - Report red light on.

(4) Pilot - Relay information to the crewman to enable him to center the bars on the hover indicator with his PITCH and ROLL bias knobs.

(5) Crewman - Move the control stick forward.

(6) Pilot - Check that the horizontal bar moves up and that the cyclic stick beeps forward.

(7) Repeat steps (5) and (6) for back, right, and left.

(8) CYC CPLR switch - OFF, THEN ON. Check that the ASE control panel light goes OFF. Crewman reports the red light OFF in the aft station.

(9) METER SELECTOR switch - ASE.

(10) ASE - RELEASE.

(11) Hover indicators - AS REQUIRED.

(12) ALTITUDE set knob - 40 FEET.

A †8. TACNAV – Check for proper operation.

A 9. (NON-ET) Rescue hoist.

After the crewman has completed a hoist check, place the rescue hoist master switch to PILOT and operate the hoist down and up, using the hoist control switch on the collective. Before operating the hoist to full-up position from the cockpit, make certain the crewman checks the up-limit switch for proper operation to prevent undue stress. Return the switch to CREW.

10.2.6 No. 2 Engine Checks

A C 1. No. 2 engine start interlocks.

a. Auxiliary servo - Turn off auxiliary servo and place No. 2 engine ignition switch to TEST. No clicking should be heard.

b. Emergency start switch - Place No. 2 engine emergency start switch ON and the No. 2 engine ignition switch to TEST. Clicking should be heard. Return emergency start switch to OFF.

c. Auxiliary servo and safety valve - Turn on auxiliary servo, open safety valve, and place No. 2 engine ignition switch to TEST. No clicking should be heard. Close the safety valve.

PROFILE

Note

The other two interlocks, pylon spread and blade spread, can be assumed operative if the light indications on the blade fold panel are proper.

†2. Ignition switch - NORMAL.

†3. Start mode switch - NORMAL.

†4. Fuel Panel - NO. 2 FIREWALL VALVE OPEN.

†5. Rotor brake - ON.

†6. Anti-ice - AS REQUIRED.

A C 7. No. 2 engine alternate start.

a. Start mode switch - MANUAL.

b. Engage starter normally and advance speed selector to GRD IDLE. Engine should accelerate normally to ground idle T_5 within limits. During the transition to ground idle, depress the ENG ST button and note that engine accelerates at a slower rate. Release the ENG ST button and note that engine continues to accelerate normally to ground idle.

c. Pull down on speed selector when N_g reaches 45 percent and note starter dropout.

g. After starter dropout, a decrease of 20 to 40 °C T_5 will be noticed to indicate normal start bleed valve operation.

h. All gauges – Checked.

i. Boost pumps – OFF.

g. No. 2 engine T-handle shutdown - Pull No. 1 engine fuel valve circuit breaker. Shut down No. 1 engine from ground idle using fire emergency shutoff selector (T-handle). Allow engine to operate for at least 1 minute. Reset No. 1 engine fuel valve circuit breaker. Time required from resetting circuit breaker until first definite drop in N_g should be less than 1 minute. When flameout occurs, immediately place the speed selector to shutoff position and reset T-handle to prevent fuel control from running dry. Begin substep “h” at this time.

h. No. 2 engine coastdown time - The engine shall be stabilized at ground idle before doing this check. Start the clock at the first positive drop of N_g if T-handle shutdown has been made, or at the moment of placing the speed selector in shutoff in a normal shutdown. Engine coastdown time should not be less than 40 seconds to the moment the compressor rotor is stopped, as visually observed at the engine bellmouth. Listen for any unusual noises. After the compressor rotor has stopped, a small amount of kickback in the opposite direction should be noted.

A C 8. No. 2 engine normal start.

a. Start mode switch – NORMAL

b. Record time to light off (should be less than 10 seconds).

PROFILE

b. Record time from light-off to ground idle (refer to Figure 10-2 from No. 1 engine normal start).

c. Record N_g at starter drop out.

d. Record maximum T_5.

e. At ground idle, record T_5, N_g, and OAT (refer to prior Figure 10-2).

†9. No. 2 Engine – START.

†10. All gauges - CHECKED.

†11. Boost pumps - OFF.

†12. ASE - OFF.

†13. Shoulder harness (all stations) - LOCKED.

†14. Collective - MINIMUM.

†15. Area clear and engage signal - CHECKED.

†16. Rotor engagement - Engage rotors in accordance with NATOPS Flight Manual and NATOPS Pilot's Pocket Checklist.

†17. Cyclic stick - Check response at 100 percent.

Prior to taxiing, actuate the cyclic stick a slight amount in all directions and check for proper response by observing the tip-path plane of the rotary wing blades.

CAUTION

If flight controls do not respond correctly, shut down by retarding No. 2 speed selector to SHUTOFF and apply the rotor brake.

A C †18. No. 2 engine maximum N_f at flat pitch. With collective full down and the No. 2 speed selector full forward, the No. 2 N_f should be 108 to 112.5 percent.

Note

With N_r above 104 percent, No. 1 engine will sense an overspeed condition and drop to 60- to 70-percent N_f.

†19. No. 1 speed selector - GRD IDLE.

PROFILE

CAUTION

If the generator caution lights and/or tail takeoff caution light go on when the No. 1 engine is retarded to ground idle, do not switch from ACCESS DR to FLIGHT. Immediately return the No. 1 speed selector to 104-percent N_f and go through a normal shutdown. This condition indicates a possible failure of the tail takeoff freewheeling unit. Under these conditions, loss of No. 1 engine will result in loss of all accessories.

†20. Accessory drive switch - AFT.

a. Accessory drive and blade panel lights - OFF.

A C — †21. No. 1 engine maximum N_f at flat pitch.

With the collective full down and the No. 1 speed selector full forward, retard the No. 2 speed selector until N_f's, are split and No. 2 torque is zero. No. 1 N_f should be 108 to 112.5 percent.

A C — 22. Tail takeoff warning system.

With the accessory drive switch at FLIGHT, reduce the rotor rpm and note that the tail takeoff warning light goes on about 94- to 98-percent N_r.

A — 23. Generators.

a. Underfrequency dropout - Reduce N_r slowly to 95 percent and wait 3 seconds. Continue reducing N_r 1 percent at a time, waiting 3 seconds after each reduction until the generators drop off the line. When the generators drop out, the respective caution lights should go on.

b. Slowly increase N_r. The generators should cut in within 2 percent of the cutout value.

V/M/T — 24. Vibrations (Ground).

WARNING

After tail rotor or high speed shaft vibes run ensure all tail pylon and high speed shaft tachometers, accelerometers and cables are removed.

a. Highspeed shaft vibrations – set N_f / N_r at 100% (103% N_f / Nr for ET) and collect highspeed shaft vibrations data IAW applicable MIMS.

PROFILE

Note

Both engines shall be operated at 100% N_r (103% N_f/Nr for ET) with the torques matched during engine high speed shaft check for either engines.

b. TRH vibrations/ smoothing – set N_f/ N_r at 100% (103% N_f/ Nr for ET) and collect tail rotor head smoothing data IAW applicable MIMS.

c. MRH smoothing – set N_f/Nr at 100% (103% Nf/Nr for ET) and collect Main Rotor Head smoothing data IAW applicable MIMS.

d. Once the MRH smoothing is within acceptable limits on the ground, with Nf/Nr matched at 100% (103% N_f/ Nr for ET), collect airframes vibration data IAW applicable MIMS.

Note

Best track and balance results will be obtained nose into the wind, speed less then 10kts and gusts of less then 15kts.

†25. N_f and N_r- 104 PERCENT.

†26. NAVAIDs - CHECKED.

†27. Landing gear lockpins/safety pins - SIGHTED.

†28. HEEDS bottles - ON.

†29. VLEA control dial - SET.

10.2.7 Taxi

†1. Area - CLEAR.

†2. Lights - AS REQUIRED.

†3. Chocks/tiedowns - REMOVED.

†4. Tailwheel locking handle - UNLOCKED.

†5. Shoulder harness (all stations) - LOCKED.

†6. Parking brake - OFF.

†7. Brakes - CHECKED.

†8. Tailwheel - CHECKED.

AB DE 9. Rotary rudder response - CHECK.

†10. RMI/BDHI wet compass - CHECK.

†11. Turn-and-slip indicator - CHECK.

10.2.8 Pretakeoff Checks

A C 1. Engine acceleration/deceleration checks.

PROFILE

a. Set N_r and both N_f's to 96 percent. Retard No. 1 speed selector until zero torque is achieved. Slowly advance the No. 1 speed selector until the first indication of torque and stabilize. Rapidly advance the No. 1 speed selector full forward. Check that No. 1 N_g and T_5 increase smoothly with no indications of compressor stall. At No. 1 N_g peak, retard the No. 1 speed selector to GRD IDLE. Cheek that No. 1 engine decelerates smoothly.

CAUTION

Be alert for possible stall on acceleration or deceleration. This would be shown by excessive rumbling or explosive noises, and possible rapid rise of T_5 above allowable limits. Do not continue to operate engine if this happens.

b. Place the No. 2 speed selector full forward. Advance the No. 1 speed selector from GRD IDLE to full forward within 1 second and note time to accelerate to 80-percent N_g. Note that the time from ground idle to 80-percent N_g should be 8 seconds or less. When N_g reaches 80-percent N_g, immediately retard the No. l speed selector to GRD IDLE and note that the engine smoothly decelerates.

CAUTION

It is important to retard speed selector immediately upon reaching 80-percent N_g to avoid sudden engagement of the freewheeling unit.

Note

If engine fails to accelerate within the limits while operating in regions of extremely high OAT, troubleshoot the engine in accordance with the MIMS and reattempt the check at a time of day when a cooler OAT is indicated.

c. No. 2 engine - Repeat procedure used for No. 1 engine to check No. 2 engine.

D

2. Gearbox serviceability check ground run (when required).

Note

For detailed preground and postground run information and other checks/inspections to be done, refer to Maintenance Instruction Manuals. An inspection is required before flight.

AB DE

3. Rotary wing dampers.

If some unusual oscillatory motion (ground roll) is noted during the engine acceleration/deceleration check or if a damper check is desired for other reasons, proceed as follows:

a. No. 1 engine speed selector - GRD IDLE.

PROFILE

Note

Before doing the damper check make sure that the tailwheel is locked and the aircraft aligned nose into the wind. The pilot should manipulate the speed selectors and monitor the rotary rudder pedals and cyclic. The copilot should hold the collective down.

b. No. 2 engine speed selector - RETARD TO OBTAIN 100-PERCENT N_r.

c. No. 2 engine speed selector - ADVANCE RAPIDLY TO FULL FORWARD.

d. No. 2 engine speed selector - RETARD SMARTLY WHEN N_r APPROACHES ITS MAXIMUM ACCELERATION (NOT RPM).

e. Any malfunction or difference in the leading relief valve of a damper or dampers will result in an in-plane oscillatory motion of the helicopter.

f. No. 2 engine speed selector - ADVANCE NORMALLY TO OBTAIN MAXIMUM N_r.

g. No. 2 engine speed selector - RETARD RAPIDLY TO OBTAIN 100-PERCENT N_r.

h. No. 2 engine speed selector - ADVANCE SMARTLY WHEN N_r APPROACHES ITS MAXIMUM DECELERATION.

i. Any malfunction or difference in the lagging relief valve of a damper or dampers will result in an in-plane oscillatory motion of the helicopter.

AB DE

4. Servos.

During this check, the copilot should place one speed selector to GRD IDLE and hold the other speed selector ready to shut down both engines in case of a malfunction.

a. Turn off the primary servo system. Some tip-path plane displacement is allowable but there should be no jump in flight controls. If any large displacement of the tip-path plane occurs, turn the servos on and abort the flight; do not turn off the auxiliary servos. With primary servo system off, move the cyclic and collective sticks in all directions and observe normal control reaction. Avoid using a circular motion of the cyclic stick that may induce ground resonance.

b. Turn off the auxiliary servo system. Control jumps should not be over one-eighth inch for cyclic and one-sixteenth inch for collective and rotary rudder pedals. Move the cyclic, collective, and rotary rudder pedals in all directions to observe normal reaction. Center the servo switch; observe that the primary and auxiliary servo pressures are within the normal range and the caution lights are off. ENSURE BOTH SPEED SELECTORS ARE ALIGNED, TORQUES MATCHED, AT 104% N_f/Nr.

A C

5. No. 1 engines start auxiliary servo pressure interlock. On the ground with rotors engaged and accessory drive switch at FLIGHT:

a. Place the No. 1 engine ignition switch to TEST; clicking should be heard.

b. Turn off the auxiliary servo and place the No. 1 ignition switch to TEST; no clicking should be heard. Turn the auxiliary servo on.

PROFILE

†6. Pretakeoff checklist.

†a. RAD ALT, BAR ALT, VGI - TEST, SET, AND CHECKED.

†b. N_r - 104 PERCENT AS REQUIRED.

†c. OAT - CHECKED.

†d. Boost pumps - AS REQUIRED.

†e. Rotor brake - CHECKED.

†f. Instruments/warning lights - NORMAL/CHECK.

†g. Lights - AS REQUIRED.

†7. Takeoff checklist.

WARNING

(ET) The crew chief's seat is not a crashworthy seat. Do not occupy this seat during takeoff or landing.

†a. Chocks/tiedowns - REMOVED.

†b. Tailwheel – LOCKED.

†c. Shoulder harness (all stations) - LOCKED.

†d. Doppler/tacan/TACNAV - AS REQUIRED.

†e. ASE/BAR ALT - ENGAGED/AS REQUIRED.

†f. Lights - AS REQUIRED.

†g. Emergency start switches - ON.

†h. Brakes - AS REQUIRED.

†i. Crew - READY FOR TAKEOFF.

a. HEEDS bottle - ON.

b. VLEA control dial - SET.

10.3 FLIGHT CHECKS

10.3.1 Hover Checks

AB DE

1. Controllability.

a. Check ASE off and apply some collective friction. Slowly lift to an approximate 5-foot hover, checking control positions and response during liftoff and after stabilizing in hover. Increase altitude to approximately 10 feet. Observe all engine and transmission

PROFILE

instruments for proper range. Check rotary rudder control by making left and right turns on the spot. Fly short distances forward, backward, and sideward to check cyclic. Check collective by making 20- to 30-percent torque changes. Observe tip-path plane. Note any unusual vibrations. Turn the primary servos off. Note that control will be sloppy and the blade track may widen with primary servos off. Expect a slight nose-up pitch in aircraft attitude. Turn the primary servos back on after conducting a controllability check in the same fashion as with the initial ASE off takeoff.

b. Repeat the preceding step with the auxiliary servos off. With auxiliary servos off, cyclic and collective control pressures will be heavier and the rotary rudder pedals will be harder to move. There should be NO INNER-CONTROL feedback with either system off. After conducting a controllability check, turn the auxiliary servos back on.

WARNING

When auxiliary servo is secured, if aircraft develops any left yaw, turn on the auxiliary servo and abort the flight.

Note

With either servo system turned off, there should be no unusual changes in pitch, roll, or altitude that require large control inputs to correct. With the auxiliary servo off, the helicopter MAY develop an accelerated yaw rate to the right unless corrected with left rudder pressure. If left rudder pressure required to hold heading exceeds 25 pounds, have the rigging of the negative force gradient spring checked.

D 2. Gearbox operation check (when required).

Note

For detailed preflight and postflight/ground run information and other checks/inspections to be performed, refer to Maintenance Instruction Manuals. An inspection before continuation of flight checks is mandatory.

a. Main gearbox - Hover at the heaviest gross weight within aircraft weight/torque/engine/transmission limits for 30 minutes and record applicable temperatures and pressures at 5-minute intervals. This allows construction of a stabilization curve.

CAUTION

If unusual temperatures, pressures, vibrations, or noises are noted, immediately terminate the flight and attempt to determine discrepancy before continuing.

PROFILE

Note

During carrier or other restricted operations, a 1-hour ground run may be made in lieu of the hover.

b. Intermediate gearbox - RUN AT 100% N_f/N_r (103% N_f/Nr for ET) FOR 30 MINUTES.

c. Tail rotor gearbox - RUN AT 100% N_f/N_r (103% N_f/Nr for ET) FOR 30 MINUTES.

A 3. Compasses - During the controllability check, note correct heading information and proper operation of the all compasses.

AB D 4. ASE Hover.

Note

The following checks test the operation of ASE. initial engagement of the ASE should be done with the helicopter on the ground. Note any large displacement of tip-path plane and position of bars and pointers on hover indicators (NON-ET) or flight directors (ET) when ASE is engaged (A mode selected). Lift off cautiously and note cyclic position and sensitivity of control.

a. Hover stability - Trim the helicopter for hands-off hover. The helicopter should maintain attitude within ±3° in pitch and roll attitude.

b. Yaw trim turn - While in a hover on a numbered heading reading on the BDHI, turn the YAW TRIM knob smoothly a full 360°. The helicopter should follow smoothly and stop at 72° ±4° from the original heading. Stabilize. Turn the yaw trim one-quarter turn in less than one-half second. The helicopter should stabilize at a new heading with no more than one overshoot.

c. Yaw pedal turn - While hovering into the wind, start a slow turn on the spot, gradually increasing the turn rate. An opposing force will be felt on the rotary rudder pedals that should increase with turning rate. Repeat in the opposite direction. Do not exceed helicopter turn rate limitations.

Note

In winds in excess of 15 KIAS or gusty winds of the same, yaw pedal turn checks can be conducted turning approximately 45 degrees either side out of the wind line to preclude possible over-torque/overturn-rate conditions due to tail-rotor vortex ring state and fuselage freeboard effect.

d. Push/pull and release - With the helicopter trimmed for a hands-off hover, push the stick forward about one-half inch against the force gradient spring, hold for 1 second, and then release (stick oscillation should be dampened by the pilot). The helicopter should return to the original attitude within one overshoot attitude oscillation. Repeat with a one-half inch cyclic pull and release in the aft, right, and left directions. Recovery should be the same as specified above.

Note

The basic ASE system stabilizes attitude only, not over-ground position.

PROFILE.

e. Power change - Make smooth 30-percent torque increase and hold briefly. The helicopter transient heading error should not exceed +10°. From a high hover, approximately 100 feet AGL, make a smooth 30-percent torque reduction. The helicopter transient heading error should not exceed -l0°.

WARNING

Ensure on 30% power reduction not to descend at such a rate as to enter vortex ring state. Power reduction should be deliberate enough to make the transient heading error check but power should be reintroduced judiciously as to arrest aircraft rate of descent to no more than 500 fpm.

f. Switch gyros - Switch the VERTICAL GYRO selector on the CHANNEL MONITOR panel to opposite gyro. A slight jump may be felt in the helicopter but hover attitude stability should be maintained. Return the switch to original gyro.

g. Collective balance.

(1) With the helicopter established in a stabilized hover, collective friction and BAR ALT off, check that the collective maintains any position from which it is released. An upload or download that may be controlled with a control pressure of one-quarter pound or less is acceptable.

(2) Turn off ASE and repeat the above procedure with AUX OFF. An upload or download with AUX OFF usually indicates boot strap springs out of adjustment.

h. Radar altimeter - With the CPLR mode of the ASE disengaged, depress the PUSH-TO-TEST control switch at any altitude. A visual indication of 100 ±l5 feet on the indicator assures satisfactory system operation. Release the PUSH-TO-TEST control switch to restore normal system operation.

A C 5. Engine anti-ice (above 93-percent N_g) - ON. CHECK FOR T_5 RISE.

A 6. Generator underfrequency - Establish a hover and reduce N_r to 92 percent. The generators should not drop off line. The underfrequency protection is bypassed through the landing gear scissors microswitches when the weight of the helicopter is off the struts.

WARNING

Controlled flight below 91% N_f/Nr is impossible.

M 7. Main Rotor head Track and Balance – Establish an out-of-ground effect hover with the torque's matched and N_F/N_R at 100%. Collect main rotor head track and balance data IAW applicable MIMS.

Note

Allow aircraft to stabilize at each regime for at least one minute before pressing run and collecting track and balance data.

PROFILE

A

8. Windshield washer and wipers - while in a hover:

For helicopters with electrically operated windshield wiper and washer systems, place WSHLD WASHER switch to ON and a continuous stream of water will be emitted from each of the holes in the washer tube. Place the WINDSHIELD WIPERS switch to LOW and HIGH and note change in wiper speed. The wiper movement should be smooth and touch the windshield over the entire length of sweep and leave no unwiped area. Place WINDSHIELD WIPER switch to PARK and wipers go to the parked position. Place WSHLD WASHER switch to OFF and the washers shut off.

CAUTION

To prevent scratching the windshield, do not operate the wipers on dry glass.

A

9. RAWS - Establish a hover below 30 ±5 feet; the ALTITUDE caution light should flash. Raise the landing gear; the ALTITUDE caution light should continue to flash and a beeping aural signal should be heard. With landing gear up, ascend to above 30 feet; both warning signals should cease at 30 ±5 feet. Lower the landing gear.

A

10. (NON-ET) Cargo sling - This check should be conducted at a neutral cg and a maximum gross weight of 15,000 pounds. Ensure that the CARGO SLING MASTER switch is in SAFE position and the RELEASE MODE switch is in the CARGO SLING position. Hover helicopter and hook up 4,000-pound weight. Raise helicopter until weight clears ground. Release load utilizing pilot release pedal. Force required to actuate the pedal should be approximately 40 pounds. The hook UNLOCKED and CARGO SLING HOOK UNLOCKED lights should illuminate momentarily while hook is open and then go out. Repeat hookup. Place CARGO SLING MASTER switch to SLING position. Release load using pilot cyclic cargo hook release button. The CARGO SLING HOOK UNLOCKED light should be on as long as the button is depressed. Repeat using copilot release button. Repeat hookup. Put master switch in AUTO position. Allow weight to touch ground lightly; load should release. Place CARGO SLING MASTER switch in SAFE position. The HOOK UNLOCKED light and the CARGO SLING HOOK UNLOCKED light should go out as the hook closes. Have crewman stow the cargo sling.

A C

11. Mechanical topping/ minimum acceptable torque.

Note

No adjustment to topping is required provided any one of the following conditions is met:

(1) N_g speed of 103.2% to 103.7% is reached before the T_5 limit. The engine is then compressor speed limited.

(2) T_5 of 745°C - 750 °C is reached before the N_g limit is reached. The engine is then temperature limited

(3) The speed limit and temperature limit are reached concurrently.

PROFILE

Ambient Temperature Range	Estimated Minimum Altitude to Check Topping
Above 22 C	Sea Level
18 to 21	500 ft
15 to 18	1000 ft
10 to 15	1500 ft
2 to 10	2000 ft
-5 to 2	2500 ft
-12 to -5	3000 ft
-18 to -12	3500 ft
-23 to -18	4000 ft
Below -23	5000 ft

Figure 10-3. Ambient Temperature Versus Minimum Altitude for Topping Check

Note

- When an engine trim checker is available, it should be used for the final readings of T_5, N_g, and N_f. Before adjustment procedures, ICS communications shall be established between the pilot and engine trim checker operator.

- During all fuel control adjustments while using the engine trim checker, the rotary TEMP switch should be at COCKPIT to allow simultaneous cockpit monitoring of torque, T_5, and N_g.

- The engine trim checker operator will communicate T_5 readings to the pilot when the rotary TEMP switch is at T.I.T.

a. If ambient temperature is below 22 degrees C, engine may be fuel flow limited and it will be necessary to climb to the correct altitude listed in figure 10-3 to adjust topping.

b. Turn off engine anti-ice.

c. Advance No. 1 speed selector full forward, observing N_g, T_5, and torque of No. 1 engine.

d. Slowly retard the speed selector on the No. 2 engine, observing the corresponding rise in N_g, T_5, and torque on the No. 1 engine as N_f/N_r droops to 100 percent.

CAUTION

Careful coordination between the trim checker operator and functional check pilot to ensure single engine limitations are not exceeded while attempting to configure the engine in a flight profile for engine topping evaluation.

e. N_g and T_5 of the No. 1 engine should stabilize. Do not go over 123-percent torque. Note the N_g and T_5 readings on No. 1 engine. This is the topping reading.

PROFILE

Note

- When using an engine trim checker after N_g and T_5 of the No. 1 engine no longer increase and N_f starts to droop, place the engine trim checker TEMP switch to T.I.T and the RPM switch to GAS GENERATOR. Check T_5 on the T.I.T. -°C digital display and N_g on the % RPM digital display. This is the topping reading.
- When the engine trim checker TEMP switch is at T.I.T., the power turbine inlet temperature indicator on the instrument panel is disabled.
- Do not exceed 123-percent torque. On a warm day, T_5 red line will generally be reached first. On a cold day, N_g red line should be reached first.

f. If T_5 is not between 745 and 750 degrees and/or N_g is not between 103.2% and 103.7% and the engine is not torque or fuel flow limited, adjust topping as follows:

(1) Advance No. 2 speed selector so that No. 1 engine falls off about 5-percent N_g.

Note

- It is not necessary to retard speed selector to make topping adjustments.

(2) Have the crewman turn the topping adjustments clockwise. One full turn (36 clicks) clockwise increases N_g about 2-1/4 percent. Ten clicks will result in an 11 °C T_5 or 0.89-percent N_g change.

g. Continue steps d through f as necessary until T_5 and/or N_g are at the topping limit.

h. If T_5 or N_g are above the topping limit, adjust topping as follows:

(1) Advance No. 2 speed selector so that No. 1 engine falls off about 5-percent N_g.

(2) Have crewman turn the topping adjustment counterclockwise. One full turn (36 clicks) counterclockwise decreases topping 2-1/4-percent N_g. Ten clicks will result in an 11 °C T_5 or 0.89-percent N_g change.

(3) Repeat steps d through h as necessary until T_5 and/or N_g are at the topping limit.

i. Repeat steps a through h for the No. 2 engine.

Note

- An increase in resistance of the topping adjustment indicates that the topping adjustment screw has bottomed. Do not attempt further adjustment. Continued turning could cause failure of internal components of the fuel control.

PROFILE

- If engine power exceeds allowable gearbox limits (123-percent torque), topping will have to be adjusted at a higher altitude; refer to Engine Operating Limits Chart in Part XI to determine at what altitude maximum power will not exceed 123-percent torque. Climb to the appropriate altitude and go through normal topping adjustment procedure, being careful to maintain a constant altitude. Take care not to exceed single-engine transient torque limits. If abnormal power turbine inlet temperatures have been observed, integrity of the temperature thermocouples must be checked before doing the topping check.

i. Minimum acceptable torque.

(1) Advance No. 1 speed selector full forward and retard No. 2 speed selector until N_f/N_r droops to 100 percent.

(2) Record torque and No. 1 engine oil pressure.

(3) Refer to minimum acceptable indicated torque charts (Figure 10-4) to determine if the engines are meeting minimum acceptable torque requirements. If direct reading gauges are available, they should be considered more accurate than cockpit indications (refer to the conversion table below).

CONVERSION TABLE

OIL PRESSURE	PERCENT TORQUE	OIL PRESSURE	PERCENT TORQUE
2	3	50	68
4	5	52	71
6	8	54	73
8	11	56	76
10	14	58	79
12	16	60	81
14	19	62	84
16	22	64	87
18	24	66	90
20	27	68	92
22	30	70	95
24	33	72	98
26	35	74	100
28	38	76	103
30	41	78	106
32	43	80	109
34	46	82	111
36	49	84	114
38	52	86	117
40	54	88	119
42	57	90	122
44	60	92	125
46	62	94	128
48	65	96	130

NOTES
1. ONE PSI OIL PRESSURE = 1.3576 PERCENT TORQUE.
2. ALL TORQUE READINGS ROUNDED OFF TO WHOLE NUMBER.

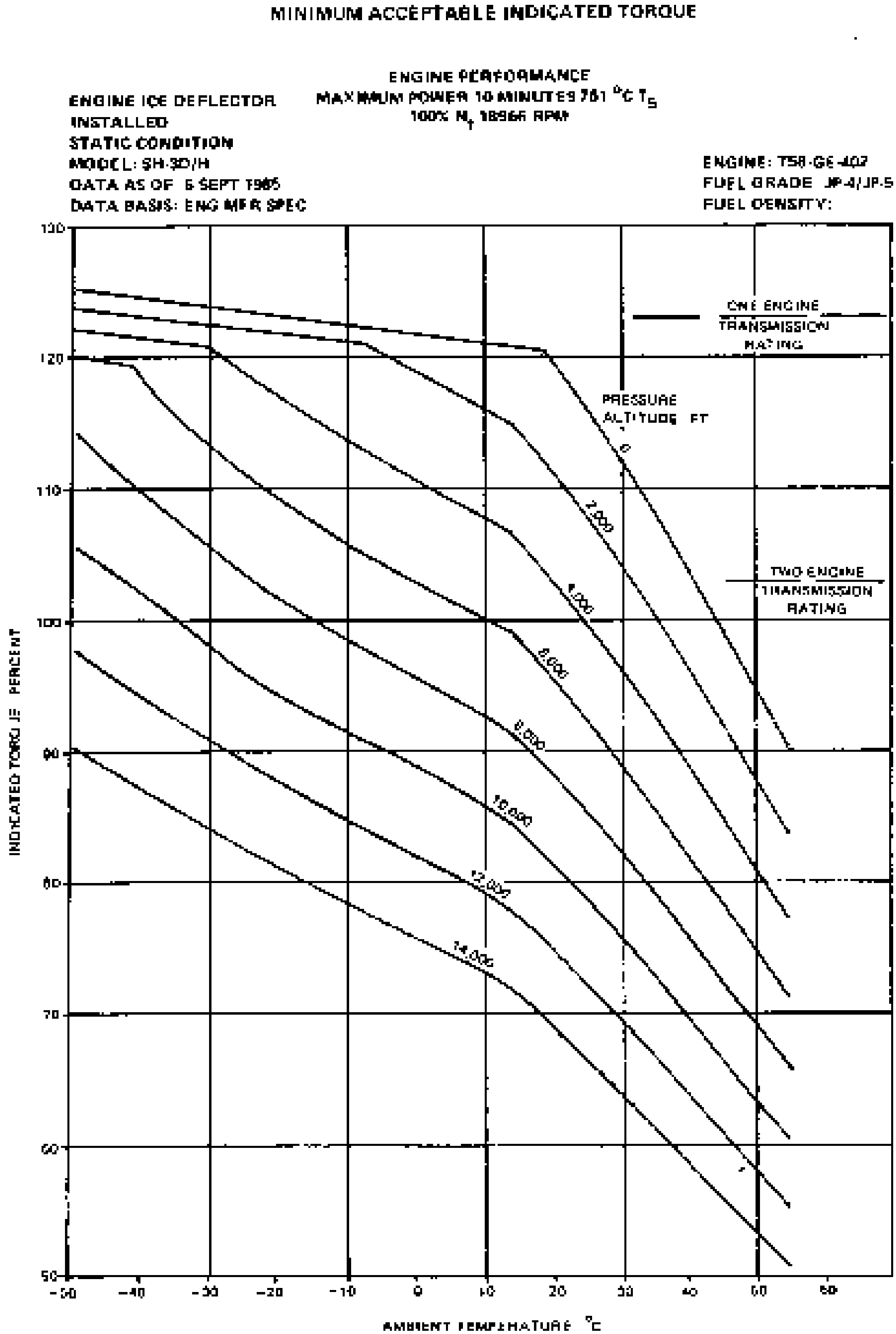


Figure 10-4. Engine Performance – Maximum Power (10 Minutes) (751°C T_5)

PROFILE

j. Maximum N_f governing.

(1) After topping has been properly set, retard the speed selector on No. 2 engine until the No. 1 N_f droops to 100 percent.

(2) Slowly advance No. 2 speed selector, watching N_g on No. 1 engine, and maintain collective setting.

(3) At the point where No. 1 engine N_g just starts to fall off read the No. 1 N_f. This is the maximum N_f governing on No. 1 engine.

(4) This N_f reading should be 103 percent or above.

Note

When using an engine trim checker, at the point where No. 1 engine N_g just starts to fall off, place the RPM switch to POWER TURB B and read No. 1 engine N_f on the % RPM digital display. This is the point of maximum N_f governing on No. 1 engine.

(5) Maintenance adjustment of any discrepancy noted should be done on the ground after engine shutdown. The maximum N_f setting should be done in accordance with the Handbook of Power Plants and Related Systems.

(6) Repeat steps (1) through (5) for No. 2 engine.

k. Manual throttle.

(1) With the No. 1 engine at topping, advance No. 2 speed selector until No. 1 engine N_g decreases 4 percent.

(2) Slowly move the No. 1 engine manual throttle toward full open, observing N_g, T_5, and torque. It will often be possible to exceed topping power; however, as a check of acceptable rigging, it should be possible to increase power to within 2-percent N_g of topping.

CAUTION

Use of the manual throttle bypasses the automatic fuel control. Limits must be carefully monitored to avoid overtemperature, overspeed, or overtorque. Lowering the collective without or before closing the manual throttle may result in exceeding aircraft limitations.

(3) Return manual throttle to the full closed position before continuing further checks.

(4) Repeat steps (1) through (3) for No. 2 engine.

PROFILE

Note

- If hovering is not feasible or is operationally undesirable, the above procedures may be done in forward flight requiring more horsepower than one engine is capable of delivering. When topping in forward flight, expect an increase of about 2-percent torque if the ice shield is not installed.
- Alternately, topping checks may be made on the ground with one engine at ground idle and at a helicopter weight to preclude hovering on one engine.
- When topping in forward flight with AFC 321 installed, use these torque reductions:

IAS-KTS	90	100	110	120
%Q NO. 1 ENG	1.5	2.1	2.8	3.5
%Q NO. 2 ENG	0.5	1.5	1.8	2.3

- When topping in forward flight with AFC 247 installed, use these torque reductions:

IAS-KTS	90	100	110	120
%Q NO. 1 ENG	2.9	3.7	4.9	5.8
%Q NO. 2 ENG	1.2	2.1	3.6	4.1

l. Engine N_g/T_5 Relationship check.

(1) Record OAT, refer to Figure 10-5, and find the corresponding Ng for existing OAT.

(2) Place engine anti-ice switch and cabin heater OFF.

CAUTION

Engine anti-ice should be OFF when making this check as the range is only valid for conditions where air is not extracted from the compressor. Care must be exercised when operating the engine in an icing condition or compressor damage may result.

(3) Advance No.1 engine manual throttle to the desired Ng.

(4) Record T_5.

(5) When establishing the “as received” baseline, move across the chart (figure 10-5) from the appropriate N_g to intersect the value closest to the T_5 recorded in step d. Move up the column from this point and determine the “as received” baseline letter from the appropriate box in the top row. Quality Assurance is to record this baseline letter in the engine logbook.

PROFILE

Note

This “as received” baseline letter will be used as the installed N_g/T_5 baseline for the engine checked and shall be recorded in the engine logbook. This baseline letter will be used when making subsequent N_g/T_5 checks. The baseline letter provides a basis for determining whether a N_g/T_5 shift has taken place and whether continued engine operation is advisable.

(6) When making subsequent N_g/T_5 checks, proceed as follows:

a. Enter chart (figure10-5) at existing OAT and move across to intersect the engine’s “as received” baseline letter column to determine baseline T_5. Add an allowable 35 °C T_5 shift to the baseline T_5 to determine the maximum allowable T_5

b. Perform steps (1) through (4) and check that the T_5 recorded in step (4) does not exceed the maximum allowable T_5..

Note

When making subsequent N_g/T_5 checks if T_5 has shifted more then 35 °C from the baseline, perform the check again at the same flight profile as the baseline. This will reduce errors caused by increased T_5 due to readings being taken in forward flight.

(7) Repeat for the No. 2 engine.

10.3.2 Forward Flight Checks

AB DE 1. Jump takeoff (heading hold) - With feet off the rotary rudder pedals, make a jump takeoff by pulling the collective up smoothly to a maximum of 103-percent torque. The transient heading error should not be over 10°.

AB DE 2. Left pedal control - Make a maximum power takeoff (not to be over 103-percent torque dual engine). There should be enough left pedal to yaw the helicopter slightly to the left.

AB DE 3. Autorotation rpm – Note total aircraft weight to within 100 pounds. Establish an autorotation at a sufficient altitude. Retard engine speed selectors if necessary to split the needles and stabilize airspeed at 70 knots. The referenced altimeter should be set at 29.92 inches Hg. Read OAT, pressure altitude, and percent N_r when all parameters are stabilized. Consult the autorotation chart for correct rotor rpm at the existing conditions. If during autorotation rpm check, rpm is noted to be abnormally high, it is possible that a rigging problem exists; adjusting the pitch change link rods (push rods) may not correct. An additional check shall be conducted at this time to be sure there is enough collective travel to permit attainment of either the main gearbox torque limit or the level of torque derived from the appropriate engine operating limits chart, whichever is less. If the collective stop is engaged before reading this torque limit, the possibility exists that designed maximum rotary wing blade pitch may not be achieved, thus degrading the ability of the helicopter in slowing or stopping large rates of descent (i.e., autorotations).

		T5 – DEGREES CELSIUS													
OAT (C)	Ng%	A	B	C	D	E	F	G	H	I	J	K	L	M	N
-20	90.0	481	485	490	494	498	503	507	512	516	520	524	529	534	539
-19	90.2	484	488	493	497	501	506	510	515	519	523	528	532	537	542
-18	90.4	487	491	496	500	504	509	513	518	522	527	531	536	541	546
-17	90.6	491	495	500	504	506	513	517	522	526	530	535	539	544	549
-16	90.8	494	496	503	507	511	516	520	525	529	534	538	543	548	553
-15	91.0	497	501	506	510	514	519	523	528	532	537	542	546	551	556
-14	91.2	500	504	509	513	517	522	527	532	536	541	546	550	555	560
-13	91.4	504	506	513	517	521	526	530	535	539	544	549	553	558	563
-12	91.6	507	511	516	520	524	529	534	539	543	548	553	557	562	567
-11	91.8	511	515	520	524	528	533	537	542	546	551	556	560	565	570
-10	92.0	514	518	523	527	531	536	541	546	550	555	560	564	569	574
-9	92.1	516	520	525	529	533	538	543	548	552	557	562	566	571	576
-8	92.2	518	522	527	531	536	541	545	550	554	559	564	569	574	579
-7	92.3	520	525	530	534	538	543	548	553	557	562	567	571	576	581
-6	92.4	522	527	532	536	541	546	550	555	559	564	569	574	579	584
-5	92.5	524	529	534	538	543	548	552	557	561	566	571	576	581	586
-4	92.7	527	532	537	541	546	551	555	560	564	569	574	579	584	589
-3	92.9	530	535	540	545	549	554	559	564	568	573	578	583	588	593
-2	93.1	534	539	544	548	553	558	562	567	571	576	581	586	591	596
-1	93.3	537	542	547	552	556	561	566	571	575	580	585	590	595	600
0	93.5	540	545	550	555	559	564	569	574	578	583	588	593	596	603
1	93.7	543	548	553	558	562	567	572	577	582	587	591	596	601	606
2	93.9	547	552	557	562	566	571	576	581	585	590	595	600	605	610
3	94.1	550	555	560	565	569	574	579	584	589	594	598	603	608	613
4	94.3	554	559	564	569	573	578	583	588	592	597	602	607	612	617
5	94.5	557	562	567	572	576	581	586	591	596	601	605	610	615	620
6	94.7	560	565	570	575	579	584	589	594	599	604	608	613	618	623
7	94.9	563	566	573	578	583	588	593	598	603	607	612	617	622	627
8	95.1	567	572	577	582	586	591	596	601	606	611	615	620	625	630
9	95.3	570	575	580	585	590	595	600	605	610	614	619	624	629	634
10	95.5	573	578	583	588	593	598	603	608	613	617	622	627	632	637
11	95.6	575	580	585	590	595	600	605	610	615	620	625	630	635	640
12	95.7	578	583	588	593	598	603	608	613	618	622	627	632	637	642
13	95.8	580	585	590	595	600	605	610	615	620	625	630	635	640	645
14	95.9	583	588	593	598	603	608	613	618	623	627	632	637	642	647
15	96.0	585	590	595	600	605	610	615	620	625	630	635	640	645	650
16	96.2	588	593	598	603	608	613	618	623	628	633	638	643	648	653
17	96.4	591	596	601	606	611	616	621	626	631	636	641	647	652	657
18	96.6	595	599	605	609	615	620	625	629	635	639	645	650	655	660
19	96.8	598	602	608	612	618	623	628	632	638	642	648	654	659	664
20	97.0	601	605	611	615	621	626	631	635	641	645	651	657	662	667
21	97.1	604	608	614	618	624	629	634	638	644	648	654	660	665	670
22	97.2	606	611	616	621	627	632	637	641	647	651	657	662	667	672
23	97.3	609	613	619	624	629	634	639	644	649	655	660	665	670	675
24	97.4	611	616	621	627	632	637	642	647	652	658	663	667	672	677
25	97.5	614	619	624	630	635	640	645	650	655	661	666	670	675	680
26	97.7	617	622	627	633	638	643	648	653	658	664	669	673	678	684
27	97.9	620	626	630	636	641	646	651	656	661	667	672	677	682	689
28	98.1	624	629	634	639	644	650	655	660	665	671	676	680	685	693
29	98.3	627	633	637	642	647	653	658	663	668	674	679	684	689	698
30	98.5	630	636	640	645	650	656	661	666	671	677	682	687	692	702
31	98.7	633	639	643	648	653	659	664	670	674	680	685	691	696	705
32	98.9	636	642	647	652	657	663	668	673	678	684	689	694	700	708
33	99.1	640	645	650	655	660	666	671	677	681	687	692	698	703	710
34	99.3	643	648	654	659	664	670	675	680	685	691	696	701	707	713
35	99.5	646	651	657	662	667	673	678	684	688	694	699	705	711	716
36	99.6	649	654	660	665	670	676	681	687	691	697	702	708	713	718
37	99.7	651	656	662	667	672	678	683	689	694	700	705	710	715	720
38	99.8	654	659	665	670	675	681	686	692	696	702	707	713	718	723
39	99.9	656	661	667	672	677	683	688	694	699	705	710	715	720	725
40	100.0	659	664	670	675	680	686	691	697	702	708	713	718	722	727

Figure 10-5. Ng/T5 Relationship Check

LOW PITCH, AUTO RPM
GROSS WEIGHT 17,000 POUNDS, 70 KNOTS IAS

RESSURE ALTITUDE	TEMPERATURE °C								
	-10	-5	0	5	10	15	20	25	30
- 1,000	100	101	102	103	104	105	106	107	108
-500	101	102	103	104	105	106	107	108	109
0	102	103	104	105	106	107	108	109	110
500	103	104	105	106	107	108	109	110	111
1,000	104	105	106	107	108	109	110	111	112
1,500	105	106	107	108	109	110	111	112	113
2,000	106	107	108	109	110	111	112	113	114

NOTES

1. INTERPOLATE TEMPERATURE TO THE NEAREST DEGREE.
2. DETERMINE AIRCRAFT GROSS WEIGHT TO THE NEAREST 100 POUNDS. USE THE FOLLOWING TABLE TO ADD OR SUBTRACT 3.5-PERCENT N_r PER 1,000-POUND GROSS WEIGHT. ADD N_r FOR GROSS WEIGHT GREATER THAN 17,000 POUNDS. SUBTRACT N_r FOR GROSS WEIGHT LESS THAN 17,000 POUNDS.

WT	N_r	WT	N_r
100	.35	600	2.1
200	.70	700	2.45
300	1.05	800	2.8
400	1.4	900	3.15
500	1.75	1,000	3.5

3. CHANGES TO AUTO RPM SHALL BE MADE TO THE PITCH CONTROL RODS IN NO LESS THAN 4 CLICK INCREMENTS (EQUIVALENT TO ABOUT 1.17% NR) ADJUST ALL PITCH CONTROL RODS IN ORDER TO RETAIN TRACK AND BALANCE CONFIGURATION
4. N_r TOLERANCE OF ±2.5-PERCENT ALLOWED.
5. MAXIMUM ALLOWABLE RPM IS 117-PERCENT N_r. FOR HIGH GROSS WEIGHTS THE AUTO RPM MAY EXCEED THIS VALUE. DECREASING GROSS WEIGHT WILL BE REQUIRED BEFORE ATTEMPTING THIS CHECK.
6. FOR PRESSURE ALTITUDES ABOVE 2,000 FEET, AUTO RPM INCREASES 1 PERCENT PER 500 FEET OF PRESSURE ALTITUDE INCREASE.

Figure 10-6. Low Pitch Autorotative Rpm Chart

PROFILE

Note

- Torque splits in excess of 30 percent can be expected during the autorotation check.
- If conducting an autorotational rpm check in conjunction with main rotor smoothing and/or vibration analysis data collection, correlation of main rotor rpm as indicated through the VATS/ATABS tachometer provide the most accurate means of determining exact Nr.

AB DE

4. Right pedal control - Enter normal 70 KIAS autorotation. During descent, there should be enough right rudder pedal remaining to yaw the helicopter to the right.

†5. Posttakeoff checklist.

   a. Landing gear - UP.

   b. Lights - AS REQUIRED.

   c. IFF/NAVAIDs- CHECK.

AB DE

   d. Compass- CHECK.

   e. Security check - COMPLETE.

   f. N_r AS REQUIRED.

AB DE

6. Battery absorber tuning - With the helicopter in stabilized flight at 80 to 90 KIAS, decrease N_r from 102 percent to 98 percent and note at what N_r five-per-revolution vibrations are at a minimum. (For ET operation, decrease Nr from 105% Nr to 101%Nr) If the minimum vibration is other than at 100-percent N_r, note the N_r so the battery absorber tuning may be corrected.

7. Controllability and vibration check.

   a. Turn off ASE and fly from 40 to 120 KIAS in 20 knot units.

   b. Stabilize at each point momentarily and note cyclic position. As airspeed is increased, the cyclic will have to be moved forward. At 120 knots, there should be some forward cyclic remaining. If in doubt about cyclic rigging, return to base and refer to Maintenance Instruction Manuals for detailed instructions regarding loading and rigging flight checks.

   c. V_{max} is defined as 120 KIAS in sea level, standard day conditions. To determine V_{max} for other conditions, refer to the blade stall chart, Figure 20-5.

AB DE

   d. At 120 knots, note any unusual vibrations. Make turns, climbs, and descents. If an intermittent vibration of about one-per-revolution is encountered or if pitch lag instability (two-thirds-per-revolution vibration) is encountered, malfunctioning rotary wing head dampers are indicated. Upon return to base, perform a damper check as outlined in paragraph 10.2.8, step 3 (Rotary Wing Dampers).

PROFILE

8. Servos.

a. Primary servo off- In flight at an airspeed between 60 and 80 knots, turn off the primary servo. There should be no large or unusual tip-path or attitude changes. When the primary servo is turned off at this speed, the normal reaction of the helicopter is to pitch slightly noseup. One to two inches of forward cyclic should be enough to maintain attitude. With the primary servo off, make climbs, turns, and descents to determine that adequate control of the helicopter can be maintained in case of a primary servo failure. Turn the primary servo on.

b. Auxiliary servo off- Maintain 60 to 80 knots, ASE off, and turn off the auxiliary servo. The cyclic should jump no more than one-eighth inch and the collective no more than one-sixteenth inch. There should be no sudden attitude or heading change. Make climbs, turns, and descents to determine that adequate control of the helicopter can be maintained in case of an auxiliary servo failure. If aircraft pedals vibrate excessively (AUX ON or OFF) while accelerating and/or adding power, seized or improperly greased tail rotor bearing may be indicated.

A 9. Landing gear - Cycle the landing gear and observe proper operation of the landing gear, indicators, landing gear downlock lights, and landing gear warning light. The landing gear downlock lights are the only indications not necessary for a positive down and locked indication.

Note

Anytime the landing gear is lowered and a positive down and locked indication is not present, the helicopter should be hovered and the landing gear lockpins inserted in the drag link before landing.

A 10. Heater - During forward flight of over 90 knots, turn on the heater and check operation of both HI and LOW positions. Check all diffusers for proper operation. Be sure that the heater is off for 5 minutes before landing.

A

11. Flight instruments - Check and compare all instruments for proper operation and indications.

A 12. Turn rate indicators.

a. Copilot.

(1) ASE - OFF.

(2) AFCS circuit breakers - PULL.

(3) Copilot turn rate indicator - INOPERATIVE.

(4) Copilot turn rate switch - ALTERNATE.

(5) Copilot turn rate indicator - OPERATIVE.

(6) Copilot turn rate switch - NORMAL.

b. Pilot.

(1) Pilot turn rate switch - ALTERNATE.

PROFILE

(2) Pilot turn rate indicator - INOPERATIVE.

(3) Pilot turn rate switch - NORMAL.

(4) AFCS circuit breakers - RESET.

(5) ASE ENGAGE.

Note

When the above check is made, the OFF flag will appear in the preselected VGI.

A 13. Communication radios.

a. UHF-l - Accomplish with antenna selector at NORMAL, then at ALT. At pilot, copilot, and all crewmen stations, select UHF with the receiver selectors and place the transmitter selectors to UHF (only pilot and crewmen may transmit). At a point about 10 nm from and with line-of-sight clearance, contact selected tower from pilot station and request UHF check. Clear sidetone and tower transmissions should be audible at all stations (pilot/copilot only for ET). Transmit from the respective stations and use both T/R and T/R + G positions on the selector switch. Background noise should be squelched in both positions. Set the tower frequency manually, move the function switch to MANUAL, and establish communications with the tower. When changing channels, a momentary 1000-Hz signal should be heard as the set channelizes.

b. UHF-2 - Check in the same manner as for UHF-l with the antenna selector switch at NORMAL and at ALT.

c. VHF (non-ET only).

A 14. Navigation radios.

a. UHF/DF(non-ET only)- Fly over a known geographical landmark at about 1,500 feet with line-of-sight clearance to tower. Fly directly over the landmark on heading to the tower. Contact tower and request a short count. Place the function switch on the UHF control panel to DF. The No. 1 pointer on the RMI should indicate the known heading within ±5 with a maximum of ±5°oscillation.

Note

This check is not accurate with the tower at a bearing other than directly off the nose of the helicopter.

b. Tacan- Fly over a geographical on the known bearing to the station. The No. 2 pointers on the BDHIs and the RMI should indicate the known bearing within ±2 and the DME should read known distance ±0.5 mile. Turn course selector knob until vertical bars are centered and ambiguity windows read TO. The course selector should read known bearing ±2.5°and the relative heading pointer should point straight up ±2 . Maintain heading toward the station.

Turn course selector knob until the vertical bar is on second dot and note course selected. Turn knob in other direction to place vertical bar on second dot on the other side and note course selected. There should be a 10° ±3° difference between course selected. Continue turning the course selector knob until the reciprocal of the known bearing is selected. The ambiguity window should now read FROM. Select A/A on

PROFILE

the function selector switch and select a channel 63 channels apart from another aircraft. Mileage should be ±0.5 mile of distance to other aircraft.

c. LF/ADF - With the selector switch at ANT and the BFO switch off, tune a station and check tuning accuracy, satisfactory reception, and adequate control of volume. Repeat for all bands. Turn the BFO switch on and tune through a station frequency to establish that the beat frequency is heard. Turn the BFO switch off. Check loop operation. Fly directly over a geographical landmark on a known bearing to a selected station. Select COMP; the No. 1 needle on the RMI should indicate known bearing ±5°. Repeat with the station off the tail and 45° left and right of nose and tail.

d. IFF/SIF - Contact local approach and request IFF/SIF check. Check all functions.

e. VOR/ILS.

(1) Tune and identify a known VOR station. - Fly over a geographical landmark on the known bearing to the station. The No. 1 pointer on the RMI should indicate the known bearing within ±2 . Turn course selector knob on the CDI until vertical bars are centered and ambiguity windows read TO. The course selector should read known bearing ±2.5°and the relative heading pointer should point straight up ±2 . Maintain heading toward the station. Turn course selector knob until the vertical bar is on second dot and note course selected. Turn knob in other direction to place vertical bar on second dot on the other side and note course selected. There should be a 10° ±3° difference between course selected. Continue turning the course selector knob until the reciprocal of the known bearing is selected. The ambiguity window should now read FROM.

(2) Using local area ILS and current approach plate tune and identify the localizer frequency on the VOR. Intercept the localizer and fly inbound at the published altitude. When the glideslope signals are received, the OFF flags on the CDI should retract. Fly down localizer making deviations to ensure the glideslope and course indicator bars will center when the aircraft is on glideslope and lined up with the centerline of the runway.

A — 15. TACNAV – Check operation inflight.

AB D — 16. ASE.

a. Collective drop - While in forward flight at 80 knots and with sufficient altitude to safely perform an autorotative maneuver, smoothly lower the collective to flat pitch (bottom stop). The transient heading error should not exceed 10°.

b. BAR ALT autorotation - With ASE engaged, engage the BAR ALT and enter autorotation, holding the momentary BAR REL button depressed. After rotor rpm stabilizes, release the momentary BAR REL button, keeping the collective in the full down position and note rotor rpm; there should be no unusual decrease in rpm. If a decrease in rotor rpm is noted, release the BAR ALT using the BAR OFF button on the ASE control panel. If a jump occurs, the collective low pitch stop may require adjustment.

Note

Do not descend greater than 500 feet per minute with BAR ALT engaged to preclude possible damage to the BAR ALT controller.

PROFILE

c. Push/pull and release - Trim the helicopter for hands-off flight at 90 knots. Engage BAR ALT, and push the cyclic stick forward 1 inch against force gradient spring for 1 second, and release (stick oscillation should be dampened by the pilot). The helicopter should return to the original attitude within one overshoot and return to the original airspeed within 5 knots. Repeat this check aft, right, and left.

d. Stability - Trim the helicopter for hands-off forward flight at 90 knots with the pitch bar centered. Remove all friction from the collective and engage BAR ALT. Fly with hands and feet off the controls for about 5 minutes. No undesirable hunting in pitch, roll altitude, or yaw should be observed. Repeat this check using the opposite gyro. (A slight jump may occur when switching gyros.) After the check is completed, return the gyro selector switch to the original position.

e. Push/pull and hold - Trim the helicopter for 90 knots forward flight, release all collective friction, and engage BAR ALT. After the helicopter has stabilized, beep the cyclic forward until 100 KIAS is attained. The helicopter should hold altitude within ±40 feet and should attain the new airspeed without excessive oscillations or overshoots. The pitch bar should remain within the circle during this maneuver. Repeat the above procedure beeping from stabilized 90 to 80 knots.

f. Roll bar - Trim the helicopter for level flight at 90 knots and observe the roll bar position. If the roll bar is not within the circle, note the position so that the roll canceller can be reset.

g. Manual turn - Trim the helicopter for 90 knots and engage BAR ALT (collective friction off). Make a coordinated 180° turn, holding the cyclic stick against the force gradient spring, then release the controls (stick oscillation should be damped by the pilot). The helicopter should return to 90 ±5 knots with no more than one overshoot in pitch and roll.

h. Trimmed turn - With the helicopter trimmed for 90 knots, engage the BAR ALT, and beep the helicopter into a l5° to 20° AOB coordinated turn. Fly hands off for 360°; the helicopter should maintain altitude within ±40 feet and there should be no undesirable oscillations in pitch or roll.

i. Momentary BAR ALT release - Trim the helicopter for 90 knots and engage the BAR ALT. Depress the BAR REL button on the collective and establish a descent of about 500 to 1,000 fpm. When the helicopter has descended 200 to 300 feet, reset the collective to the cruise power setting, note the altitude, and release the BAR REL button. The helicopter should stabilize on the new altitude within ±40 feet, Repeat this check for ascending flight.

V/M/T

17. Main Rotor Head Track and Balance – Establish desired airspeed (60, 90, 120kts) with torques matched and N_f/N_r at 100% (103% N_f/N_r for ET),Collect main rotor head track and balance data IAW applicable MIMS.

Note

Allow aircraft to stabilize at each regime for at least one minute before pressing run and collecting track and balance data.

Note

If a high vibration is felt during the collection of track and balance data at a flight regime and the vibration level increases with airspeed to an unacceptable level, run the remaining flight test regimes at the maximum safe airspeed. This provides the CIPS with the data required to calculate an adjustment to lower the vibration level.

PROFILE

V/M/T

18. Autorotation rpm – Note aircraft gross weight to within 100 pounds. Establish an autorotation at a sufficient altitude over a prepared surface. Retard engine speed selectors if necessary to split the needles and stabilize airspeed at 70 knots. The referenced altimeter should be set at 29.92 inches Hg. Read OAT, pressure altitude, and percent N_r when all parameters are stabilized. Consult the autorotation chart (Figure 10-6) for correct rotor rpm at the existing conditions. If during autorotation rpm check rpm is noted to be abnormally high, it is possible that a rigging problem exists; adjusting the pitch change link rods (push rods) may not correct. An additional check shall be conducted at this time to be sure there is enough collective travel to permit attainment of either the main gearbox torque limit or the level of torque derived from the appropriate engine operating limits chart, whichever is less. If the collective stop is engaged before reading this torque limit, the possibility exists that designed maximum rotary wing blade pitch may not be achieved, thus degrading the ability of the helicopter in slowing or stopping large rates of descent (i.e., autorotations).

Note

Complete step 18 only if PCR adjustments were made during Main Rotor Head Track and Balance. If during Main Rotor Head Track and Balance evolution, blade solutions exceed 8 total turns on both PCL's or exceed 4 turns on one, perform autorotational RPM check as described above to ensure proper Nr available for autorotative maneuvering.

V/M/T

19. Airframe Vibrations – Once the main rotor track and balance is with in acceptable limits, collect airframe vibrations data IAW applicable MIMs.

a. On the ground with N_f/N_r matched at 100% (103% N_f/N_r for ET), collect airframes vibrations data (as required).

b. In a hover with N_f/N_r matched at 100% (103% N_f/N_r for ET) collect airframes vibrations data

c. Establish 90kts level flight with N_f/N_r matched at 100% (103% N_f/Nr, collect airframes data.

Note

- Allow aircraft to stabilize at each regime for at least 1 minute before pressing run and collecting balance data.
- If aircraft is configured with a main rotor head tachometer, utilize VATS/ATABS rpm feature to confirm 100% Nr (103% N_r for ET)

A

20. RAWS.

a. Fly at or slightly below 500-foot altitude and turn off the radar altimeter at each indicator. The aural and visual warning signals should be noted.

PROFILE

Note

After turning equipment on, allow about 3 minutes for system to reach operating temperature. To avoid damage to system components, do not place system in operation until 3 minutes have elapsed since system was last turned OFF. (Not required on aircraft modified by AFC 448).

b. Turn on the radar altimeter and note that while warming up it goes unreliable (pointer behind the mask). With the gear up, both warning signals should be noted. Lower the gear. When the gear is down, both signals should disappear. Retract the gear and commence a climb. As the helicopter ascends through 700 ±200 feet both signals should be inhibited.

c. Make an approach using a rate of descent of less than 300 fpm. When passing through 100 ±5 feet indicated on the radar altimeter, the aural and visual warnings should be observed for 3 seconds (six beeps and six flashes).

d. (non-ET only) Make two approaches with a slow rate of descent, one with RDR ALT selected and one with VERT ACCEL selected. In each case as 100 feet of altitude is approached, engage the coupler and note that no warning signals are observed passing through 100 feet.

Note

A slow rate of descent must be used when descending through 100 feet, otherwise the observed warning signals will not agree with the actual altitude at the time the signals are noted.

A 21. Cruise coupler (non-ET only).

Note

The following check must be made over good Doppler return water.

The following checks may be done to determine proper operation of basic ASE, Doppler, radar altimeter, and coupler when used as an integrated system.

a. Helicopter trimmed for balanced flight 150 feet and 60-knot groundspeed.

b. Mode select switch - SEA.

c. CYC CPLR - DOPP.

d. Altitude coupler - RDR ALT.

e. Hover indicator - A MODE.

f. METER SELECTOR switch - CPLR.

g. DRIFT knob - TURN TO CENTER VERTICAL BAR.

h. SPEED knob - TURN TO CENTER HORIZONTAL BAR.

i. ALTITUDE set pot -150 FEET.

PROFILE

j. Coupler - ENGAGED.

Helicopter should remain at approximately the preselected attitude and altitude. Undesirable changes in pitch, roll, or altitude may indicate inability of the helicopter to perform an automatic transition.

22. (NON-ET) Automatic approach - Complete Automatic Approach checklist and engage coupler at gate.

a. The copilot should commence timing when the coupler is engaged. Groundspeed, altitude, drift, and roll should be recorded every 10 seconds. The approach profile for automatic approach chart should then be consulted to ensure correct approach programming.

b. After completing normal transitions, make one using the VERT ACCEL mode. Switch from RDR ALT to VERT ACCEL before reaching 60 feet. The switch should be made when vertical pointer on the hover indicator in D mode is at its maximum deflection from the null. Expect a slight collective jump. After switching, the transition will be accomplished but may not behave in the same manner as a normal transition. Altitude overshoot should not be over 10 feet.

c. Alternate approach - Make at least one approach regardless of the sea state.

(1) Alternate approach predip checklist - COMPLETED.

(2) Coupler - ENGAGED AT GATE. If flown properly, the approach profile should be similar to an automatic approach. An exception is a high rate of descent (500 to 600 fpm) and loss of about 70 feet of altitude during the first 10 seconds of the approach.

A 23. Aft tank float valve - With at least one aft tank boost pump on, note aft tank drops to and maintain 600 to 900 pounds in the tank until the center tank is empty.

A 24. Crossfeed:

a. Do this check with the center tank empty. Turn on both forward boost pumps, open crossfeed, and have one aft boost pump on. Note fuel is used only from the forward tank. With one forward and both aft boost pumps on, note fuel is used only from the aft tank.

A 25. Fuel dumping - While in forward flight, check the forward and aft tank dump systems individually by monitoring fuel gauges or visually check fuel dumping.

†26. Before landing checklist.

†a. Landing gear - DOWN AND LOCKED.

†b. Speed selectors - CHECKED.

†c. Cabin heat (NON-ET) or air conditioner (ET) - OFF.

†d. Master Jettison Panel – SAFE.

†e. Lights - SET.

†f. Stores load panel switches (NON-ET) - OFF/SAFE.

PROFILE

†g. Shoulder harness- LOCKED.

†h. Tailwheel- LOCKED.

†i. Brakes - CHECKED.

†J. CREW – LANDING CHECK LIST COMPLETE.

†27. After final landing.

†a. ASE - OFF.

†b. Emergency start switches - OFF.

†c. Lights- AS REQUIRED.

†d. IFF- STBY.

†e. Doppler (NON-ET) - STBY.

†f. Crossfeed – CLOSED.

†g. Boost pumps - OFF.

†h. Tailwheel - AS REQUIRED.

†28. Taxiing.

†a. Area - CLEAR.

†b. Lights - AS REQUIRED.

†c. Chocks/tiedowns- REMOVED.

†d. Tailwheel locking handle- UNLOCKED.

†e. Shoulder harness (all stations)- LOCKED.

†f. Parking brake- OFF.

†g. Brakes - CHECKED.

†h. Tailwheel - CHECKED.

A 29. Check valves - With the center fuel tank empty, forward tank below 1,000 pounds, and crossfeed closed, turn off all fuel boost pumps. If the check valve in the ejector line between the forward and center tank is malfunctioning, the No. 1 engine may flame out. If the check valve in the ejector line between the aft and center tank is malfunctioning, the No. 2 engine may flame out. Boost pumps should be OFF for a minimum of 2 minutes.

10.4 SHUTDOWN CHECKS

10.4.1 Shutdown

†1. Collective (copilot monitor) – MINIMUM.

PROFILE

†2. Brakes and tailwheel – LOCKED.

†3. Landing gear lockpins – IN.

a. Safety pins - AS REQUIRED.

b. Tiedowns - AS REQUIRED.

†4. No. 1 speed selector - GRD IDLE.

†5. Accessory drive switch - FORWARD AND LIGHT ON.

†6. No. 1 speed selector - 104-PERCENT N_f

†7. Area clear/disengage signal – CHECKED.

†8. No. 2 speed selector - GRD IDLE.

†9. Droop stops – IN.

†10. No. 2 speed selector – SHUTOFF.

†11. Rotorbrake – ON.

†12. No. 2 fuel switch – CLOSED.

†13. No. 2 engine instruments – CHECKED.

†14. All electronic equipment- AS REQUIRED.

†15. Area – CLEAR.

A

†16 Blades – FOLDED.

10.4.2 No. 1 Engine Secure.

†1. No. 1 speed selector - GRD IDLE.

†2. No. 1 speed selector – SHUTOFF.

3. HEELS illuminates during engine coast down (NON-ET) – CHECKED.

†4. Fuel switch – CLOSED.

†5. All engine instruments – CHECKED.

†6. All switches – OFF.

†7. HEEDS bottles – OFF.

10.4.3 Postflight Inspection.

†1. A thorough postflight should be conducted with emphasis on inspecting for hydraulic and oil leaks.

PART IV

Flight Characteristics

This Page Left Blank Intentionally

CHAPTER 11

Flight Characteristics

11.1 GENERAL

Since the flight characteristics of a helicopter are independent of forward speed, a helicopter is able to move in any direction at a controlled low speed and still remain safely airborne. The normal speed range extends from a rearward speed of about 20 knots to a forward speed of about 120 knots and also includes lateral speeds, either to the left or the right, of 30 knots. The forward safe operating speeds are defined in Chapter 4.

11.2 FLIGHT CHARACTERISTICS

WARNING

The discussions of Settling With Power, Vortex Ring State, and Blade Stall describe situations that should not occur under normal operating conditions with proper preflight planning.

11.2.1 Level Flight Characteristics Under Various Speed Conditions. Normally, for hovering, greater power is required than for forward flight. As the pitch of the rotor blades is increased, the lift derived from the rotary wing is also increased; however, higher power settings will be required to keep the rotary wing turning at a constant rpm. Forward flight is initiated by moving the cyclic stick forward, with a corresponding increase in collective pitch to simultaneously obtain forward movement and an increase in altitude. As the forward speed of the helicopter increases, the airflow through the rotor system results in translational lift, thereby reducing the amount of power required. Further increases in airspeeds result in increasing translational lift. This condition holds true up to about 60 knots. As increased speed is desired, increased power will be required. This increase in speed is accomplished by further displacing the cyclic stick forward. This in turn increases the angle of the rotary wing plane and the helicopter will assume a nosedown attitude as the fuselage becomes aligned with the rotor tip-path plane. As this attitude changes, a greater percentage of the lift being produced by the rotary wing is being used to increase the horizontal velocity of the helicopter. Thus, the vertical lift component is restored by increasing power to maintain altitude. The ASE acts to overcome erratic external forces such as gusts, etc., and to maintain the helicopter in the attitude selected by the pilot.

11.2.2 Ground Resonance. Ground resonance is a self-excited vibration that occurs when a coupling interaction occurs between the movement of the rotary wing blades and the helicopter. For ground resonance to occur, there must be some abnormal lead/lag blade condition that would dynamically unbalance the rotor, and a reaction between the helicopter and ground that could aggravate and further unbalance the rotor. Ground resonance can be caused by a blade being badly out of track, a faulty damper tie down chains that are too tight, or a peculiar set of landing conditions. When a wheel reaction occurs, such as a hard one-wheel landing, that would cause out-of-phase rotary wing blades to be aggravated to the point where maximum lead and lag blade displacement is realized, ground resonance may occur. This helicopter does not have a history of ground resonance. However, if ground resonance should occur, primary consideration should be given to getting the helicopter airborne. If this is impossible, immediately reduce collective pitch, place engine speed selectors to SHUTOFF, and apply both the rotor brake and wheelbrakes.

11.2.3 Settling With Power. 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 because of the lack of power that 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 Part XI will aid in avoiding extreme situations. To recover from this condition:

*1. Speed selectors - FULL FORWARD.

*2. Contain Nr.

*3. Establish single-engine airspeed and level attitude.

*4. Reduce gross weight by dumping fuel and/or jettisoning stores.

11.2.4 Vortex Ring State. At high density altitudes, high gross weights, no wind or low forward velocity, and certain rates of descent, a critical power settling condition may occur resulting in roughness and partial loss of control. The vertical velocity of the downwind airflow through the main rotor is extremely high while at or near hovering attitude. Under certain power and rate-of-descent combinations, the downwash from the rotor begins to recirculate up, around, and back down through the effective outer rim of the rotor disc. The helicopter sinks into the airmass it has just displaced in trying to obtain lift, and the rotary wing blades work continually in their own turbulent airstream.

Vortex ring state is likely to occur as a result of any of these conditions:

1. Moderate vertical rates of descent initiated from a hover.

2. Steep approaches at low airspeeds.

The vortex ring state phenomenon is not restricted to high gross weights or high density altitudes. It may occur in a variety of conditions. Indications to the pilot may be the following:

1. Rapid increase in descent rate.

2. Increase in vibrations.

3. Loss of control effectiveness.

The most reliable indicator is a rapid increase in rate of descent. Loss of cyclic and collective control effectiveness may be hidden by the ASE/servo control system. To recover from this condition, proceed as follows:

*1. Decrease collective pitch.

*2. Increase forward airspeed.

*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, the condition causing vortex ring state should be avoided.

CAUTION

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 be made only by entering autorotation before regaining airspeed.

11.2.4.1 Hovering Over Salt Water. Salt spray ingestion in the engine will result in a loss in performance that makes the engine susceptible to stalls, particularly during decelerations. As the spray is ingested, salt is deposited on the compressor blades and stator vanes. The resulting buildup gradually changes the airfoil sections, which in turn affects performance. This deterioration will be noticed as an increase in T_5 for a given torque. Should the deterioration reach a point where the compressor actually stalls, a muffled explosive sound will be heard, and T_5 will rapidly reach overtemperature while N_g and torque decrease rapidly. If hovering is an operational necessity in a salt spray environment, the amount of salt spray observed on the windshield is usually the best indication of the amount of salt to which the engines are being subjected. Also, a general rule of thumb for maximum allowable deterioration is a T_5 increase of 30 to 50 °C for a given torque setting. In a severe salt spray environment, the time for a deterioration of this magnitude may occur as early as 3 to 4 minutes. Although salt-encrustation-type stalls generally occur during conditions of N_g deceleration, compressor surges can occur at a steady state power or during acceleration. A surge (partial stall) is characterized by one or more muffled but quite discernible bangs or pops without attendant increase of T_5 and loss of power. However, since deceleration precipitates a stall, the most beneficial pilot action would be to increase collective stick and leave hover following a noise of this type. Then, attempt to make sure that the engine does not decelerate, make only minor or slow power changes, and proceed to a point of intended landing.

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 stall margin. Engines should be washed after each over-water flight below 40 feet.

11.2.5 Blade Stall. Blade stall, the tendency of the retreating blade to stall in forward flight, limits the high speed potential of the helicopter, increases stresses, and decreases component life. The retreating blade (the blade moving away from the direction of flight) has a tendency to stall because the blade tip is traveling at the rotational velocity minus the forward speed of the helicopter. As the 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 stall (lost lift and increased drag). The increased drag will cause loss of rotor speed unless power is increased. The advancing blade (the blade moving into the direction of flight) on the other hand is traveling at a substantially higher speed and has relatively uniform low angles of attack and is not subjected to blade stall. Blade stall will first occur at the blade tip, and is most likely to occur when operating at high values of airspeed, gross weight, density altitude, and power, and especially with 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 as presented in Figure 20-5 portrays the airspeeds at various pressure altitudes, temperatures, gross weights, rotor speeds, and load factors (angle of bank) as limited by blade stall. This blade stall chart establishes maximum recommended 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 rotary wing blade will stall as it passes through the stall region and create vibrations per revolution equal to the number of blades. If stall is allowed to fully develop (speeds in excess of those shown in the blade stall chart Figure 20-5), loss of control will be experienced and the helicopter will pitch upward and to the left. The use of forward cyclic stick to control this pitchup is ineffective and may aggravate the stall as it increases the blade angle of attack of the retreating blade. When severe blade stall is encountered, a VIDS/MAF shall be submitted.

11.2.5.1 Methods of Eliminating Roughness Caused By Blade Stall. If blade stall is causing roughness in the helicopter during high speed flight or when maneuvering at lower speeds, either condition may be eliminated by accomplishing one or any combination of the following:

*1. Decrease collective pitch.

*2. Decrease the severity of the maneuver.

*3. Gradually decrease airspeed.

*4. Increase rotor rpm.

*5. Reduce altitude - AS NECESSARY.

11.2.6 Rollover Characteristics. There exists for all helicopters both a static and dynamic tipover angle. The static tipover angle is the angle at which the helicopter will turn over on its side if it were mounted on a platform and slowly tilted. This angle is about 37° for the UH-3 helicopter. The dynamic tipover angle, as its name implies, is a dynamic condition of flight, and, although the dynamic tipover angle is considered to be around 15°, cases can exist in which the helicopter will turn over from a level attitude if high sideward velocity exists at touchdown combined with a solid object to prevent lateral sliding of the wheel. An explanation is presented below, in conjunction with slope landings, in order to develop a single set of logical responses for the pilot.

11.2.6.1 Slope Landing and Takeoff. As shown in Figure 11-1 (1), there are only three major forces involved, assuming the helicopter is maintained in a hover (no longitudinal or lateral drift and no yaw rate). A cross-slope landing should be made by descending slowly, placing the upslope wheel on the ground first. Coordinate reduction of collective pitch with lateral cyclic (into the slope) until the downslope wheel touches the ground. The cyclic should always be positioned in order to maintain the rotor lift vector Figure 11-1(2) vertical in order to prevent up or downslope drift. Continue coordinating reduction of collective pitch and application of cyclic into the slope until all the weight of the helicopter is resting firmly on the slope. If the cyclic control contacts the stop or rotor-to-ground clearances become marginal before the downslope wheel is resting firmly on the ground, return to a hover by raising the collective and centering the cyclic. Select a position where the degree of slope is not so great. After completion of a slope landing and after determining that the helicopter will maintain its position on the slope, place the cyclic stick in neutral position. Reference to Figure 11-1 will show that in the cross-slope landing condition, the collective in effect becomes a method of roll control and cyclic is positioned to keep the thrust vector vertical. Cyclic will still affect roll control, but at a greatly degraded rate since the roll center has been transferred from the cg to the upper wheel, and the roll inertia is greater. Across-slope landings or takeoffs should not be attempted on slopes of higher angle than the lateral control capability of the helicopter (±8°). Across-slope takeoffs should be made by first positioning the cyclic into the slope for a vertical lift vector and slowly coordinating raising the collective and centering the cyclic until the helicopter becomes level and lifts off the ground. If the helicopter rolls past level and into the slope, lower the collective to maintain level or set it back down and check for a stuck or restrained wheel.

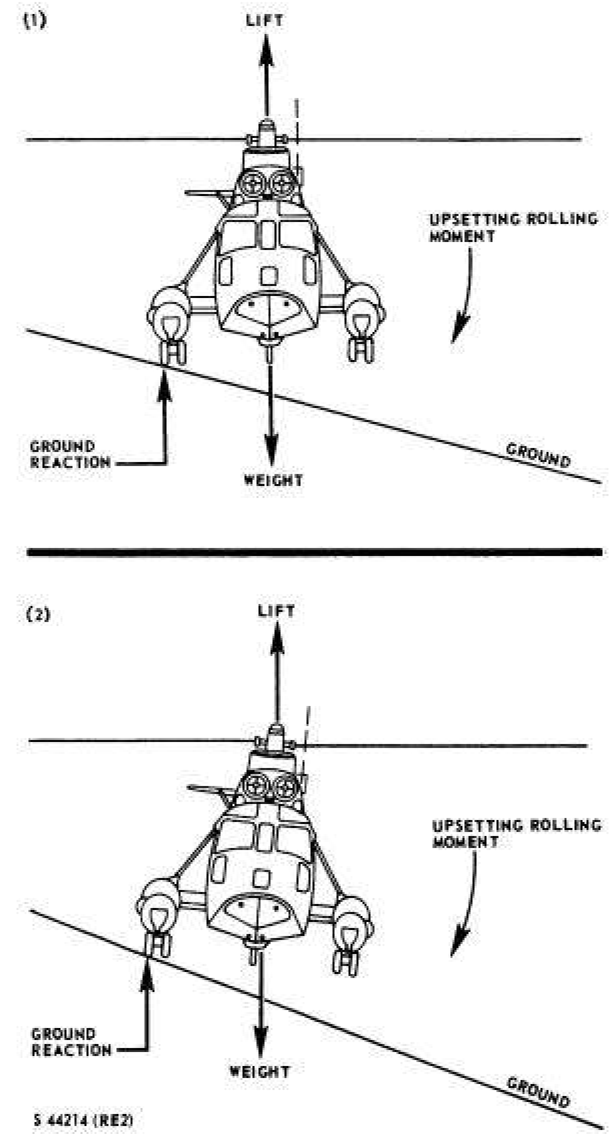


Figure 11-1. Slope Landing/Takeoff Force Diagram

11.2.6.2 Dynamic Tipover. Figure 11-2 applies to the dynamic tipover case. In this condition, the upsetting rolling moment is provided by a side force on the wheel contacting the ground (analogous to the downslope wheel in the slope landing discussion) instead of a vertical force on the upslope wheel. This side force can be extremely large depending on the degree of restraint of the wheel. The pilot can correct his roll angle with lateral control, but it will be sluggish, as described in the previous section, until the lateral control contacts the stop. Figure 11-2 is drawn to show a full lateral control position. As in the slope landing case, the collective is a method of roll control. Since the cyclic control cannot be moved far enough to get the main rotor lift line outside of the wheel, the rotor generates an upsetting moment (Lxd) about the wheel. The only restoring moment capability is the weight of the helicopter (W) times the offset distance (e). The restoring moment decreases to zero at the static tipover angle at which the helicopter will tip over. It is important for the pilot to realize that once the lateral control contacts the stop, roll angle control can still be effected with the collective; down collective to level the helicopter and up collective to roll over. The rate at which the collective should be lowered depends on the dynamics of the situation (roll rate at contact of the lateral stop). The pilot should definitely lower the collective if it appears that cyclic control is ineffective, even though it has not yet contacted the stop.

WARNING

If lateral cyclic control becomes sluggish or ineffectual or contacts the lateral stop or if bank angle becomes excessive (8^0 to 10^0) with one wheel on the ground and thrust about equal to the weight, the helicopter will roll over on its side. Use full cyclic control and reduce collective to stop the roll, and then correct the bank angle to wings level.

CAUTION

When landing or taking off, with thrust about equal to the weight and one wheel on the ground, keep the helicopter under control and do not allow drift or yaw rates to build up. Fly smoothly off (or onto) the ground, carefully maintaining a steady position.

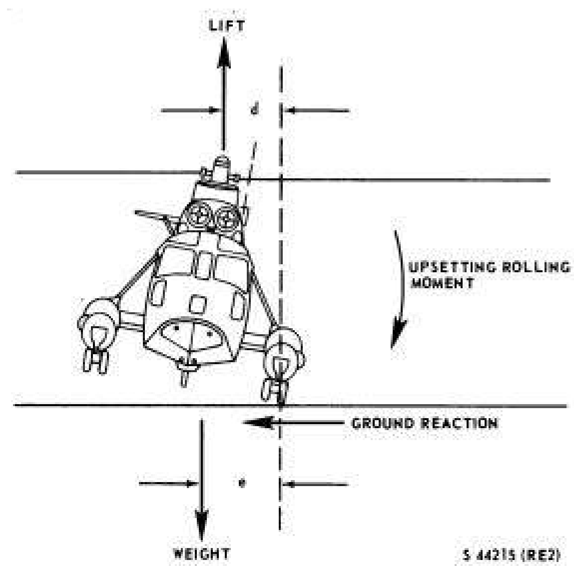


Figure 11-2. Dynamic Tipover Force Diagram

11.3 Mountain and Rough Terrain Flying

CAUTION

The transmission oil cooler was designed for maximum efficiency during sea level operations. Higher than normal main gear-box oil temperatures can be anticipated when operating at altitudes above sea level when combined with high ambient temperatures and high power settings. The reduced pressure/density of air passing through the radiator causes a loss in cooling efficiency of the main gearbox cooler.

Many helicopter missions require flight and landings in rough and mountainous terrain. Refined flying techniques along with complete and precise knowledge of the individual problems to be encountered are required. Landing site condition, wind direction and velocity, gross weight limitations, and effects of obstacles are but a few of the considerations for each landing or takeoff. In a great many cases, meteorology facilities and information are not available at the site of intended operation. The effects of mountains and vegetation can greatly vary wind conditions and temperatures. For this reason, each landing site must be evaluated at the time of intended operation. Altitude and temperature are major factors in determining helicopter power performance. Gross weight limitations under specific conditions can be computed from the performance data in Part XI. A major factor improving helicopter lifting performance is wind. Weight carrying capability increases rapidly with increases in wind velocity relative to rotor system. However, accurate wind information is more difficult to obtain and more variable than other planning data. It is therefore not advisable to include wind in advanced planning data except to note that any wind encountered in the operating area may serve to improve helicopter performance. In a few cases, operational necessity will require landing on a prepared surface at an altitude above the hovering capability of the helicopter. In these cases, a rolling landing and takeoff will be necessary to accomplish the mission. Data for these conditions can be computed from the charts in Part XI.

11.3.1 Wind Direction and Velocity. There are several methods of determining the wind direction and velocity in rough areas. The most reliable method is by the use of smoke generators. However, it must be noted that the hand-held day/night distress signal and the standard ordnance issue smoke hand grenade are satisfactory for wind indication but constitute a fire hazard when in areas covered with combustible vegetation. Observation of foliage will indicate to some degree the direction of the wind but is of limited value in estimating wind velocity. Helicopter drift determined by eyesight without the use of navigational aids is the first method generally used by experienced pilots. The accuracy with which wind direction may be determined through the "drift" method becomes a function of wind velocity. The greater the wind value the more closely the direction may be defined.

11.3.2 Landing Site Evaluation. Six major considerations in evaluating the landing area are:

1. Height of obstacles that determine approach angle.

2. Size and topography of the landing zone.

3. Possible loss of wind effect.

4. Power required.

5. Departure route.

6. Surface composition.

Type of terrain and surface composition may dictate whether a hover-type landing is feasible. When practical, this type of landing should be accomplished; however, high gross weight, density altitude, or presence of loose sand, soil, or grass may require a no-hover landing. To preclude aircraft damage, groundspeed at touchdown should be minimized. The transition period is the most difficult part of any approach. As helicopter performance decreases, the transition period becomes more critical, and of necessity approaches must be shallower and transition more gradual.

Therefore, as the height of the obstacle 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 wind generally occurs as a result of the airflow being unable to immediately negotiate the change prevalent at the upwind side of the landing zone where a virtual null area exists. This null area extends toward the downwind side of the clearing and will become larger as the height of the obstacle and wind velocity increases. It is therefore increasingly important in the landing phase that this null area be avoided if marginal performance capabilities are anticipated. The null area is of particular concern in making a takeoff from a confined area. Under heavy load or limited power conditions, it is desired to achieve a significant value of forward velocity and transitional lift prior to transitioning to a climb so that the overall climb performance of the helicopter will be improved. If the takeoff cycle is not commenced from the most downwind portion of the area and translational velocity is achieved before arrival in the null area, a significant loss in lift may occur at the most critical portion of the takeoff. It must also be noted that in the vicinity of the null area nearly vertical downdraft of air may be encountered, that 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. Even though this is a departure from the cardinal rule of takeoff into the wind, it may well be the proper solution when all factors are weighed in their true perspective. Never plan an approach to a confined area wherein there is no reasonable route of departure. The terrain within site is considered 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 rotor wash before landing. Power should be maintained so that an immediate takeoff may be made should the helicopter start tipping from soft earth or a gear dropping into a hidden hole.

WARNING

Helicopters with wheel-type landing gear are not well suited to landing in unprepared terrain. Landing sites must be chosen with extreme care to avoid damage to helicopter or injury to personnel. Excessive slopes or obstacles must be avoided. Be prepared to effect an immediate takeoff to a hover if the helicopter settles unevenly or encounters difficulty while landing.

11.3.3 Effects of High Altitude. Engine power available at altitude is less, and operations can easily be in a situation of limited hovering ability. High gross weight at altitude increases the susceptibility of the helicopter to blade stall. Conditions that contribute to blade stall are high forward speed, high gross weight, high altitude, low rpm, induced g loading, and turbulence. Shallower turns at slower airspeeds are required to avoid blade stall. A permissible maneuver at sea level must be tempered at a higher altitude. Smooth and timely control application and anticipation of power requirement will do more than anything else to improve altitude performance.

11.3.4 Turbulent-Air Flight Techniques. Helicopter pilots must be constantly alert to evaluate and avoid areas of severe turbulence; however, if encountered, immediate steps must be taken to avoid continued flight through it to preclude the structural limits of the helicopter being exceeded. Severe turbulence is often found in thunderstorms and helicopter operations should not be conducted in their vicinity. The most frequently encountered type of turbulence is orographic turbulence. It can be dangerous if severe and is normally associated with updrafts and downdrafts. It is created by moving air being lifted by natural or manmade obstructions. It is most prevalent in mountainous regions and is always present in mountains if there is a surface wind. Orographic turbulence is directly proportional to the wind velocity. It is found on the upwind side of slopes and ridges near the tops and extending down the downwind slope (see Figure 11-3). It will always be found on tops of ridges associated with updrafts on the upwind side and downdrafts on the downwind side. Its extent on the downwind slope depends on the strength of the wind and the steepness of the slope. If the wind is fairly strong (15 to 20 knots) and the slope is steep, the wind will have a tendency to blow off the slope and not follow it down; however, there will still be some tendency to follow the slope. In this situation, there will probably be severe turbulence several hundred yards downwind of the ridge at a level just below the top. Under certain atmospheric conditions, a lens-shaped cloud may be observed above the ridge. On more gentle slopes, the turbulence will follow down the slope but will be more severe near the top. Orographic turbulence will be affected by other factors. The intensity will not be as great when climbing a smooth surface as when climbing a rough surface. It will not follow sharp contours as readily as gentle contours.

Man-made obstructions and vegetation will also cause turbulence. Extreme care should be taken when hovering near buildings, hangars, and similar obstructions. The best method to overfly ridgelines from any direction is to acquire sufficient altitude before crossing to avoid leeside downdrafts. If landing on ridge lines (see Figure 11-4), the approach should be made along the ridge in the updraft, or select an approach angle into the wind that is above the leeside turbulence. When the wind blows across a narrow canyon or gorge (see Figure 11-5), it will often veer down into the canyon.

Turbulence will be found near the middle and downwind side of the canyon or gorge. When a helicopter is being 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 upslope wind. This procedure not only provides additional lift but also provides a readily available means of exit in case of emergency. Maximum turning space is available and a turn into the wind is also a turn to lower terrain. The often used procedure of flying through the middle of a pass to avoid mountains invites disaster. This is frequently the area of greatest turbulence (see Figure 11-6), and in case of emergency, the pilot has little or no opportunity to turn back because of insufficient turning space. Rising air currents created by surface heating cause convective turbulence. This is most prevalent over bare areas.

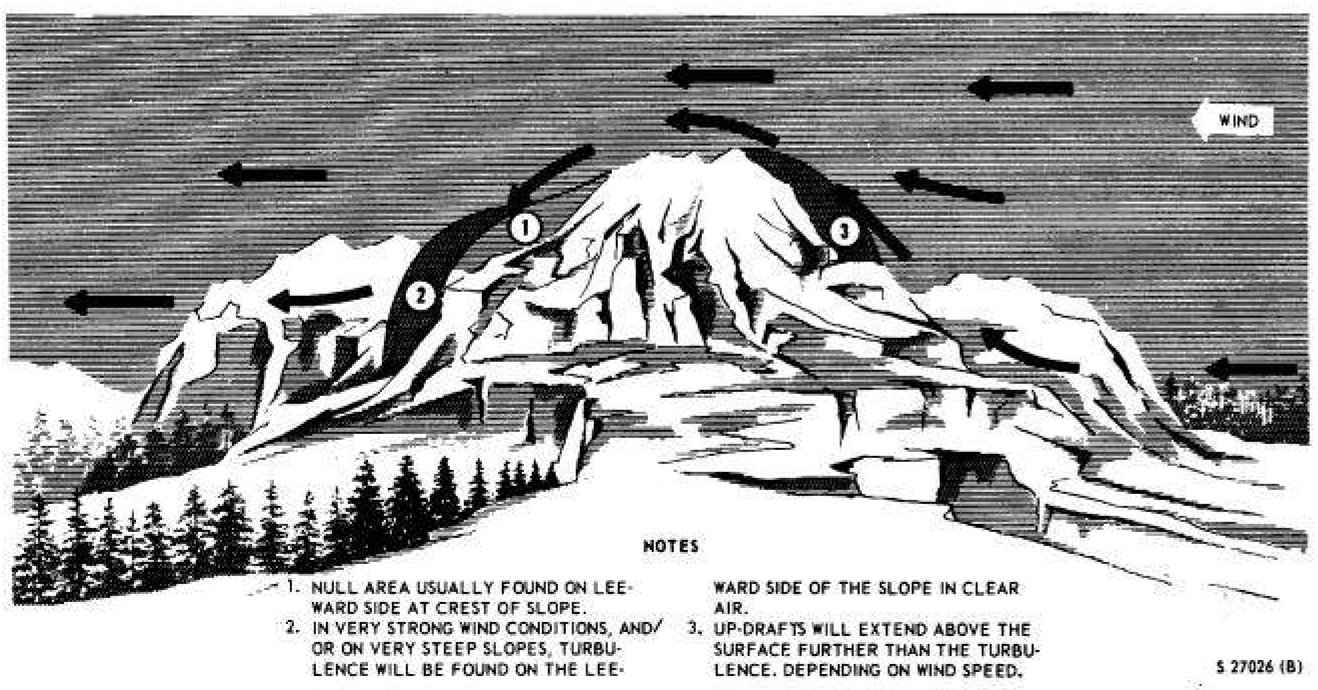


Figure 11-3. Wind Flow Over and Around Peaks

Convective turbulence is normally found at a relatively low height above the terrain, generally below 2,000 feet. It may, however, under certain conditions and in certain areas, reach as high as 8,000 feet above the terrain. Attempting to fly over convective turbulence should be carefully considered, depending on the mission assigned. The best method is to fly at the lowest altitude consistent with safety. Attempt to keep your flightpath over areas covered with vegetation. Turbulence can be anticipated when transitioning from bare areas to areas covered by vegetation or snow.

Convective turbulence seldom gets severe enough to cause structural damage.

11.3.5 Adverse Weather Conditions. When flying in and around mountainous terrain under adverse weather conditions, it should be remembered that the possibility of inadvertent entry into clouds is ever present. Air currents are unpredictable and may cause cloud formations to shift rapidly. Since depth perception is poor with relation to distance from cloud formation and to cloud movement, low hanging clouds and scud should be given a wide berth at all times. In addition to being well briefed, the pilot should carefully study the route to be flown. A careful check of the helicopter compass should be maintained in order to fly a true heading if the occasion demands.

11.3.6 Summary. The following guidelines are considered to be most important for mountain and rough 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 wind is relatively calm, try to select a hill or knoll for landing so as to take full advantage of any possible wind effect.

4. When evaluating a landing site, execute as many fly-bys as necessary with at least one high and one low pass before conducting operations into a strange landing area.

5. Evaluate the obstacles in the landing site and consider possible null areas and routes of departure (see Figure 11-7).

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

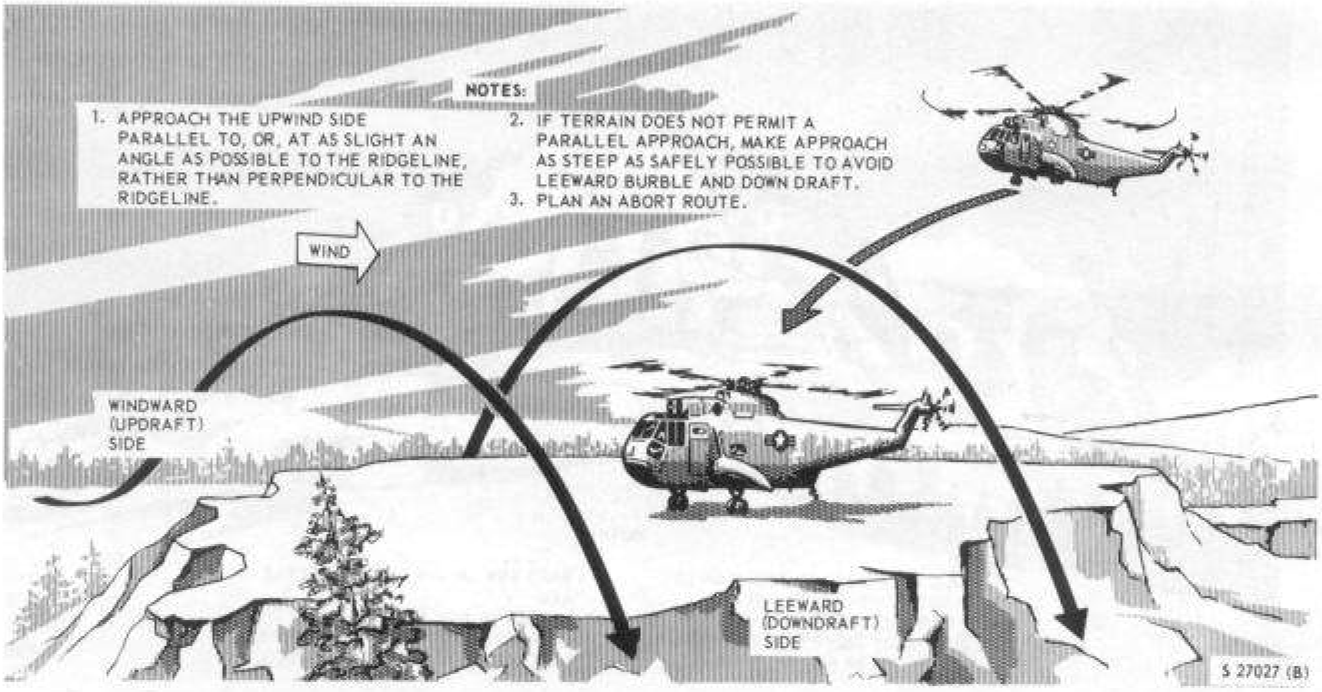


Figure 11-4. Wind Effect on Ridgeline Approach

Figure 11-5. Windflow Over Gorge or Canyon

Figure 11-6. Windflow in Valley or Canyon

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

8. Watch for rpm surges during turbulent conditions. Strong updrafts will cause rpm to increase, whereas downdrafts will cause rpm to decrease.

9. Avoid flight in or near thunderstorms.

10. Give all cloud formations a wide berth.

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

12. Cross mountain peaks and ridges high enough to stay out of downdrafts on the leeside of the crest.

13. Avoid downdrafts prevalent on leeward slopes.

14. Plan your flight to take advantage of the up-drafts on the windward slopes.

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

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

17. Know your route and brief well for flying in these areas.

Note

Careful preflight analysis of engine performance charts, hovering charts, and blade stall charts will aid in avoiding extreme situations during mountainous operations.

11.4 Terrain Flying

11.4.1 General. 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. Consult appropriate manuals for procedures and techniques for terrain flying to avoid visual and/or electronic detection in a threat environment.

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. 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.

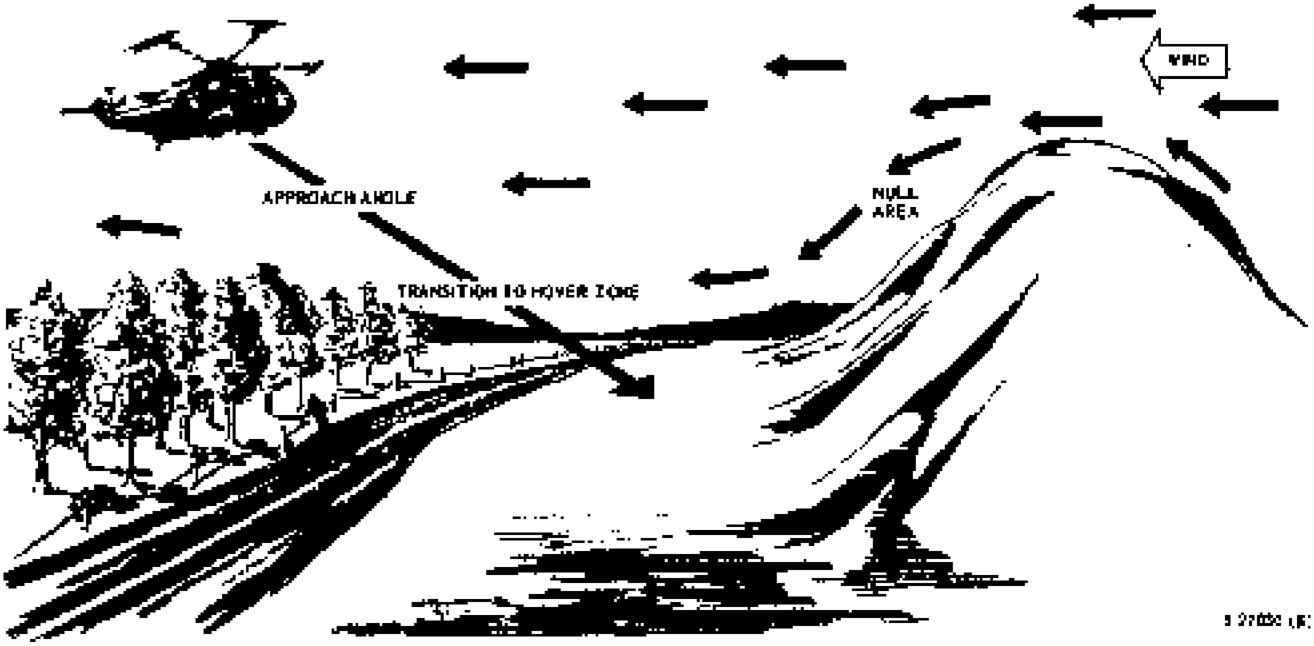


Figure 11-7. Wind Effect in a Confined Area

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.

Learning terrain flying is a long-term cumulative process. Low level must be mastered before attempting contour flying that must precede NOE. Terrain flying is very demanding of both crew and aircraft.

The close proximity to obstacles, rapid attitude adjustment, and many power changes with frequent high-power demands puts 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 prebriefed and rigidly enforced. Standard phraseology should be developed and used in intercrew communications to avoid confusion during critical segments of flight. Constant navigation is critical and the crewmember navigating should keep the aircraft position fixed (as accurately as possible). 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 known and considered when determining route of flight and altitude.

11.4.2 Crew Coordination. In addition to other individually assigned duties, all crewmembers are responsible for maintaining a visual lookout and recognizing and communicating obstacles/hazards of flight to the pilot at the controls. The pilot at the controls is responsible for controlling the aircraft and avoiding obstacles. His attention must constantly be outside of the aircraft and he may aid in navigation by reporting prominent landmarks.

The pilot not at the controls will be responsible for monitoring flight and engine instruments and will be the crewmember primarily responsible for navigation. He should provide speed and direction of flight recommendations, utilizing clock position or direction of turn rather than compass headings. He should also assist in determining altitude by providing information on obstacles out of the pilot's field of vision.

One air crewman will be assigned a lookout station at the cargo door. He will be responsible for obstacle clearance on the starboard side and for clearing the tail, especially during approaches and hovering. The second air crewman will be assigned a lookout station on the port side of the aircraft and be responsible for obstruction clearance.

WARNING

All crewmembers shall use crewman safety belts while not in their seats because of the frequent maneuvering involved.

11.4.3 Summary. The following guidelines are considered to be most important for terrain flying.

1. The pilot at the controls must concentrate his attention out of the cockpit, primarily concerned with terrain/obstacle avoidance.

2. The pilot not at the controls must perform all collateral cockpit functions, monitor gauges, and navigate.

3. Crewmembers must be assigned responsibility for obstacle clearance of specific portions of the aircraft.

4. Proper scheduling, briefing, preflight planning, preflight, and crew coordination are essential.

5. In a terrain flight envelope, emergency procedures must be known perfectly and responses must be immediate.

This Page Left Blank Intentionally

PART V

Emergency Procedures

CHAPTER 12 – EMERGENCY PROCEDURE

This Page Left Blank Intentionally

CHAPTER 12

Emergency Procedures

12.1 GENERAL

The emergency situations and procedures outlined in this chapter cover the common types of emergencies encountered; however, the procedures used in each actual emergency encountered must result from consideration of the complete situation. Compound emergencies may require departure from normal corrective procedures set forth below for any specific emergency. Because of varied types of equipment installed, pilots and air crewmen must be thoroughly familiar with the emergency procedures in the succeeding paragraphs. A radio call and/or a switching of the IFF to emergency should be attempted in emergencies requiring forced landing or diverting. The terms land as soon as practicable, land immediately, and land as soon as possible refer to the degree of urgency with which a landing must be made and are not meant to preclude the use of sound judgment on the part of the pilot in command under these conditions.

12.2 CRITICAL PROCEDURES

Procedures marked with an asterisk (*) are considered critical. Air crewmembers shall be able to accomplish asterisked procedures without reference to the checklist.

12.2.1 Recommended Dual Concurrence Items.

It is recommended to gain dual concurrence before manipulating the following items:

a. Accessory Drive
b. T-Handles
c. Manual Throttles
d. Speed Selectors
e. Fuel Management Panel
f. Generators at night/IMC
g. Fuel Dump Switches

12.3 EMERGENCY ROTOR ENGAGEMENT

It may be necessary to engage the rotor with the No. 1 engine and the accessory drive stuck in the FLIGHT position or engage the rotor with the No. 2 engine while the No. 1 engine is shut down or stuck in the FLIGHT position. There will be no servo pressure and no gearbox lubrication until the rotary wing has turned through several revolutions. For this reason, the correct technique is as follows:

1. Release the rotor brake and advance the speed selector slightly to allow the rotary wing to begin a slow acceleration.

2. Carefully monitor transmission oil pressure and primary and auxiliary servo pressure for a rise. The rotor system should not be accelerated until pressures register normal.

3. The cyclic stick and collective must be held firmly. Slight kicks may feed back into the controls when servo pressures are rising.

12.4 FIRE

WARNING

It is recommended that secondary indications of fire (smoke, fumes, seeing the fire) be considered before a decision is made to execute emergency procedures.

12.4.1 Engine Fire on the Ground. .If an engine fire occurs while on the ground:

*1. Engine speed selectors - SHUTOFF.

*2. Engine T-handle - PULL.

*3. Engine fire extinguisher switch - MAIN (CIRCUIT BREAKER-CHECK), THEN RESERVE, IF NECESSARY.

*4. Rotor brake - ON.

5. Fuel management panel - SECURED.

WARNING

Vapors from the fire extinguisher agent, bromotrifluoromethane, while not poisonous, can cause asphyxiation through reduction of oxygen, especially in confined spaces. The liquid can cause low-temperature burns when in contact with the skin. All personnel should stand clear and in the open air. If the helicopter is on the ground, the cabin should be vacated as a precautionary measure.

6. Battery – OFF.

7. When rotor blades have stopped - ABANDON AIRCRAFT.

12.4.2 Engine Fire In Flight.

WARNING

If dual-engine fire occurs, enter autorotation and secure engines.

Note

When hovering in low wind conditions and/or high ambient air temperatures, a fire warning light may go on when fire is not present. If a fire warning element breaks, it may cause a fire warning light to go on when fire is not present.

*1. Confirm Fire.

*2. Speed selectors - FULL FORWARD.

*3. Contain N_r.

*4. Establish single-engine airspeed and level attitude.

*5. Reduce gross weight, if necessary, by dumping fuel and/or jettisoning stores.

*6. Speed selector (bad engine) – SHUTOFF.

*7. Engine T-handle - PULL.

*8. Engine fire extinguisher switch - MAIN (CIRCUIT BREAKER-CHECK), THEN RESERVE, IF NECESSARY.

CAUTION

In case of fire in both engines, if reserve position was used on the first engine fire in place of main position, reserve must be used on the second engine fire. There will be no extinguishing agent available if both main and reserve positions were used on the first engine fire.

Note

- The close proximity of both engine compartment fire detection elements makes it possible for indications of a fire to be transmitted from one compartment to the other, thus producing false dual-engine fire indications in the cockpit.
- The fire detection element requires a period of time to cool after the heat has been removed and may cause the fire warning lights to remain on for a period of time. Realization of this may avoid the needless use of the reserve fire bottle. It should not, however, discourage use of the reserve bottle if continued fire is confirmed after using the main fire extinguisher.

9. Boost pumps and crossfeed - AS REQUIRED.

10. Determine normal engine's power available.

11. Landing gear – AS REQUIRED.

12. Land as soon as possible.

If fire continues, proceed as follows:

12. Landing gear - AS REQUIRED.

13. Land immediately.

12.4.3 Fuselage or Electrical Fire.

1. Pilot compartment sliding windows – CLOSED.

2. Cabin doors and hatches – CLOSED.

3. Ventilation and heating fan switch - OFF.

4. Determine source of fire.

a. If source is known – turn off affected equipment and pull affected circuit breakers.

b. If source is unknown – secure all nonessential equipment and pull nonessential circuit breakers.

5. Portable fire extinguisher – USE.

6. If fire goes out – Land as soon as practicable. Refer to Smoke/Fume/Noxious Gas Elimination as required.

If fire continues, proceed as follows:

7. Landing gear - AS REQUIRED.

8. Land immediately.

12.4.4 Heater Fire.

1. Cabin heater switch - SECURE.

If fire continues, proceed as follows:

2. Cabin heater fan switch - SECURE.

3. Cabin heater circuit breaker - PULL.

4. Vents - CLOSE TO CONTAIN FIRE.

5. Fight fire using fire extinguisher at heater fire access port and/or heater ducts.

Note

Vents should be closed to contain fire and provide more effective use of fire extinguisher.

12.4.5 Smoke/Fume/Noxious Gas Elimination. Smoke, fume, or noxious gases may be eliminated by opening the pilot compartment sliding windows and the cargo doors to get airflow throughout the cabin. Consider adjustment of the registers and diffusers in the pilot compartment and cabin. Do not push out the cabin windows or the cabin door emergency escape window while the helicopter is in flight, because of the possibility of their being carried into the rotary rudder blades by the airstream.

12.4.6 Postshutdown Engine Fire. A fire may occur within the combustion chamber after shutdown that may continue to feed itself unless blown out by compressor air.

SYMPTOMS

1. T_5 rises above 300 °C.

2. Engine smoke.

CORRECTIVE ACTION

* 1. Check speed selector - SHUTOFF.

*2. Ignition switches - OFF.

*3. Battery - ON.

*4. Emergency start switch - ON.

*5. Engine T-handle - PULL.

*6. Starter - ENGAGE.

After T_5/smoke decreases, disengage starter.

7. If fire continues, proceed as follows:

a. On the ground, have crewman or lineman discharge fire bottle in engine intake while motoring starter. If fire warning light remains on, fire extinguisher switch - MAIN (CHECK CIRCUIT BREAKER), THEN RESERVE, IF NECESSARY.

12.5 FUEL SYSTEM FAILURE

12.5.1 Fuel Boost Pump Failure.

1. If both fuel boost pumps are lost in one tank, land as soon as practicable.

2. If the fuel boost pump warning light goes on activate the remaining boost pump for that tank before securing the affected pump. If the fuel boost pump failure light goes off when both pumps are activated, there may be a fuel leak. Instruct the crewman to investigate for fuel fumes/leaks. If a leak is detected or fuel gauges indicate abnormal consumption, proceed as follows:

WARNING

With both boost pumps off in the affected tank and the crossfeed open, transfer of all fuel from the good tank will result in dual-engine flameout.

a. Crossfeed from the good tank.

WARNING

b. Land as soon as practicable.

Securing both pumps in one tank may cause engine flameout.

12.5.2 Fuel Crossfeed Malfunctions. If fuel does not crossfeed utilizing normal procedures, proceed as follows:

1. If no evidence of crossfeed is noted, change pump usage in the noncrossfeeding tank.

2. If fuel crossfeed is still not evident, turn on all boost pumps, open crossfeed switch, and land as soon as practicable.

CAUTION

A malfunctioning transfer check valve can result in air being drawn into the fuel system from the empty center tank and can result in flameout of the engine serviced by the fuel tank in which both boost pumps are either inoperative or off.

12.5.3 Fuel Filter Bypass. Contamination of either airframe fuel line filter will result in the lighting of the FWD FUEL BYPASS or AFT FUEL BYPASS caution light. To preclude fuel control contamination and flameout because of fuel exhaustion or fuel control malfunction, proceed as follows:

WARNING

With both boost pumps off, in the affected tank and the crossfeed open, transfer of all fuel from the good tank will result in dual-engine flameout.

1. Crossfeed from the good tank.

2. Land as soon as practicable.

12.5.4 Inadvertent Fuel Dumping in Flight. In case of experiencing inadvertent fuel dumping in flight, proceed as follows:

1. Fuel dump switches/valves – CHECK AT OFF POSITION.

2. Fuel dump pump circuit breakers - PULL.

3. Crewman visually check fuel dump tube to be sure fuel dumping has been secured.

4. Landing criteria predicated upon amount of fuel remaining.

WARNING

When the fuel low-level caution lights go on, attitudes of over 6° noseup should be avoided because of the possibility of fuel starvation.

12.6 STARTER HANGUP

If the starter fails to disengage, proceed as follows:

1. Speed selector lever - PULL DOWN.

2. If starter still engaged - PULL STARTER CIRCUIT BREAKER.

3. If starter still engaged - SECURE ENGINES.

4. Secure electrical power.

12.7 ENGINE MALFUNCTIONS

The material contained herein assumes a certain knowledge of basic engine operation. In regard to cockpit indications, it is particularly important to consider the relationship of N_g and T_5. These two indicators on a properly operating engine will always rise and fall together as a function of engine power.

When analyzing any engine malfunction, it is imperative that corrective action be based on an intelligent analysis of all indications of engine operation and not on any one source, particularly not on torque indication alone. The list of symptoms that will be given for each malfunction are only the discrepant indications. Except where otherwise noted, other cockpit instruments remain normal.

WARNING

With manual throttle actuated, resistance may occur in the speed selector during conditions requiring movement at or below the minimum governing range marking on the throttle quadrant. Attempts to retard speed selector beyond the point at which this resistance occurs may result in inadvertent engine shutdown.

12.8 RAIN INGESTION

Power loss may be experienced when operating in heavy rainfall. Fuel requirements become excessively large as the engine attempts to supply fuel for water vaporization. When fuel requirements exceed the capacity of the fuel control, the engine will decelerate until a stabilization point occurs at a lower power setting. The following procedures apply:

1. If a slight loss of N_g occurs, crosscheck torquemeters for indicated loss of power. If a substantial power loss occurs, apply manual throttle as necessary to restore power.

2. Manual throttle must be retrimmed to avoid overspeed or overtemperature.

WARNING

A substantial loss of N_r may occur before engine stabilization is attained, resulting in rotor decay. Autorotative flight may be required to effect recovery.

12.9 SINGLE INSTRUMENT INDICATIONS

In the case of an abnormal indication on only one instrument, it is possible that an instrument system failure has occurred. Prudence, however, will dictate a cautious approach according to which instrument is used, and the manner in which it fails.

12.9.1 N_g Tachometer System Malfunctions.

SYMPTOMS

1. N_g tachometer needle falls to zero.

2. Engine oil pressure, T_5, and N_f indicators normal.

CORRECTIVE ACTION

1. Continue flight.

2. Check engine oil pressure indicator circuit breaker in.

3. Keep torques matched and use other engines N_g tachometer for approximate indication.

12.9.2 N_g Tachometer Fluctuations.

SYMPTOMS

1. N_g tachometer needle fluctuations of over ±l percent under normal loads and/or grinding sound from front frame.

2. Engine oil pressure, T_5 and N_f indicate normal.

CORRECTIVE ACTION

1. Maintain safe single-engine parameters.

2. Monitor engine oil pressure and torque for corresponding fluctuations.

3. Land as soon as practicable.

WARNING

N_g tachometer fluctuations of over ±1 percent under normal loads and/or grinding sounds from the front frame could be indicative of impending engine failure originating in the front frame accessory drive section.

12.9.3 N_f Tachometer System Malfunction.

SYMPTOMS

1. No. 1 or No. 2 N_f tachometer needle on one or both gauges falls to zero.

2. All other indications are normal.

CORRECTIVE ACTION

1. If one or both needles on the same gauge fails - CONTINUE FLIGHT.

2. If the same needle on both gauges fails - LAND AS SOON AS PRACTICABLE.

3. Keep torques matched and use other engine N_f tachometer for approximate indication.

12.9.4 N_f Tachometer Fluctuations.

SYMPTOMS

1. N_f tachometer needle fluctuations greater than ±l percent under normal loads and audible engine fluctuations.

2. Engine oil pressure, T_5, N_g, and torque indicate normal.

CORRECTIVE ACTION

1. Maintain safe, single-engine parameters.

2. Monitor torque and N_g for corresponding fluctuations.

3. Land as soon as practicable.

Note

Rapid N_f fluctuations may be indicative of any impending flex driveshaft failure, freewheeling unit failure, other main gearbox failure, or a faulty N_f tach generator.

12.9.5 T_5 System Malfunction.

SYMPTOMS

1. T_5 fluctuates, fails to rise and fall in harmony with N_g, or falls to zero.

2. Other gauges normal.

CORRECTIVE ACTION

1. Check the jumper plug on the engine trim checker panel for proper installation.

2. Use other engine instruments.

3. Avoid high power settings.

4. Land as soon as practicable.

Note

Proper N_g topping adjustment will normally prevent overtemperature; however, prolonged operation at military power can result in exceeding temperature versus time limitations.

12.9.6 Engine Oil Pressure Fluctuations.

SYMPTOM

Engine oil pressure fluctuates in excess of ±3 psi (6 psi differential) while engine power is at steady state. All other indications are normal.

CORRECTIVE ACTION

Land as soon as practicable. If oil pressure falls below minimum, engine oil temperature exceeds maximum, or abnormal engine noise is heard, secure engine in accordance with procedures listed under engine malfunctions.

12.9.7 Oil Pressure Failure.

SYMPTOMS

1. Oil pressure decreasing to zero.

2. Other gauges are normal.

CORRECTIVE ACTION

*1. Speed selectors - FULL FORWARD.

*2. Contain N_r.

*3. Establish single-engine airspeed and level attitude.

*4. Reduce gross weight if necessary by dumping fuel and/or jettisoning stores.

5. Check engine oil pressure and inverter circuit breaker.

6. Secure affected engine.

7. Landing gear – AS REQUIRED.

8. Land as soon as practicable.

12.9.8 Oil Temperature System Malfunction.

SYMPTOM

Oil temperature reading fluctuates erratically, pegs, or falls to zero. All other instruments are normal.

CORRECTIVE ACTION

1. Check circuit breaker.

2. Continue flight, paying close attention to oil pressure. Check cause of discrepancy upon return to base.

SYMPTOM

Oil temperature rises above red line.

CORRECTIVE ACTION

1. Attain safe single engine flight parameters.

2. Retard speed selector to minimum governing range.

3. Land as soon as practicable.

WARNING

Because of the possibility of subsequent engine seizure, a single-engine profile shall be flown.

Note

Speed selector may be advanced into the governing range for a short duration during the landing phase if necessary, if required for landing.

12.9.9 N_r Tachometer System Malfunction.

SYMPTOMS

1. N_r tachometer needles on one or both gauges fall to zero.

2. N_f indications normal.

CORRECTIVE ACTION

1. If one indicator fails - CONTINUE, FLIGHT.

2. If both indicators fail - LAND AS SOON AS PRACTICABLE.

Avoid high N_r regimes.

12.10 FLIGHT CHARACTERISTICS

12.10.1 Vortex Ring State. Refer to paragraph 11.2.4 for description of vortex ring state.

*1. Decrease collective pitch.

*2. Increase forward airspeed.

*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, the condition causing vortex ring state should be avoided.

CAUTION

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 be made only by entering autorotation before regaining airspeed.

12.10.2 Settling With Power. For discussion of settling with power, refer to paragraph 11.2.3.

*1. Speed selectors - FULL FORWARD.

*2. Contain N_r.

*3. Establish single-engine airspeed and level attitude.

*4. Reduce gross weight by dumping fuel and/or jettisoning stores.

12.10.3 Blade Stall. For discussion of methods of eliminating roughness caused by blade stall, refer to paragraph 11.2.5. Eliminate blade stall by accomplishing one or any combination of the following:

*1. Decrease collective pitch.

*2. Decrease the severity of the maneuver.

*3. Gradually decrease airspeed.

*4. Increase rotor rpm.

*5. Reduce altitude - AS NECESSARY.

12.11 ENGINE FAILURE

12.11.1 Immediate Emergency Procedures. In all malfunctions in which engine power retards or goes to full power, load sharing is such that the other engine will show a corresponding decrease or increase in power as the fuel control of the properly operating engine tries to maintain the selected rpm. In cruise flight there is usually time to ascertain which engine has malfunctioned. In a hover with loss of rpm imminent or on the deck at flat pitch with overtemperature or overspeed threatening, immediate action may be necessary without time to analyze the situation.

12.11.1.1 Main Rotor Decay Rate (Figure 12-1). The main rotor decay rate following single-engine failure is essentially a function of engine torque required at the time of failure, irrespective of airspeed, turn rate, or climb rate. Flight regimes that require high torque settings will produce higher main rotor decay rates. As shown, a 5-percent decay in 1 second can be expected when failure occurs in flight regimes requiring 74.5-percent torque. Rotor speed can be regained satisfactorily by lowering the collective.

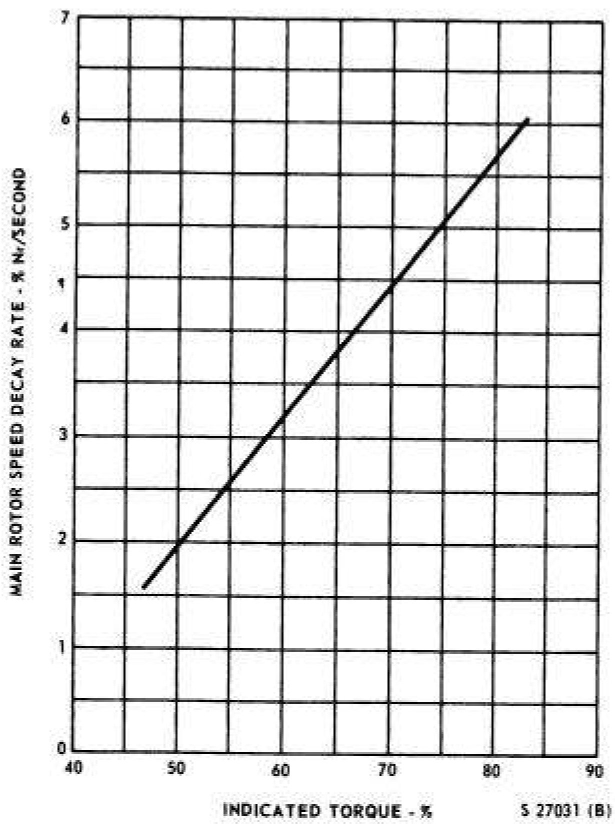


Figure 12-1. Rotor Speed Decay Rate Following Single-Engine Failure

12.11.2 Single-Engine Failure on Takeoff.

*1. Speed selectors - FULL FORWARD.

*2. Contain N_r.

*3. Assume approach attitude/airspeed.

*4. Landing gear - AS REQUIRED.

12.11.3 Single-Engine Failure or Loss of Power While Hovering. A rule of thumb method that may prove helpful is to check the amount of torque required to hover on two engines and then to estimate if one engine could supply the required power.

*1. Speed selectors - FULL FORWARD.

*2. Maintain level attitude.

If unable to maintain hover:

*3. Cushion landing with collective.

If able to maintain stable hover with greater than 92-percent N_r:

4. If necessary, transition to forward flight.

Note

For single-engine failure or loss of power in an overwater hover, see paragraph 12.33.7 for further information.

12.11.4 Single-Engine Failure in Flight. Density altitude, gross weight, and availability of a prepared landing area will affect the pilot decision to abort or continue flight.

*1. Speed selectors - FULL FORWARD.

*2. Contain N_r.

a. If N_r is decreasing, lower collective to keep N_r 92 percent or above.

b. If N_r is increasing, raise collective to keep N_r below 112.5 percent.

*3. Establish single-engine airspeed and level attitude.

*4. Reduce gross weight, if necessary, by dumping fuel and/or jettisoning stores.

5. If altitude cannot be maintained, make single-engine landing.

6. If altitude can be maintained, proceed as follows:

a. Analyze source of engine malfunction; restart engine, secure engine, or use manual throttle as appropriate.

b. Determine power available on properly operating engine.

7. Maintain autorotative altitude/airspeed.

WARNING

When established in single-engine cruise flight, loss of the remaining operating engine will cause rapid rotor rpm decay. Within 3 to 5 seconds, rotor rpm will decay to an unrecoverable state with resultant loss of control unless autorotation is entered immediately.

8. Landing gear - AS REQUIRED.

9. Land as soon as practicable.

12.11.5 Jettison.

1. Jettison selector knob - AS DESIRED.

2. Individual RELEASE button - PRESS.

Note

JETTISON ALL switch will jettison all external stores.

12.11.6 Engine Shutdown in Flight.

1. Engine speed selector - SHUTOFF.

2. Fuel firewall valve - CLOSED.

3. Boost pumps and crossfeed - AS DESIRED.

4. All engine instruments - CHECK.

5. Land as soon as practicable.

12.11.7 Single-Engine Restart During Flight

CAUTION

A failed engine should not be started in flight unless it can be determined that it is reasonably safe to do so. Before restarting engine in flight, allow 30 seconds of turbine windmilling without energizing starter and with engine speed selector in SHUT-OFF to purge the engine of fumes and fuel.

1. Engine T-handle - IN.

2. Manual throttle - CLOSED.

3. Fuel firewall valve - OPEN.

4. Ignition - NORMAL.

5. Emergency start switch – ON.

6. Perform start.

Note

- If the auxiliary servo has failed or is secured, both engine safety interlocks are opened and the emergency start switch must be used to start the No. 1 and 2 engines.

- Above 10,000 feet altitude, manual throttle assist may be necessary during starts below 80 KIAS. If the engine does not accelerate smoothly after light-off with the speed selector in GRD IDLE, carefully advance the manual throttle to assist engine acceleration. Monitor turbine inlet temperature closely when using manual throttle lever. When engine speed reaches GRD IDLE, manual throttle should be fully closed and all further engine operation controlled by the speed selector.

12.11.8 COMPRESSOR STALL. Compressor stall is normally encountered during engine deceleration at the N_g when the variable vanes begin to close from the full open position (about 89% on standard day). Failure of the variable vanes to close due to either mechanical binding or fuel control scheduling may result in a decel stall. Compressor fouling, FOD, erosion and salt encrustation will reduce available stall margin, increasing the possibility of compressor stall.

SYMPTOMS

1. T_5 increasing, possible overtemperature.

2. N_g decreasing or stabilized below ground idle.

3. Torque and N_f decreasing.

4. Possible audible rumble or airframe shudder. T_5 may begin to decrease if thermocouple harness has been damaged by overtemperature. Since combustor airflow has been significantly reduced by compressor stall, pilot should be alert for evidence of post shutdown fire in engine.

CORRECTIVE ACTION

IN FLIGHT

*1. Speed selectors - FULL FORWARD.

*2. Contain N_r.

*3. Establish single-engine air- speed and level attitude.

*4. Reduce gross weight, if necessary, by dumping fuel and/or jettisoning stores.

5. Secure affected engine if overtemperature is suspected. If T_5 stabilizes at a temperature less than maximum allowable, normal engine operation may be restored by reducing power on the affected engine to ground idle, then slowly bringing it into the governing range.

CAUTION

If affected engine is not secured, abrupt power and attitude changes must be avoided. Due to the likelihood of subsequent stalls during the landing phase it is recommended that a single-engine landing profile be flown.

6. Determine normal engine's power available.

7. Landing Gear – AS REQUIRED.

8. Land as soon as practicable.

ON GROUND

*1. Secure affected engine.

2. Follow up procedure, use checklist.

12.11.9 LUBE PUMP OR SHAFT FAILURE. The gear train from the radial shaft to the accessory drive is divided into two paths. One shaft powers the fuel pump and fuel control while the other drives the lube pump and N_g tachometer. Loss of lube pump is indicated by the following symptoms.

SYMPTOMS

1. N_g suddenly decreases to zero.

2. Oil pressure decreases suddenly.

3. Oil temperature may rise.

Note

If in a hover, over water, or rough terrain, continued operation with the affected engine is possible to permit a climb to a safe altitude.

CORRECTIVE ACTION

IN FLIGHT

*1. Speed selectors - FULL FORWARD.

*2. Contain N_r.

*3. Establish single-engine airspeed and level attitude.

*4. Reduce gross weight, if necessary, by dumping fuel and/or jettisoning stores.

5. Secure affected engine.

6. Determine normal engine's power available.

7. Landing Gear – AS REQUIRED.

8. Land as soon as practicable.

ON GROUND

*1. Secure affected engine.

2. Follow up procedure, use checklist.

12.11.10 HIGH SPEED SHAFT (POWER TURBINE SHAFT). Impending failure may be recognized by a high pitched whine or grinding sound eminating from the forward section of the main gear box. Failure of the high speed shaft will unload the power turbine rotor and result in a sudden N_f increase. Between 119%-123% N_f, the fuel control overspeed protection will shut off fuel flow from the control and flameout the engine. When N_f decreases below the overspeed trip point, fuel flow will again be initiated. If relight occurs, the engine may enter compressor stall, or stabilize at some low power setting.

WARNING

Failure of the high speed shaft may result in compound emergencies including fuselage damage, damage to oil and hydraulic lines and/or fire. Damage to the main gearbox could result in a loss of main gearbox oil and/or internal damage with a possible N_r decay.

SYMPTOMS

IN FLIGHT

1. Loud sound from transmission area.
2. Rapid rise in N_f, peak N_f dependent upon engine power before shaft failure.
3. Torque drop, if engine relights and stabilizes some residual torque may be indicated on the torque gauge.
4. Rapid engine deceleration as fuel flow is shut off.
5. Possible compressor stall if engine relights. The possibility exists that the engine may stabilize at some lower power range attempting to maintain the N_f selected in the normal range. The free turbine (N_f), on the affected engine, will probably stabilize at some value higher than normal (110% - 114%) and can be recognized by a N_f, N_r split with N_f stabilizing above the N_r.
6. Possible transmission chip detection light, if break occurred at the sleeve bearing or inside the main gear box.
7. Possible main gear box oil leak and hydraulic leaks, possible smoke, fumes or fire from oil or hydraulic fluid leaking on hot surfaces.
8. Possible illumination of engine fire warning light (s) if exhaust casing or firewall is damaged.
9. Possible illumination of ROTOR BRAKE caution light resulting from friction caused by damage to the rotor brake assembly.
10. Possible N_r decay caused by increased friction as a result of above listed collateral damage.

STARTING

1. No. 1 engine.
   a. No rise in transmission oil pressure or hydraulic system pressure.
2. No. 2 engine
   a. N_f rises above N_r as engine accelerates.
   b. No torque increase.

CORRECTIVE ACTION

IN FLIGHT

*1. Speed selectors - FULL FORWARD.

*2. Contain N_r.

*3. Establish single-engine airspeed and level attitude.

*4. Reduce gross weight, if necessary, by dumping fuel and/or jettisoning stores.

5. Secure affected engine.
6. Determine normal engine's power available.
7. Landing Gear – AS REQUIRED.
8. Land as soon as practicable.

ON GROUND

*1. Secure affected engine.

2. Follow up procedure, use checklist.

12.11.11 AXIAL DRIVE SHAFT FAILURE. In-flight symptoms are identical to fuel pump drive or radial accessory drive failure. If shaft failure occurs during engine motoring or start, all starter drive will be transmitted to accessories with an immediate increase in N_g and oil pressure.

SYMPTOMS

STARTING

1. Sudden rise in N_g above 23%.
2. Increase in engine oil pressure.
3. Compressor not turning or coast down audible.
4. If compressor drive is lost after light-off, but before starter dropout, compressor stall may occur.

CORRECTIVE ACTION

*1. Secure affected engine.

2. Do not attempt restart.
3. Follow up procedure, use checklist.

Note

Axial drive shaft failure in flight will result in engine flameout due to loss of drive to engine accessories. Follow procedures for engine failure. No corrective action is available to the pilot.

12.11.12 LOSS OF N_g SIGNAL TO FUEL CONTROL. The N_g speed signal is transmitted to the fuel control via the front frame accessory drive and fuel pump gear train. Loss of the coupling between the fuel pump and fuel control will allow continued engine operation. However, the fuel control sensing N_g at “0” will completely close the variable stator vanes, causing a power loss. The 3D cam in the control, which translates as a function of N_g, will become immobile. Thus, the 3D cam contours, which schedule engine acceleration, topping, ground idle and variable vane angle, no longer function.

CAUTION

Use of manual throttle will cause T_5 overtemp since variable vanes remain closed, restricting airflow.

IN FLIGHT

1. Torque and N_f decrease. Engine power output becomes essentially that normally produced at ground idle.

2. N_g stabilizes at about 80%.

3. Engine does not respond to speed selector movement.

STARTING

Engine will light off and accelerate to about 80% and stabilize. Engine does not maintain ground idle (about 56% N_g) and will not respond to speed selector movement.

IN FLIGHT

*1. Speed selectors - FULL FORWARD.

*2. Contain N_r.

*3. Establish single-engine air- speed and level attitude.

*4. Reduce gross weight, if necessary, by dumping fuel and/or jettisoning stores.

5. Securing the engine is at the discretion of the pilot. Securing the No. 1 engine is not recommended because of the possible subsequent failure of the tail takeoff freewheeling unit.

6. Do not attempt use of the manual throttle.

7. N_f/N_r as required.

8. Determine normal engine’s power available.

9. Landing Gear – AS REQUIRED.

10. Land as soon as practicable.

ON GROUND

*1. Secure affected engine.

2. Follow up procedure, use checklist.

CAUTION

Loss of N_g governor drive may be difficult to differentiate from certain P_3 losses and other fuel control malfunctions. Loss of drive is indicated by retarding the speed selector to ground idle with no reduction in N_g.

12.11.13 LOSS OF P_3 SIGNAL TO FUEL CONTROL. Reduction of the compressor discharge pressure (P_3) sensed by the fuel control will result in a comparable decrease in fuel flow. Complete loss of the P_3 signal (fuel control now sensing ambient pressure) will result in engine operation below ground idle. Most P_3 malfunctions are characterized by partial reduction of pressure due to a loose P_3 line fitting or contamination in the line. Use of manual throttle will regain normal engine operation.

SYMPTOMS

STARTING-ON GROUND

1. Slow engine acceleration and possible N_g hangup below ground idle.

2. Engine acceleration time is over 8 secs. from ground idle to 80% N_g.

IN FLIGHT

1. Reduction in N_g, T_5, N_f and torque dependent upon the magnitude of the P_3 leak.

CORRECTIVE ACTION

ON GROUND

*1. Secure engine.

IN FLIGHT

*1. Speed selectors - FULL FORWARD.

*2. Contain Nr.

*3. Establish single-engine airspeed and level attitude.

*4. Reduce gross weight, if necessary, by dumping fuel and/or jettisoning stores.

5. Analyze -Check N_r.

   a. Slowly advance manual throttle on malfunctioning engine until a rise in N_g or T_5 is noted or full travel is reached, whichever is first.

   b. Slowly reduce engine speed selector to ground idle or binding. Make sure manual throttle is functioning.

   c. Adjust power with manual throttle.

   d. Allow normal engine to do governing.

6. Landing gear – AS REQUIRED.

7. Land as soon as practicable.

12.11.14 FLEXIBLE DRIVE SHAFT FAILURE. This shaft and its drive gearing, including the power turbine radial shaft, provide the N_f signal for both the actual N_f to the fuel control and the cockpit tachometer indication. The fuel control, attempting to maintain selected N_f, and never “seeing” it, calls for full power. This discrepancy is distinguishable from all other malfunctions in that the N_f on the high torque engine drops to zero.

CAUTION

Upon encountering flexible drive shaft failure in high speed cruising flight, reduction of collective and/or aft cyclic movement may result in rapid acceleration of the rotor system leading to overspeed and/or compressibility effects.

Note

- Loss of flexible drive shaft will result in loss of mechanical overspeed protection.
- Close coordination between the pilot and copilot with regard to manual throttle/collective action is mandatory.

SYMPTOMS

IN FLIGHT

1. N_f to zero on affected engine.
2. N_g, T_5, and torque to topping power indications.
3. Engine does not respond to speed selector movement in N_f governing region.

Note

The opposite engine will retard in power correspondingly as its N_g governing system attempts to prevent any increase in N_f.

ON START

Danger of overspeed does not exist until the speed selector is moved out of ground idle since the effect of the N_f governing section is not felt in the fuel control until the speed selector is moved forward to the transition range. Any attempt to move the speed selector out of ground idle will result in the following:

1. No. 1 engine (in accessory drive) - Starting indications for the No. 1 engine will be N_f not rising and remaining at zero. If the speed selector is moved out of ground idle, the engine will accelerate rapidly until the overspeed limiting system actuates at about 108% N_f (±3%), at which point erratic cycling of the engine will occur. N_f will remain at zero.
2. No. 2 engine - Engine light-off will be normal and there will be no abnormal indications prior to engagement. During engagement, N_r will advance without an indication of N_f on either triple tach. If the SSL is advanced into the governing range, a rapid increase in torque will commence.

CORRECTIVE ACTION

IN FLIGHT

*1. Speed selectors - FULL FORWARD.

*2. Contain N_r.

*3. Establish single engine flight airspeed and level attitude.

4. Analyze -Check N_f.

   a. Slowly advance manual throttle on malfunctioning engine until a rise in N_g or T_5 is noted or full travel is reached, which ever is first.

   b. Slowly reduce engine speed selector to ground idle or binding. Make sure manual throttle is functioning.

   c. Adjust power with manual throttle.

   d. Allow normal engine to do governing.

5. Landing gear – AS REQUIRED.

6. Land as soon as practicable.

ON GROUND

*1. On ground, both speed selectors to ground idle.

*2. Secure affected engine.

3. Follow-up procedures, use checklist.

12.11.15 FUEL CONTROL CONTAMINATION. Fuel contamination may disrupt the normal operation of the fuel control. Although control malfunction depends upon where contamination finally lodges, unstable engine operation may be observed before power loss. Unstable engine operation may also be caused by N_f flex shaft slippage before failure. In either situation, use of emergency throttle will stabilize engine oscillations and lessen potential malfunction.

SYMPTOMS

1. Oscillations of N_g, T_5 and N_r during steady state engine operation, N_g cycling is greater than ±1%.

Note

Fuel control caused engine oscillations are normal during autorotations. Engine oscillations should only be checked when engine is driving rotor.

CORRECTIVE ACTION

IN FLIGHT

*1. Speed selectors - FULL FORWARD.

*2. Contain N_r.

*3. Establish single-engine airspeed and level attitude.

*4. Reduce gross weight, if necessary, by dumping fuel and/or jettisoning stores.

5. Analyze - N_g and T_5.

   a. Slowly advance manual throttle on malfunctioning engine until a rise in N_g or T_5 is noted or full travel is reached, whichever is first.

   b. Slowly reduce engine speed selector to ground idle or binding. Make sure manual throttle is functioning.

   c. Adjust power with manual throttle.

   d. Allow normal engine to do governing.

6. Landing gear – AS REQUIRED.

7. Land as soon as practicable.

ON GROUND

*1. Secure engine.

2. Follow up procedure, use checklist.

12.12 MAXIMUM RANGE

Should the condition arise where fuel remaining aboard may not be enough to reach a practicable landing site on two engines, best range may be gained by flying single-engine at maximum speed for the single-engine configuration (100-percent N_r). This situation constitutes an emergency.

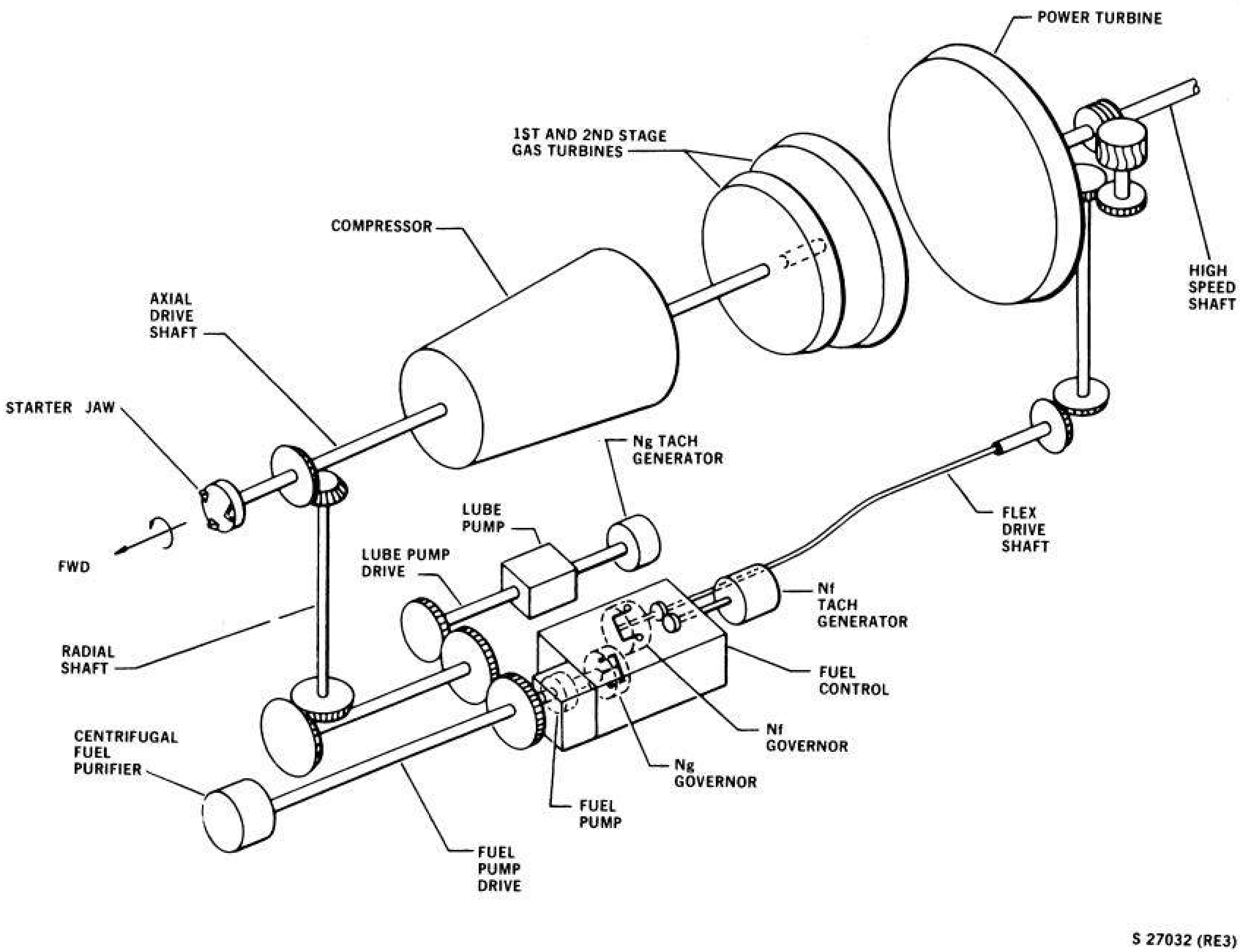


Figure 12-3. Engine Shaft Diagram

12.13 SINGLE-ENGINE LANDING (LAND OR SHIP)

During single-engine operation, fuel may be used from the forward and aft tank systems or from one tank system at a time. When using fuel from both tank systems, it is possible that fuel will actually be supplied from one tank system only. This can occur if the difference in the normal operating pressure of the boost pumps in one tank is enough to close the check valve, downstream of the weaker pumps. Therefore, the fuel quantity gauges should be monitored; if fuel is being consumed at an unequal rate, use crossfeed procedures to adjust tank quantities.

The helicopter may be flown safely in forward flight and landed on a single engine, provided that the proper techniques and safety precautions are observed (see Figure 12-4). Under conditions of a single engine, advance the engine speed selector full forward and attempt to maintain 70 KIAS and 100-percent N_r. Observe single-engine limitations. When the good engine is operating at topping, further increasing the collective will only result in rotor rpm decreasing. Because of a loss of lift in a turn, steep turns should be avoided, particularly at a low level during an approach for landing. Under conditions of low gross weight, light fuel load, low density altitude, and appreciable winds (10 to 20 knots), a normal approach to a hover and a vertical landing may be made on a single engine. However, with conditions of high gross weight, medium to heavy fuel load, fairly high density altitude, and little or no wind, a run-on landing must be made to prevent a high rate of descent. All single-engine landings should be on a smooth, hard surface area. The following procedures are indicated:

1. Before landing check – COMPLETED.

2. Engine speed selector (for operative engine) - FULL FORWARD.

3. Approach airspeed – 70 KNOTS.

4. Establish a rate of descent not to be over 1,000 fpm and reduce to 500 fpm on straightaway.

5. At about 150 feet altitude, reduce airspeed and rate of descent.

6. Continue approach so as to arrive at an attitude not to be over 5° nose high about 10 feet above the deck and 0 to 40 knots groundspeed.

7. Increase collective pitch slightly to cushion the landing.

8. Ground contact.

   a. Attitude - LEVEL TO SLIGHTLY NOSE HIGH (MAXIMUM 1° TO 2°).

   b. Collective pitch lever - REDUCE SLOWLY, SIMULTANEOUSLY MOVING CYCLIC STICK SLIGHTLY FORWARD OF NEUTRAL.

9. Apply wheelbrakes to lessen ground roll; do not use cyclic for aerodynamic braking.

CAUTION

The procedure described is for a typical single-engine landing and is also applicable to single-engine landings in confined areas, such as nonaviation ships with small landing areas and unprepared sites. The dangers of excessive speed, excessive sink rates, extreme tailwheel low touchdown, and the tendency to use aft cyclic shall be emphasized when making landings of this type. Maximum control of the helicopter is required to perform this maneuver. Avoid abrupt control movements of either the cyclic or collective and be especially aware of the attitude and groundspeed on touchdown.

12.13.1 Single-Engine Waveoff.

*1. Contain N_r utilizing ground effect as necessary.

*2. Lower nose to horizon to accelerate to 60 KIAS.

*3. Resume normal climb attitude of 2° to 3° noseup.

12.14 DUAL-ENGINE FAILURE

Failure of both engines requires immediate action if a safe power-off landing is to be accomplished. The altitude and airspeed at which a two-engine failure occurs will dictate the action to be taken. Immediately upon a two-engine failure, rotary wing rpm will decay and the helicopter will yaw to the left. Collective pitch must be immediately reduced to prevent excessive loss of rotary wing rpm, and right rotary rudder should be applied to compensate for loss of torque to control heading.

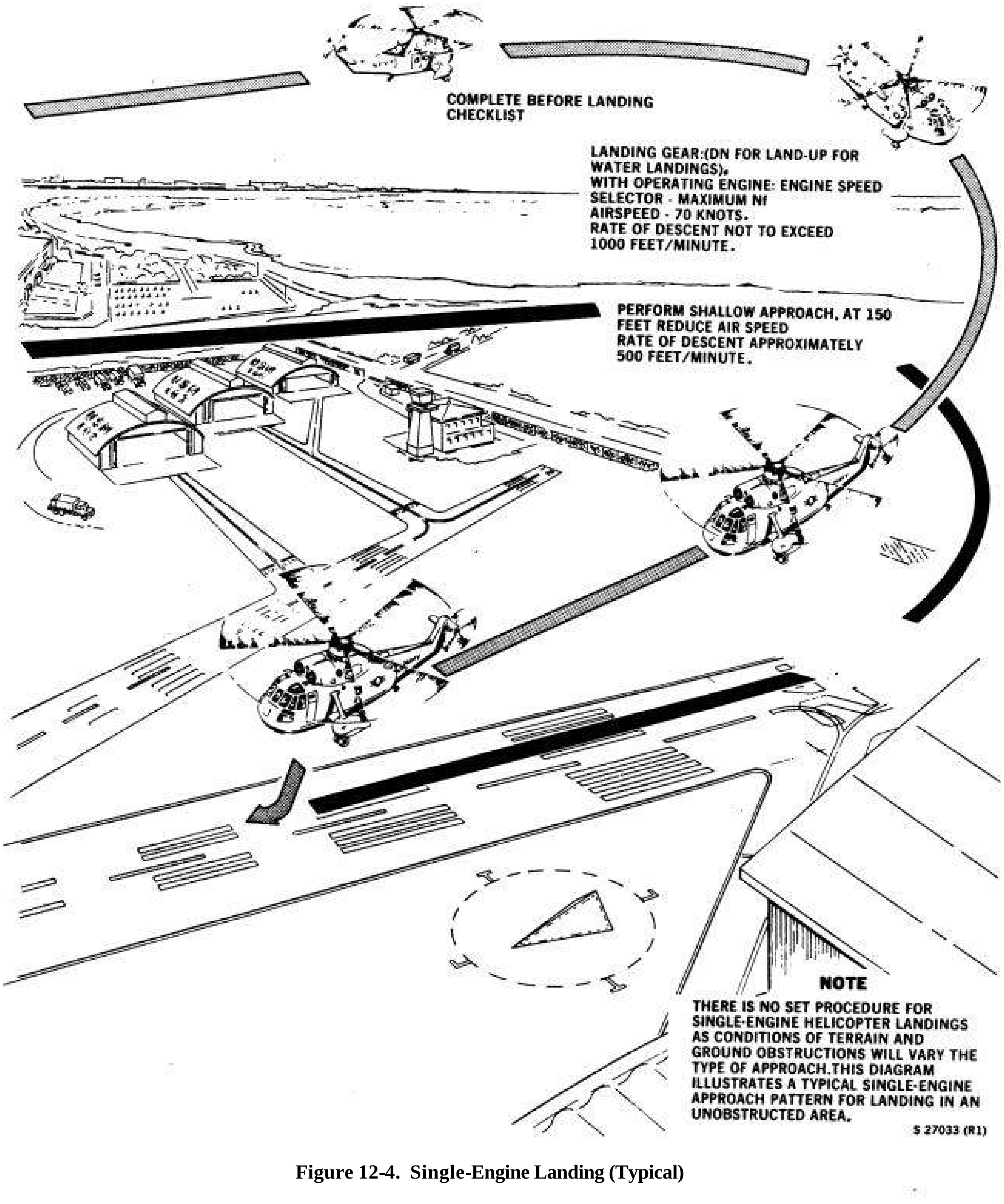


Figure 12-4. Single-Engine Landing (Typical)

If at low airspeed and high power setting, apply forward cyclic stick in an attempt to regain airspeed (minimum of 70 knots). This action normally requires 400 to 500 feet of altitude if the recovery is initiated at zero airspeed.

In a condition of high power and high airspeed, a moderate flare will reduce loss of altitude while making a recovery and entry into autorotation. At high airspeeds if a constant airspeed is maintained while normal recovery procedures are being used, a loss of about 300 to 500 feet of altitude will result. The altitude loss may be reduced by simultaneously applying aft cyclic stick as the collective pitch is reduced. Judicious use of collective pitch during the flare to keep rotary wing rpm within limits also reduces the loss.

WARNING

Rotor rpm will decay to an unrecoverable state with resultant loss of control unless autorotation is entered immediately.

CAUTION

Avoid abrupt control movements during high-speed autorotation to preclude rotor overspeed and/or blade stall. Blade stall is more likely to be encountered when operating in rough air.

12.14.1 Dual-Engine Failure While Hovering at Low Altitude. Settling will be so rapid if both engines fail at low altitude that little can be done to avoid a hard landing. The landing can be cushioned somewhat by increasing collective pitch as the helicopter settles to the ground. Do not reduce collective pitch as in normal procedures in case of both engines failing at higher altitude. In this case, a reduction of pitch would cause the helicopter to settle more rapidly. The helicopter should be held in a level attitude and, when contact is made with the ground, the cyclic stick should be moved slightly forward of the neutral position. Regardless of the force with which the helicopter strikes the ground, damage will be much less if it strikes level. After contact with the ground is made, reduce collective pitch to minimum, apply rotor brake, and secure engines.

12.14.2 Dual-Engine Failure During Flight (Autorotative Landing). In case of a dual-engine failure during flight, a safe autorotative landing can be made provided the helicopter is being flown at a safe altitude airspeed combination and the in-flight altitude is sufficient to permit selection of a suitable landing area.

*1. Autorotate.

*2. Jettison External Load as required.

*3. Landing gear as required.

*4. Harness locked.

*5. Mayday/IFF.

12.15 MAXIMUM GLIDE

Maximum autorotative gliding distance is obtained at 100 KIAS and about 104-percent rotary wing speed. The rate of descent will be about 2,400 fpm. Increased rotary wing speed above these values will result in a greater rate of descent, resulting in reduced gliding distances.

12.16 LANDING IN TREES

A power-off landing into a heavily wooded area can be made by executing a normal autorotative approach and full flare. The flare should be executed so as to reach zero rate of descent and zero groundspeed as close to the top of trees as possible. As the helicopter settles, increase collective pitch to maximum and allow the helicopter to descend vertically through the trees.

12.17 EMERGENCY DESCENT

During an extreme emergency, the condition or type of landing area may determine the type of emergency descent to be made. If a long distance must be covered to a selected landing site, a dive with power would be most feasible. A normal power-on vertical landing may be made when the landing site is reached. If a short distance must be covered to a selected landing site, attaining a rapid rate of descent with no power, minimum pitch, and slow forward speed is the most practical means of accomplishing an emergency descent.

12.18 MAIN GEARBOX SYSTEM FAILURE

When massive loss of MGB oil occurs, an immediate landing should be made. Continuing to fly the helicopter, even for a short time, will further jeopardize the helicopter and crew.

If an abnormal gearbox noise is heard, check all instruments. If the noise persists, monitor the instruments for an adverse indication. If an adverse condition is indicated, land as soon as possible or make an immediate landing.

Note

Loss of the primary transmission oil pump will be accompanied by malfunctioning torque indications if the common drive shaft has failed. Failure of the secondary transmission oil pump will also result in a pressure decrease and may be accompanied by failure of the utility hydraulic pump. In either case, safe flight may be continued since one oil pump will adequately lubricate the main gearbox. Land as soon as practicable.

If any one of the following conditions occurs, land as soon as practicable.

1. TRANS OIL PRESS caution light ON and indicated pressure within limits.

2. TRANS OIL HOT caution light ON and indicated temperature within limits.

3. CHIP DETECTOR caution light ON.

4. Unreliable MGB temperature or pressure indications not supported by respective caution light.

If the following occurs, land as soon as possible.

1. Indication of low pressure plus an indication of high temperature.

2. The MGB oil temperature rises above the red line. If in a hover, an emergency action may be averted by entering forward flight when a rising temperature condition is observed.

3. If the MGB oil temperature hot light goes on and the MGB oil temperature (gauge) rises toward the red line (145°), and in the pilot's judgment will exceed this limit.

4. CHIP DETECTOR caution light on if accompanied by any other indication of MGB failure.

*If any of the following conditions occur, make an immediate landing.

1. TRANS OIL PRESS caution light ON and pressure indicator below low limit red line.

2. When it is suspected that all main gearbox oil is lost or when a filter assembly or main oil line ruptures resulting in sudden and massive loss of transmission oil, complete catastrophic main gearbox failure is imminent, and the following indications are noted immediately: TRANS OIL PRESS caution light ON, transmission oil pressure indicator below low-limit red line, torque needles for both engines fluctuating or indicating zero, yaw kicks, and a possible indication of high transmission oil temperature.

WARNING

In the event of a transmission oil loss situation with the emergency lubrication system functioning, it is critical to maintain balanced flight and to avoid excessive aircraft attitudes. Proper operation of the ELS is attitude-dependent and the aircraft should be maintained as level as possible in balanced flight to minimize oil loss.

3. Helicopters modified by AFC 368 (the emergency lubrication system) may continue flight for a limited time to reach a safe landing site. The emergency lubrication system may become inoperative within 2 minutes following a rupture in either the main system or ELS (i.e., to a filter assembly or to the torquemeter filter bowl) that results in the sudden massive loss of all gearbox oil. The ELS activates when oil pressure at the input sleeve bearings falls below 20 to 25 psi on the oil pressure gauge. Upon complete failure of the main lubrication system the oil pressure falls to zero, the oil pressure caution light goes on, and the oil temperature indicator gives an erroneously low temperature. During ELS operation, indicated torque reading will be lower than normal for any given power setting because of oil flow to the sleeve bearing as well as the torque system. Torque readings will decrease steadily as the oil changes viscosity because of the rising oil temperature. When continued flight is necessary, the following will allow the system to operate most effectively:

a. If in a hover over water or over a surface to which a safe landing cannot be made, and with confirmed low pressure (warning light on and gauge confirmation) or if a substantial oil loss is observed and reported by the crew, transition to forward flight immediately.

b. Reduce helicopter weight.

c. Maintain level attitude. A mild right turn will minimize oil loss should a rupture in the oil system occur. ELS operation is optimized by maintaining pitch limits of 3° noseup and 6° nosedown and roll limits of 2° left and 4° right, while keeping aircraft in balanced flight (ball centered).

d. Maintain speed at 70 to 90 KIAS to obtain desired range and endurance.

e. Flight at minimum safe altitude is recommended to minimize the time required to execute an immediate landing should it be required.

Note

When terrain, obstacle clearance, and visibility permit, descent to below 100 feet AGL is recommended.

f. Avoid abrupt input power or rotor load changes.

g. Decrease power smoothly and maintain level attitude for approach and landing.

(1) Plan to execute a roll-on landing, as 3° noseup attitude may not provide sufficient deceleration to terminate in a hover.

(2) If a hover termination is required (i.e., shipboard landing) and 3° noseup provides insufficient deceleration, minimize the time above the pitch limit by employing a sharp but effective flare just prior to landing.

h. Land as soon as possible.

i. If ELS operation (as indicated by a low and steady torque) is accompanied by loud noises from the transmission or if either engine fails, land immediately.

j. Fluctuating torque readings or a zero torque reading is indication of imminent sleeve bearing seizure. If either indication occurs, land immediately.

Note

In the above situation, the transmission oil temperature indicator may not immediately indicate the adverse condition. When complete loss of lubrication occurs, fluid ceases to pass over the temperature sensor; a rise in temperature of the surrounding metal may not register immediately.

12.18.1 Tail Takeoff Freewheel Unit Caution Light. If the tail takeoff caution light goes on during flight, use this procedure:

1. Speed selectors - FULL FORWARD.

3. Land as soon as possible.

WARNING

Under no conditions should the No. 1 speed selector be retarded to shutoff during flight when failure of the tail takeoff is indicated. In case of a No. 1 engine failure, controlled flight would no longer be possible.

Note

If, after placing speed selectors to full forward, the TAIL TAKEOFF caution light stays on, this indicates a failure of the tail takeoff warning system. If the light goes out, this indicates an actual tail takeoff free-wheeling unit failure.

3. If caution light goes out, retard speed selectors until TAIL TAKEOFF caution light reilluminates.

4. After landing, perform normal shutdown.

WARNING

The No. 1 engine shall not be shut down before stopping the rotor to preclude loss of servo pressures.

12.18.2 Torque Sensing System Failure

TYPE FAILURE	POSSIBLE MALFUNCTION	CORRECTIVE ACTION
ONE TORQUE NEEDLE ERRATIC ON ONE GAUGE (ASSUMING NO COR-RESPONDING DROP IN N_G, T_5, N_F)	ELECTRICAL (WIRING GAUGE)	CONTINUE FLIGHT.
TWO TORQUE NEEDLES ON ONE GAUGE	ELECTRICAL (WIRING GAUGE)	CONTINUE FLIGHT.
SAME TORQUE NEEDLE ERRATIC OR READING LOW ON BOTH GAUGES	1. ELECTRICAL (WIRING, CIRCUIT BREAKER, OR TORQUE TRANSMITTER) 2. OIL LEAK BETWEEN SENSING CHAMBERS AND TORQUE TRANSMITTER	A. CHECK CIRCUIT BREAKER IN. B. CHECK FOR OIL LEAK BY ALL MEANS AVAILABLE. (1) IF NO LEAK APPARENT, MATCH ENGINES WITH N_G AND T_5; LAND AS SOON AS PRACTICABLE. (2) IF OIL LEAK IS APPARENT, LAND AS SOON AS POSSIBLE. (3) IF OIL LOSS NECESSITATES AN IMMEDIATE LANDING, COMPLY WITH SECTION UNDER MAIN GEARBOX FAILURE.
BOTH TORQUE NEEDLES ERRATIC OR READING LOW ON BOTH GAUGES.	1. TORQUE PUMP FAILURE. 2. OIL LEAK BETWEEN TORQUE PUMP AND SENSING CHAMBERS.	SAME AS ABOVE.

Note

The preceding malfunctions assume torque needle fluctuations only with no corresponding fluctuations on any other engine instrument.

12.19 MAIN ROTOR OVERSPEED

If N_r exceeds 117 percent, land as soon as practicable.

12.19.1 Blade Pressure Caution Light.

If the blade pressure caution light illuminates, the blade pressure circuit breaker should be checked in. Because of the sensitivity of the system, the caution light may illuminate because of electromagnetic interference (EMI), giving the pilot a false indication of impending spar failure. If the blade pressure caution light remains on with the blade pressure circuit breaker in and EMI is not verified:

In flight:

*1. Airspeed – 80 KIAS, minimize maneuvering.

*2. Altitude – Minimum safe.

*3. Blade Pressure Circuit Breaker – Check in.

*4. Land as soon as practicable. Do not exceed 2 hours unless necessary to reach a safe landing site.

On ground:

If all spar pressure indicators are white, but the blade pressure caution light remains illuminated or the IBIS caution bit is unsatisfactory, a malfunction in the radiation detector of the signal processor is indicated. The helicopter may then be flown in either of the following profiles before landing for a visual inspection of the spar pressure indicators.

Profile A – For all gross weights up to 20,500 pounds:

Max Airspeed (KIAS)	Required Inspection 100 Percent Nr	Interval (Hours) 103 Percent Nr
80	4	4
90	3	4
100	2	2
110	1	1.5
120	0.75	1.0

12.20 ROTARY RUDDER SYSTEM FAILURES

Rotary rudder system failures can be generally classified as drive system failure or as control system failure. The information that follows is based on flight tests in which a drive system failure resulting in loss of the rotary rudder thrust was simulated. In either case, very little factual data can be drawn from this experience. Consequences of rotary rudder failure may vary widely and will require the utmost in pilot technique. The case of a control system failure is believed to be less critical than drive system failure and was not covered during the tests.

WARNING

Impending rotary rudder system failure may be indicated by a loud "thump", "bang", "whine", or "grinding" appearing to emanate from the aft section of the main transmission. Secondary indications may include torque fluctuations of up to 15 percent (without corresponding N_g or T_5 fluctuations), and/or airframe shuffle. Imminent failure may be indicated by an increase in the noise level from the accessory section or an undetermined location within the transmission. **Land immediately.**

Note

Rotary rudder servo failure may give a hardover input in either direction and could be confused with rotary rudder system failure. If the rudder pedals cannot be moved then, turning the auxiliary servo pressure off may restore manual control.

12.20.1 Rotary Rudder Drive System Failure.

WARNING

Extended flight is not possible after rotary rudder drive system failure. Autorotation must be entered immediately.

A rotary rudder drive system failure, whereby rotary rudder rpm and thrust are lost, may be caused by fracture of the shaft, coupling, or gearbox, or separation of the rotary rudder assembly from the helicopter. Rotary rudder separation from the helicopter is usually caused by severe vibration that has been induced by the fracture of a rotating component. A drive system failure is the most difficult type for the pilot to cope with as it is accompanied by the loss of the rotating disc area that would normally assist as a stabilizing fin in forward flight.

Since rotary rudder drive system failure at high speeds is expected to produce violent helicopter response, recognition of impending failure is extremely important. Excessive vibration or noise in the tail section usually precedes rotary rudder drive system failure. Therefore, when this occurs, airspeed should be reduced immediately to the best autorotational speed. A rotary rudder drive system failure is always accompanied by loss of directional control and a sharp yaw to the right. The rate and amount of yaw are governed by the power applied and the airspeed. The yaw tendency can only be reduced by immediate reduction in power. Yaw angles in excess of 50° can be expected. Immediate entry into autorotation will reduce the yaw angle.

*1. Autorotate.

*2. Jettison External Load as required.

*3. Landing gear - AS REQUIRED.

*4. Harness - LOCKED.

*5. Mayday/IFF.

*6. Proceed as follows:

a. If enough altitude is present at time of autorotation, the pilot can minimize helicopter yaw to near balanced flight by assuming a new flightpath based upon helicopter heading after initial yaw. Initiate a flare at about 150 feet to reduce rate of descent and groundspeed.

b. If enough altitude is not present at the time of autorotation to assume a new helicopter flightpath, the pilot may be forced to fly in a sideslip condition. Because of this, higher rates of descent will be experienced and the pilot will be required to initiate a moderate sideways flare at about 200 feet to reduce rate of descent and groundspeed.

*6. When desired, pilot at controls gives the command, “Speed selectors off”.

Note

- Maintain 65 to 75 KIAS. The airspeed indicator, although in error, will indicate the approximate airspeed.
- Recovery from a rotary rudder drive failure in forward flight at altitudes of 150 feet or below can be safely completed by executing the remaining portion of the autorotation profile.
- Ground contact speed must be held to a minimum, as a sideslip condition may cause roll over on touchdown.
- Loss of tail rotor authority may be misinterpreted as rotary rudder drive system failure. This condition could be encountered because of combination of drift, turn rate, low N_r, and torque values exceeding dual-engine limitations. If under these conditions directional instability with right rotation of the helicopter is encountered, immediately reduce collective and transition into

forward flight to restore directional stability.

12.20.2 Rotary Rudder Drive System Failure While Hovering.

*1. Collective - DECREASE TO DESCEND AND REDUCE RATE OF HELICOPTER ROTATION.

*2. Maintain attitude and attempt to achieve zero surface speed.

*3. Reduce gross weight if necessary by jettisoning external loads.

*4. At approximately 10 feet, pilot at controls gives the command, "Speed selectors off".

*5. Collective - INCREASE AS NECESSARY TO CUSHION LANDING.

WARNING

Rate of rotation is directly proportional to main rotor torque; therefore, decreased collective will reduce main rotor torque and thus rate of rotation. Cutting engines above 10 feet will result in very hard landings on land or sea and may cause loss of the helicopter. A slower rate of descent allows more time to bring surface speed to zero.

12.20.3 Rotary Rudder Control System Failure. A rotary rudder control system failure is a serious emergency and will result in a loss of rotary rudder response. These failures can be divided into three major categories:

1. Failure forward of the auxiliary servo.

2. Failure at the auxiliary servo.

3. Failure aft of the auxiliary servo.

12.20.3.1 Rotary Rudder Control Failure Forward of the Auxiliary Servo. Rotary rudder control failure forward of the auxiliary servo occurs when the rudder pedal linkage becomes disconnected from the auxiliary servo.

SYMPTOMS

Sloppiness in rudder pedal controls; helicopter does not respond to pilot/copilot rudder inputs. Helicopter may maintain heading at time of failure.

CORRECTIVE ACTION

Control inputs using both sets of rudder pedals should be attempted. It is possible that only one pilot's controls are ineffective. If neither pilot's rudder pedals are effective, collective to yaw mixing and ASE yaw trim should be available. The collective to yaw mixing will provide the pilot with limited control of the tail rotor pitch through the mechanical mixing of the collective and tail rotor controls that increases tail rotor pitch when collective is raised and reduces tail rotor pitch when the collective is lowered. Use ASE yaw trim to make heading changes and land as practical. Readjust ASE yaw trim as necessary with changes in collective.

12.20.3.2 Rotary Rudder Control Failure at the Auxiliary Servo.

SYMPTOMS

Rudder pedals lock up and will not respond to inputs, or rudder pedals go hard over in either direction and will not respond to input in the opposite direction.

CORRECTIVE ACTION

If the rudder pedals lock up there will be some initial confusion as to whether the malfunction is the result of an auxiliary hydraulic servo failure or a mechanical jam in the flight controls. To troubleshoot the problem, secure the auxiliary servo. If the jam or hardover is corrected, follow the procedures for flight control servo unit malfunction and land as soon as possible. If the jam remains, turn the auxiliary servo back on and refer to the tail rotor control cable or rod jam procedures. With the auxiliary servo off and the cables jammed, the ASE, rotary rudder, and pedal damper are inoperative.

12.20.3.3 Rotary Rudder Control Failure Aft of the Auxiliary Servo. Landing the aircraft with a tail rotor control problem aft of the auxiliary servo is difficult. The ability of the pilot to control the aircraft is dependent upon a number of factors:

1. Type of malfunction.

2. Weight of aircraft.

3. Ambient conditions (wind, temperature, D.A.).

4. Tail rotor pitch when the malfunction occurred.

5. Power required for level flight/hover.

For the malfunction that will be discussed, the pilot should troubleshoot the problem to the fullest extent possible and perform an aircraft controllability check. In forward flight, the aircraft should be decelerated and accelerated to determine what torque/airspeed combinations give balanced flight. Also, determine the slowest airspeed at which the aircraft's yaw rate can be controlled. Perform simulated approaches at an altitude (500 feet AGL) that will allow the pilot to waveoff using the cyclic to accelerate the aircraft and reduce aircraft yaw and yaw rate without large collective increases.

After the aircraft controllability check has been performed and the pilot has determined how the aircraft will respond when a landing is attempted, the pilot should determine which runway and wind combination will aid him the most. Usually, for a left yaw condition, a right crosswind is desired and for a right yaw condition, a left crosswind is desired.

WARNING

When operating in the shipboard environment, there is the possibility that the aircraft will veer off to either side of the flight deck when a landing is attempted. The ship should maneuver to obtain maximum winds down the centerline of the ship.

The basic rule to follow when troubleshooting and landing the aircraft is the following:

1. To yaw the aircraft right, raise the collective RAISE RIGHT.

2. To yaw the aircraft left, lower the collective LOWER LEFT.

Failures aft of the auxiliary servo are divided into three categories:

1. Control cable or control rod jam.

2. Total control failures – Either dual-cable separation or control tube failure.

3. Single control cable separation.

12.20.3.3.1 Troubleshooting. If possible, perform troubleshooting in the flight regime where the malfunction occurred. If in a hover, do not transition to forward flight - LAND AS SOON AS POSSIBLE. When troubleshooting, leave ASE on with the ASE yaw channel off. Troubleshoot as follows:

FORWARD FLIGHT

1. Fly 80 KIAS level flight.

2. If aircraft is yawed to the left - STUCK LEFT CONTROL.

3. If aircraft is yawed to the right - STUCK RIGHT CONTROL.

Crewmen may be able to visually check for cable movement for the following:

1. Left pedal operable - BROKEN RIGHT CABLE.

2. Right pedal operable - BROKEN LEFT CABLE.

WARNING

Excessive motion of the right pedal with a broken left cable may drive the negative force gradient spring to its full right position inducing an unrecoverable flight condition.

3. Both pedals inoperable - DUAL CABLE/ TOTAL CONTROL FAILURE.

Note

Separation of a single cable can become a stuck cable condition because of the tendency of the steel cable to "bird nest".

HOVER

1. Remain in hover.

2. Use forward flight troubleshooting techniques.

12.20.3.3.2 Stuck/Jammed Flight Control Cable/Rod. If a jam occurs in any part of tail rotor control system aft of the mixing unit, the pilot will have no control of the tail rotor pitch. Collective to yaw mixing and rudder pedals will be ineffective. The torque and flight regime where the jam occurred should be noted. Most likely, the approach and landing will have to be attempted at this same combination of airspeed and torque. The pitch at which the jam occurs is directly related to the difficulty of controlling and safely landing the aircraft. Extreme difficulty will be encountered landing the aircraft during stuck conditions at both extremely high (left pedal) and low (right pedal) values of pitch. For stuck tail rotor control that occurs at high torque and airspeed conditions, it may be necessary to maneuver the aircraft to less than 40 KIAS using a cyclic flare in order to fly the aircraft in near balanced flight at a combination of slow airspeed and high torque/power setting.

Note

Testing has shown that in forward flight for stuck control conditions, changes in N_r within NATOPS limits has minimal effect on aircraft sideslip and yaw rate.

Stuck tail rotor control full right is a more serious emergency condition than tail drive shaft failure. If a tail drive shaft failure occurs, the yawing moment from the main rotor to the aircraft can be removed by lowering the collective and entering an autorotation. During a stuck full right control condition, the yawing moment from the tail rotor cannot be removed. Entering an autorotation and securing the aircraft's engines will not remove the yawing moment that the fixed pitch of the tail rotor is applying to the aircraft.

12.20.3.3.3 Stuck Left. For a stuck left condition it should be possible to execute multiple practice approaches at altitude above the selected landing area. These approaches are made at successively slower airspeeds to determine what the slowest airspeed and minimum rate of descent at which the aircraft can be leveled off and controllable flight maintained. The altitude to which these approaches are made must be sufficient enough to permit waveoff by increasing airspeed and making minimal power changes. If running landing is attempted, aligning the aircraft with the runway and maintaining aircraft sideslip in touchdown will be difficult. Waveoff is possible with small power changes. Avoid excessive delays in executing a landing. The following procedures apply to all gross weights; however, a higher gross weight is desirable.

1. Execute practice approaches at successively slower airspeeds to determine lowest airspeed and rate of descent combination.

2. Plan approach to arrive at the intended point of landing at the minimum airspeed and rate of descent determined during practice approaches. It may be necessary to use a cyclic only climb to slow the aircraft while maintaining constant collective.

WARNING

Reducing collective with a stuck left pedal condition may induce an unrecoverable left yaw.

3. Use “raise-right and lower-left” method to align the aircraft with the runway.

4. After touchdown, use brakes and small collective inputs to control aircraft yaw. If collective is rapidly lowered, the aircraft will yaw left. On roll-out, a coordinated reduction in N_r and adjustment of the collective will be necessary to control aircraft heading until brake control becomes effective.

5. Waveoff is possible using minimal power changes.

12.20.3.3.4 Stuck Right. The amount of right pitch determines the severity of the emergency. For a stuck right condition it should be possible to execute multiple practice approaches at altitude. The approaches should be made at successively slower airspeeds to determine the slowest airspeed and minimum rate of descent at which the aircraft can be leveled off and controllable flight maintained. The altitude to which these approaches are made must be sufficient enough to permit waveoff by increasing airspeed and making minimal power changes. The following procedures apply to all gross weights; however, a lighter gross weight is desirable.

WARNING

During landing, if collective is applied to decrease the aircraft sink rate, the aircraft will yaw right and may become unrecoverable.

1. Execute practice approaches to determine the airspeeds/torque combination that gives minimum sink rate and the smallest possible aircraft sideslip.

2. Plan the approach to arrive at the intended point of landing at the minimum power and airspeed required for flight (usually best single-engine airspeed - 70 KIAS).

3. Expect a high rate of descent on touchdown.

4. After touchdown, smoothly lower the collective and retard speed selectors to GRD IDLE.

5. Waveoff is possible using minimal power changes.

12.20.3.3.5 Stuck Pedal - Hover. In a stuck pedal condition, expect the aircraft to develop a slow yaw.

1. Left yaw - Keep engine on.

2. Right yaw - If it cannot be controlled with collective, shut engines down and handle like loss of tail drive.

3. Attempt landing on a flat open surface.

4. Expect to land with a yaw rate. Use cyclic to minimize drift.

5. After touchdown, use cyclic to maintain aircraft upright and brakes to stop yaw.

12.20.3.3.6 Dual Cable/Total Tail Rotor Control Failure. With a dual cable/total tail rotor control failure the tail rotor will seek a balance point of blade pitch that is the result of the combination of NFG spring forces, tail rotor blades, blade aerodynamic forces, and blade inertial forces (streamlining of the tail rotor blades). The aircraft can be flown in forward flight in this condition between 30 and 120 knots and at near balanced flight at 70 to 90 knots.

LANDING TECHNIQUE

Note

Lighter gross weights are recommended.

1. Initiate an approach at airspeed greater than the minimum airspeed determined at altitude.

2. Approaching the intended point of landing, begin to decelerate towards the established minimum airspeed as the copilot retards the speed selectors toward 94-percent N_r.

WARNING

If airspeed is allowed to decrease below the minimum determined during practice approaches, waveoff may not be possible.

3. Touch down at the minimum speed at which the yaw control can be maintained.

4. If yaw rate becomes excessive and a safe running landing or waveoff is not possible, entering a hover is the best course of action.

WARNING

Retarding the speed selectors below 92-percent N_r may result in loss of control.

Note

It may be possible to hover with no yaw at 94-percent N_r.

If landing from a hover, close coordination is required between pilot and copilot. Each collective increase/decrease will need to be countered by speed selector adjustments. Advancing speed selectors will yaw the aircraft right, retarding them will yaw the aircraft left.

5. After touchdown, use brakes to slow any yaw rate and follow aircraft with cyclic to reduce drift. Aircraft heading may be maintained with coordinated use of collective and N_r control.

12.20.3.3.7 Single Cable Failure. The pilot will still have either left or right pedal, depending on which cable failed. Failed cable could become stuck cable because of bird nesting. Tail rotor will seek the same pitch as with total control failure.

BROKEN RIGHT

If right cable is broken, you will have tail rotor control from approximately midtravel to full left pedal. High gross weights are desirable and planning the approach to make left turns will aid in a safe landing.

1. Plan a long, shallow 70-knot approach.

2. Prior to reaching the intended point of landing, decrease airspeed using cyclic only and maintain power setting.

3. As airspeed decreases toward the hover, follow the ensuing left turn with cyclic. Expect a higher than normal hover.

4. From a high hover, make small collective changes to decrease altitude.

5. On deck, execute a normal shutdown.

6. Waveoff will be possible.

BROKEN LEFT

Broken left cable range of control will be from approximately midpitch to full right pedal.

WARNING

Excessive motion of the right pedal can cause a stuck full right pedal situation, an unrecoverable flight condition, necessitating a full autorotation.

Best recovery situation is with lighter gross weights. Use minimal power and fast landing speeds (up to 80

KIAS). Waveoff is not an option, you have only one chance. Successful landing rollout is possible using small collective changes, pedals, and differential braking. During a running landing, aircraft will veer when collective is lowered.

Note

After careful consideration of available landing areas and speed at which a running landing will be attempted, best course of action may be a full autorotation.

12.20.4 Impending Rotary Rudder System Failure. Illumination of either the intermediate or tail gearbox chip lights on the caution panel is an indication of metallic particles on the gearbox sump plugs or an overheat condition in the gearbox and might be indicative of a forthcoming rotary rudder drive system failure. If either intermediate or tail gearbox chip light should go on, this action should be taken by the pilot:

1. Land as soon as possible. Descent and approach should be made with minimum power to aid entry into autorotation if rotary rudder drive failure occurs. A running or no-hover landing using minimum power should be executed as conditions dictate.

WARNING

High power settings require maximum performance of the rotary rudder drive system and may precipitate ultimate drive failure.

2. At night, over water or rough terrain where a suitable landing site is not immediately available, attain a safe autorotation altitude and airspeed. Use flood/hover/spotlights as necessary.

3. If, along with the chip light going on, there are strong intermediate frequency vibrations, hot metal fumes in the pylon or after station area, or any other indications of impending rotary rudder failure, land immediately.

WARNING

Impending rotary rudder system failure may be indicated by "grinding" or vibrations from the tail section and may be felt on the rudder pedals. Secondary indications may include torque fluctuations, yaw kicks, and/or airframe shuffle.

12.20.5 Tail Pylon Unlock Light.

SYMPTOM

Flickering or steady pylon unlock light.

CAUSE

A steady or flickering pylon unlock light may illuminate in flight if one of the tail pylon hinges fail. The indicator may go on during high-power regimes and go off during lower-power regimes; thus, a flickering may occur.

CORRECTIVE ACTION

*1. Avoid high power regimes.

*2. Land as soon as possible.

*3. If secondary indications exists – LAND IMMEDIATELY.

12.21 ELECTRICAL MALFUNCTION

See Figure 12-5.

12.21.1 Alternating Current System Failure. The ac system is powered by two ac generators. If either generator fails, its primary bus load is automatically transferred to the remaining generator. With a failed generator, all monitor bus loads (ac and dc) are automatically dropped. For indications of malfunctions in the ac electrical system, see Figure 12-5.

Note

Gauges powered by ac electrical current tend to freeze when electrical power has been interrupted. Indicator needle can move from the vertical position in either direction, with time and vibration. Erroneous indications should be expected.

12.21.1.1 Generator Failure. If No. 1 and/or No. 2 generator caution light is ON:

1. Move generator switch corresponding to the generator caution light to OFF/RESET; then on and release.

WARNING

- Generator failure, if caused by a mechanical malfunction of the generator, can become a potential fire hazard.

- Do not recycle a failed generator in a coupled hover at night IMC. Depart the hover and recycle the generator at a safe altitude to lessen adverse coupler inputs and preclude the chance of pilot disorientation.

2. If generator output is not restored, cycle switch to OFF, secure unnecessary equipment, and land as soon as practicable.

3. If both generators fail and output cannot be restored, cycle switches to OFF, secure unnecessary equipment, and land as soon as possible.

Note

- If either generator should fail while the heater is on, the heater blower will be dropped. A presence of heater exhaust fumes and fuel odor in the cabin or cockpit may be noted.

- If the No. 1 generator fails while hovering with coupler engaged, a transient down signal may be introduced into the coupler causing a momentary loss of 10 to 12 feet of altitude. If this condition occurs, do not shut off ASE as the No. 2 generator will take over the load and return the helicopter to the original altitude. The transient signal will disappear about 2 seconds after the No. 2 generator takes over.

12.21.1.2 Radio Transformer Failure. Two 26-vac radio transformers, designated Nos. 1 and 2, are powered by the No. 1 ac primary bus and protected by circuit breakers marked AUTO XMFR 1 and 2 under the general heading RADIO on the copilot circuit breaker panel. The transformers supply power to these systems:

NO. 1	NO. 2
	AN/ARN-84 (TACAN) AN/ARN-118(V) (TACAN)
AN/ARN-59 (LF/ADF)	
AN/ASN-123 (TACNAV)	A/A24G-39 GYRO
AN/APN-182(V) (GSDA)	AN/ARN-25A AND ID-250 #1 POINTER
BDHIs	UHF-DF

Failure of the equipment associated with a respective transformer is an indication of failure of the transformer or that the circuit breaker has opened. Attempt to restore operation of the transformer by resetting the circuit breaker.

12.21.1.3 Electrical Transformer Failure. The electrical autotransformer powered by the No. 1 ac primary bus is protected by a circuit breaker marked AUTO XMFR phase C on the copilot circuit breaker panel. This transformer supplies power to the No. 1 torquemeter indicator, No. 1 engine oil pressure indicator, primary hydraulic pressure indicator, and utility hydraulic pressure indicator. Failure of all of the above indicators is an indication of failure of the transformer or that the circuit breaker has opened. Attempt to restore operation of the transformer by resetting the circuit breaker.

The isolation transformer powered by the No. 2 ac primary bus is protected by a circuit breaker marked XMFR No. 2 phase C on the pilot circuit breaker panel. This transformer supplies power to the No. 2 torquemeter indicator, No. 2 engine oil pressure indicator, transmission oil pressure indicator, and auxiliary hydraulic pressure indicator. Failure of all of the above indicators is an indication of failure of the transformer or that the circuit breaker has opened. Attempt to restore operation of the transformer by resetting the circuit breaker.

ELECTRICAL SYSTEM MALFUNCTION DATA (SH-3H)

Component Failure	Failure Indication	Action Within System	No. 1 and No. 2 Primary AC Bus Loads	Monitored AC Bus Loads	Primary DC Bus	Monitor DC Bus
No. 1 GENERATOR	No. 1 Generator Caution Light	Automatic Transfer of No. 1 Primary AC Bus Loads to the No. 2 Generator	Retained	Dropped	Retained	Dropped
No. 2 GENERATOR	No. 2 Generator Caution Light	Automatic Transfer of No. 2 Primary AC Bus Loads to the No. 1 Generator	Retained	Dropped	Retained	Dropped
No. 1 and 2 GENERATORS	All Generator and Rectifier Caution Lights (With Battery Switch On)	No. 1 and 2 Primary and Monitor AC Buses - *Primary and Monitor DC Buses Automatically Dropped; Inverter Bus Loads Retained (With Battery Switch On)	Dropped	Dropped	Retained (With Battery Switch On)	Dropped
No. 1 RECTIFIER	No. 1 Rectifier Caution Light	No. 2 Rectifier Takes Over the Entire Primary DC Bus Load	Retained	Retained	Retained	Dropped
No. 2 RECTIFIER	No. 2 Rectifier Caution Light	No. 1 Rectifier Takes Over the Entire Primary DC Bus Loads	Retained	Retained	Retained	Dropped
No. 1 and 2 RECTIFIERS	No. 1 and 2 Rectifier Caution Lights (With Battery Switch On)	*Primary and Monitor DC Buses Automatically Dropped	Retained	Retained	Retained (With Battery Switch On)	Dropped

*With battery switch ON, battery will supply power to primary dc bus.

Figure 12-5. Electrical System Malfunction Data

12.21.2 Direct Current System Failure. Direct current is supplied to the dc primary and monitor buses by two rectifiers. The system is so designed that failure of either rectifier will be indicated by lighting of the respective caution light and will cause the dc monitor bus to be dropped from the system. If both rectifiers fail, the primary bus will be powered by the battery only. For indications of malfunctions in the dc electrical system, see Figure 12-5.

12.21.2.1 Rectifier Failure. If No. 1 or No. 2 rectifier caution light is ON:

1. Check rectifier circuit breaker.

2. Land as soon as practicable.

If Nos. 1 and 2 rectifier caution lights are ON:

1. Check rectifier circuit breakers.

2. Secure unnecessary electrical equipment; land as soon as possible.

Note

- When both generators or rectifiers fail, the battery is the only source of dc power available, and, accordingly, all equipment not absolutely necessary should be turned off by pulling the applicable circuit breakers. Under normal conditions, the battery will provide enough power to operate essential equipment required for flight for about 15 minutes. The following equipment requires ac and dc power:

ADF	NO. 1 FUEL PUMP CONTROL FWD TANK	CREW ICS
AFCS	NO. 1 FUEL PUMP CONTROL AFT TANK	HEATER
FUEL DUMP PUMP	NO. 2 ENG INLET ANTI-ICE	WINDSHIELD DEICE
IFF RT	NO. 2 ENG IGV ANTI-ICE	RAD ALT
OTPI	NO. 1 ENG ANTI-ICE	TACNAV
MK 46	NO. 1 ENG INLET ANTI-ICE	TACAN

- If both generators fail, equipment using ac and dc will not be operational but will continue to draw dc power. If both rectifiers fail, equipment using ac and dc power will be operational until battery exhaustion.

12.21.2.2 Battery Overheat. An overheated NI-CD aircraft battery is generally signaled by one of the following conditions: smoke or fumes emanating from the battery compartment or battery vent tubes, sound described as a "bang" or "thud" coming from the battery compartment, or electrolyte leakage in the battery compartment area or from the battery vent tubes. If any of these conditions occur, secure the battery from the charging source by placing the battery switch off. If on the deck, the helicopter should be secured and the crash crew alerted. If airborne, the helicopter should land as soon as practicable and the crash crew should be alerted.

WARNING

In no case should a $C0_2$ fire extinguisher be directed into a battery compartment to effect cooling or to displace explosive gases. The static electricity generated by the discharge of the extinguisher could explode hydrogen/oxygen gases trapped in the battery compartment. Use water fog for cooling and displacement of explosive gases. $C0_2$ is an acceptable fire extinguisher agent once a fire has developed.

12.22 FLIGHT CONTROL HYDRAULIC SERVO SYSTEM

12.22.1 Flight Control Malfunction. Indications of flight control problems may be the result of one of many different systems failures or malfunctions. Gyro failure may cause deviations in roll and pitch, and ASE failure or malfunction may cause partial or full hardovers in pitch, roll, yaw, and collective pitch. Auxiliary hydraulic servo system failure or malfunction may cause partial or full lockup in pitch, roll, yaw, or collective. Primary servo system failure or malfunction may cause partial or full lockup in pitch, roll, and collective. It is most important that the pilot be able to recognize impending failure, distinguish between types of malfunctions, and take immediate corrective action. It is possible that in some cases the ASE could mask a malfunction in the auxiliary servo system. When experiencing a flight control malfunction and not able to make an immediate determination of cause, the most prudent action, flight regime permitting, would be to secure the auxiliary servo. Once the auxiliary servo is secured, investigate for further control malfunctions.

12.22.1.1 System Failure. Control of the helicopter can be maintained through either the primary or the auxiliary flight control hydraulic servo system if one or the other should fail; however, prolonged operation on one servo system is not recommended. This is a serious emergency because control is impossible with both servo systems inoperative; a flight condition and flight route should be chosen so as to make an immediate landing if warranted. If the conditions do not warrant an immediate landing, land as soon as possible. With the auxiliary servo system inoperative, the automatic stabilization equipment and rotary rudder pedal damper becomes inoperative.

12.22.2 Servo Hydraulic Pressure Failure. Loss of hydraulic pressure of either the primary or auxiliary servo systems will be indicated by the lighting of either of the servo hydraulic low-pressure caution lights and/or lower than normal operating pressure on the corresponding servo hydraulic pressure gauge. When this condition occurs, proceed as follows:

*1. Position the flight control servo switch to turn off the affected system.

*2. If the system does not secure, check servo circuit breaker IN.

3. Land as soon as possible because of the serious control problems that would arise should the remaining servo fail.

If additional malfunctions exist:

4. Land immediately.

WARNING

If all generated power is lost or secured subsequent to securing a malfunctioning hydraulic system, the battery switch should remain ON. This will retain the electrically operated hydraulic valve in the close position and keep the malfunctioning servo off the line. Because of the critical nature of such losses, the pilot should land as soon as possible.

12.22.3 Illumination of Servo System Caution Light.

1. Affected system, press circuit breaker - IN.

2. Affected system pressure gauge – CHECK.

If pressure is below normal:

3. System - SECURE.

4. Land as soon as possible.

If pressure is normal:

3. Land as soon as possible.

WARNING

Illumination of the light is provided by the 1,000-psi switch that interconnects the two servo systems. Failure of one servo system 1,000-psi switch would preclude securing the second system in case of subsequent failure.

Note

Because of the pressure switch interlock, it is impossible to turn off one servo system when the pressure in the other servo system is below 1,000 psi.

12.23 FLIGHT CONTROLS JAMMED OR RESTRICTED

12.23.1 On Ground.

1. Leave controls in position where restriction or jam occurs.

2. Request inspection by qualified technician.

12.23.2 In Flight.

1. Land as soon as possible.

12.24 FLIGHT CONTROL SERVO UNIT MALFUNCTION

Malfunction of the rotary wing or rotary rudder servo units during flight will result in erratic behavior of the helicopter, roughness, uncontrollable maneuvers, or locking of the cyclic stick and collective pitch lever. Sometimes it is difficult to determine whether the auxiliary or primary servo system is causing the trouble. Whenever a servo unit malfunction is encountered, control difficulties may be eliminated by turning off the system containing the malfunctioning unit. The indications of servo unit malfunction can be divided into two categories: coupled indications and uncoupled indications.

12.24.1 Coupled Indications. Coupled indications are felt in both collective pitch and one cyclic pitch direction (either fore and aft or lateral). Coupled indications identify a malfunction in a primary servo unit or in the control linkage between the mixing unit and the primary servo units. For example, if the fore-and-aft primary servo unit should jam, cyclic stick motion (fore and aft) as well as collective pitch lever motion would be free to move within the limits of the auxiliary servo sloppy link but additional control movement would be possible only by trading off cyclic stick fore-or-aft motion for collective pitch lever motion. Should control difficulty occur in collective pitch plus one channel of cyclic pitch, place the flight control servo switch to PRI OFF.

12.24.2 Uncoupled Indications. Uncoupled indications are felt either in yaw, collective pitch, or one cyclic pitch direction (either fore and aft or lateral). Uncoupled indications identify a malfunction in an auxiliary servo unit or in the linkage between the flight controls in the cockpit and the auxiliary servo units. For example, a hardover in the fore-and-aft auxiliary servo unit will drive the cyclic stick to one extreme position (either fore or aft), and a hardover in the collective auxiliary servo unit will drive the collective pitch lever to an extreme position, or a hardover in the yaw auxiliary servo unit will drive the pedals to an extreme position. There is no interaction between cyclic and collective pitch. Should control difficulty occur in either yaw, collective pitch, or in one channel of cyclic pitch, place the flight control servo switch to AUX OFF.

12.24.3 Hardover in the Fore-and-Aft Primary Servo or Blocked Common Return in One Auxiliary Servo. One exception to the rule for coupled and uncoupled indication will be a hardover in the primary servo that will overpower the auxiliary servo and drive the cyclic stick (longitudinal direction) to an extreme. At the same time, because of the action of the mixer, a force will be applied to the collective channel of the auxiliary servo. However, the force output of this channel is enough to withstand the applied force and the effect will not be felt at the collective stick. The end result is symptomatic of an auxiliary servo hardover, but in this case is actually caused by a primary servo malfunction. If the pilot reacted to the situation by turning off the auxiliary servo, he would immediately know that he had made the wrong choice since the collective stick would now be forcibly moved. The corrective action at this point is to shut off the primary system.

Another case where a servo malfunction may be misinterpreted is the case of a blocked common return in one channel of the auxiliary servo. Since the return line is common to all four channels, a blocked return would give a coupled reaction although it may not necessarily involve the collective with pitch or roll. For example, it could affect the pitch and yaw. A rule of thumb method for identifying a malfunctioning servo is as follows:

*1. If a single or uncoupled force (either collective pitch or cyclic stick) is felt at the pilot controls without vibrations, shut off the auxiliary servo system. Check servo circuit breaker in if system does not secure.

*2. If vibratory force with or without a coupled indication is felt in the flight controls, then turn off the primary servo system. Check servo circuit breaker in if system does not secure.

*3. If unusual forces are felt in the pedals that cannot be eliminated by turning off the ASE or turning off the yaw channel, turn off the auxiliary servo system. Check servo circuit breaker in if system does not secure.

Note

Once a malfunctioning servo has been identified and corrective action is taken, an airspeed of approximately 70 knots will minimize the control forces. However, slower airspeeds and low altitude may be dictated.

12.24.4 Vibratory Forces.

A malfunction in a primary servo unit or in the control linkage between the mixing unit and the primary servos will generally be accompanied by severe vibratory forces. In addition, if a primary servo is displaced to an extreme position, the cyclic will move in the corresponding direction and may cause movement of the collective pitch lever. The vibratory forces associated with a primary servo malfunction are caused by the rotary wing reacting against a frozen servo with no dampening affect. These vibrations will be transmitted throughout the airframe and the controls. Should a control difficulty occur accompanied by strong vibratory forces, place the servo switch to PRI OFF.

12.25 AUTOMATIC STABILIZATION EQUIPMENT SYSTEM FAILURE

12.25.1 Power Supply Failure. The automatic stabilization equipment and coupler system will become inoperative regardless of the switch positions in case of failure of the auxiliary servo system or both generators.

12.25.2 ASE Malfunction

WARNING

If erratic attitude changes of increasing amplitude occur and cannot be controlled by manual inputs, secure the auxiliary servo before securing the ASE.

If automatic stabilization signals cause the helicopter to oscillate in pitch, roll, or yaw, or barometric altitude retention is erratic, the system may be rendered inoperative as follows:

1. Check cg trim (pitch only).

2. Check the ASE CHAN MON (hardover power) switch - OFF.

3. Pitch or roll hardover - SWITCH GYROS.

   a. If hardover remains - DISENGAGE RESPECTIVE CHANNEL.

4. Yaw or collective hardover - DISENGAGE RESPECTIVE CHANNEL.

Note

- Pressing the button marked CPLR REL will disengage the coupler.
- Pressing BAR OFF will release BAR ALT if the coupler is not engaged.
- Pressing the AUTO STAB RELEASE button will disengage all four channels of the ASE system.
- Placing the flight control servo switch in the AUX OFF position will render ASE inoperative.

Since the authority of the automatic stabilization equipment on all channels is limited to a fraction of total control travel, any attempted emergency override of a malfunction may normally be achieved by introducing a control correction. The possibility of a failure that would not be entirely eliminated by pressing the AUTO STAB RELEASE button is extremely remote. When the automatic stabilization equipment is nulled mechanically, by using the AUTO STAB RELEASE button on either cyclic stick, all values will be centered immediately. Unlike a servo malfunction, an ASE hardover in a cyclic channel will not result in stick movement or pressure.

Should the ASE malfunction during instrument flight, the pilot must decide whether the degree of failure necessitates complete disengagement or whether partial disengagement of the ASE is desirable with the pilot flying the failed channel. Instrument flight at reduced airspeed (approximately 70 knots) and mildly banked tums (10° to 15°) can be made with a partial ASE malfunction. If the ASE completely fails, the instrument flight should be terminated as soon as practical.

Note

With ASE off and an extreme aft cg, reduce the airspeed limits as determined from the Blade Stall Chart, Figure 20-5, by 25 knots.

12.25.3 Beeper Trim Malfunction.

Beeper trim fails to respond, proceed as follows:

1. Beeper trim fails to respond, proceed as follows:

   a. BEEPER TRIM switch - CHECK ON.

   b. BEEPER TRIM circuit breaker - CHECK IN.

   c. Landing criteria predicated on mission or meteorological conditions.

2. Beeper trim runaway in pitch or roll, proceed as follows:

   a. BEEPER TRIM switch - OFF.

   b. Landing criteria predicated on mission or meteorological conditions.

12.26 UTILITY HYDRAULIC SYSTEM FAILURE

The main landing gear, rescue hoist, and automatic blade fold system will be inoperative in case of failure of the utility hydraulic pump. Land as soon as practicable.

12.27 RESCUE HOIST MALFUNCTION

In case of a malfunction of the rescue hoist, stop hoisting and inform the pilot. Attempt to determine the cause of the malfunction. Check the circuit breakers, electrical switches, and connections; check the cable level wind and takeup drum; and ensure utility hydraulic pressure. Hoisting evolutions may continue if the cause of the malfunction is positively determined to be electrical. If the malfunction cannot be identified and depending upon the urgency of the hoisting evolution, the decision shall be made by the pilot either to continue hoisting by means of the manual hydraulic override valve or to secure hoisting. The manual hydraulic override should be used for emergency situations only.

CAUTION

In the manual hydraulic override mode, no limit switches are operative. Do not lower the cable past the last 10 feet as indicated by red paint.

If the malfunction has been determined to be a jammed cable, as with a broken level wind assembly or no utility hydraulic pressure, stop hoisting and secure the hoist to the helicopter by means of the Chicago grip and crewman safety belt attached to the rescue hoist frame. Apply tension to the crewman safety belt, being sure to take the strain off the cable takeup drum. In case of a personnel transfer, the pilot may elect to lower the helicopter and deposit the individual. In case of a hook separation or broken cable, depending on the urgency of the situation, use of the quick splice may become necessary.

WARNING

The quick splice will not engage upper limit switch; separation of the quick splice is possible when cable reaches upper limit.

Note

For proper quick splice and safety belt procedures, refer to NWP 3-50.1.

SYMPTOM

Hoist has stopped.

CORRECTIVE ACTION

1. Inform pilot.

2. Inspect hoist for a "bird's-nest condition".

Note

Hoisting shall be discontinued if a bird's-nest condition exists.

If bird's-nest condition exists:

3. Lower aircraft, thereby lowering personnel/cargo back to deck or into water.

4. If decision is made not to lower back to the deck or water, the Chicago grip shall be installed.

If bird's-nest does not exist:

5. Check:

   a. Hoist master switch - CREW POSITION.

   b. Hoist circuit breaker – IN.

   c. Utility hydraulic pressure - NORMAL.

   d. Rescue hoist switch (coolie hat) – FOR OPERATION.

   e. Hoist master switch - PILOT POSITION (while pilot controls hoist functions, the crewman relays verbal commands and tends cable as normal).

   f. If all checks do not correct problem, request permission from the pilot to use manual hydraulic override valve.

SYMPTOM

Runaway hoist.

CORRECTIVE ACTION

*1. Crewman…………………….Inform pilot.

*2. Pull Hoist Circuit Breaker.

Note

Runaway hoist malfunctions are usually electrical in nature.

*3. Press both the up and down manual hydraulic override valve buttons to ensure that valve is not stuck open. If this step corrects function, proceed with hoisting using normal procedures.

4. If hoist cable stops once fully deployed:

   a. Hand-over-hand cable into afterstation and close cargo door if possible.

   b. Guillotine cable, as required.

Note

The circuit breakers on the center circuit breaker panel must be set or the hoist cable cannot be guillotined.

Rescue Hoist Cable Shearing:

*1. Cabin Door…………… CLOSE.

*2. Shear switch guard…… Lift.

*3. Shear switch………….. SHEAR Position.

12.28 LANDING GEAR FAILURE

In case of failure of the utility hydraulic system or if the electrical circuit to the landing gear fails, the landing gear cannot be retracted; however, it can be lowered by use of the blowdown emergency landing gear pneumatic system. A light in the landing gear actuating lever or failure of the landing gear indicators to match the position of the lever requires use of the procedure outlined below.

WARNING

This procedure should not be used until a hover preparatory to landing to lessen potential compounding of the emergencies.

1. Landing gear actuating lever – DOWN.

2. Check circuit breaker - IN.

3. Emergency landing gear extension handle - TURN 90° AND PULL.

Note

A strong pull may be required to release both actuating pins.

This action withdraws the emergency uplock release actuating pin and also releases air into emergency landing gear system forcing the landing gear into the down and locked position. Position indicators should indicate down. If gear indicates down and locked, proceed as follow:

4. Emergency landing gear extension handle - PUSH DOWN (ONLY IF THE GEAR INDICATES DOWN AND LOCKED).

This repositions the air emergency release valve and the air pressure will escape from the starboard side of the fuselage.

If the landing gear does not extend after actuating the emergency air bottle, the following procedure will be applied. The landing gear actuating lever must be down.

5. Emergency landing gear release lever – PULL FORWARD.

This will allow the up-line fluid to return to the reservoir without passing through the solenoid valve (landing gear control handle), thus allowing the air pressure in the landing gear actuating cylinder to force the gear into the down and locked position.

If air pressure has been lost, this will allow the landing gear to drop by force of gravity (indicators should show down and looked). If the landing gear does not fall free to the down and locked position:

6. Hover the helicopter and have ground personnel move the gear into locked position. Ensure that helicopter is grounded before allowing ground personnel to inspect landing gear or insert lock pins.

WARNING

Do not attempt to reset the landing gear circuit breaker once the emergency gear bottle has been actuated. If attempts to lower the landing gear by action of the landing gear emergency system are unsuccessful, it may be possible to jar the gear loose by an abrupt increase in collective pitch after a shallow dive.

12.28.1 Landing With Wheels Retracted or Improperly Lowered. By proper selection of a landing site and careful hovering and letdown, it is possible to land with minimum danger to personnel or damage to the helicopter. Landings with both wheels retracted or with one or both wheels down but not locked may be made by placing soft objects, such as mattresses, under the malfunctioning landing gear and the bottoms of the fuselage, as required, just before touchdown. Ground personnel should direct the pilot when a landing is made under these conditions.

1. After attaining a hover, perform a vertical landing with no drift.

2. As soon as the wheels (or wheel) touch, they may be pushed backward as in partial retraction. The helicopter will settle on the hull.

3. Reduce rotor speed slowly to note which way, if any, the helicopter will tilt. The greatest damage with nonwheel landings that may occur will be to the rotary wing head and blades if the helicopter tips to one side and the blades strike the ground. The blades may possibly touch the ground even if the helicopter rests on the hull.

4. Maintain control as long as possible with the cyclic stick as the rotary wing blades slow down.

5. Apply the rotor brake gradually when control is no longer effective and the helicopter starts to tip.

12.28.2 Landing Gear Fails to Retract. If the landing gear fails to retract completely or will not raise, leave the gear in a down-and-locked position.

WARNING

Because of loss of the RAWS aural and visual warning of unreliable radar altimeter and absence of 30-foot aural RAWS, night/IFR overwater operations below 150 feet shall not be conducted with landing gear down.

12.29 HUNG DROOP STOPS

In the event a droop stop fails to seat, the LSE shall notify the pilots by giving the hung droop stop signal. The pilot shall reengage the rotor and reattempt disengagement.

WARNING

It is recommended to reposition the aircraft to preclude injury to personnel and/or damage to aircraft and equipment in the event of a tail pylon strike.

Note

Slight displacement of the cyclic while disengaging may dislodge a jammed droop stop. If after several attempts the droop stop fails to seat, reengage the rotor and perform the following steps.

1. LSE shall position himself forward and right of the aircraft outside of the rotor arc and clear all unnecessary personnel from the area.

2. Pilot shall proceed with rotor disengagement.

3. When, in the judgment of the LSE, the blade will no longer clear the tail pylon, he shall give the rotor brake signal.

4. Pilot - ROTOR BRAKE FULL ON.

5. Secure aircraft in accordance with the checklist.

12.30 ROTOR BRAKE CAUTION LIGHT

SYMPTOM

Rotor brake caution light goes on.

CORRECTIVE ACTION

*1. Check manual rotor brake seated.

If light remains illuminated, proceed as follows:

Over water:

*2. Immediately descend to hover/air taxi.

*3. If secondary conditions exist, land immediately.

4. If no secondaries exist for 15 minutes, land as soon as possible.

Over land:

*2. Land as soon as possible.

*3. If safe landing site is not available, proceed as if over water.

On deck

*2. Secure both speed selectors.

3. Rotor brake as required

Note

If necessary, the crewman may eliminate pressure on the rotor brake by removing the cotter pin and actuating the lever on the rotor brake accumulator. If the cotter pin cannot easily be removed, a flat-tipped screwdriver can be inserted in between the lever and the accumulator itself to alleviate pressure (Figure 12-6). The pressure switch cylinder is on the port side cabin overhead, adjacent to the left sonar seat.

12.31 ROTOR BRAKE FAILURE

In case of failure of the manual rotor brake, the rotary wing may be stopped by using the automatic rotor brake incorporated in the automatic blade fold system. After shutting down the number two engine and determining that the manual rotor brake has failed, do this:

WARNING

The automatic rotor brake should not be used if there is evidence of a hydraulic leak in the area of the rotor brake. If a ruptured line exists, actuation of the automatic rotor brake may spray fluid causing a fire.

1. Manual rotor brake – OFF.

2. No. 2 firewall valve - OPEN.

3. Allow N_r to decrease as low as is safe and comfortable. (This will depend on wind conditions).

4. SAFETY VALVE switch – OPEN.

5. MASTER switch - ON.

If the automatic rotor brake appears to be slowing the rotary wing too rapidly, the master switch may be cycled on and off.

CAUTION

Make sure that the BLADES FOLD-SPREAD switch is OFF until the rotary wing has come to a complete stop. Inadvertent actuation of the BLADES switch to FOLD could cause premature engagement of the positioning unit if the No. 2 firewall valve is closed.

12.32 COUPLER MALFUNCTIONS

Note

Flight conditions that determine the corrective action are assumed to be night/IFR.

12.32.1 Loss of Doppler Receiver.

INDICATIONS

1. OFF flag in D mode.

2. MEMORY light on.

3. Incorrect indications of groundspeed and drift on GSDA and D mode indicators.

Note

Receiver loss may be caused by either a poor Doppler signal return because of a low sea state or by an internal failure of the Doppler receiver.

EFFECT

1. In an approach with altitude coupler in RAD ALT, a high sink rate may develop. With altitude coupler in VA, there will be no noticeable effect on the approach. Cyclic coupler inputs are in relation to incorrect Doppler information as displayed by D mode.

2. In a hover, complete loss of coupler inputs to beeper trim resulting in the helicopter drifting from original hover position.

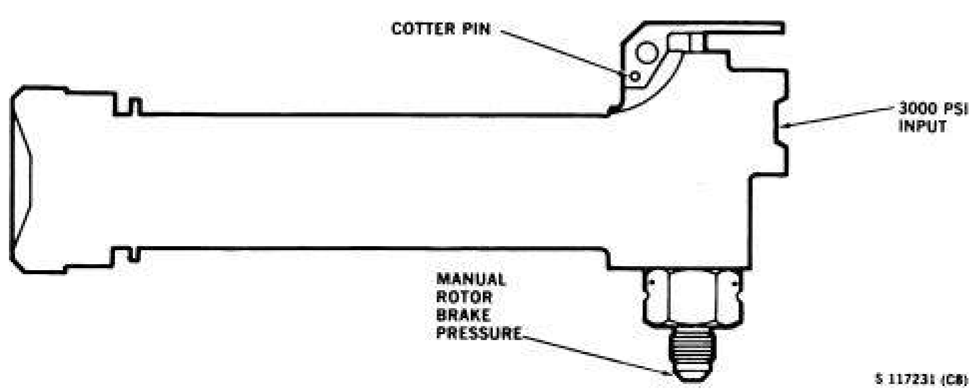


Figure 12-6. Rotor Brake Accumulator

CORRECTIVE ACTION

In an approach:

1. Check Doppler control panel for light indications. MEM light indicates loss of Doppler receiver. STBY light indicates loss of transmitter.

2. If conducting an automatic approach, switch the Doppler selector from SEA to LAND/ALT to reacquire the Doppler signal. If the signal is reacquired (OFF flag disappears and MEM light goes off) continue the approach. If the Doppler signal is not reacquired, abort the approach or switch the cyclic coupler to OFF and proceed with an alternate approach.

3. If conducting an alternate approach because of low sea state, ensure that the Doppler selector is in LAND/ALT. If the Doppler signal is not acquired after passing through translational lift, abort the approach.

In a hover:

1. If disorientation occurs, execute a free-stream recovery, Figure 12-7.

12.32.2 Loss of Doppler Transmitter.

INDICATIONS

1. OFF flag in D mode.

2. Lighting of both MEM light and STBY lights.

3. Incorrect indications of groundspeed and drift on GSDA and D mode indicators.

EFFECT

1. In an approach - Same as loss of Doppler receiver.

2. In a hover - Same as loss of Doppler receiver.

CORRECTIVE ACTION

1. If disorientation occurs in the hover, execute a free-stream recovery.

2. If Doppler transmitter failure is noted, abort the approach.

3. Once the helicopter is at a safe altitude, check the Doppler circuit breaker IN.

12.32.3 Sidelobe Lock-On.

INDICATIONS

1. D mode drift bars frozen, usually in center.

2. No OFF flag in D mode.

3. No MEM or STBY light on Doppler panel.

EFFECTS

1. Erratic or incorrect inputs to cyclic coupler.

2. Incorrect indications of groundspeed and drift on GSDA and D mode.

CORRECTIVE ACTION

If sidelobe lock-on is suspected, beep the aircraft to a nose-level attitude. If the groundspeed on D mode/GSDA does not increase, do the following:

1. If conducting an automatic approach, select LAND/ALT and switch cyclic coupler to OFF. Proceed with an alternate approach.

2. If conducting an alternate approach, switch the Doppler selector to STBY until the Doppler enters memory (OFF flag in D mode and MEM light). Return the Doppler selector to LAND/ALT to acquire a valid signal.

3. If a valid signal cannot be acquired, abort the approach.

12.32.4 Loss of Radar Altimeter.

INDICATIONS

RAWS warning, both aural and visual, and the RAD ALT will show a yellow striped flag.

EFFECT

1. Approach - Helicopter will return to 150 feet or level off.

2. Hover - Helicopter will normally remain in hover.

CORRECTIVE ACTION

1. Approach - ABORT.

2. Hover:

a. On RAD ALT or VA - Abort and recover by free-stream recovery.

3. When established in flight at a safe altitude, check the circuit breakers.

12.32.5 Malfunction of Stick Trim.

INDICATIONS

1. No trim - Cyclic stick will have no "feel".

2. Stuck valve - Unable to release artificial "feel".

3. In either case the coupler will not control the helicopter in pitch and roll.

EFFECT

Loss of coupler control in pitch and roll.

CORRECTIVE ACTION

1. Approach - ABORT.

2. Hover - Abort and recover by free streaming, if disorientation occurs.

3. When established in forward flight at a safe altitude, check the circuit breakers.

12.32.6 Loss of ASE.

INDICATIONS

Loss of artificial stability and programmed approach.

EFFECT

Loss of coupler control and helicopter stability.

CORRECTIVE ACTION

1. Approach - ABORT.

2. Hover - Abort by free streaming.

3. When established in flight at a safe altitude, check the circuit breakers.

Note

A complete loss of ASE/COUPLER will occur if the auxiliary servo fails or both generators fail.

12.32.7 Loss of Attitude Indicator.

INDICATION

OFF flag in the attitude indicator.

EFFECT

1. Copilot Attitude Indicator - Loss of copilot attitude reference, and when gyro processes, hardovers in pitch and roll will result.

WARNING

In the event of an AHRS failure, the left-seat pilot will have no attitude reference and there will be no reliable heading reference in the cockpit (RMI and BDHIs will be unreliable). Executing a free-stream recovery under these conditions will be extremely difficult. Close cockpit coordination and use of the turn needle and wet compass are required. Consideration should be given to switching the compass control panel to COMP (old panel) or EMERG (new panel) at the first reasonable opportunity.

CORRECTIVE ACTION

1. Release ASE if hardovers give control problems.

2. If copilot's fails, ensure that gyro selection switch is in STBD.

3. Abort approach.

4. Hover- abort by free streaming.

5. When established in flight at a safe altitude, check the circuit breakers.

12.32.8 SAR FREESTREAM RECOVERY.

If a stable coupled hover cannot be maintained because of a malfunction and/or vertigo, an emergency departure should be executed.

*1. Alert the crew.

*2. Level aircraft to hover attitude and establish zero drift.

*3. Disengage coupler - start a 100- to 500-fpm vertical climb. Continue hoisting swimmer/survivor if on hook.

*4. When passing thru 100 feet, adjust nose attitude to attain 60 to 70 KIAS.

*5. Level off at a safe altitude and troubleshoot malfunction.

WARNING

Until rescue swimmer and survivor are in aft station, airspeed shall be kept below 40 KIAS.

12.32.9 Loss of Generator.

INDICATIONS

1. Caution light.

2. Loss of ac- and dc-monitored bus.

EFFECT

1. No. 2 generator - Loss of ac- and dc-monitored bus.

2. No. 1 generator - Loss of ac- and dc- monitored bus. Helicopter will drop rapidly but briefly until the shift of loads is complete. The helicopter will then return to its original hovering altitude.

Note

Should the No. 1 generator fail or be otherwise secured while the helicopter is in a hover, the Doppler will shift into memory when the generator load is switched. Should this occur, the Doppler selector switch must be placed to LAND/ALT until the Doppler signal is regained. If the selector switch is at LAND/ALT when the generator load is switched, the Doppler will go into memory for about 6 seconds before the Doppler signal is automatically reacquired.

CORRECTIVE ACTION

1. Approach – Abort.

2. Hover - Wait until load shift is complete and then depart the hover. When established in flight at a safe altitude, recycle the generator. If the output of the generator is not restored, turn the switch off and land as soon as practicable.

12.32.10 Cg Not Within Prescribed Limits. If the cg trim is not set within the prescribed limits, the ASE may run out of authority and the helicopter will go to an extreme nosedown or noseup attitude.

CORRECTIVE ACTION

Release coupler and manually control attitude.

12.33 EMERGENCY WATER OPERATIONS

This helicopter in its normal configuration is not an amphibious helicopter and will under no conditions other than that of an emergency be landed on the water.

12.33.1 General Information. The helicopter, when landed on the water, will eventually acquire water internally through various antenna and drainage points. If the helicopter is capable of further flight with both engines operating, a normal vertical takeoff may be executed. If power is reduced because of partial or complete loss of one engine, the helicopter under certain gross weights may be flown from the water, using a running takeoff technique. If neither type of takeoff can be executed, the helicopter may possibly be taxied to a shoreline or salvage area. Due consideration should first be given to flying the helicopter from the water whenever possible. Should circumstances exist that would preclude a takeoff because of excessive gross weights but that would allow a takeoff at lower gross weights, initial consideration should be given to lightening the helicopter by dumping fuel.

When operating on or near the surface of salt water, the turbine compressor blades will acquire salt encrustation. Encrustation buildup will result in compressor stall of the engine. The acquisition rate of salt within the engine is proportional to the spray ingested. The rate of such ingestion increases rapidly with increases of power; therefore, hovering close to the water or holding too much power when on the surface should be minimized whenever possible. Ingestion rates will decrease slightly with increased wind conditions. Stability of the helicopter on the water must be maintained by the pilot in control at all times. Although the static helicopter without emergency flotation gear can right itself from a roll of several degrees, wind and water conditions higher than sea state one may cause excessive rolling and capsizing will probably occur. However, a helicopter with emergency flotation gear inflated can right itself from a roll in seas up to sea state three. Frequently, when operating on the surface, visual reference to the horizon will be lost. In such cases, the VGls should be employed to maintain the helicopter in a level attitude. Windshield wipers should be employed, particularly when attempting to take off or in sea states that cause water to splash onto the windshield. Before water operation of any nature, the landing gear should be checked in the UP position. The helicopter should not be taxied down swell above sea state three, as the rotary rudder may contact the water.

WARNING

- In moderate to high sea states, taxiing the helicopter in any direction not directly into the waves (particularly at night) may be disorienting, cause increased instability, and result in uncommanded roll of the helicopter.

- The cockpit windows are more difficult to jettison when the helicopter is inverted than when upright because of interaction between the window frame pins and the airframe. The cockpit windows should be jettisoned in anticipation of capsizing, if possible.

Note

Do not panic if it appears that the helicopter is taking on water. The initial gush of water up the sonar funnel has been a factor in previous accidents where the pilot has made a premature decision to abandon the helicopter with resultant loss of the helicopter.

Following engine shutdown, the rotor brake should be applied only when rotor decay without braking action would create a more hazardous condition. Torque resulting from rotor brake application will cause the helicopter to rotate in the water and possibly capsize. If both engines fail or an uncontrollable fire is experienced, the decision to abandon the helicopter must be made quickly. Attempts to lower the landing gear and deploy the sea anchor, if equipped, should be made to stabilize the helicopter as much as possible while preparations are being made to abandon. If time permits, secure all power and fuel switches. The signal to abandon helicopter will be given by the plane commander, and all personnel on board shall evacuate with their individual survival equipment.

12.33.2 Water Taxiing. Water taxiing procedures follow the same basic procedures as those specified for taxi operations ashore. Water taxi should be thought of as an air taxi with reduced gross weight. Balanced flight should be maintained as much as possible while in the water. When the collective is reduced to the flat pitch condition, stability becomes marginal. As the sea state increases, instability increases accordingly. Therefore, while water taxiing, a slight amount of collective is necessary to maintain positive stability. Initiation of forward speed is a result of slight forward displacement of the cyclic in conjunction with slight up collective. Additional speed may be obtained by increasing either but is normally a result of increasing collective position. It must be remembered, however, that raised collective positions increase salt ingestion within the engines. In higher sea states, it may be necessary to reduce taxi speeds and to maintain partial up collective in order to lessen wave impact on the front of the fuselage. At all times the helicopter must be kept level, using the cyclic control and referring to the VGIs if necessary. Turns should be made using the rudder pedals for steering control. Two factors, the high cg and the large sail area, will normally affect list of the helicopter while taxiing. Normal taxi speeds will be associated with a prominent bow-wave effect that in calm water will splash against the lower panels of the windshield at deck level. Taxi speed of over 15 knots may cause the nose to tuck. Should this occur, the collective should be immediately lowered to the minimum position and the forward movement stopped. Sideward and rearward taxiing may be made by use of the cyclic and collective but is not recommended.

WARNING

In moderate to high sea states, taxiing the helicopter in any direction not directly into the waves (particularly at night) may be disorienting, cause increased instability, and result in uncommanded roll of the helicopter.

12.33.3 Fuel Dumping Afloat.

1. Determine the amount of fuel to be offloaded. To determine gross weight for takeoff, refer to the performance charts in Figure 12-9.

2. Taxi slowly upwind or crosswind.

3. Crossfeed - CLOSED.

4. All fuel boost pumps - ON.

5. Fuel dump switches - AS REQUIRED.

6. After desired quantity dumped, fuel dump switches – OFF.

12.33.4 Flotation Bags. The emergency flotation bags are installed to improve helicopter stability on the water with the rotary wing shut down. It is only necessary to inflate the bags if the rotary wing must be shut down. The bags will maintain the stability of the helicopter for subsequent rescue and/or salvage operations. With the rotary wing turning and under control, sufficient flotation and stability is available to carry out any maneuver previously described.

If the emergency flotation bags were inflated, maintain airspeeds of less than 60 knots and pressure altitudes of less than 3,000 feet. No degradation of handling qualities will be noted when flying with the bags inflated.

Upon return to the ship or base, the helicopter should be landed vertically if possible and the bags deflated before moving. If the helicopter is taxied with bags inflated, they will scuff and probably tear. If it is necessary to taxi with the bags inflated, a rope should be tied around the bags to hold them up against the sponsons.

CAUTION

If flotation bags are inflated while airborne, the possibility of tearing a bag on a subsequent rough water landing is highly likely, resulting in the hydrostatic characteristics of the helicopter being greatly reduced.

12.33.5 Dual-Engine Vertical Landing. A vertical water landing with both engines operating should be approached in the same manner as a vertical landing over an unprepared surface. If available, visual reference to floating objects in the water will aid as a reference during the descent. During the descent, a slight amount of forward speed (1 to 2 knots) is desired during the landing phase. This can best be accomplished by setting a nose-level attitude using the VGI passing through 8 to 10 feet on the RAD ALT. As the helicopter comes to rest, the collective pitch should be reduced to the minimum required for taxi and, simultaneously, the helicopter maintained in a wings-level attitude. In calm water with collective pitch at minimum, the water level will appear to be slightly more than a foot below the cockpit deck. Because of the 3° inclination of the rotor mast, the helicopter will have a tendency to move forward in the water. In calm water with the forward movement stopped, the helicopter will move sideward at a speed of about one-half knot because of thrust of the rotary rudder.

12.33.6 Single-Engine Water Landing. The approach to a single-engine water landing should employ the standard techniques used during single-engine approaches ashore. During the initial stages of the approach (150 feet and below), nose attitude and power adjustments should be made in order to arrive at 5 feet and 5 knots of groundspeed before water entry. Nose attitudes and power required to attain this 5 feet and 5 knots will be dependent on helicopter gross weight, density altitude, and surface wind conditions. At this time, the nose should be adjusted to 2° to 3° above the horizon and the helicopter cushioned as necessary. If the nose attitude is lowered to less than 2° to 3°, the possibility of acceleration before touchdown is present. This, coupled with the flat attitude, may cause possible damage to the electronics compartment door at touchdown and/or possible flameout of operating engine because of water ingestion. Conversely, excessive attitudes at touchdown if coupled with high sink rates and/or high speeds may cause the tailwheel to sink too deeply, thereby subjecting the rotary rudder to possible damage. The accompanying pitching forward tendency may cause serious damage to the electronics compartment door, the wind screen area, and the engines. Under no conditions should the speed at touchdown be over 15 knots. Once established on the water, collective pitch should be reduced to the minimum required for taxi and the helicopter maintained in a level attitude.

12.33.7 Single-Engine Failure or Loss of Power in an Overwater Hover. It is most unlikely that the helicopter can be flown from a coupled hover following an engine failure. Because of the low altitude, reaction to a complete single-engine failure must be instantaneous. Since average pilot reaction time is 1.8 seconds, correlation with the rotor decay chart (Figure 12-1) shows that available N_r remaining before reaction begins is less than 90 percent from an engine loss in an over-water hover where dual-engine torque was about 80 percent. The decision should be made to land in the water with the primary concern being the preservation of enough rotor rpm to cushion the landing. Since the attendant loss of N_r is over 10 percent before pilot reaction begins, there will also be an attendant loss of altitude because of the rotor becoming less efficient. With the coupler engaged, the pilot will first notice a rise in collective caused by the coupler system trying to maintain its preselected altitude. This upload must be overcome to avoid further rotor speed decay. However, since the helicopter would probably be below 40 feet because of rotor speed decay, any excessive reduction in collective would be disastrous. Collective should be lowered only as altitude permits and then only slightly to retard N_r decay. Avoid abruptness if possible. Nose attitude is another critical factor in achieving a safe water entry. At the time collective is lowered, the nose attitude should be lowered so that the nose is slightly above the horizon, ideally about 2° above to impart a slight forward velocity and to preclude backing down. Cushioning should be started about 8 to 10 feet above the water, with the nose attitude no lower than the horizon because of collective to cyclic coupling. Aft cyclic displacement under impact loads may produce contact between rotary wing blades and the tail pylon. Excessively high nose attitudes at touchdown, particularly in high seas, may cause loss of the rotary rudder because of surface contact.

Time is a crucial consideration. A simple application of up collective and forward cyclic should be enough to avoid injury in a power loss situation but will likely result in a hard landing and possible helicopter damage prohibiting a single-engine water takeoff. Neither engine should be secured until careful analysis can be made of the malfunction.

If after experiencing a power loss the helicopter settles but still remains airborne, a "creep out" can be accomplished. If the N_r is above 92 percent, a slow, smooth transition to forward flight can be made. With N_r stabilized below 92 percent and with the helicopter still airborne, judicious use of the manual throttle is an alternative to increase N_r allowing a transition to forward flight.

CAUTION

- Monitor N_g, T_5, N_f, and N_r to avoid exceeding engine limitations when possible. Maintain topping power setting only as long as necessary to become safely airborne.

12.34 DITCHING PROCEDURES

12.34.1 Water Landing (Uncontrolled).

*1. Alert crew.

*2. Lock shoulder harness.

*3. Mayday/IFF.

12.34.2 Water Landing (Controlled).

*1. Speed selector(s) - FULL FORWARD.

*2. Alert crew.

*3. Harnesses - LOCKED.

*4. Mayday/IFF.

*5. External stores - JETTISON.

6. Execute single-engine approach profile.

7. Jettison windows during landing flare.

CAUTION

Jettisoning pilot compartment windows in high-speed flight may result in damage to the rotary wing blades or the rotary rudder blades.

8. Land on top of swell - HEAD INTO WAVES, 0 TO 15 KNOTS GROUNDSPEED.

WARNING

In moderate to high sea states, taxiing the helicopter in any direction not directly into the waves (particularly at night) may be disorienting, cause increased instability, and result in uncommanded roll of the helicopter.

12.34.3 After Water Entry. Unless obviously sinking and the decision has been made to remain on the water, the following checklist should be used by the crew as a guide to enhance helicopter and crew survivability. Do items that were not completed in Water Landing (Controlled) Checklist.

1. External and internal stores/windows - JETTISON.

2. Helicopter integrity - CHECK.

3. UHF antenna selector - UPPER ANTENNA. Broadcast MAYDAY.

If water takeoff is not to be attempted, comply with Water Shutdown Procedures, paragraph 12.34.6.

12.34.4 Dual-Engine Vertical Water Takeoff. Procedures for the dual-engine water takeoff except for the initial stages are the same as when executed from a hard surface. To preclude the possibility of excessive salt ingestion when taking off, an exaggerated rate of climb is performed until clear of salt spray. When the decision has been made to take off, firmly and smoothly apply power. As the helicopter clears the water, continue to apply power until an altitude clear of water spray is attained. At this time, the transition to forward flight should be commenced in the normal manner.

Note

Windshield wipers are recommended because of the heavy amount of spray that may be encountered.

12.34.5 Single-Engine Water Takeoff. Because of the salt ingestion of the engines, the associated loss of power, and the acquisition of water through the various openings along the bottom of the helicopter, it is essential that the single-engine takeoff be attempted as soon as possible (Figure 12-7).

Note

The various voids in the helicopter will the hold upwards to 2,000 pounds of water. The rate of water intake will vary with different helicopters, but the helicopter will normally acquire this amount of water in about 15 to 45 minutes. Execute single-engine water takeoff as follows.

1. Conduct integrity check for airframe damage.

Note

Should an excessive rate of water leakage appear in the cargo or pylon area after a water landing, the possibility exists that structural damage has occurred to the underside of the fuselage section or pylon. An integrity check for damage to the helicopter should be completed before executing a single-engine water takeoff.

2. External and internal stores/smokes/ windows – JETTISON.

3. Crossfeed - CLOSED.

4. All fuel boost pumps - ON.

5. Fuel dump switches - ON AS NECESSARY.

Note

Fuel quantity should be monitored because of high dump rate.

6. Speed selector - FULL FORWARD.

7. Collective - RAISED.

8. Manual throttle - TOPPING.

CAUTION

Monitor N_g, T_5, N_f, and N_r to avoid unnecessarily exceeding engine limitations. Limitations imposed by topping adjustments do not exist while using manual throttle. Manual throttle should be used only long enough to become safely airborne.

9. Collective - LOWER TO 117-PERCENT N_r.

10. Cyclic - FORWARD FOR MAXIMUM TAXI SPEED AT 117-PERCENT N_r.

11. Collective - RAISED FOR TAKEOFF.

Note

If single-engine takeoff is not possible using the above procedures, increase the mechanical topping adjustment of operating engine to full increase and attempt another takeoff.

12. Accelerate to and maintain normal single-engine flight.

13. Manual throttle - OFF WHEN ESTABLISHED IN CLIMB OR ON WATER REENTRY.

14. Fuel dump - SECURED.

WARNING

Mechanical overspeed protection can be actuated from 119- to 123-percent N_f. In moderate to high sea states, judicious use of collective will be required to prevent N_f/N_r, overspeed.

Tip-path plane should be adjusted forward and power initially adjusted to about 50- to 55-percent torque (single engine) to attain maximum forward taxi speed. As the leading edge of the bow wave becomes visible through the pilot windshield (maximum taxi speed), continue to apply power to become airborne to an altitude of about 5 feet above the water. It is essential that a nose position on the horizon be maintained. As the helicopter clears the surface of the water, rotor rpm will decay to some lesser value, but should stabilize at 92 percent or above. If the altitude and attitude remain as outlined above and N_r has stabilized at 92 percent or above, the helicopter will accelerate. As the helicopter reaches 45 KIAS, the nose position should be adjusted to 1° to 2° noseup and N_r allowed to increase to 96 percent, or if the N_r has stabilized at a higher value, then it should be maintained. A perceptible rate of climb will occur and acceleration will continue. When the indicated airspeed reaches 65 knots, set the attitude and N_r to the normal single-engine climb parameters. If the N_r cannot be stabilized at 92 percent, then reland as outlined in single-engine water landing section. At this time, the pilot must decide either to attempt another takeoff immediately or to further reduce weight by dumping fuel or other means available before takeoff.

SINGLE ENGINE WATER TAKEOFF CHART

MODEL: SH-3H/UH-3H
DATA AS OF: 31 OCTOBER 1980
DATA BASIS: NATC

ENGINE: (1) T58-GE-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

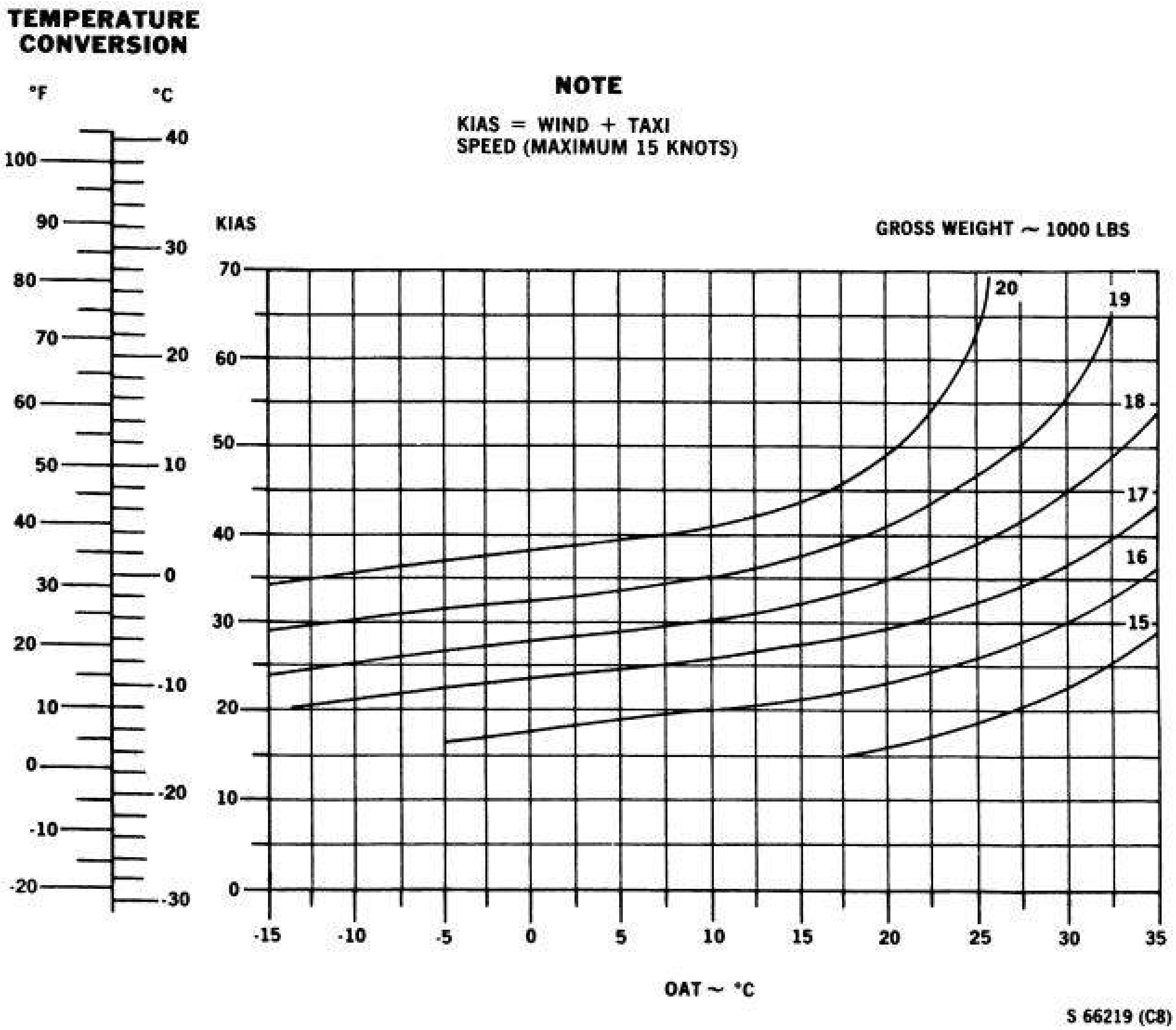


Figure 12-7. Single-Engine Water Takeoff Chart

12.34.6 Water Shutdown Procedures.

1. Crew alerted.

2. Landing gear - DOWN.

Note

Landing gear should be lowered prior to securing engines. Lowering the landing gear will aid in attaching the emergency flotation collar.

3. Raft/first-aid kit/matrix light/buoy - POSITION FOR LAUNCH.

4. Flotation bags - DEPLOYED.

   a. Arming switch – ARMED.

   b. Inflate switch - DEPRESS.

5. Shoulder harness all stations – LOCKED.

Note

If situation warrants, use normal shutdown checklist to place No. 1 engine in ACCESS DR to provide power for continued use of communication/lighting equipment.

6. Speed selector(s) - SECURE AS APPROPRIATE.

WARNING

Judicious use of rotor brake during shut-down is recommended. Torque resulting from rotor brake application will cause the helicopter to rotate and possibly capsize.

7. Rotor brake - AS NECESSARY.

Before abandoning helicopter, consider the following:

1. Condition of helicopter.

2. Environmental conditions.

3. Condition of crew.

4. Time to rescue.

12.34.7 Abandoning Helicopter.

1. Rotor brake - ON.

2. Secure helicopter - AS NECESSARY.

3. Deploy raft - UPON COMMAND.

CAUTION

- When launching a life raft, be sure that the raft does not become fouled on parts of the helicopter.

4. Abandon helicopter - UPON COMMAND.

12.34.7.1 Towing Helicopter.

1. Secure tow ship line to the nose tow ring.

2. Maximum speed 4 to 5 knots in moderate sea and 1 to 2 knots in heavy sea.

CAUTION

- Under no circumstances shall the helicopter be towed by the tailwheel while in the water. Towing the helicopter from any point other than the nose tow ring may result in loss of the helicopter.

12.34.8 Emergency Water Towing With Emergency Floats Inflated. When towing the helicopter under emergency conditions in water, secure the tow ship line to the nose tow ring. If the sea anchor is being used, the tow ship should retrieve the parachute and disconnect it; then connect its towline at the point where the parachute was removed. Tow tension should be increased gradually and initiated in line with the helicopter longitudinal axis.

CAUTION

Under no circumstances shall the helicopter be towed by the tailwheel while in the water. The center of gravity shifts forward and forces one sponson under the water. Towing the helicopter from any point other than the nose tow ring may result in loss of the helicopter.

12.35 EMERGENCY ENTRANCES AND EXITS (Figure 12-8)

CAUTION

Jettisoning the pilot compartment windows in high-speed flight may result in damage of the rotary wing or rotary rudder blades.

12.35.1 Pilot Compartment Jettisonable Window Assembly.

12.35.1.1 Interior Release Handle. The window emergency release handle for each window assembly is below the window. The handle marked EMER RELEASE is pulled up to release the window assembly.

12.35.1.2 Exterior Release Handle. The exterior window handle marked EMER EXIT RELEASE, PUSH TURN is pressed in on one end which causes the handle to extend outward, then the handle is turned downward to release the window assembly. After the window has been released, it will have to be manually pushed out.

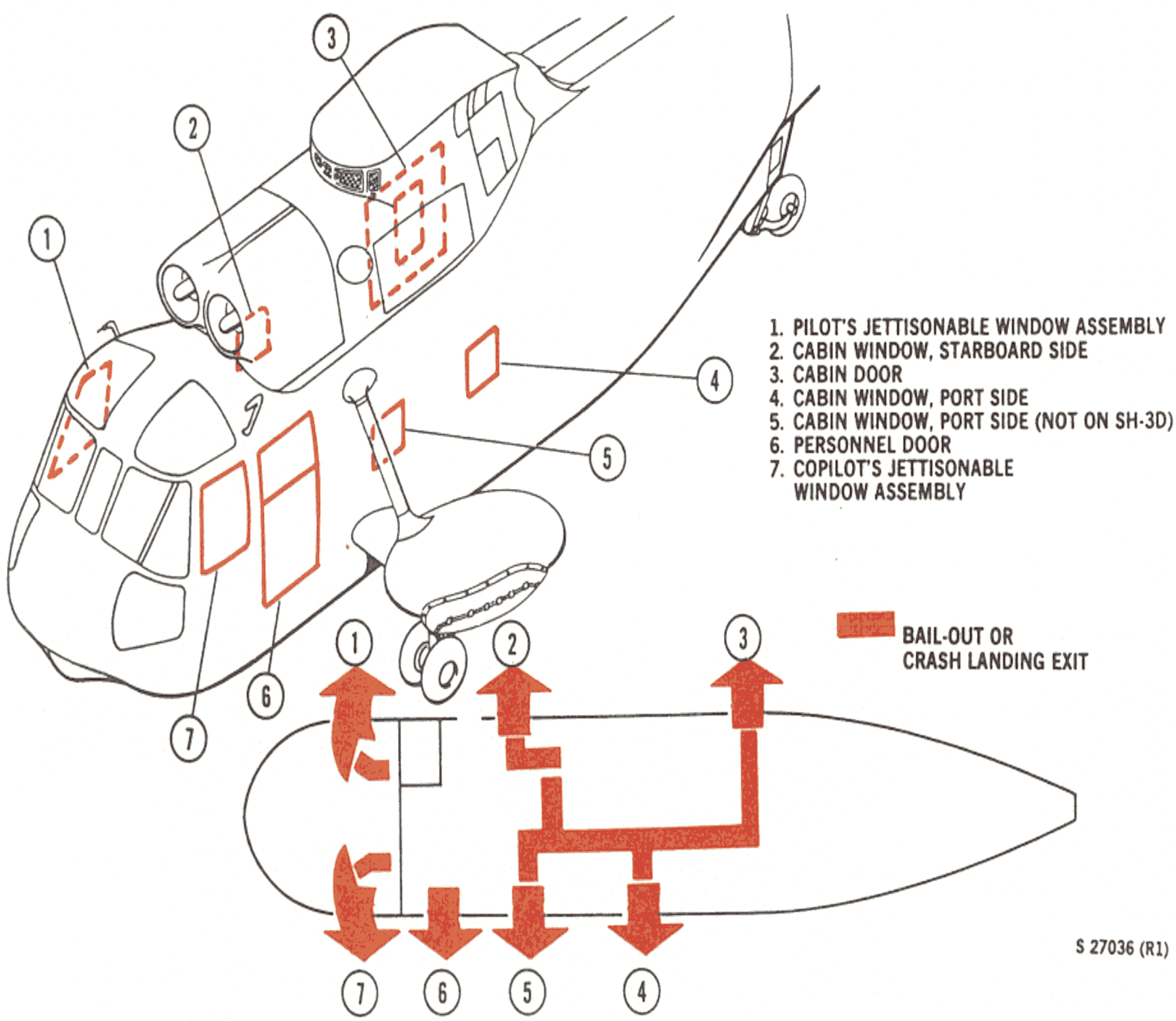


Figure 12-8. (NON-ET) Emergency Routes of Escape and Exits

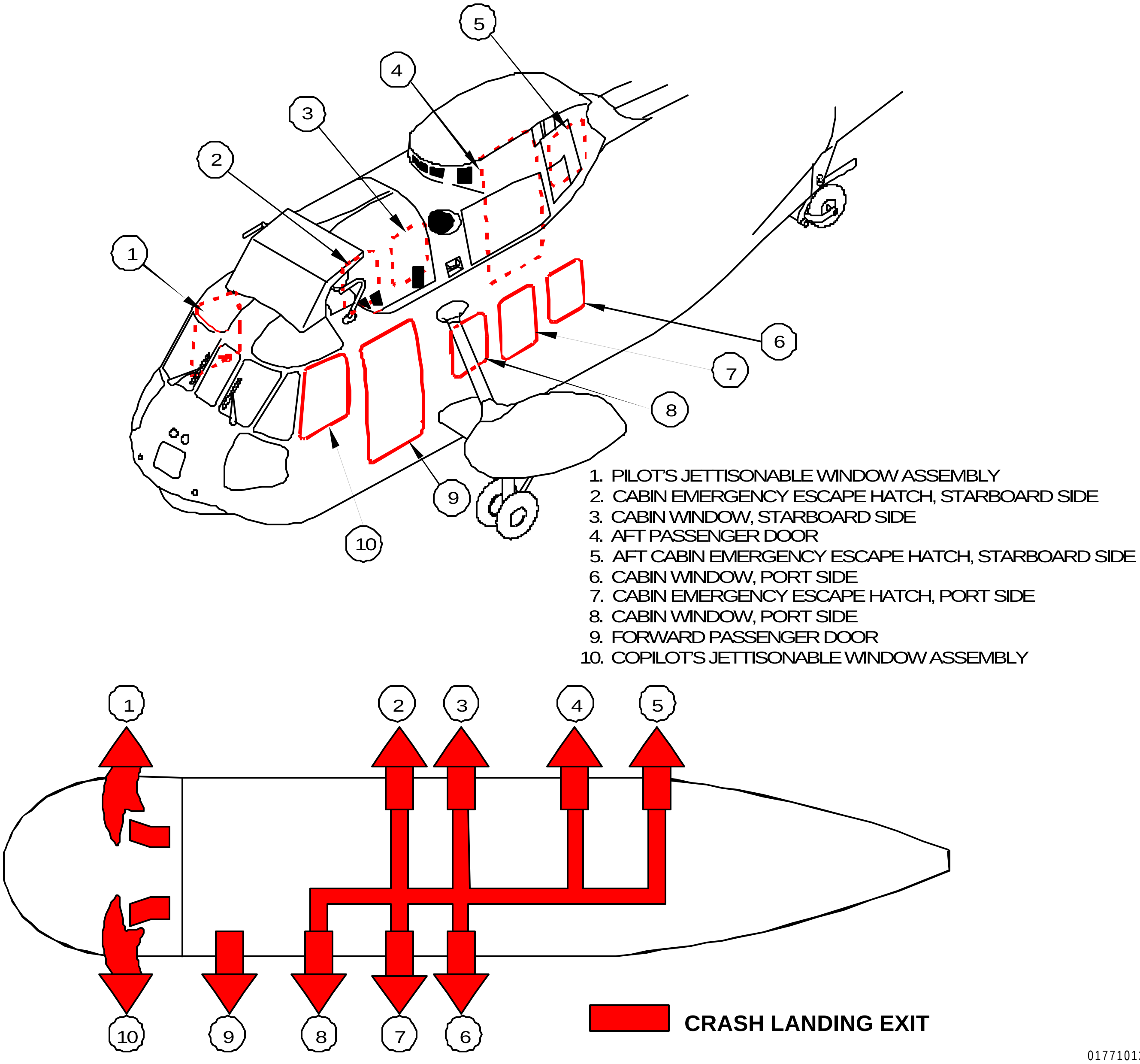
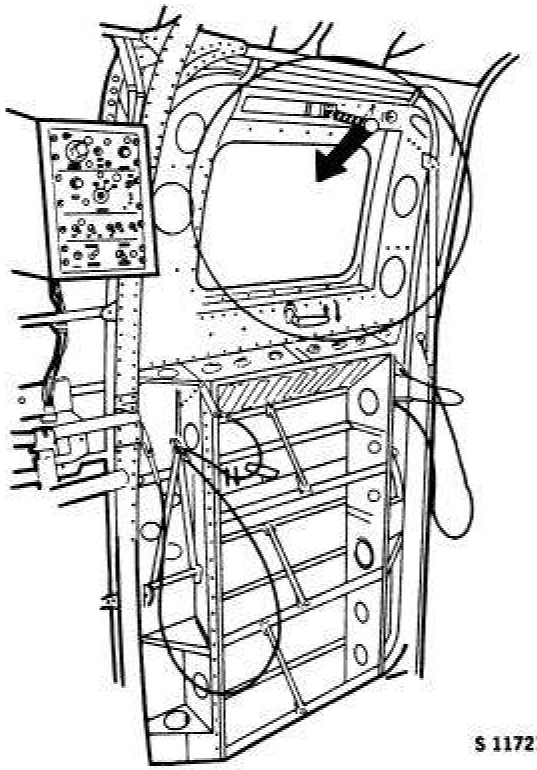


Figure 12-8.1 (ET) Emergency Routes of Escape and Exits

12.35.2 Personnel Door.



S 117215 (C8)

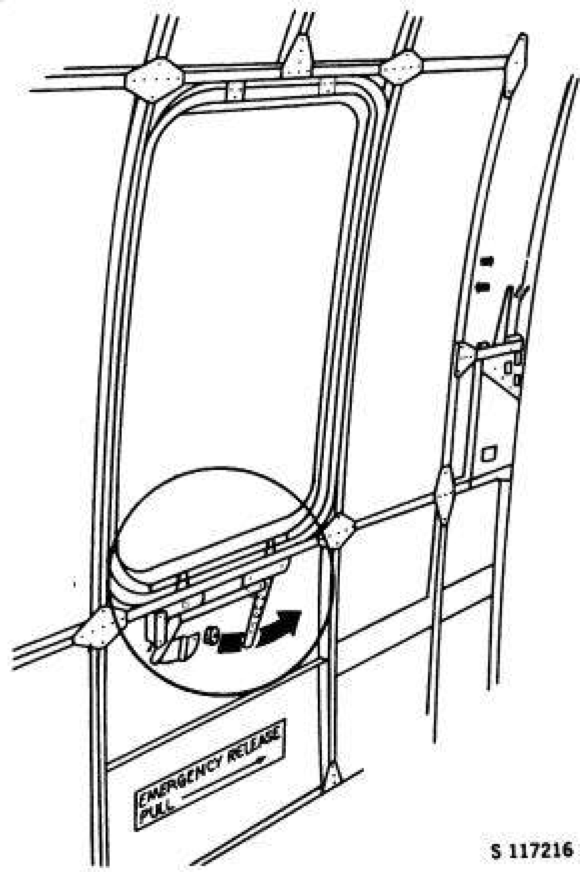
WARNING

Wrapping the support cables for the lower personnel door around the latch located at the top center of the lower door or around the latch below the window on the upper personnel door will prevent use of this exit during an emergency egress and shall be avoided.

12.35.2.1 Interior Release Handle. Pull down on the yellow knobbed handle marked EXIT RELEASE, TURN that is centered on the door frame above the window in the upper door. Pull the lower end of the support tube from the fitting on the forward portion of the fuselage and push outward. A self-luminous marker mounted next to this handle indicates its location. The lower half of the door can be opened by turning the latch at the top center of the door and pushing outward.

12.35.2.2 Exterior Release Handle. The upper door may be opened by pulling the handle marked EXIT RELEASE, TURN. The handle is centered on the door frame above the window. The lower half of the door may be opened by turning the latch marked EXIT RELEASE, PUSH, TURN at the center of the door.

12.35.3 Cabin Door.



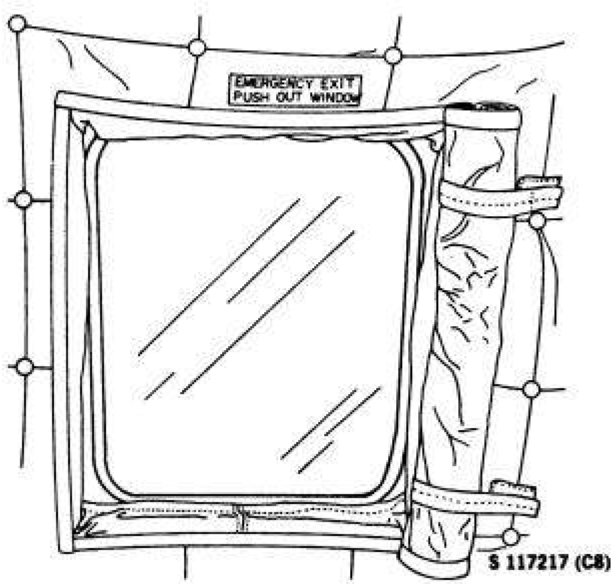
S 117216 (C8)

12.35.3.1 Interior Release Handle. A handle marked EMERGENCY EXIT, TURN is below the window. A self-luminous marker is mounted below the handle to indicate its location. To open the emergency escape window, the handle is pulled aft and the window is pushed out.

12.35.3.2 Exterior Release Handle. A handle marked EMERGENCY EXIT, TURN is on the outside of the cabin door at the lower aft comer of the window. This handle is moved clockwise, and the window is pulled out for emergency entrance or exit.

12.35.4 Cabin Windows.

12.35.4.1 Interior. The three cabin windows, one on the starboard side and two on the port side of the cabin, may be pushed out by sharply striking the corner to provide additional emergency exits. EMERGENCY EXIT WINDOW, PUSH OUT is stenciled above each window on the inside.



12.35.4.2 Exterior. Each of the cabin windows is equipped with a pull tab in the outside for emergency entrance at the lower aft corner marked PULL TAB EXIT RELEASE, by which the locking strip may be pulled out of the rubber seal surrounding the window pane. The panes may then be removed to provide emergency openings.

12.36 INADVERTENT OPENING AND/OR LOSS OF ACCESS PANELS/DOORS

Loss of an access panel or door in flight will generally dictate a slowing of the helicopter and landing as soon as practicable to inspect for further damage.

However, severe vibrations or control difficulties may indicate damage to control surfaces. Land as soon as possible.

Note

Should a panel or door open in flight and remain attached to the helicopter, abrupt attitude changes must be avoided to reduce wind flow changes on the access panel or door. Landing criteria are as the situation dictates.

12.37 UNDERWATER EGRESS

WARNING

Inflating flotation equipment inside aircraft may impede egress.

* 1. Reference point - LOCATE.

AFTER WATER ENTRY

*2. Window – JETTISON.

*3. Grip HEED/HABD mouthpiece with teeth and take a breath to ensure function. Breathe through nose until submerged to conserve air.

*4. Reference point - GRASP.

*5. Helmet cord - DISCONNECT.

*6. Lap belt - RELEASE.

*7. Egress. (Breathe through HEED/HABD as necessary.)

WARNING

Holding a breath taken at depths as shallow as 4 to 6 feet may result in a gas embolism. If breathing is initiated underwater, breathe continuously during egress and ascent. If air is exhausted prior to surfacing, exhale continuously until surface is reached.

*8. Once you are well clear of the aircraft, inflate the LPU. Allow natural buoyancy of initiated LPU to float you to the surface.

12.38 AUXILIARY FLOTATION COLLAR

12 38.1 Application Checklist.

Note

- Position aircraft downwind of the stricken aircraft (maximum 50 yards/ minimum 50 feet) to prevent capsizing of ditching aircraft.
- All swimmers, including the team leaders, are suited out in appropriate SAR gear.
- Team leader takes PRC-90 radio for communications with airborne helicopter.
- Standard rescue swimmer hand signals apply as per NWP 3-50.1, Navy Search and Rescue (SAR) Manual.

1. Fiberglass containers - Check for proper air bottle pressure through the plastic see-through windows (3,000 psi).

2. Bundle strap - Check for security and determine starboard/port bag.

3. Method of deployment - 40-foot hover, down the hoist.

4. Order of deployment:

   a. Team leader.

   b. Starboard bag .

   c. Starboard swimmer.

   d. Port bag .

   e. Port swimmer.

CAUTION

Upon completion of auxiliary flotation collar deployment, the delivery aircraft should reposition as to not interfere with swimmer operations.

5. Team leader - Assume position off nose of aircraft and establish communications with airborne helicopter via PRC-90.

6. Sponson attachment - Port/starboard swimmers connect auxiliary flotation collar to aircraft main landing gear attachment points.

Note

If landing gear is down, attach to the mooring rings; if up, attach to the no picketing point.

7. Nose strap attachment - Connect starboard "V" ring to port "J" hook and attach to towline eyelet.

8. Tail strap attachment - Connect starboard "V" ring to port "J" hook and attach to tailwheel mooring ring.

Note

If aircraft is upright, tail strap shall be forward of the tailwheel yoke assembly. If inverted, tail strap shall be passed through the tailwheel yoke assembly.

9. Sponson attachment recheck - Port/starboard swimmers change sides of aircraft and recheck sponson hookups.

10. Inflation preparation - Port/starboard swimmers pull safety pins from inflation cylinders and proceed to the nose of the aircraft at a 45° angle with heaving rings in hand.

11. Bag inflation - Upon command from team leader, port/starboard swimmers pull sharply on heaving rings to actuate inflation valves.

12. Strap adjustment - As required.

12.39 (NON-ET) WEAPON RECOVERY EMERGENCIES

12.39.1 Helicopter External Load Jettison.

If jettisoning becomes necessary under controlled conditions, the jettison area will be over water, well clear of equipment, vessels, etc. Jettisoning will be accomplished at a slow cruise speed and at as low an altitude as determined safe by the pilot. If using the hoist, guillotining of the hoist cable is not necessary because of a weak link; however, in a controlled jettison, it is desired to prevent flyback of the cable.

At any time the pilot considers the load a jeopardy to the safety of the aircraft, it will be jettisoned clear of the surface craft, or inhabited areas without delay.

Note

Single engine circumstances that are not complicated by compound emergencies will not automatically require immediate jettisoning of the load unless altitude cannot be maintained on one engine.

12.39.2 Emergency Jettison Procedures.

The emergency procedures to be followed depend on the nature of the emergency and are left to the discretion of the pilot. The following guidelines are suggested:

1. A critical emergency is one in which the helicopter and personnel are in immediate danger. Emergency jettison utilizing either cyclic switch or manual release pedal will release the external loads as a unit.

2. A noncritical emergency is one which there is no immediate danger to the helicopter or personnel. The survival of the target then becomes a priority. If possible, separate the target from the helicopter at the lowest acceptable airspeed and altitude. This will minimize damage to the external load. Shallow water depths may permit post jettison recovery if the external load sinks.

12.39.3 Load Oscillation Techniques.

Load oscillations can be caused by such factors as inherent load instability, wind conditions, and aircraft maneuvers. In most cases, the oscillations dampen on their own if the ASE is engaged and resistive control inputs are avoided. In some cases, the oscillations continue to build until the helicopter becomes uncontrollable, in which case jettison of the load may be necessary. Close observation plus timely and proper corrective action (reduction of forward airspeed with slow turn to port or starboard) is therefore required to dampen increasing oscillations before they become unmanageable and jettisoning the load becomes the only option.

If the target fails to separate from the launcher after retracting the SAFE/LAUNCH handle, perform the following steps:

1. Immediately slide off the handle and pull the SAFE knob out fully.

2. If no response, ensure LAUNCH knob is fully out and cycle SAFE knob in and out once.

3. If no response, return the LAUNCH and SAFE knobs to secured (fully in) positions. If the SAFE knob can be fully secured, the helicopter can return to base under normal conditions.

4. If the SAFE knob cannot be secured, the helicopter must return to base or an alternate site in a "low and slow" condition. The altitude and groundspeed chosen will depend upon the transit distance, fuel remaining, and aircraft safety margin considerations. Deposit the launcher at the water's edge.

CAUTION

Do not fly over land with an unsecured SAFE knob.

12.39.4 Mk 2 Mod 0/1 Entanglement Procedures.

12.39.4.1 Rigging Entanglement. In a hover, the cage has a tendency to spin if the hoist cable is slack, causing the nose cable to wrap around the lifting line.

WARNING

If hoist cable above the weak link is wrapped around the lifting line, the safety release system is bypassed and cargo hook release may result in hoist cable failure and snapback.

Under normal circumstances, a wrap will occur below the weak link and thus does not constitute a safety hazard. With a loaded cage, the wrap can be left in place with no adverse effect. With an empty cage, the lines will unwrap after the cage is raised to capture position, although raising the hoist with a wrap in the line might cause damage to the lifting line. Therefore, it is important to prevent wraps at lift-off by keeping the nose of the cage high until the cage stabilizes in forward flight.

A "nuisance failure" of the weak link is more likely to occur if rescue hoist adjustments (starting/stopping) are with the weight of the empty cage on the hoist. If the weak link fails with the cage empty, the helicopter must proceed to the nearest landing site to replace it, or the special grapple can be used to retrieve the nose pendant and continue the recovery. If the weak link fails with the cage loaded, the cage may be flown up to established limits.

12.39.4.2 Disentanglement. Disentanglement of hoist and lifting lines can be accomplished by any of four methods:

1. Helicopter follows landing procedures after untangling lines. This is recommended for two or more wraps.

2. Helicopter descends slowly until HWRS is on the ground and then maintains hover. Groundcrew then disconnect rescue hoist cable, disentangles it, and then reconnects it.

3. Bring helicopter to 40-foot hover over water. Bring empty cage to capture position. As tension comes on hoist cable, the lines will begin to unwrap. As the cage starts to rotate, the crewman operating the hoist may aid by pulling hoist cable inside standoff brace perimeters. Once cage becomes free of wraps, lower hoist back to flight position.

4. If wind conditions allow, helicopter lowers HWRS to the ground and performs pedal turn on the spot until lines are disentangled.

12.40 (ET) UH-3H EXECUTIVE TRANSPORT EMERGENCY PROCEDURES

12.40.1 (ET) Smoke and Fume Elimination.

Smoke, fume, and noxious gases may be eliminated by:

1. Pilot's compartment sliding windows .... Open.
2. Aft Cabin emergency escape hatch .... Open.

WARNING

Do not push out the emergency escape windows while the helicopter is in flight because of the possibility of their being carried into the rotary rudder blades by the airstream.

3. Vent air switch .... On.
4. Evap Blow switch .... On.
5. Registers and diffusers .... Open.
6. Ensure the cabin air temperature control is NOT in RE-CIRCULATE.
7. Foyer Curtains .... Open.

If smoke and fumes are not illuminated:

8. Land as soon as possible.

If smoke and fumes are inhibiting cockpit visibility and safe control of the aircraft, the following may be considered:

9. Slow aircraft below 25 knots, level flight.
10. Emergency escape hatches jettison.
11. Yaw aircraft to ventilate fuselage.
12. Land immediately.

12.40.2 (ET) Heater/Air Conditioner Fire.

1. Cabin heater/air conditioner switches .... SECURE.

If fire continues, proceed as follows:

2. Cabin heater/air conditioner fan switch .... SECURE.
3. Cabin heater/air conditioner circuit breakers .... PULL.
4. Vents .... CLOSED TO CONTAIN FIRE.
5. Fight fire using fire extinguisher at heater/air conditioner access ports and/or heater/air conditioner ducts.

Note

Vents should be closed to contain fire and provide more effective use of fire extinguisher.

12.40.3 (ET) APU Fire on the Ground.

1. APU .... SECURE.
   a. APU generator switch .... OFF.
   b. APU ON switch .... OFF.
2. APU circuit breakers .... PULLED.
3. Fight fire using fire extinguisher.

If fire does not go out:

4. Speed selectors .... SHUT OFF.
5. Rotor brake .... ON.
6. Fuel management panel .... SECURE.
7. Battery .... OFF.

When rotors stop:

9. Aircraft .... ABANDON.

12.40.4 (ET) Interior Release Handle. The door can be opened by turning the latch at the top center of the door and pushing it outward.

12.40.5 (ET) Exterior Release Handle. The door can be opened by turning the latch marked EXIT RELEASE, TO OPEN, TURN, located at the center of the door.

12.41 (ET) Cabin Emergency Exit Hatches.

12.41.1 (ET) Interior. There are three jettisonable emergency exit hatches, one on each side of the cabin and one located aft of the starboard personnel door. The exit release handle button is depressed and the handle is turned upward to release the hatch. The hatch may be pushed out after it has been released. The aft emergency exit hatch is hinged and must be lifted off the hinge to remove the hatch.

12.41.2 (ET) Exterior. An exterior emergency release handle is located at the bottom of each jettisonable emergency exit hatch for emergency entrance or exit. The release handles are painted yellow for easy identification. The handles are otherwise unmarked. The exit release handle button is depressed and the handle turned upward to release the hatch.

PART VI

All-Weather Operations

This Page Left Blank Intentionally

CHAPTER 13

Instrument Procedures

13.1 GENERAL

The helicopter is capable of operating under full instrument conditions within the limitations specified in Extreme Weather Operations, Chapter 14, and in turbulence not over prescribed g loading. The automatic stabilization equipment permits automatic cruising and hands-off flight. Normal airways flight may be accomplished within the limitation of the navigation equipment installed in the helicopter. As with all instrument flying, careful preflight planning is mandatory.

Note

Under instrument conditions, when the flight controls are manned from the copilot position to prevent a dual failure (ASE and attitude indicator) associated with a GYRO or power excitation malfunction, the vertical GYRO selector switch should be placed to STBD. When the flight controls are manned by the pilot, the switch should be placed to the normal PORT position.

13.2 SIMULATED INSTRUMENT PROCEDURES

The seriousness of a midair collision requires continuous caution on the part of all pilots and crewmen engaged in simulated instrument flights. When a device is used to obstruct pilot vision, the area of surveillance for which he is responsible must be covered by another person familiar with aviation, instructed in his duties, and provided with direct communication with the safety pilot.

13.2.1 Safety Precautions. When engaged in simulated instrument flights, the pilots and air crewmen involved are responsible for the knowledge of and compliance with the following safety precautions:

1. Communications shall be tested between all stations and when such communications cannot be effected with the pilots, simulated instrument flight shall not be attempted.

2. The lookout shall be indoctrinated thoroughly in the nature and importance of his duties and should be selected from air crewmen currently receiving flight orders.

3. The safety pilot shall observe the performance of the lookout carefully and will be responsible for him. No lookout shall be permitted to read or otherwise be distracted from his duty. The safety pilot keeps the lookout informed when approaching congested areas.

13.3 INSTRUMENT FLIGHT PROCEDURES

13.3.1 On Entering Helicopter. Normal preflight procedures as prescribed in Part III will be adhered to. In addition, the following areas should be carefully checked before takeoff:

1. Compass system checked for stabilization of needle and check for 180° ambiguity against standby compass 3 to 4 minutes after power has been turned on.

2. Vertical velocity indicator checked for zero reading.

3. Pitot heat operation checked by plane captain.

4. Radio communication. Check all frequencies possible that are anticipated.

5. Clock set.

6. Altimeter checked with control tower.

Note

Do not accept helicopter for instrument flight if altimeter is off ±75 feet.

7. Windshield wipers - as required.

8. Monitor magnetic bearings on RMI to selected station during taxi turns.

9. Plane captain check operation of exterior lights.

13.3.2 Instrument Takeoff. If visibility will allow a normal hover, the safety checks of flight controls, engines, and ASE should be accomplished. When a normal hover is not possible the helicopter may be flown off the deck and into a normal climb without any outside reference. In the case of full instrument takeoff (when outside visual reference cannot be maintained at hover altitudes), the D-mode position of hover indicator (NON-ET) must be used for stability of vertical position. The Doppler velocities displayed on the hover indicator (NON-ET) must be used until airspeed and vertical speed indicators become reliable. The collective should be increased steadily as the helicopter leaves the ground. A level attitude must be maintained with reference to the attitude indicator. As altitude increases through 15 feet as indicated on the radar altimeter, the nose should be beeped to an attitude approximately 5° nose low or 5° to 8° below the hover attitude. Simultaneously, the collective should be increased as necessary within transmission torque limitations. Until a normal climb airspeed of 70 knots is attained, climbout should be maintained by a combination of attitude and power. Airspeed indications are usually unreliable at speeds below 60 knots, and reliance on indications below 60 knots may result in premature level-off airspeeds.

13.3.3 Instrument Climb. Climb under instrument conditions is similar to the climb technique and procedure prescribed for normal climb.

13.3.4 Instrument Cruising Flight.

CAUTION

The transmission oil cooler was designed for maximum efficiency during sea-level operations. Higher than normal main gearbox oil temperatures can be anticipated when operating at altitudes above sea level when combined with high ambient temperatures and high power settings. The reduced pressure/density of air passing through the radiator causes a loss in cooling efficiency of the main gearbox cooler.

13.3.4.1 Speed Range. Performance data must be checked before flight for accurate airspeed limitations based on proposed cruising altitudes at various temperatures and gross weights. Reduce the maximum airspeed by 6 knots for each thousand feet of altitude above 4,000 feet MSL. Airspeed limitations at altitude must be considered when accepting changes in cruising altitudes on airway instrument flight plans.

13.3.4.2 Level Turn. Level turns during low-level instrument flying should be made by overcoming the stick trim pressure for the following reasons:

1. The pitch attitude, as referenced by a fixed fore-and-aft cyclic position, will be retained.

2. Level roll attitude will be preserved in the trimmed position of the cyclic.

3. An excess rate of roll is retarded.

4. A quick recovery is provided.

13.3.4.3 Attitude Changes. Attitude changes during the low-level night mission should be made with the beeper valve. Changes in airspeed are comparatively more permanent than changes in banks for turns. Therefore, overcoming trim pressure is not recommended.

Note

In changes in either bank or pitch during the night instrument mission, the use of the TRIM RELEASE button should be avoided. If a pilot is distracted while the button is depressed, inadvertent and undesired cyclic movements may take place, resulting in changes in helicopter attitude. These changes may be undetected beyond a reasonable time if pilot attention is attracted outside of the cockpit.

13.3.4.4 Barometric Altitude Control.

WARNING

For flight safety, the barometric altitude controller should be maintained ON while in the night landing pattern ashore or while embarked and should not be shut off until in visual contact with the desired landing spot; however, intermittent operation may be obtained by depressing the momentary BAR REL button on the collective stick during pattern descents.

After leveling off and stabilizing airspeed and power, the BAR ALT channel may be engaged. Under smooth air conditions, collective friction is not necessary. If operating in turbulence with the BAR ALT channel engaged, a slight amount of collective friction is required to reduce random movement of the collective caused by the turbulence. The BAR ALT control shall be used at all times while performing the low-level instrument mission.

13.3.5 Holding. A maximum endurance airspeed of approximately 70 knots can be easily maintained during normal holding and presents no fuel problem. However, a navigational problem will be present while attempting to maintain a pattern in high winds. For normal shipboard holding procedures, the CV NATOPS Manual should be consulted. Drift correction angles of 30° are as common to the helicopter as 10° corrections are to a fixed-wing aircraft.

13.3.6 Instrument Descent. Normal descents are made by reducing power until the desired rate of descent is accomplished. En-route descents are normally made at cruising airspeed. Emergency descent can be made by entering autorotation.

13.3.7 Instrument Approaches. Instrument approaches are made using standard instrument approach procedures. By using cruising speed during the entire approach, the pilot can reduce the effect of wind on the track and groundspeed of the helicopter and be able to fly a more precise approach. During the final approach, it is important that the airspeed be held constant to control drift and ground speed. Small changes in heading may be made by turning the YAW TRIM knob of the ASE. Refer to Figures 13-1 and 13-2 for typical instrument approaches.

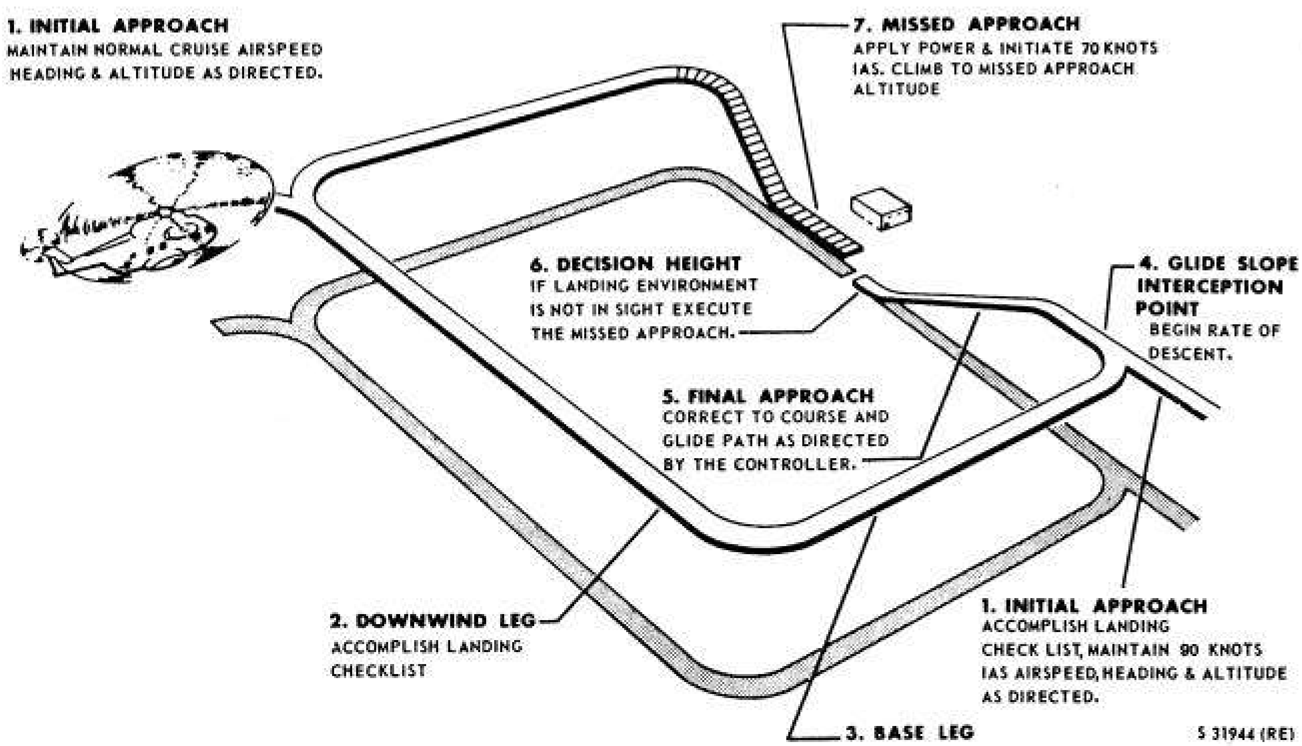


Figure 13-1. Ground-Controlled Approach (Typical)

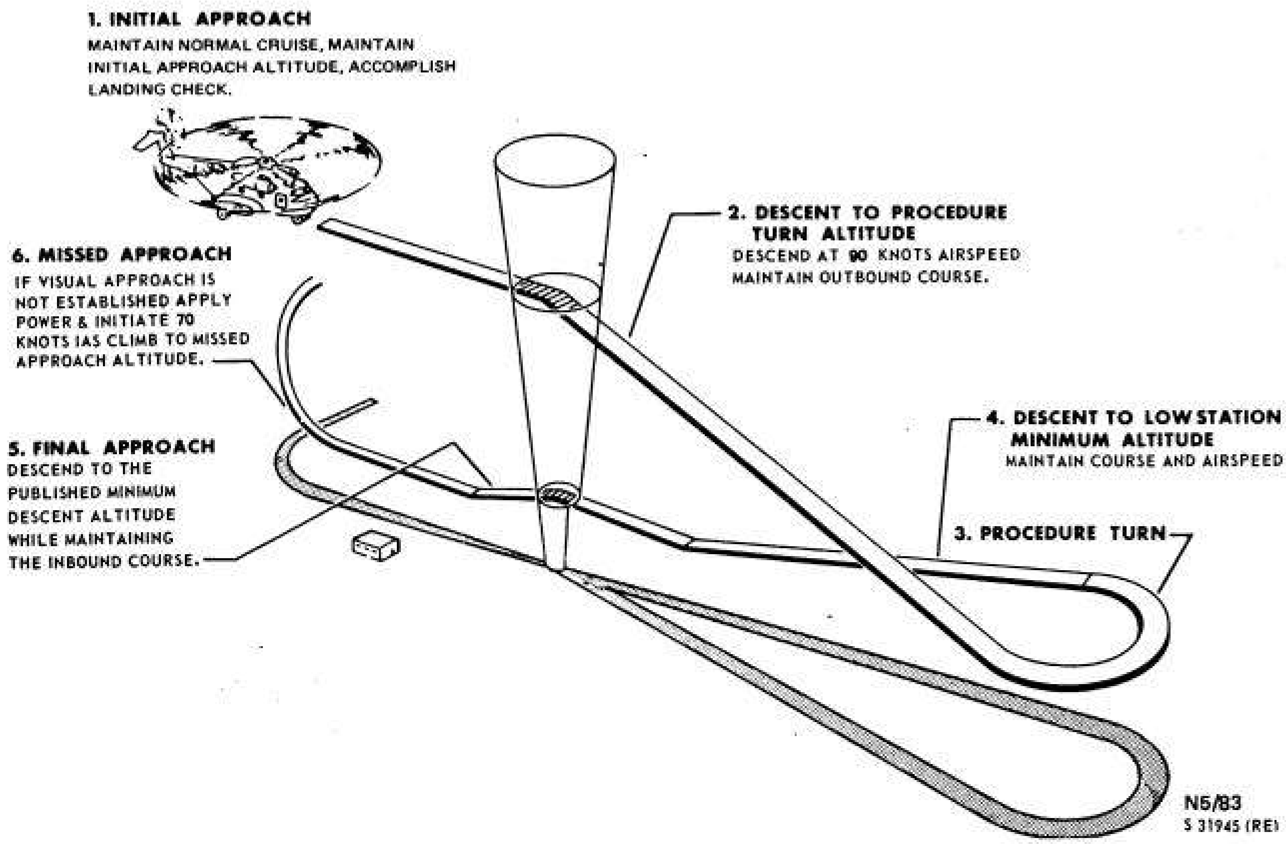


Figure 13-2. ADF Approach (Typical)

CHAPTER 14

Extreme Weather Operation

14.1 ICE, RAIN, AND SNOW

Takeoff is prohibited with snow and ice on the helicopter. Failure to remove snow and ice accumulated while on the ground can result in serious aerodynamic and structural effects when flight is attempted. Takeoff, hovering, and climbout performance as well as stall speeds and handling characteristics can be adversely affected. Unbalanced loads of snow and ice will result in heavy vibration in flight, causing severe structural damage. The rotary wing head, rotary wing blades, rotary rudder, and flight controls should be thoroughly inspected and be free from ice and snow.

WARNING

This helicopter shall not fly through areas of forecast icing unless the weather has not developed as forecast. When icing conditions, except dry snow, are inadvertently encountered, immediately turn on the engine/inlet and windshield anti-icing systems. With dry snow present, use of the anti-icing system may result in melting of the snow on the intake ducts and subsequent refreezing and ice accumulation at the engine front frame. Under such conditions, use of the inlet anti-icing system is not recommended.

Some significant locations to observe for ice or snow accumulation are the windshield wipers, pitot tubes, and wing stubs. If snow or ice accumulates during flight, a precautionary landing should be made to remove the accumulation. If a landing is not possible, change altitude to leave icing environment. Continued flight may cause ice ingestion in the engine from areas forward of the inlet. Icing of the air inlet area is an ever present possibility when operating in weather with temperatures of 10 °C and below with visible moisture with the exception of dry snow. Snow below a temperature of –4 °C can be assumed to be dry if there is no accumulation on the helicopter.

Takeoffs into fog or low clouds when the temperature is at or near freezing could result in engine air inlet icing. Climbs should be made at higher than normal rates of climb under such conditions. Engine air inlet icing does not necessarily occur with blade icing.

14.1.1 Flight With Ice Shield.

CAUTION

- The auxiliary pitot static tube sleeves shall be installed when the ice shield is installed and removed when the ice shield is not installed to prevent excessive airspeed indicator error.

- Engine power loss will occur with the ice shield installed.

Note

Because of change of airflow around the pitot tubes, a reduced effectiveness in the barometric altitude hold system may be experienced.

Helicopters modified by either AFC 247 or AFC 321 have a removable ice shield installed forward of the engines to prevent engine ice ingestion. The AFC 321 ice shield is identified by a smooth contoured ramp directing airflow into the engine. The AFC 247 ice shield does not have the flow director.

Operating procedure with ice shield installed is as follows:

1. Flight operators may be conducted when icing conditions are forecast. However, known areas of icing shall be avoided.

2. If icing conditions are encountered in flight, immediately leave area where icing exists.

3. Do not hover in freezing mist conditions.

A loss of gas generator speed (no mechanical difficulties present) and a rise in power turbine inlet temperature may indicate engine icing. If power turbine inlet temperature increases, retard engine speed selector to maintain normal power turbine inlet temperatures. Engine failure may occur rapidly because of overheating of turbine and exhaust area.

WARNING

- Whenever the helicopter is to be operated where temperatures of -28 °C are expected to be encountered, the rotary rudder cables should be tensioned in accordance with the Manual Maintenance Instruction, NAVAIR 01-230HLH-2-3.9.

- When operating in cold temperatures, flight control movements during servo checks should be completed slowly at first to avoid damage to the control linkages and servos.

- While still a factor for successful cold-weather operation, cold-weather preflight preparation is not generally as critical in turbine-powered helicopter operation as in reciprocating engine helicopter operation because there is not need for oil dilution, etc. In order to expedite preflight inspection and ensure satisfactory operation for the next flight, normal operating procedures outlined in Part III should be adhered to with the following additions and exceptions.

14.1.2 Before Entering the Helicopter.

1. Check lower section of the engine air inlets for evidence of ice. Moisture collected on previous flights can accumulate in the lower section between the front stator and rotor blades and freeze. An attempted engine start will result in starter failure. If ice is suspected, check the engine for freedom to rotate, external heat must be applied to forward engine section to permit thawing. Start engine as soon as possible after heat application to remove all moisture before refreezing can occur.

2. Check that all protective covers have been removed.

3. Check that the helicopter, including surfaces, controls, ducts, oleo shock struts, drains, etc., has been cleared of all snow, frost, and ice.

14.1.3 On Entering Helicopter. Check the electrical and radio equipment with external power source connected.

14.1.4 Warmup and Ground Check.

1. Turn on cabin heater and windshield ice protection systems, as required, immediately after engine start.

WARNING

- Hot exhaust from the heater may burn personnel in the vicinity of the heater exhaust.

- If windshield anti-ice is to be used, the LOW position should be selected before selecting NORMAL. Personnel in the vicinity of the helicopter should be warned that a possible missile hazard exists in case of a defective or arcing heating elements.

2. Check transmission oil temperature.

CAUTION

If an emergency rotor engagement is made when the ambient temperature is –29 °C or less, a VIDS/MAF shall be submitted. The gearbox may be damaged from lack of lubrication at these low temperatures.

3. Check the flight controls for proper operation.

Note

Cycle the flight control on each servo system.

14.1.5 Taxiing. Avoid taxiing in deep snow, as taxiing and steering are extremely difficult and frozen brakes are likely to result.

14.1.6 Before Takeoff.

1. Check that windows, cabin doors and passenger doors (ET) are fully closed.

2. Turn the pitot heater switch ON just before moving into position for takeoff.

14.1.7 After Takeoff.

1. After takeoff from water, wet snow, or slush covered field, operate the landing gear through several complete cycles to prevent freezing in the retracted position.

2. Check instruments.

14.1.8 During Flight. Use cabin heater, engine air inlet anti-icing, and windshield ice protection systems, as required.

14.1.9 Before Leaving Helicopter.

1. Release brakes after wheels are chocked.

2. Whenever possible, leave helicopter parked with full fuel tanks. Every effort should be made during servicing to prevent moisture from entering the fuel system.

3. Check that the battery is removed when the helicopter is parked outside for any extended period of time.

4. Check that all protective covers have been installed. (Engine exhaust and air inlet protective covers should not be installed until after engine cooldown).

This Page Left Blank Intentionally

PART VII

Communications-Navigation-Identification Systems

This Page Left Blank Intentionally

CHAPTER 15

Communication-Navigation-Identification Systems

15.1 INTRODUCTION

The role of communications is to provide an effective means of control and coordination. It is of primary importance that all transmissions be as brief and accurate as possible. To accomplish this without overloading the tactical circuits requires strict adherence to proper voice procedures and radio discipline. Brevity code words will be used whenever appropriate.

15.2 COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

The intercommunication system provides intercommunication for the pilot, copilot, crew, and the hoist operator when those stations are manned. Two communications stations are provided in the pilot compartment, one each for the pilot and copilot. Each station is equipped with headset and microphone connections, microphone switches, and interphone control panels. Three other communication stations are in the cabin: one for the cabin; one for the hoist operator at the cargo door; and one at the No. 2 hoist operator station aft of the cargo door. Each station is equipped with headset jacks and microphone connections, a microphone switch, and intercommunication controls. The hoist operator stations also have facilities on the radio intercommunication panel for monitoring radio signals. The communication and associated electronic equipment installed in the helicopter is listed in Figure 15-1. The equipment is connected to the helicopter electrical systems at the circuit breaker panels. Operating controls for all the equipment are at the various crew stations. Indicators used in conjunction with the navigation sets are on the instrument panel. The location of antennas is shown in Figure 15-2. The intercommunication system (ET) provides intercommunication for the pilot, copilot, crew chief, and aft crewman. The pilot and copilot stations are equipped with headset and microphone connections, microphone switches, and interphone control panels. The crew chief, station 160, and aft crewman, station 425, are each equipped with headset and microphone connections and an interphone control panel.

15.2.1 Radio Operating Controls. A three-position microphone trigger switch marked ICS and RADIO, and spring-loaded to the off position on the pilot and copilot cyclic stick grip connects their respective microphones to the interphone transmission circuit when held in the ICS position and to the radio transmission circuit when held in the RADIO position. When the pilot or copilot desires to communicate with the crewmen when they are on SONAR INTERCOM, the pilot or copilot must ensure that the HOIST select switch on the overhead switch panel is at OFF or CREW and depress the HOIST/SONAR CALL switch to the UP hoist position on his collective pitch stick grip, or place the switch marked SONAR INTERCOM with marked positions OFF and ON on the overhead switch panel to ON. The HOIST/SONAR CALL switch on the collective pitch grip is of the momentary-contact type and connects the intercommunication system only when depressed. The SONAR INTERCOM switch provides for continuous intercommunications between pilot, copilot, and crew.

Foot switches are mounted on the deck at the pilot and copilot stations that can be used in place of the microphone trigger switch. The floor switches will key either ICS or radios depending on which one is selected on the transmitter selector panel.

The ICS and LF/ADF are operated on dc power only. All other radio equipment require both ac and dc power for operation.

15.3 INTERPHONE-RADIO CONTROL SYSTEM (ICS)

The AN/AIC-l4 ICS (Figure 15-3 (NON-ET) or Fig. 15-3.1 (ET) amplifies inter-phone and received radio signals and provides control for ICS isolation between crewmen and pilots, crew radio transmission (HF and UHF on frequency set in by pilot), and ON-OFF selection of radio receivers.

TYPE	DESIGNATION	FUNCTION	PRIMARY OPERATOR	RANGE	LOCATION OF CONTROLS
No. 1 UHF/ COMM	AN/ARC-159 (NON-ET)	Short range two-way voice	Pilot or Copilot	Line of sight	Cockpit console
VHF Transmitter Receiver	ARC-186 (NON-ET)	Two-way communication	Pilot or Copilot	Line of sight	Cockpit console
UHF/VHF/COMM No. 1	AN/ARC-182(V)	Two-way communication	Pilot or Copilot	Line of sight	Cockpit console
UHF/VHF/COMM No. 2	AN/ARC-182(V) (UH-3H Executive Transport)	Two-way communication	Pilot or Copilot	Line of sight	Cockpit console

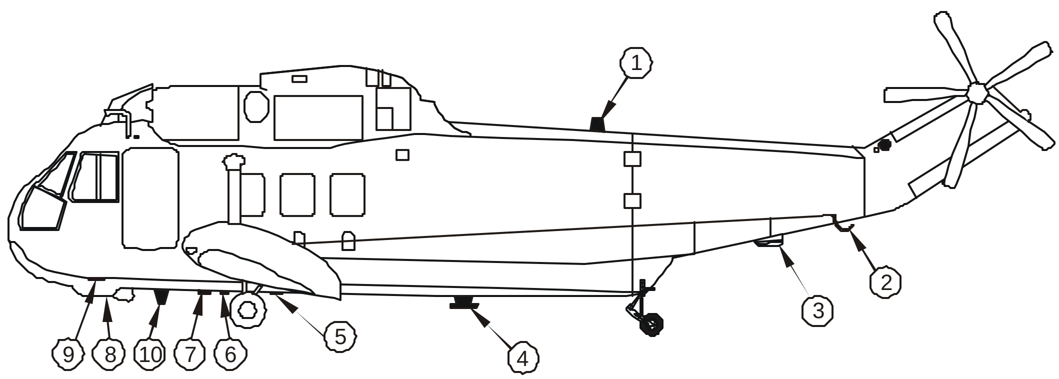


Figure 15-2.1. (ET) Antennas

TYPE	DESIGNATION	FUNCTION	PRIMARY OPERATOR	RANGE	LOCATION OF CONTROLS
ICS	AN/AIC-14	Intercommunication of crew and control over communication facilities	Crew Members	Interior of helicopter	(1) Pilot — Pilot's console (2) Copilot — Copilot's console (3) Crew — Crew stations
HF/COMM	AN/ARC-94	Medium range two-way voice	Pilot or Copilot	Long range-line of sight plus surface wave and sky wave distances determined by atmospheric conditions	Cockpit console
Secure Speech	TSEC/KY-58	Secure speech through UHF No. 1	Pilot or Copilot		Cockpit console
No 1 UHF/ COMM	AN/ARC-159	Short range two-way voice	Pilot or Copilot	Line of sight	Cockpit console
No 2 UHF/ COMM	AN/ARC-159	Short range two-way voice	Pilot or Copilot	Line of sight	Cockpit console
VHF Transmitter Receiver	ARC-186	Two-way communication	Pilot or Copilot	Line of sight	Cockpit console
ADF Group	AN/ARA-25A	ADF	Pilot or Copilot	Line of sight	Cockpit console
OTPI System	R-1047A/A receiver	ADF	Pilot or Copilot	30 miles	Cockpit console
LF/ADF	AN/ARN-59	ADF	Pilot or Copilot	Bearings inaccurate at ranges over 100 miles at night	Cockpit console
TACAN	AN/ARN-84	Bearing and distance to beacon or distance to another aircraft	Pilot or Copilot	Line of sight	Cockpit console
TACAN	AN/ARN-118 (V)	Bearing and distance to beacon or distance to another aircraft	Pilot or Copilot	Line of sight	Cockpit Control
AIMS Transponder System	ATCRB IFF Mark XII	Identification, azimuth, range, and altitude	Pilot	Line of sight	Cockpit console

N8/97

Figure 15-1. Communication and Associated Electronic Equipment

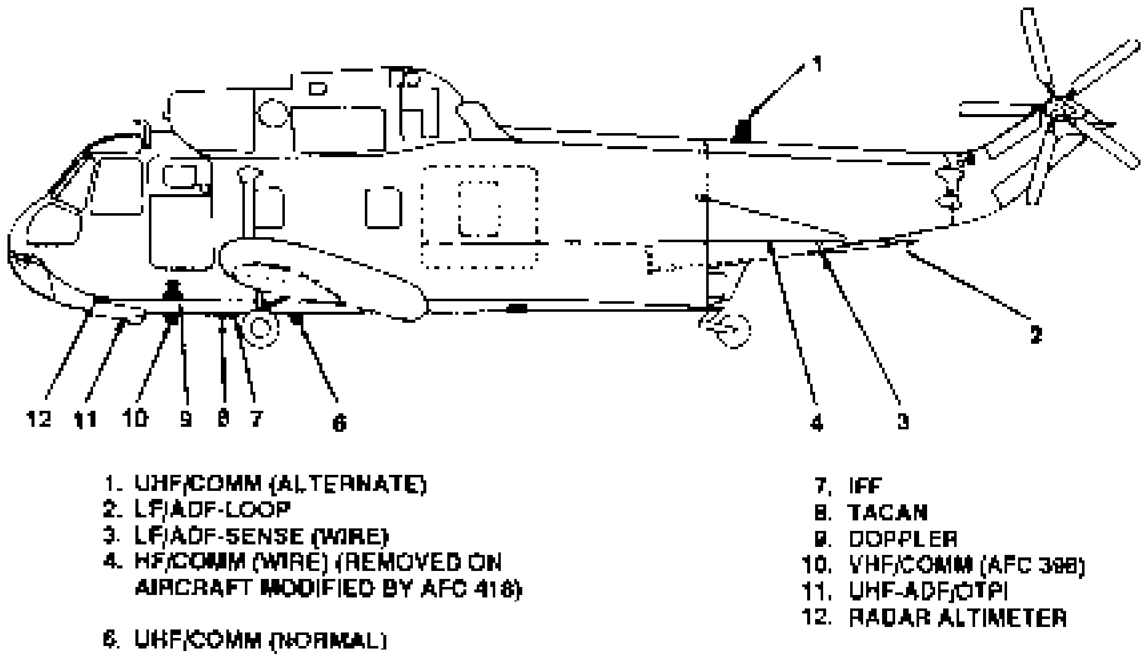


Figure 15-2. (NON-ET)Antennas (Typical)

15.3.1 Interphone Control Panels. Each crewmember has an individual ICS master control panel, transmitter selector panel, and a radio receiver selector panel. The crewmen each have an ICS master control panel, a receiver selector panel, and a transmitter selector panel. The hoist operator has a radio receiver and transmitter selector panel, an ICS master control panel, and an ICS mixer control panel. The No. 2 hoist operator station is also equipped with a radio receiver selector panel, an ICS master control panel, and an ICS mixer control panel. The system operates on direct current and is protected by two circuit breakers. The system is operative when the battery switch is turned ON or an external source is plugged in. The pilot, copilot, and forward crewman are provided with radio communication. The pilot, copilot, and crewmen are provided with audio signal reception from automatic direction finder ADF. The pilot and copilot are provided with audio signal reception from tacan. The set provides separate interphone communications between the pilot and the copilot independent of interphone communications between the sensor operators.

15.3.1.1 Interphone Control Panels (ET). The pilot and copilot each have an individual ICS master control panel, transmitter selector panel, and a radio receiver selector panel. The crew chief and aft crewman are equipped with individual ICS master control panels. The system is operative when the battery switch is turned ON or an external source is plugged in. The pilot and copilot are provided with radio communication on HF and UHF. The pilot and copilot are provided with audio signal reception from the automatic direction finder ADF and TACAN. There is an external ICS jack installed forward of the port passenger door.

The hoist operator can select either the pilot or the crew ICS. The pilot interphone can be connected with the crew interphone by either the SONAR CALL switch on the collective pitch lever grip or the SONAR INTERCOM ON-OFF switch on the overhead switch panel.

15.3.1.2 ICS Master Control Panel. Interphone master control panels (Figure 15-4) at each station contain isolation and microphone amplifiers and are the master controls for the interphone radio control system for that location (see Figure 15-3). Each panel marked ICS consists of an amplifier selector switch marked AMPL SEL, a VOX sensitivity control, a microphone selector switch marked MIC SEL, and an interphone volume control knob marked INTPH VOL. The amplifier selector switch is a four-position, rotary-type switch with positions marked EMERG, NORM, ALT 1, and ALT 2. When the amplifier selector switch at any station is turned to EMERG and the corresponding sonar ICS switch is switched from L-OPR or R-OPR ICS to TRANS, as in the failure of both amplifiers, the headset is connected directly to any of the first three switches of the receiver selector panel at that station. No interphone operation is possible when the amplifier selector switch is at EMERG. Under these conditions, communications are possible only by using radio sidetone (HF (if installed) and UHF). In the ALT 1 position, the isolation amplifier transfers its load to the microphone amplifier. Normal ICS is possible at ALT 1 or ALT 2 positions, using the corresponding amplifier. The microphone selector switch has three positions: COLD that is used in normal operations and that requires use of the microphone trigger switch; HOT that gives the operator continuous microphone, hands-off operation; and CALL, a spring-loaded override position that allows ICS to all interphone stations regardless of their switch positions. Upon releasing the MIC SEL switch from CALL, the microphone selector switch will return to HOT and only the station that has initiated the call circuit will have a hot microphone.

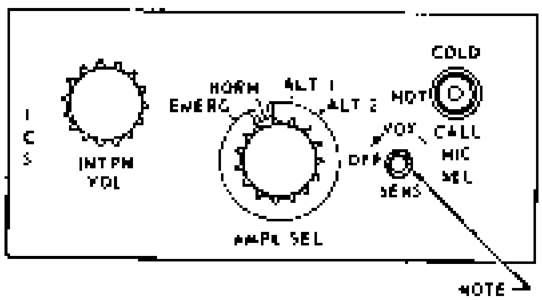
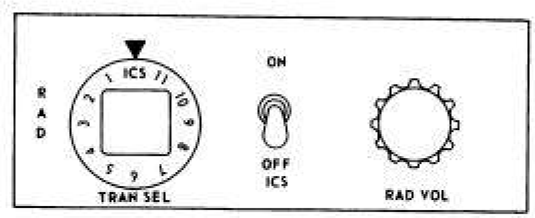


Figure 15-4. ICS Master Control Panel

The CALL position will cancel the SONO DIR mode selected on the sensor operator receiver selector panel. The knob marked VOX (voice operated switch) is to the right of the AMPL SEL rotary switch and has a marked position OFF, plus an arrow in a clockwise direction. Operation of the VOX function is as follows. The system is energized by turning the knob clockwise out of the OFF detent. The ICS should be keyed by placing the MIC SEL switch to HOT. The VOX knob should now be adjusted so that the microphone is energized when the operator talks in a normal tone and deenergized when the operator stops talking. Turning the knob clockwise decreases the sound level necessary to key the microphone. On helicopters equipped with VOX, only the interphone will be keyed through the VOX system. Helicopters not equipped with VOX-MIC SEL-HOT switch position will key the interphone system. The knob marked INTPH VOL is used to adjust the level of the incoming signal as well as the sidetone level.

15.3.1.3 Transmitter Selector Control Panels. Four transmitter selector control panels (Figure 15-5) enable the pilot, copilot, sensor operators, and forward crewman to turn the interphone set on or off, to select the transmitter to which audio and keying circuits are connected, and to adjust the radio receiver volume. The panel is marked RAD and consists of an ICS control switch with positions ON and OFF; a twelve-position transmitter selector-switch marked TRANS, SEL, ICS, and 1 through 11; and a volume control marked RAD VOL. The ICS ON and OFF switch controls the incoming interphone signals and is used in conjunction with the ICS master control panel. When the ICS ON and OFF switch is placed OFF, only radio signals can be heard. If the MIC SEL switch on the ICS master control panel at any of the crew stations is placed to CALL, the ICS ON and OFF switch is bypassed. The transmitter selector switch positions are 1 (UHF 1), 4 (UHF 2), and 6 (VHF). The volume control adjusts the level of the received radio signals. On UH-3H Executive Transport helicopters, two transmitter selector control panels (Figure 15-5.1) enable the pilot and copilot to turn the interphone set on or off, to select the transmitter to which audio and keying circuits are connected, and to adjust the radio receiver volume.



TRANSMITTER SELECTED		
SW POS	Pilot / Copilot	Crewmen
1	UHF 1	
4	UHF 2	
6	VHF	
2,3,5,7-11	NOT USED	NOT USED

Figure 15-5. Transmitter Selector Control Panel

15.3.1.4 Hoist Operator ICS Mixer Control Panels. The hoist operator ICS mixer control panels (Figure 15-8) consist of a PILOTS ICS - SONAR ICS switch and RAD VOL control. The PILOTS ICS - SONAR ICS switch permits the hoist operator to communicate with the pilot and copilot, and forward crewman. The RADIO VOLUME control is used with the selected receiver on the radio receiver and transmitter selector panel.

15.3.2 Interphone Operation

1. AMPL SEL switch (master control panel) - NORM. All stations.

2. MIC SEL switch (master control panel) - AS DESIRED.

3. TRANS SEL switch (transmitter selector panel) - DESIRED TRANSMISSION. Pilot and crew.

4. ICS ON-OFF switch (transmitter selector panel) - ON. Pilot and crew.

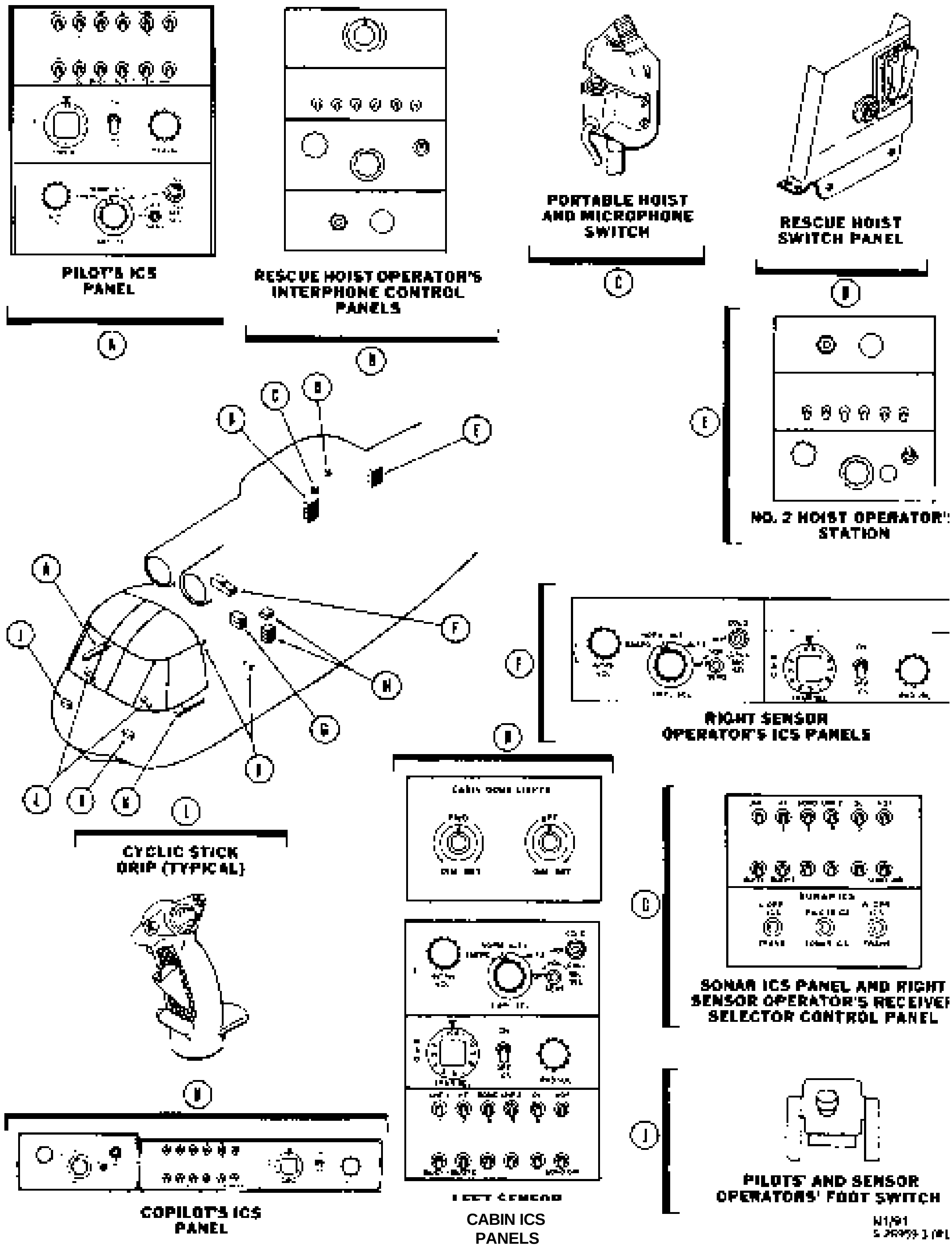


Figure 15-3. Intercommunication System

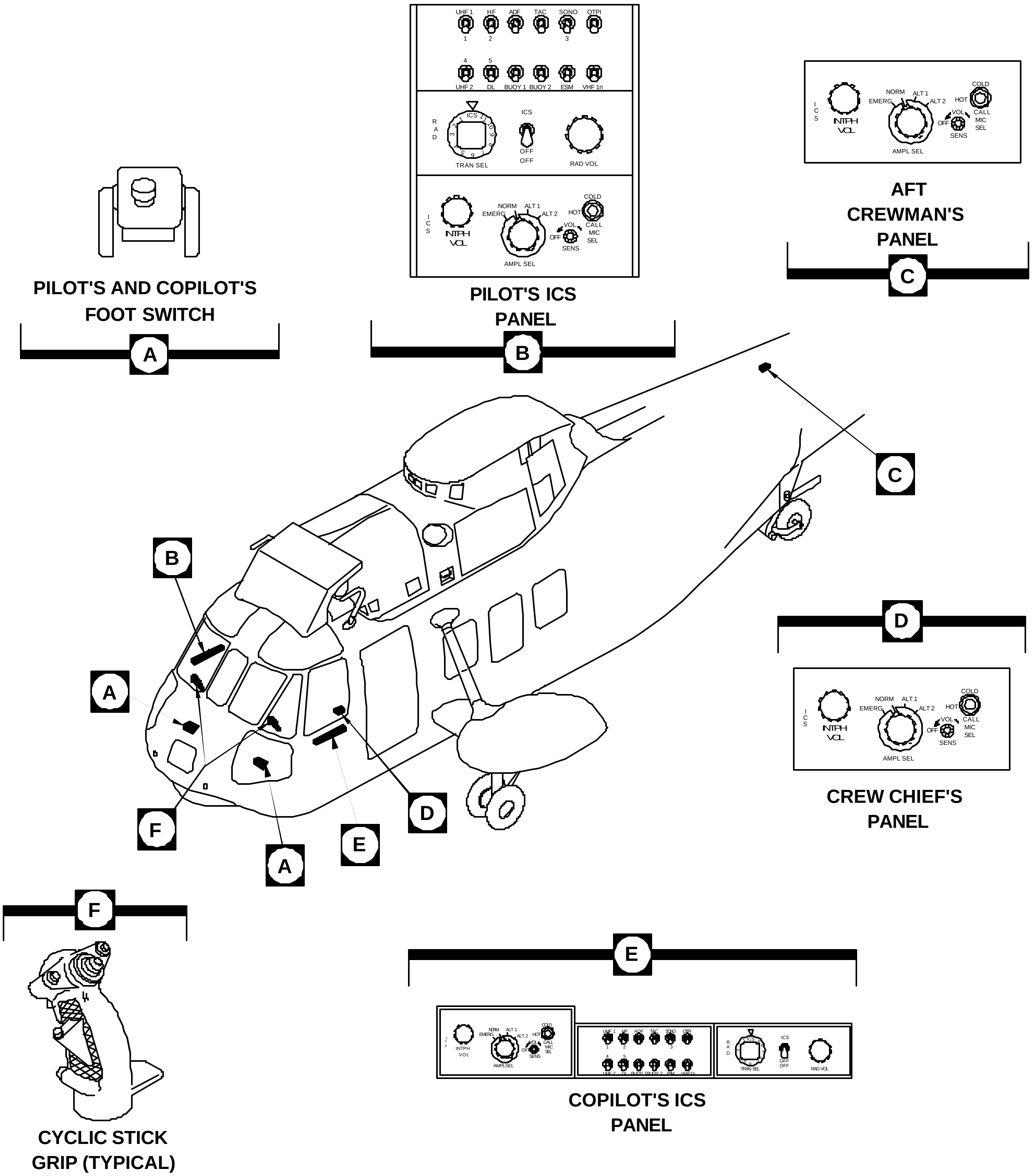
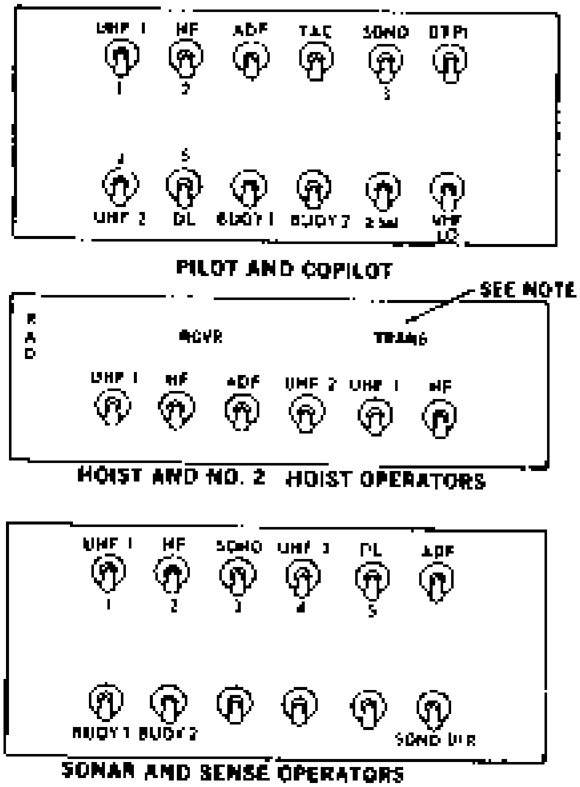


Figure 15-3.1. (ET) Intercommunication System



Note

Not on hoist operators panel

Figure 15-6. Receiver Selector Control Panels

To transmit:

5. COLD MIC/microphone switch - DEPRESS; pilot/copilot cyclic trigger switch, pilot/copilot foot switch, sensor operator foot switch (for use of foot switch, ICS must be selected on the TRANS SEL switch), hoist operator portable hoist, and microphone switch. HOT MIC/VOX – VOICE ACTIVATED.

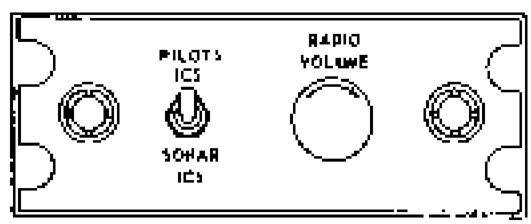
TRANSMITTER SELECTED	
SW POS	PILOT, COPILOT
1	UHF/VHF
2	NOT USED
3	NOT USED
4	UHF
5-11	NOT USED

Figure 15-5.1 (ET) Transmitter Selector Control Panel

SEL. FUNC	SIGNAL SOURCE	SIGNAL INFORMATION	SIGNAL DISTRB.
VHF	VHF / COMM	COMMUNICATION	PILOT / COPILOT
UHF 1	UHF / COMM	COMMUNICATIONS AND ADF IDENTIFICATION	PILOT / COPILOT
UHF 2	UHF / COMM	COMMUNICATIONS AND ADF IDENTIFICATION	PILOT / COPILOT
ADF	LF / ADF	IDENTIFICATION	ALL STATIONS
TAC	TACAN	IDENTIFICATION	PILOT AND COPILOT

Figure 15-7. Receiver Selector Control Panel Function

Figure 15-8. ICS Mixer Control Panel



15.4 UHF/COMM SET (AN/ARC-159)

The helicopters are equipped with one AN/ARC-159 UHF/COMM sets that provide two-way voice communication. This can be accomplished on any one of 20 preset frequencies or manual selection of any one of 7,000 channels within the equipment frequency range of 225.00 to 399.975 MHz. The set includes a guard receiver that permits continuous monitoring of the guard frequency whenever the main transmitter-receiver is tuned to a tactical frequency. The radio set also provides automatic direction finding in conjunction with the UHF-OTPI/ADF group. Relative and magnetic bearing will be displayed by the No. 1 pointer on the RMI. In addition, the No. 1 UHF/ COMM is used in conjunction with the TSEC/KY-58 secure speech set as a speech security system.

15.4.1 UHF/COMM (AN/ARC-159) Control Panel. The control panel (Figure 15-9) is on the cockpit console. The function selector has four positions. At OFF, all power is removed from the equipment. The MAIN position energizes the receiver-transmitter. The BOTH position energizes the receiver-transmitter and guard receiver

At ADF, the UHF-OTPI/ADF group is engaged to provide automatic direction-finding operation. The mode selector has four positions. The PRESET position permits selection of one of 20 preset channels by means of the preset channel control. At MANUAL, any one of 7,000 frequencies may be selected by use of the manual frequency selectors. The GUARD position selects the preset guard frequency for the transmitter and receiver with the function selector set to MAIN. The READ position will display the preset frequency of the preset channel selected on the preset channel/frequency indicator. Setting the function selector to BOTH with the mode selector set at GUARD turns the guard receiver on and places the transmitter, guard receiver and main receiver on the guard frequency. The PRESET channel control selects any one of the 20 preset channels. The preset channel/frequency indicator displays the preset channel. Frequency selectors provide manual frequency selection when the mode selector is set at MANUAL and the frequencies are displayed in the preset channel/frequency indicator. The VOL control adjusts the audio level of the receiver. The SQ/OFF switch has two positions, SQ and OFF. At OFF, the receiver squelch is disabled; at SQ position, the receiver squelch circuit is unaffected. The TONE button, when pressed, transmits a continuous tone. The LAMP TEST button, when pressed, displays a series of digit eights in the preset channel/frequency indicator to check operation of the indicator.

15.4.2 UHF Antenna Selector Switch. UHF antenna selector switch marked UHF ANT SEL on the dome light panel has marked positions NORMAL and ALT. With the switch at NORMAL, the lower antenna will provide for two-way communication from the No. 1 UHF/COMM set, and the upper antenna will provide for two-way communication from the No. 2 UHF/ COMM set. With the switch at ALT, the UHF/COMM sets are reversed.

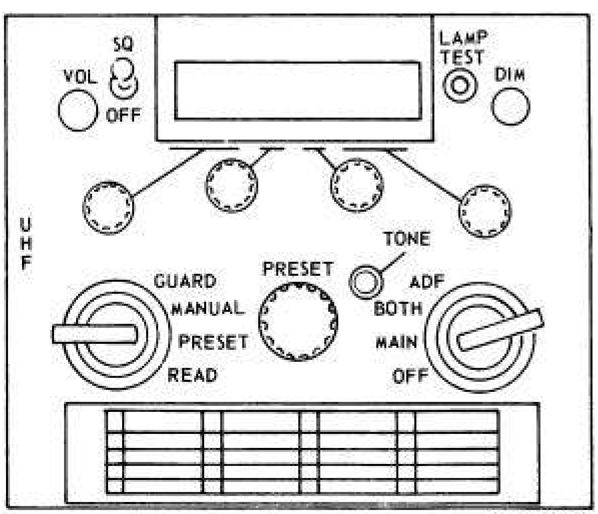


Figure 15-9. UHF/COMM Control Panel (AN/ARC – 159)

The radio set is powered by the primary dc bus through a circuit breaker marked UHF 1 or UHF 2 under the general heading RADIO on the pilot circuit breaker panel.

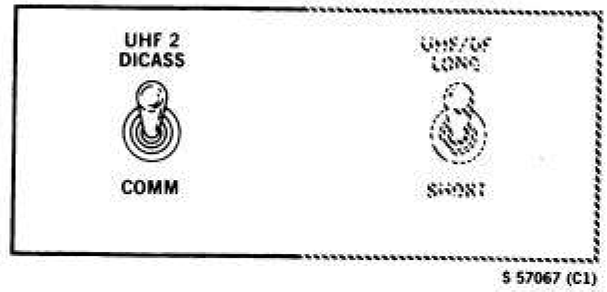


Figure 15-10. UHF 2 Selector Swi tch

Note

UHF communications may be degraded when using the upper antenna between relative azimuth 5° right and 10° left.

15.5 UHF/VHF/COMM SET (AN/ARC-182 (NON-ET))

UH-3H helicopters are equipped with an AN/ARC-182 UHF/VHF, AM-FM, two-way communication system for normal or secure voice. The system can be tuned to any of 11,960 channels spaced 25 kHz apart within the frequency bands shown below:

FREQUENCY (Mhz)		MODE	NO. OF CHANNELS
30.000 to	87.975	FM	2,320
108.000 to	117.975	AM (Rec. Only)	400
118.00 to	155.975	AM	1,520
156.000 to	173.975	FM	720
225.000 to	399.975	AM/FM	7,000
		Total	11,960

The four guard frequencies (40.500 Mhz FM, 121.500 Mhz AM, 156.800 Mhz FM, and 243.000 Mhz AM) are automatically tuned for the band selected. Power to operate the AN/ARC-182 radio set is obtained from the 28-vdc primary bus through the 5 ampere UHF/VHF circuit breaker on the pilot's circuit breaker panel. On UH-3H Executive Transport helicopters, a second AN/ARC 182 is installed.

15.5.1 UHF/VHF/COMM (AN/ARC-182) Control Panel. The UHF/VHF control panel (Figure 15-11) is located in the center console. The control panel contains the mode selector, frequency controls, channel selector controls, and squelch and volume controls.

The five-position mode selector allows the operator to select one of the following operational modes: (1) OFF - Shuts off equipment unless function selector is set to 243; (2) T/R - Enables main receiver and transmitter; (3) TR&G - Enables guard receiver, main receiver, and transmitter; (4) DF (Direction Finder) - Enables direction finding equipment, main receiver, guard receiver, and transmitter; (5) TEST - Initiates 14-second built-in test of radio unless function selector is set to 243. Test results are displayed on the FREQ (CHAN) display. All 8's on the display indicates that the radio set is functional.

15.6 KY-58 SPEECH SECURITY SYSTEM

The TSEC/KY-58 is a small, lightweight, wideband secure speech digital communications unit designed for panel or console mount. The equipment operates half-duplex push to talk at a 15 kb rate and is used with the No. 1 AN/ARC- 159 UHF radio.

On aircraft with H-3 AFC 428 incorporated, the TSEC/KY-58 speech security unit is located in the center console. On aircraft without H-3 AFC 428 incorporated, the TSEC/KY-58 speech security unit is located in a Z-AHQ adapter which is installed in the KY-28 mount located on the aft electronics rack.

15.6.1 First Start (KY-58)

1. KY-58 power switch - ON.
2. Mode switch to C cipher.
3. Fill switch to desired channel.
4. Set volume control.
5. Switch toggle switch to C cipher.

    a. Get a continuous beeping tone with background noise.

6. Key UHF momentarily.
7. Ready for secure operations.

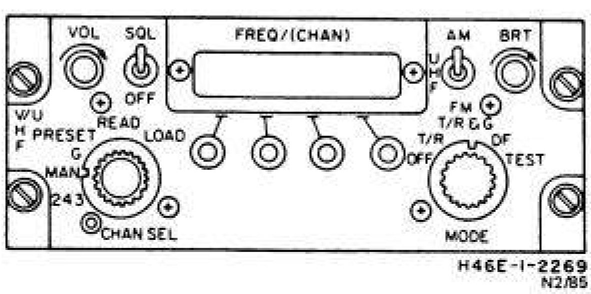


Figure 15-11. AN/ARC – 182 UHF/VHF AM-FM Control Panel

Note

- For subsequent secure voice transmissions utilizing the KY-58. First start assumes secure voice equipment previously keyed. If start does not proceed as outlined, and corrective action cannot be taken, see local remedy of minor problems as follows:

    a. If continuous beep occurs after release of MIC switch, repeat turn-on procedures. If problem persists, switch to plain uncovered voice.

    b. If a continuous tone occurs, load KY-58 with a new cryptovariable. If problem persists, switch to plain uncovered voice.

    c. If the problem continues after troubleshooting, turn secure voice off and use first start procedures again.

    d. In case of emergency, press zeroize switch to automatically erase the key setting.

- Classified information will not be discussed on ICS or radios operating in a secure mode while other radios are transmitting in clear mode. Conversely, no radio will transmit in clear mode while classified information is being discussed on ICS or other radio is transmitting in secure mode.

- The KY-58 has plain text override capability that allows crews to monitor all plain text transmissions while operating in cypher text mode. Pilots must ensure that the KY-58 is in cypher mode in both aircraft when discussing classified material via UHF transmissions.

15.7 UHF/ADF GROUP

The UHF/ADF group (AN/ARA-25A) is used in conjunction with the No. 1 UHF/COMM set, the No. 2 UHF/COMM set, and the OTPI system to indicate the bearing of radio signal sources on the No. 1 pointer of the RMI. The operating frequency range is the same as the UHF/COMM sets and the OTPI system. When a UHF signal is being received, a 100-Hz tone is heard; when a VHF (OTPI) signal is being received, a 400-Hz tone is heard. The system is controlled either by the UHF/COMM sets function switch at ADF or by turning on the OTPI system. Precedence for the No. 1 needle of the RMI from highest to lowest is: OTPI, No. 1 UHF/ADF, No. 2 UHF/ADF, and LF ADF. The ADF group is powered by the primary dc bus through a circuit breaker marked UHF DF under the general heading RADIO on the pilot circuit breaker panel. Twenty-six vac power is received from the No. 2 radio transformer to power the No. 1 RMI pointer and is protected by a circuit breaker marked UHF DF under the general heading RADIO on the pilot circuit breaker panel. Helicopters are furnished with additional power from the No. 2 ac primary bus through a circuit breaker marked UHF DF under the general heading RADIO on the pilot circuit breaker panel.

15.8 UHF/ADF GROUP OPERATION

To operate the set, proceed as follows:

1. OTPI - OFF.
2. Receiver selector panel - UHF.
3. UHF/COMM panel - SELECT FREQUENCY.
4. Function switch (UHF/COMM panel) - ADF.

To secure the set, proceed as follows:

1. Function switch (UHF/COMM panel) - OFF.

Note

To call a station and request transmission of a homing signal, it is necessary to turn the function switch (UHF/COMM panel) to a transmitting position (T/R or T/R+G).

To DF on guard frequency (243.0), the channel selector switch must be placed in the guard transmit position or manually select 243.0 since the direction- finder group only receives audio information from the main receiver unit and not the separate UHF guard receiver incorporated in the transceiver unit.

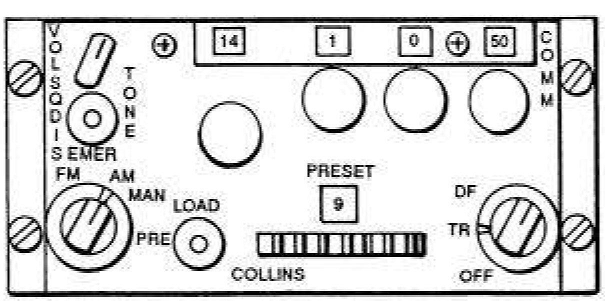


Figure 15-12. ARC-186 Radio Set Control Panel

15.9 VHF/COMM SET (AN/ARC-186(V))

H-3 helicopters modified by AFC 398 are equipped with one AN/ARC-186(V) VHF/COMM set (Figure 15-12) that provides two-way voice communication in both the AM and FM bands. This can be accomplished on any one of 20 preset frequencies or manual selection of any one of 4,358 frequencies. Selection of any frequency within the range of 30.00 to 87.975 MHz will automatically result in transmission/ reception in the FM band. Selecting a frequency between 116.00 and 151.975 MHz results in transmitting/ receiving in the AM band.

15.9.1 VHF/COMM SET (AN/ARC-186(V)) Control Panel. The control panel (Figure 15-12) is on the cockpit console. The mode select switch has three positions. At OFF, all power is removed from the equipment. The TR position energizes the receiver/transmitter and allows two-way communication. The DF position is not enabled in the AFC 398 configuration. The frequency control emergency select switch has four positions. At MAN, any one of 4,358 frequencies may be selected by use of the manual frequency selectors. The PRE position permits selection of one of 20 preset channels (AM or FM) by means of the preset channel control. The switch has two positions under the EMER heading. In the AM position, the radio will receive and transmit on the prestored AM guard channel (121.5 MHz). The FM position selects 40.500 MHz. The squelch disable/tone switch has three positions. In the SQ DIS position, the receiver squelch is disabled. The center position enables squelch. Holding the switch in the tone position will transmit a 1000 Hz tone on the selected frequency. The switch is spring loaded to return to the center position from the tone position. The VOL control adjusts the audio level of the receiver. The radio set is powered by the primary dc bus through the ARC-186 dc circuit breaker on the pilot circuit breaker panel.

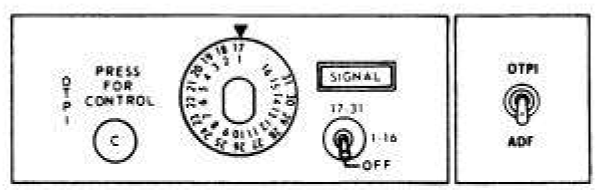


Figure 15-13. OTPI Control Panel and Transfer Switch

Note

The crewmen ICS stations can monitor VHF transmissions but cannot transmit (with AFC 398 part 4).

15.9.2 VHF/COMM Operation.

1. ICS transmitter selector switch - 6.

2. ICS receiver selector panel - VHF LO.

3. Mode select switch (VHF/COMM panel) - TR.

4. Volume control - AS DESIRED.

5. Frequency control switch - AS DESIRED.

6. Preset/manual frequency selectors - AS DESIRED.

7. To transmit - PRESS MICROPHONE TRIGGER SWITCH ON CYCLIC STICK GRIP TO RADIO POSITION OR PRESS FOOT SWITCH AND SPEAK INTO MICROPHONE.

15.10 VHF Radio Receiver. The VHF radio receiver converts the AN/ARA-25 ADF group radio navigation aid into a VHF sonobuoy on-top position indicating beacon locator. When the AN/ARA-25 is transferred from the ADF mode to the OTPI mode, only the frequency range is changed. The receiver operates in the frequency range of 162.25 to 173.50 MHz that permits selection of 31 channels. In the ADF mode, it functions normally as a direction finder. However; in the OTPI mode, the range of operation is shortened and the over-the-top capability is used to locate the exact reference point over the marker beacon. When the helicopter passes directly over the marker beacon, the receiver seeks a null position. This null will be indicated by the number one pointer of the RMI ID-250/ARN. The pointer will move to a new position 180° opposite to its previous position prior to passing over the marker beacon.

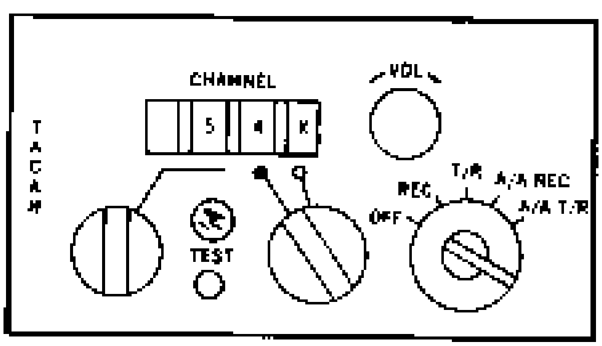


Figure 15-14. TACAN Navigation Set AN/ARN-118(V)

15.11 TACAN SET (AN/ARN-118(V))

The AN/ARN-118(V) tacan set is a polar coordinate navigation system that is used to determine the magnetic bearing and slant line distance from the aircraft to a selected tacan station. The selected tacan station can be ground, shipboard, or airborne tacan station. The ground and shipboard tacan stations are considered surface stations and supply both bearing and distance to the helicopter. An airborne station without a bearing transmitter only supplies distance information. An airborne station with a bearing transmitter supplies bearing and distance information.

This installation is not capable of transmitting bearing information but does supply distance information when interrogated. Although maximum range of station reception is governed by line-of-sight considerations, the maximum operating range of the set is 390 nm when the selected tacan station is a surface station, and 200 nm when the selected station is an airborne station. The tacan navigation set has provisions for 126 X channels and 126 Y channels. The X channels are those presently in use by surface stations. The Y channels differ from the X channels in frequency assignment and pulse spacing.

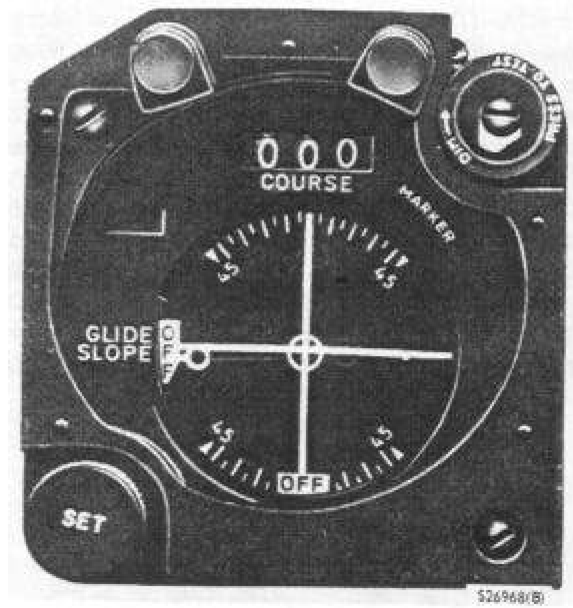


Figure 15-15. Course Indicator.

Note

> The Y channels were developed to alleviate congestion of the X channels, but have not yet been implemented in ground stations. They are, however, available for use in the A/A modes. Use of the Y channels in the A/A mode is encouraged to eliminate possible interference with ground stations.

The magnetic bearing of a selected tacan station is indicated by the No. 2 double-barred pointer on the pilot and copilot BDHIs (Figure 15-20) and the RMI (Figure 15-17). The distance to the tacan station is indicated by the BDHIs range indicator. A course to or from the tacan station may be set in the pilot course indicator (Figure 15-15) COURSE selected window. The course indicator ambiguity window shows whether the selected course is to or from the tacan station. The course indicator CDI and the BDHI range indicator have warning flags that appear when unreliable signals below minimum usage are received. When correct bearing information cannot be determined, the BDHI No. 2 pointer will search or turn in a manner that prevents the pilot from deriving improper information from it.

The tacan is powered by the No. 1 primary ac bus through the circuit breaker marked tacan under the general heading RADIO on the copilot circuit breaker panel, and from the primary dc bus through the circuit breaker marked TACAN under the general heading RADIO on the pilot circuit breaker panel. 26-vac power is received from the No. 2 radio transformer to power the indicating instruments and is protected by a circuit breaker marked TACAN on the pilot circuit breaker panel.

15.11.1 TACAN Control Panel. The control panel (Figure 15-14) marked TACAN is on the cockpit console. The controls include a function selector switch, tens channel selector switch, units channel selector switch, X/Y channel selector; volume control knob, and self-test button. The control panel also contains a test indicator light and a channel digital display.

15.11.1.1 Function Selector Knob. A five-position (OFF-REC-T/R-A/A REC-A/A-T/R) function selector knob selects the mode of operation. OFF removes power from the set. The REC position allows only bearing information to be received from a surface station. The T/R position allows both bearing information and distance data to be received from a surface station. The A/A REC position allows only bearing information to be received from a suitably equipped cooperating aircraft. In the A/A T/R position, both bearing and distance information are received from another aircraft. If the cooperating aircraft is not equipped to transmit bearing signals, only the distance will be received in this mode.

Note

Operation in the air-to-air mode requires prearrangement with a cooperating aircraft. The second aircraft must be equipped with an air-to-air tacan that is set to the air-to-air mode of operation and is set to a channel 63 channels away from the channel setting of the tacan in the first aircraft. One aircraft may reply to as many as five others, but it will only display the distance to the nearest aircraft.

The tacan navigation set requires a 90-second warmup period, regardless of the position selected by the function selector knob.

15.11.1.2 Channel Selector Knobs. The tens channel selector and units channel selector switches are rotary knobs that tune the tacan navigation set to any of 126 tacan channels. The X,Y channel selector, a movable ring around the units channel selector knob, selects either the X set of 126 channels or the Y set of 126 channels.

CAUTION

The units channel selector knob contains a built-in mechanical stop to prevent turning past the nine position. Do not attempt to override this mechanical stop. Direction of knob must be reversed when the stop is reached.

15.11.1.3 Volume Control Knob. The volume control knob marked VOL varies the volume of the audio signals.

15.11.1.4 Self-Test Button. The manual self-test button marked TEST provides a test of the complete tacan system except for the antennas when pressed.

15.11.1.5 Manual Self-Test. To initiate the self-test, select T/R and set a course of 180° in the pilot course indicator window. Press the TEST button and observe that the test indicator light goes on for about 1 second, the BDHI and CDI flags come into view for about 7 seconds, and the No. 2 pointers of the pilot BDHI indicate 270°. For the next 15 seconds, the flags go out of view, the range indicator displays 000.0 ±0.5, the No. 2 pointer indicates 180° ±3°,the CDI centers to within one-half dot, and the ambiguity window indicates TO. When the self-test is complete, all indicators return to the indications displayed prior to the initiation of self-test. A failure is recorded if the test indicator light remains on during the test and/or the indicators are out of limits. The test can be done again in the REC mode, and if the indicator light does not go on, the malfunction is isolated to the transmitter section and the bearing information is valid.

15.11.1.6 Automatic Self-Test. To be sure that the tacan system is operating properly, an automatic self-test occurs when the receiver signal becomes unreliable or the signal is lost. The results of the automatic self-test are the same as for the manual self-test except that the BDHI and CDI flags remain in view throughout the test.

CAUTION

Bearing and/or distance indications may still be present when the TEST lamp is on. Such indications could be either partially usable or grossly inaccurate. They should be cross-checked using every available means. Be prepared for the possibility of tacan equipment failure if the test indicator light goes on.

15.11.2 Tacan Navigation Set (AN/ARN-118(V)) Operation

15.11.2.1 To Operate the Set.

1. Channel selector knobs - SELECT DESIRED CHANNEL.

2. Function selector - REC, T/R, A/A REC OR A/A T/R

3. Volume control knob - ADJUST TO DESIRED VOLUME IF FUNCTION SELECTOR KNOB IS AT EITHER REC OR T/R.

15.11.2.2 To Secure the Set.

1. Function selector knob - OFF.

15.11.3 VHF/NAV SET (AN/ARN-126) UH-3H helicopters modified by AFC 431 Part 2 are equipped with one AN/ARN-126 VHF/NAV SET. This system is needed for helicopters operating with VHF Navigation Ground Stations. The system consists of an AN/ARN-126 Radio Navigation Receiver with glideslope, Control Panel, ID-250 A/ARN Radio Magnetic Indicator (RMI), Course Deviation Indicator (CDI), two VOR/LOC antennas and a glideslope antenna. The VOR antennas operate over the 108.00 to 122.00 MHz frequency band and are mounted horizontally opposite each other on the side of the helicopter at fuselage station FS 149, waterline WL 94. The glideslope antenna operates over the 328.6 to 335.4 MHz frequency band is mounted horizontally on the nose of the helicopter at FS 90 and WL 136. The CDI and RMI are located in the cockpit instrument panel. The RMI is used with the VOR function of the ARN-126 only. Both needles point to the VOR station when a valid VOR frequency is selected on the control panel. VOR stations operate in the frequency range from 108.00 to 117.95 MHz. When a VOR station is tuned, the CDI displays only the horizontal bar to indicate deviation from a selected VOR radial. The relative heading pointer indicates the number of degrees of deviation from the course selected in the CDI window. Loss of a VOR signal is indicated by an OFF flag at the bottom of the CDI and by loss of bearing information on the RMI. When the ARN-126 is used for Instrument Landing System (ILS) approaches, information is displayed on the CDI only. The glideslope and localizer functions are selected by tuning a valid localizer frequency in the range 108.10 to 111.95 MHz. Each localizer frequency is automatically paired to a corresponding glideslope frequency in the range of 329.15 to 335.00 MHz. The vertical bar on the CDI indicates aircraft position relative to the glideslope beam (glideslope). An invalid glideslope signal is indicated by the OFF flag on the left side of the CDI. An invalid localizer signal is indicated by the OFF flag at the bottom of the CDI.

15.11.4 VHF/NAV SET (AN/ARN-126) Control Panel The control panel is on the cockpit console. The radio set contains all control necessary for VHF/NAV system operation. The radio set is powered by No. 2 AC primary bus through the 5 amp VHF/NAV AN/ARN-126 circuit breaker on the pilot's circuit breaker panel at 26 VAC.

15.11.5 Normal Operation of the VHF Navigation Receiver.

1. Place the Power Test switch to the ON position.

2. Select the desired operating frequency. Turn either the left knob (selects 1-MHz steps) or the right knob (selects 50 or 25 kHz).

3. Both knobs rotated clockwise for an increase in frequency.

4. The selected frequency is displayed on the digital counter.

To turn the receivers off.

5. Place the Power/Test switch to the OFF position.

Note

The AN/ARN-126 system has the capability of testing all of its own instrumentation circuits through a self test feature.

15.12 COURSE INDICATOR (ID-387/ARN)

The course indicators (ID-387/ARN) (Figure 15-15) on the pilot side of the instrument panel consists of a knob marked SET in the lower corner, a press-to-test light marked MARKER in the upper right corner, a three-digit counter window marked COURSE, a vertical bar and a horizontal bar marked GLIDE SLOPE, a scale at the top and bottom of the indicator with linear markings each 100 and numerical markings at 450 to the left and right of the center line, a relative heading pointer with a circle at the center and the tip, and a sensing window in the upper left of the indicator. The SET knob is used to set a course in the course window at the top of the indicator. The sensing window will indicate TO or FROM, depending on whether the selected course is to or from the tacan station. The vertical bar indicates whether the helicopter has deviated to the left or right of the course to the station. The relative heading pointer indicates the number of degrees the helicopter is heading from the course set in the three-digit course window. Two warning flags marked OFF are on the face of the instrument and will appear when tacan signals are weak, unreliable, or nonexistent. The horizontal bar marked GLIDE SLOPE and the press-to-test light marked MARKER are deactivated on the top course indicator which is used with the tacan. On the bottom indicator, which is used with the VOR/ILS, the horizontal bar marked GLIDESLOPE and the press-to-test light marked MARKER are activated.

15.13 LF AUTOMATIC DIRECTION FINDER (AN/ARN-59)

LF/ADF (AN/ARN-59) is an airborne radio compass system designed to automatically provide a visual indication from which an incoming radio RF signal is received. It provides for the aural reception of AM signals from 190 to 1750 kHz in three bands: 190 to 400 kHz, 400 to 840 kHz, and 840 to 1750 kHz. The equipment includes a receiver, a loop antenna, a sense antenna, a control panel, and a dynamotor and utilizes the radio magnetic indicators for bearing indications. The dynamotor furnishes 13-volt 100-Hz ac and 125-vdc power to the radio set. The set is dc powered and is protected by a circuit breaker marked ADF.

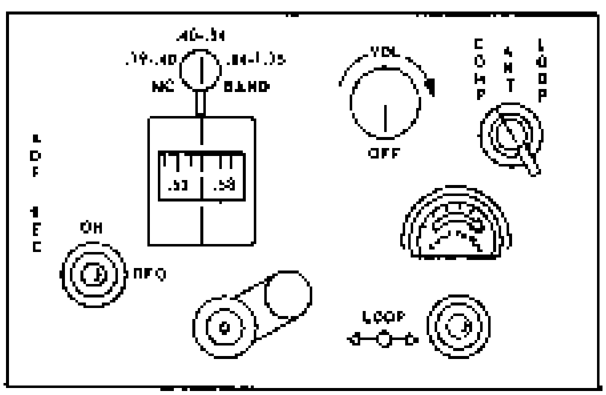


Figure 15-16. LF/ADF Control Panel

15.13.1 LF/ADF Control Panel. The automatic direction-finder set is controlled from a panel (Figure 15-16) marked ADF REC on the cockpit console. Controls include a band switch; a volume control marked VOL-OFF; a function switch marked COMP, ANT, and LOOP; a tuning meter; a loop switch marked LOOP; a tuning control; and a beat frequency oscillator switch marked BFO-ON. The volume control turns the set on or off, adjusts receiver audio level when the function switch is in COMP, and adjusts receiver RF sensitivity when the function switch is in ANT or LOOP. With the function switch in COMP, the set operates as an automatic direction-finder using both the sense and loop antennas. The tuning control may be adjusted to give maximum indication on the tuning meter for any given station, and the relative bearing is automatically indicated by the No. 1 single-barred pointer on the RMI. With the function switch at ANT, the set operates as a communications receiver using the sense antenna only. With the function switch at LOOP, the set operates as a receiver using the loop antenna. The LOOP switch positions the loop antenna when the function switch is at either COMP or LOOP. The BFO switch is used as an aid in the determination of aural nulls on either unmodulated or voice-modulated signals. With the BFO switch ON, place the function switch to LOOP and press the LOOP switch in the desired direction to determine the aural null when the tone drops to minimum. Read the relative bearing of the transmitting station on the No. 1 single-barred pointer on the RMI. The tuning crank tunes the receiver to the desired frequency within the selected band.

15.13.2 LF Automatic Direction Finder Operation. To turn the set on for use as a conventional radio receiver:

1. Volume control - ROTATE CLOCKWISE.
2. Function switch - ANT.
3. Band switch - SET TO DESIRED OPERATING BAND.
4. Tuning control - TUNE TO DESIRED FREQUENCY.
5. Volume control - ADJUST AS NECESSARY.

To turn the set on for use as an automatic direction finder:

1. Volume control - ROTATE CLOCKWISE.
2. Function switch - COMP.
3. Band switch - SET TO DESIRED OPERATING BAND.
4. Tuning control - TUNE TO DESIRED FREQUENCY.
5. Volume control - ADJUST AS NECESSARY.
6. Function switch - COMP.

Note

> To find whether the relative bearing on the RMI is accurate when the function switch is at COMP, throw the LOOP switch to the right and observe that the pointer rotates clockwise. After approximately 20° of pointer travel, release the LOOP switch and note the action of the indicator pointer. If the signal is normal and reliable, the pointer will immediately return to the original reading.

To turn the set on for use as a manual direction finder, using the LOOP position and with the BFO switch ON, proceed as follows:

1. Volume control - ROTATE CLOCKWISE.
2. Function switch - LOOP.
3. BFO switch - ON.
4. Band switch - SET TO DESIRED OPERATING BAND.
5. Tuning control - TUNE TO DESIRED FREQUENCY.
6. LOOP switch - PRESS IN DESIRED DIRECTION.

Rotate the loop until the tone drops to minimum and read the relative bearing of the transmitting station on the indicator.

To secure the set:

1. Volume control - OFF.

Figure 15-17. Radio Magnetic Indicator

15.14 RADIO MAGNETIC INDICATOR

The ID-250/ARN RMI indicator (Figure 15-17) located on the instrument panel marked RADIO MAGNETIC INDICATOR, consists of an azimuth scale numerically marked in 30° units and linear markings in 20° units, a fixed index at the top of the indicator, a single-barred No. 1 pointer, and a double-barred No. 2 pointer. The azimuth scale, coupled to the compass system, turns the compass card of the indicator and indicates the magnetic heading of the helicopter on the scale beneath the fixed index at the top of the indicator. The No. 1 pointer provides bearing readout for the LF/ADF, UHF-DF sets, and the OTPI system. The No. 2 double-barred pointer indicates the magnetic bearing of a station as determined by the tacan set.

15.15 AIRBORNE IDENTIFICATION MOBILE TRANSPONDER SYSTEM

The AIMS (ATCRBS IFF Mark XII system) transponder system is capable of automatically reporting coded identification and altitude signals in response to interrogations from surface (or airborne) stations so that the stations can establish and/or maintain identification and/or control of air traffic. The system has five operating modes (1, 2, 3/A, C, and 4). Modes 1 and 2 are IFF modes, mode 3 (Civil mode A) and mode C (automatic altitude reporting) are primarily air traffic control modes, and mode 4 is the secure (encrypted) IFF mode. (Mode 4 is not operational unless the system includes a KIT-1A/TSEC transponder computer).

15.15.1 AIMS Transponder System Components. The basic AIMS transponder components are as follows:

1. AIMS transponder set control panel, C-6280A/APX.
2. Transponder, APX-72.
3. Transponder test set, TS-1843/APX.

The AIMS altimetry consists of:

4. AAU-21/A barometric altitude encoder.

The following components provide the secure IFF (mode 4) function:

5. Transponder computer, KIT- 1A/TSEC.
6. IFF caution light.
7. Right main landing gear scissor switch.

15.15.2 Transponder Test Set. The integral TS-1843 transponder test set provides the self-test and monitor functions for modes 1, 2, 3/A, and C. The TS-1843 accomplishes the self-test functions, when actuated, by interrogating the transponder and monitoring the replies. The monitor function is accomplished, when selected, by monitoring the replies to external interrogations. The controls for the TS-l843 are included in the IFF control panel.

15.15.3 IFF Control Panel. All of the pilots controls for the AIMS transponder system are included on the IFF control panel (Figure 15-18). The reply light and the controls on the left side of the control panel are associated with mode 4 operation. The test light and remaining controls are associated with modes, 1,2, 3/A, and C, except that the MASTER switch controls all modes of operation.

15.15.3.1 MASTER Switch. The MASTER switch applies power to all of the AIMS transponder components except the altimetry component. It is a five-position rotary switch placarded OFF-STBY-LOW-NORM-EMER. The switch must be lifted over a detent to switch to EMER or to OFF, and STBY should be selected for 2 minutes before switching to LOW or NORM to allow the transponder to warm up. At NORM, the system is operational at normal receiver sensitivity. In the LOW position, the system is operational but the transponder transmits replies at reduced intensity to mode 1, 2, and 3/A interrogations. The mode 3/A emergency reply includes code 7700. When EMER is selected, modes 1, 2, 3/A, and C are enabled, regardless of the position of the selector switches.

15.15.3.2 IDEN-OUT-MIC Switch. The IDEN-OUT-MIC switch is a three-position toggle switch. The spring-loaded IDEN position adds an identification of position pulse to modes 1, 2, and 3/A replies for a period of 15 to 30 seconds (nominal 20 seconds). In the MIC position, the identification of position function is activated for 15 to 30 seconds each time the UHF microphone button is pressed.

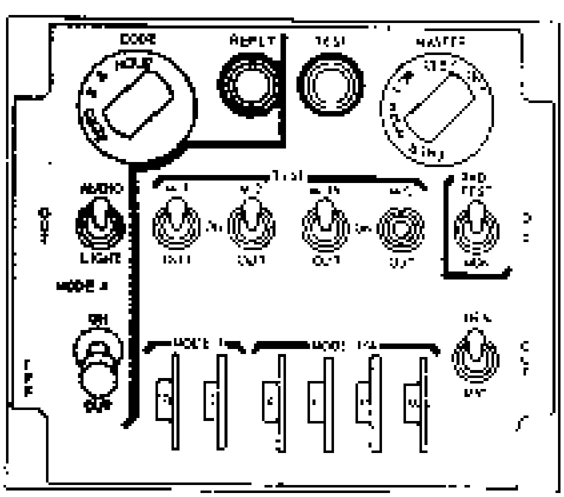


Figure 15-18. IFF Control Panel and Functions (Sheet 1 of 4)

15.15.3.3 Mode 1, 2, and 3/A CODE Selectors. The two MODE 1 thumbwheel selector switches allow selection of mode 1 codes from 00 through 73, and the four MODE 3/A thumbwheel selectors allow selection of mode 3/A codes from 0000 to 7777. The mode 2 selector switches are on the transponder (in the Doppler compartment). The mode 2 code is selected prior to flight by ground maintenance personnel.

15.15.3.4 Mode Switches. The four mode switches (M-1, M-2, M-3/A, and M-C) each have OUT, ON, and spring-loaded TEST positions. The center ON position of each switch enables that mode providing the master switch is in LOW or NORM. To test the transponder, press and hold the mode switch of each mode to the TEST position. Continuous illumination of the TEST light while the mode switch is held to the TEST position indicates proper operation of that mode. Intermittent illumination of the TEST light indicates improper operation of the respective mode. No TEST light indicates failure of the TEST equipment. The MASTER switch must be set to NORM for the test function to operate. The mode switches of the modes not being tested should be at OUT when testing on the ground to prevent unnecessary interference with nearby ground stations.

Note

> The TEST light may flash once as each mode switch is released from the test position, and as the RAD TEST-OUT-MON switch is moved. This is a characteristic of the TS-1843 transponder test set and is meaningless.

15.15.3.5 RAD TEST-OUT-MON Switch. The MON position of the RAD TEST-OUT-MON switch is used to monitor the operation of modes 1, 2, 3/A, and C. When MON is selected, the TEST light will come on for 3 seconds each time an acceptable response is made to an interrogation on a selected mode.

The spring-loaded RAD TEST position is used for testing. It enables a mode 3/A code reply to a test mode interrogation from a ramp test set. It also enables a mode 4 reply to a verify 1 interrogation from a surface station of a ramp test set. A verify 1 interrogation is a modified mode 4 interrogation used for testing.

15.15.3.6 Mode 4 Operation. Mode 4 operation is selected by placing the Mode 4 toggle switch ON, provided the master switch is at LOW or NORM. Placing the mode 4 switch to OUT disables mode 4.

The mode 4 code switch is placarded ZERO, B, A, and HOLD. The switch must be lifted over a detent to switch to ZERO. It is spring loaded to return from HOLD to the A position. Position A selects the mode 4 code for the present code period, and position B selects the mode 4 code for the succeeding period. Both codes are mechanically inserted by a code changing key. The codes are mechanically held in the transponder computer, regardless of the position of the MASTER switch or the status of helicopter power, until the first time it becomes airborne. Thereafter, the mode 4 codes will automatically zeroize anytime the MASTER switch or helicopter power is turned off. In order to prevent the mode 4 codes from automatically zeroizing anytime the master switch or helicopter power is turned off, HOLD must be selected after weight on wheels, at least 15 seconds prior to shutdown. With AFC 446 incorporated, codes will be retained regardless of flight or power conditions and must be manually zeroized to drop the code. The mode 4 codes can be zeroized anytime the helicopter power is on and the MASTER switch is not in OFF by turning the code switch to ZERO.

An audio signal, the reply light, and the IFF caution light are used to monitor mode 4 operation. The AUDIO-OUT-LIGHT switch controls the audio signal and the REPLY light, but not the IFF caution light. In the LIGHT position, the REPLY light comes on as mode 4 replies are transmitted. In the AUDIO position, an audio tone in both pilot headsets indicates that valid mode 4 interrogations are being received and the REPLY light comes on if mode 4 replies are being transmitted. In the OUT position, the audio indications and the REPLY light are inoperative, and the REPLY light does not incorporate a press-to-test function.

Note

- The audio tone may only be adjusted at the IFF transponder (in the Doppler compartment). Report any audio tone level discrepancies to maintenance personnel.
- The microswitch attached to the scissors of the right main landing gear is the airborne/on deck sensor for mode 4 operations.

15.15.3.7 IFF Caution Light. The IFF caution light goes on to indicate that mode 4 is inoperative. The light is operative whenever helicopter power is on and the MASTER switch is not at OFF. However, the light will not operate if the KIT-lA/TSEC computer is not physically installed in the helicopter. Illumination of the IFF caution light indicates that the mode 4 codes have zeroized, the self-test function of the KIT-1A/TSEC computer has detected a faulty computer, or the transponder is not replying to proper mode 4 interrogations.

If the IFF caution light goes on, switch the MASTER switch to NORM (if in STBY) and make sure that the mode 4 toggle switch is ON. If illumination continues, employ operationally directed flight procedures for an inoperative mode 4 condition.

The AIMS transponder system uses ac and dc power and is protected by circuit breakers.

15.16 BEARING DISTANCE HEADING INDICATORS

Note

The RMI always displays tacan azimuth information whenever a tacan station is selected and being received regardless of the selection made on the BDHI selector.

15.16.1 Bearing Distance Heading Indicators. Two BDHIs are on the instrument panel. The indicator (Figure 15-19) has a rotating compass card, driven by the compass system, that displays helicopter heading under a lubber index. A double-barred No. 2 pointer and a single-barred No. 1 pointer display bearing information from TACNAV or tacan and Doppler respectively. In addition, nautical mile distance to a tacan station or TACNAV destination is furnished by a three-digit counter. A warning flag will appear over the counter if tacan signals are erroneous or too weak.

15.16.1.1 BDHI Selectors. Two selector switches (Figure 15-21) are on the instrument panel. Either pilot can independently select TACAN or TACNAV to be displayed on his BDHI. When TACAN is selected, the associated BDHI No. 2 pointer and digital counter display bearing and slant range distance to the selected tacan station. When COMPUTER is selected, the associated BDHI No. 2 pointer and digital counter display bearing and distance to a selected or predicted destination with TACNAV. The No. 1 pointer on each BDHI automatically displays the drift angle when the Doppler is turned on.

NOMENCLATURE	FUNCTION
1 Mode 4 code select switch	HOLD – retains the preset code for both A and B positions. Must be momentarily actuated at least 15 seconds prior to securing power, after weight on wheels, to hold preset code. With AFC 446 incorporated, the requirement to activate the hold function is eliminated as previously stated. A — selects the preset code for the A position. B — selects the preset code for the B position. ZERO — zeroizes code from both A and B positions, provided the Master switch is not OFF when ZERO is selected.
2. Mode 4 reply light	ON — With the Audio-Off-Light switch at AUDIO or LIGHT, indicates valid mode 4 replies are being transmitted.
3 Test light	ON — (with the Rad Test-Out-Mon switch at OUT) — indicates proper receiver-transmitter response when switches for modes 1, 2, 3/A, or C are placed to TEST position, or proper response to an outside interrogation if Rad Test-Out-Mon switch is at MON.
4. Master control switch	OFF — disconnects power to AIMS transponder system. STBY — connects power to receiver-transmitter for warm up (at least 1 minute for standard temperatures and no more than 2 minutes for extreme temperatures). After initial warmup, maintains system in operation-ready status. LOW — energizes set and provides reduced transmitter intensity. NORM — energizes set at normal receiver sensitivity

Figure 15-18. IFF Control Panel and Functions (Sheet 2 of 4)

NOMENCLATURE	FUNCTION
	EMER—enables modes 1, 2, and 3/A for special emergency replies regardless of mode switch's position. Enables mode C for normal replies, regardless of the position of selector switch.
5. Mode switches (M-1, M-2, M-3/A, and M-C)	TEST—enables an internal transponder tester to locally interrogate modes 1, 2, 3/A, or C. Master switch must be at NORM.
	ON—enables receiver-transmitter to reply to the selected mode interrogations.
	OUT—disables reply capability to mode interrogations.
6. RAD TEST-OUT-MON switch	RAD TEST—momentarily engaged (spring loaded to OUT) enables a mode 3/A reply to test mode interrogations from test equipment. Also enables a mode 4 reply to a Verify 1 (modified mode 4 interrogation used for testing).
	MON—enables the monitor circuits of an internal test set. TEST light will go on when replies are transmitted in response to either internal or external interrogations of modes 1, 2, 3/A, or C.
	OUT—deenergizes RAD TEST and MON.
7. IDEN-OUT-MIC switch	IDEN—momentarily actuated (spring-loaded to OUT) initiates identification of position reply for about 20 sec.
	OUT—prevents triggering of identification of position reply.
	MIC—enables identification of position replies to be transmitted for about 20 seconds after pressing the microphone button.
8. Mode 3/A code selectors	Selects and displays the four digit reply code for mode 3/A
9. Mode 1 code selectors	Selects and displays the two digit reply code for mode 1
10. Mode 4 ON-OUT switch	ON—enables the receiver-transmitter to reply to mode 4 interrogation provided the Master switch is at LOW or NORM.
	OUT—disables the reply capability to mode 4 interrogations.

Figure 15-18. IFF Control Panel and Functions (Sheet 3 of 4)

NOMENCLATURE	FUNCTION
11. Audio-light-out switch	AUDIO—enables aural and REPLY light monitoring of valid mode 4 interrogations and replies. LIGHT—enables REPLY light monitoring of valid mode 4 replies. OUT—disables aural and REPLY light monitoring of mode 4. Also, the REPLY light will not press-to-test.
12. AAU-21A altimeter	The barometric altitude encoder functions as a barometric altimeter for the pilot and a pressure altitude sensor for the IFF transponder. It provides a digital output in units of 100 feet of pressure altitude. CODE OFF—warning flag will appear if ac power to the altimeter is lost. NOTE The copilot's altimeter (AAU-24/A) is not an altitude encoder. There is no warning flag in this indicator
13. IFF caution light	ON (IFF)—with the KIT-1A/TSEC computer in operation, indicates mode 4 has received an interrogation and has not generated a valid reply, mode 4 code is zeroized or self-test has detected a faulty computer.

Figure 15-18. IFF Control Panel and Functions (Sheet 4 of 4)

Figure 15-19. BDHI

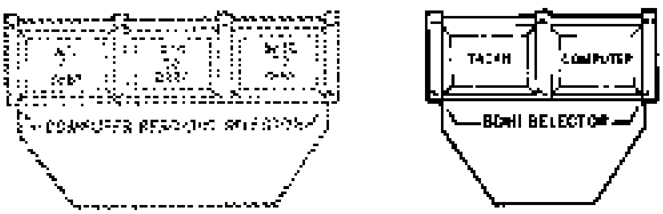


Figure 15-20. BDHI Selector Panel

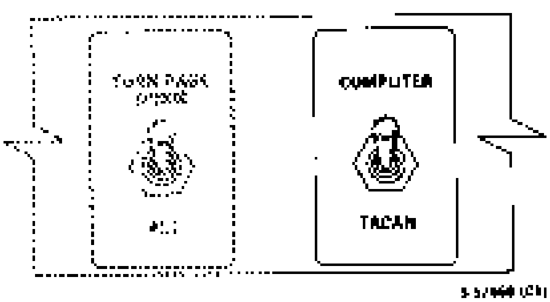


Figure 15-21. BDHI Selectors

15.17 (NON-ET) DOPPLER

The (AN/ARN-182(V)) Doppler is a self-contained ground velocity sensor that uses continuous-wave radar energy to automatically measure the heading, drift, and vertical components of the helicopters motion. These signals are supplied to the ASE coupler, TACNAV or navigation system, GSDA, and the hover indicator. The Doppler consists of a receiver-transmitter, a signal data converter, a power supply, and a control indicator on the cockpit console. The Doppler operates on ac power and is protected by a circuit breaker marked DPLR on the copilot circuit breaker panel under the general heading RADIO.

15.17.1 Doppler Control/Indicator Panel. The Doppler control/indicator panel (Figure 15-22) marked NAV on the cockpit console controls the operation of the Doppler. Operational control and indicators consist of two amber lights marked MEM and STBY respectively, and a five-position mode selector switch marked OFF, STBY, LAND/ALT, SEA, and TEST. Lighting of the MEM light indicates the Doppler signal is inadequate and the system is operating in the memory mode. When the hover indicator in the D mode, the OFF flag will appear whenever the MEM light is on. Lighting of the STBY light indicates that the system is operating in the STBY mode. The STBY position supplies all power to the system except high voltage to the transmitter. The LAND/ALT position energizes the system for operation over land or for operation during an alternate approach. The SEA position energizes the system for operation over water (except alternate approaches). The TEST position energizes the built-in test circuitry. The mode selector switch must be pushed in and then turned to reach TEST.

15.17.2 Doppler System Operation. During normal flight, the system operates automatically and requires no operator control. The system provides accurate velocity information over land and over sea state 1/2 or rougher. Over glassy smooth sea states, intermittent or sustained memory can be expected. During memory operation, the velocity outputs are locked at their last computed values. The system should always be operated in the SEA mode when over water except for the special case of alternate approach. The selector switch is placed in the LAND/ALT mode for this maneuver. During the initial phase of the alternate approach (down to 10 knots), the system will either be in memory or will be indicating obviously incorrect velocities (usually zero). In either case, these velocity indications are to be ignored. During the remainder of an alternate approach, the Doppler will come out of memory and operate normally. See "Approach To A Hover and Sonar Search," Chapter 18, for a detailed explanation of the Doppler alternate approach procedure.

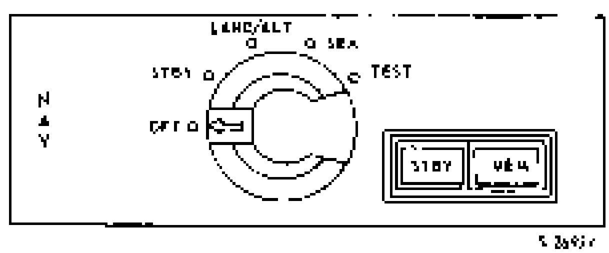


Figure 15-22. Doppler Control/Indicator Panel

Protective circuitry in the SEA mode inhibits the system from acquiring Doppler signals below 35 knots. This is to prevent the incorrect velocity indications discussed previously in connection with alternate approach. The ability of the system to acquire Doppler signals is equal in

LAND/ALT and SEA modes above 35 knots. The system will continue to operate (track) in SEA mode below 35 knots following acquisition of signal at speeds above 35 knots. Consequently, if memory should occur while below 35 knots in SEA mode, one of the following should be accomplished to permit the system to reacquire the Doppler signal:

1. Select LAND/ALT until memory ceases, then reselect SEA.

2. Increase groundspeed to above 35 knots.

In either case, observe that velocity indications are within reason. If obviously incorrect indications are displayed, recycle the mode selector switch and allow the system to release itself from the "false-lock" and reacquire the correct Doppler signal.

Ascending and descending maneuvers and steady hovers do not normally produce memory indications. The Doppler indicates memory only with legitimate signal loss. When approaching water from land, care should be taken to switch from LAND/ALT to SEA well before reaching the water. This will preclude any chance of incorrect velocity indication that can occur when operating the LAND/ALT mode over a glassy smooth sea state. If an incorrect solution should appear, normal operation is restored by recycling the system as follows:

1. Set selection switch to STBY until memory occurs.

2. Set switch to SEA. (Groundspeed must be above 35 knots to acquire Doppler signal).

Note

Should the No. 1 generator fail or be otherwise secured while the helicopter is in a hover, the Doppler will shift into memory when the generator load is switched. Should this occur, the Doppler selector switch must be placed to LAND/ALT until the Doppler signal is regained. If the selector switch is at LAND/ALT when the generator load is switched, the Doppler will go into memory for about 6 seconds before the Doppler signal is automatically reacquired.

15.18 GROUNDSPEED AND DRIFT ANGLE INDICATOR

The GSDA indicator (Figure 15-23) on the instrument panel has an outer dial marked GROUND SPEED numerically marked at each 10 knots from 0 to 180 knots and linear marks at each 5 knots. An inner dial marked DRIFT ANGLE is numerically marked at 0°, 90°, 180°, 270° with linear marks at each 15° unit, and dots at each 5° unit. The long pointer indicates speed, and the short pointer indicates the drift angle. The GSDA receives its input directly from the Doppler.

15.19 TRUE AIRSPEED TRANSDUCER

The true airspeed transducer is an electromechanical device forward of the pilot rudder pedals on the deck. It receives pitot and static inputs from the pitot tube and free-air temperature from a shrouded bulb mounted below the pilot window. Its function is to mechanically compute true airspeed from indicated airspeed, pressure altitude, air temperature, and send to the TACNAV or navigation system an electrical signal proportional to true airspeed.

15.20 ASN-123C TACTICAL NAVIGATION SYSTEM

Note

For detailed description of TACNAV operation, consult the TACNAV Rev. F-l Operators Guide (June 1989), NADEP Software Support Activity, NAS North Island, CA 92135.

The AN/ASN-123 TACNAV system (Figure 15-24) performs navigation dead-reckoning computations to provide helicopter and the base ship within a 512-nm square tactical plot area. The aircraft computations are based on Doppler radar, magnetic heading, and TAS transducer inputs. The base ship position computations are provide helicopter and the base ship within a 512-nm square tactical plot area. The aircraft computations are based on Doppler radar, magnetic heading, and TAS transducer inputs. The base ship position computations are based on manually entered values of ship course and speed. The system also records the positions of contacts to provide a display that aids in mission planning and execution of SAR. Limited access to system memory via the data extract function is provided to aid in mission debrief. The system consists of a TACNAV processor, a TACCO panel, and a TACNAV display. Avionic equipment used in conjunction with the TACNAV system is shown in Figure 15-25. The No. 1 primary ac bus furnishes three-phase 115-vac and 26-vac power to the system through two circuit breaker panels. The primary dc bus furnishes power to the system through two circuit breakers marked TACNAV and TACNAV DISPLAY on the pilot circuit breaker panel.

Figure 15-23. Groundspeed and Drift Angle Indicator

15.20.1 Inputs. The UH-3H TACNAV system receives analog inputs from the AN/APN-182 Doppler radar, the A/A24G-39 AHRS, and the TAS transducer. Using Doppler-derived ground velocity, magnetic heading, and true airspeed, the TACNAV processor unit continuously computes aircraft present position and updates the display. Steering outputs are provided to the pilot BDHIs. BIT and self-test functions are also included in the system.

Note

On the UH-3H Executive Transport helicopter, the doppler and sonar functions are removed.

.

15.20.2 Navigation Processing. When the Doppler out of memory signal indicates that the Doppler velocity data is valid and/or its value is reasonable, the TACNAV computer operates in the Doppler (normal) mode. In the Doppler mode, the magnetic heading signal from the A/A24G-39 AHRS compass system and the heading and drift velocity signals from the Doppler are applied to the computer for processing. The magnetic heading signal and the magnetic variation correction signal (inserted into the computer as the entry data from the TACCO panel) are processed to provide a true heading signal. The true signal is processed with the heading velocity and drift velocity signals to provide display data signal input as the aircraft present position on the display indicator. From the aircraft present position, the computer derives range, bearing, and time-to-go data to a specified fly-to point. When the TACNAV computer range and bearing data is valid, the fly-to-range and fly-to-bearing signals from the computer are applied to the BDHIs. Helicopter present position, range/bearing, and time-to-go information is provided to the display indicator as display data.

When the Doppler out-of-memory signal indicates that the Doppler velocity data is not valid and/or its value is unreasonable, the TACNAV computer operates in the air data mode. In the air data mode, the true airspeed signal from the true airspeed transducer, the last calculated value of wind velocity, and the true heading signal are processed by the computer to provide aircraft present position. This aircraft present position is processed in the same manner as in the Doppler mode to provide navigation information to the associated avionics and display.

Note

The TAS transducer is inaccurate at low speeds; therefore, when there is no Doppler return, TACNAV will assume a hover at airspeeds of less than 38 knots.

Base ship position is calculated from the manually inserted parameters for ship course and speed. When the PIM of the ship is entered into the computer using the TACCO panel, ship course and speed information is applied as entry data to the TACNAV computer. The computer processes the entered data to produce latitude and longitude information that are supplied to the display as display data to update the ship's position. The positions of the ship, helicopter, and other symbols may be changed by the pilot using the symbol position correct procedures.

15.20.3 System Tests

15.20.3.1 BIT Signal Processing. The BIT circuits of the TACNAV set perform operational tests to ensure that the TACNAV computer is operational. Computer BIT subprogram routines continuously perform memory checksum, register and instruction, and discrete input and output tests. When one of the tests indicates a failure, the BIT circuit provides a signal that causes the computer BIT indicator to indicate white and the nature of the failure to be indicated in the equipment status tableau alert area. If no failure is detected for one complete cycle of the BIT, the external BIT indicator will be reset by the program.

15.20.3.2 Self-Test Signal Processing. When the TACCO panel mode select switch is set to TEST, the TACNAV computer applies test signals as display data to the display, and TACCO panel. The display prints out the name of each switch indicator of the TACCO panel as each switch is pressed. The SENSO panel MAD, RADAR, SONAR, and PASSIV indicator triangles, and the NUMBER, RNG, BRG, YDS, MILES, RE, and TIME indicator legends illuminate green and the numeric display digits all indicate 8. The TACCO panel CORR, MOT, FTP, COOPD, L/L, ATTACK, SENSO, BEARING, CONT, BUOY, CIRCLE, VECTOR, MAG, VERIFY and CLEAR indicator triangles illuminate green. The MENU indicator triangle illuminates amber.

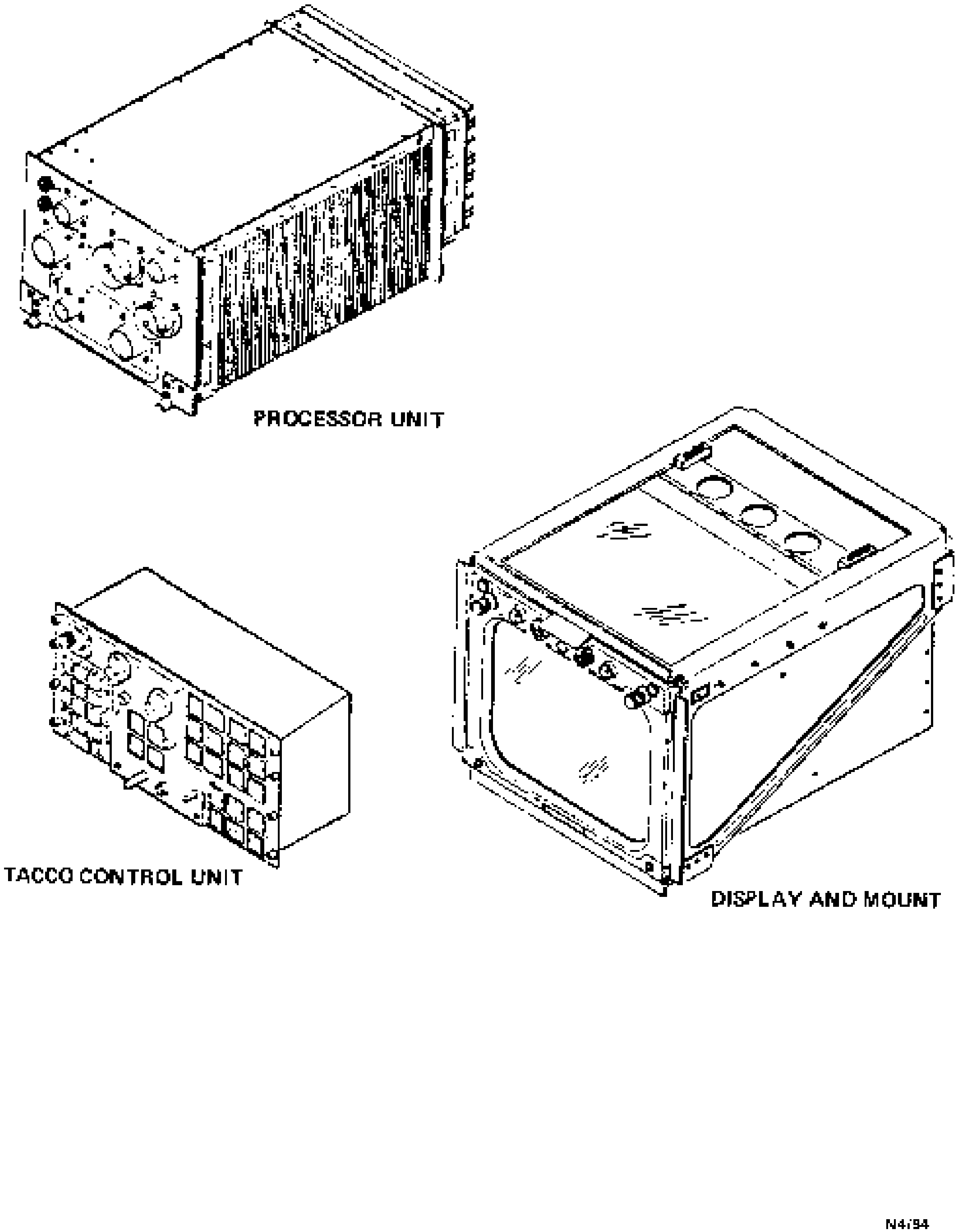


Figure 15-24. TACNAV System Components

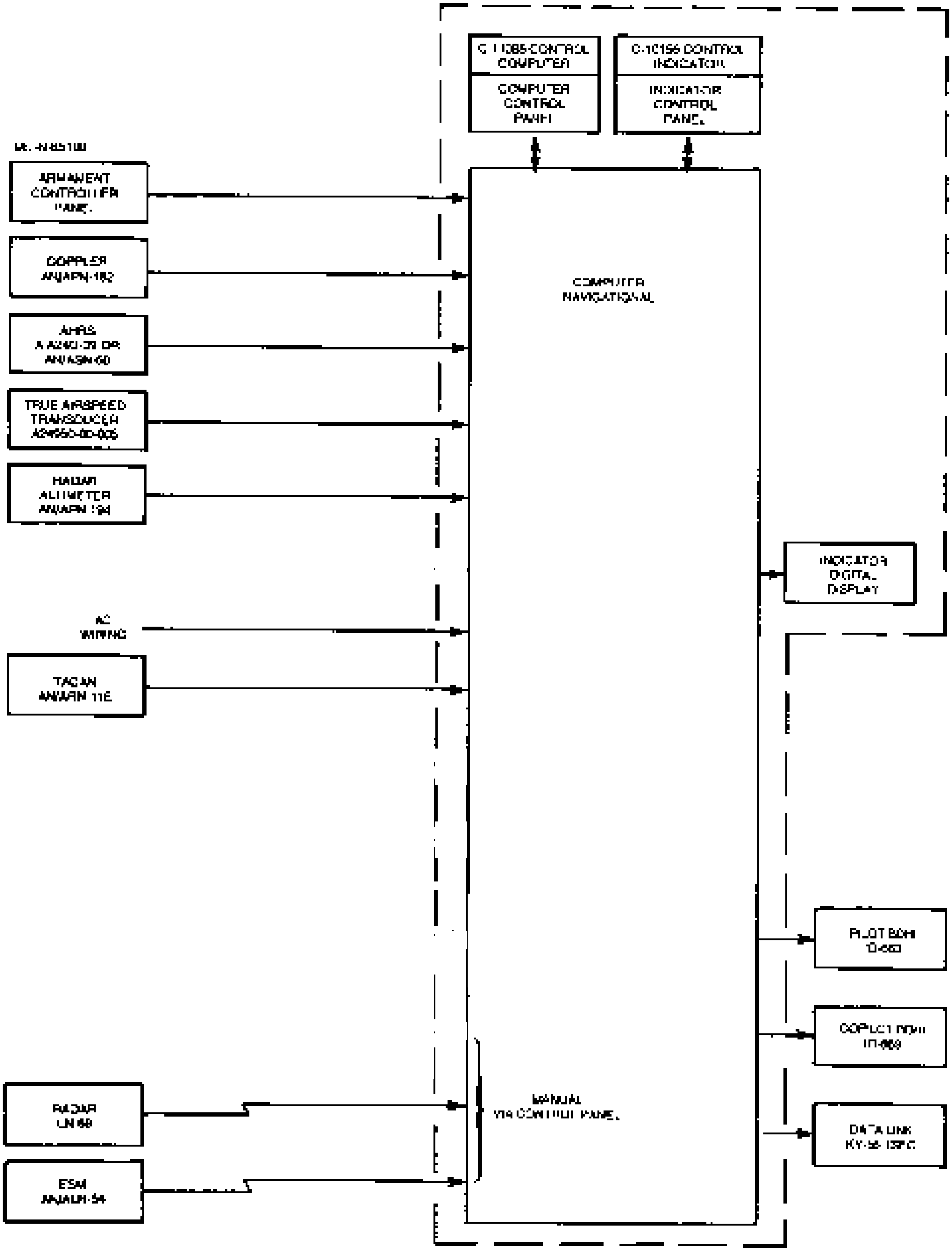


Figure 15-25. AN/ASN Navigation Set, Tactical, Block Diagrams

15.20.4 TACNAV Processor Unit. The TACNAV processor is in the electronics compartment. It processes and stores information furnished by the operator control panels and sensors. The computer furnishes processed information for display to the various display indicators associated with the system as shown in (Figure 15-25). The front panel of the computer (Figure 15-26) contains a meter that shows the elapsed running time of the computer. There is an electrically resettable BIT indicator that shows white when the computer fails built-in test. The indicator is electrically reset to all black (normal) by the program when there is no failure. In addition, there is an OVERTEMP indicator that shows black and white when the computer is overheated. It is reset to all black (normal) by manually rotating the indicator clockwise and releasing. The computer converts the aircraft power (115/200 and 400 Hz, 3 phase) to stabilized dc voltages required to power the computer. The processor unit performs all of the digital computations required for the TACNAV operation.

In addition, the processor unit provides all memory functions required for the operation of the display unit.

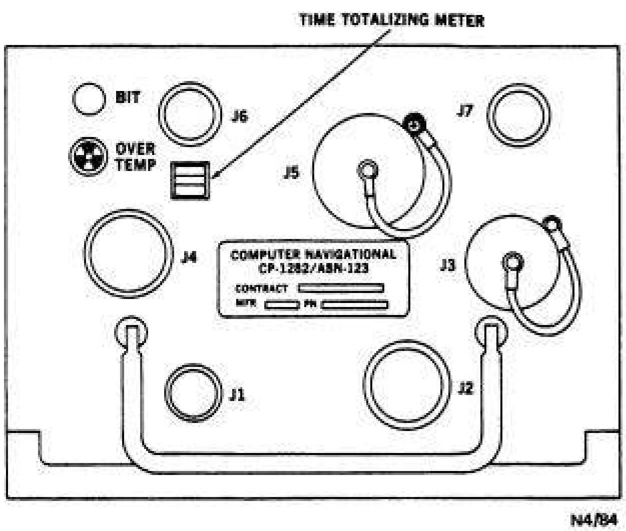


Figure 15-26. TACNAV Time Totalizing Meter

15.20.5 TACCO Panel. The TACCO panel is the focal point for operating the TACNAV display. Located in the aircraft between the pilot and copilot, it allows either operator to control the TACNAV set and displays. Controls and indicators on the TACCO panel are illustrated in (Figure 15-27). Legends on all switch indicators of the computer control are illuminated red whenever input power is connected to the unit (system is turned on). Some switch indicators have upper-half red and lower-half green indicators. Whenever the switch function of a switch indicator is selected (by depressing the switch indicator), the green indicator lights to signify the switch function is active. Lighting of the green indicator is under the control of the navigational computer. The keyboard switch indicators and the following switch indicators have only red-illuminated legends: REDIS, ERASE, MARK, DATA, and RCNTR.

15.20.5.1 DIM Control. The DIM control controls intensity of triangular lighting on all switch indicators.

15.20.5.2 Mode Selector Switch.

15.20.5.2.1 OFF. Removes input power from TACNAV computer, and TACCO panel. All stored data is retained in core memory and reappears when switch is returned to ON.

15.20.5.2.2 ON. Applies input power to computer, and TACCO panel.

15.20.5.2.3 TEST. Initiates self-test, generates system test pattern on display, sequences indicators through illumination test, and performs digital/synchro and analog/digital converter BIT function.

15.20.5.2.4 RESET. Permanently erases all stored data displayed data and symbols including the SLT tableau data; or permanently erases all to the preceding entry data, as selected by cue. After reset selection is completed, INITIAL alert appears to advise the operator that the system must be reinitialized.

15.20.5.3 CLEAR Switch Indicator. Used in conjunction with DNT switch DECLUTTER positions to temporarily clear display of selected symbol groups. Indicator triangle lights when switch indicator is pressed and remains lighted whenever there are cleared (decluttered) symbols in the computer.

15.20.5.4 REDIS Switch Indicator. When pressed, it is used in conjunction with DNT switch DECLUTTER positions to redisplay cleared symbol groups.

15.20.5.5 Display Selector Switch (DECLUTTER-NORM-TABLEAU (DNT))

15.20.5.5.1 DECLUTTER. The six positions are used for thinning out symbols on a cluttered display. Six types of symbols and associated data can be removed and kept in memory for redisplay if desired: MAD marks, RADAR contacts, ESM contacts, sonobuoy (BUOY) symbols, SONAR contacts, and circles and vectors (CONICS). These positions are used in conjunction with the CLEAR and REDIS switch indicators.

15.20.5.5.2 NORM. This is the position for normal operation of the tactical display.

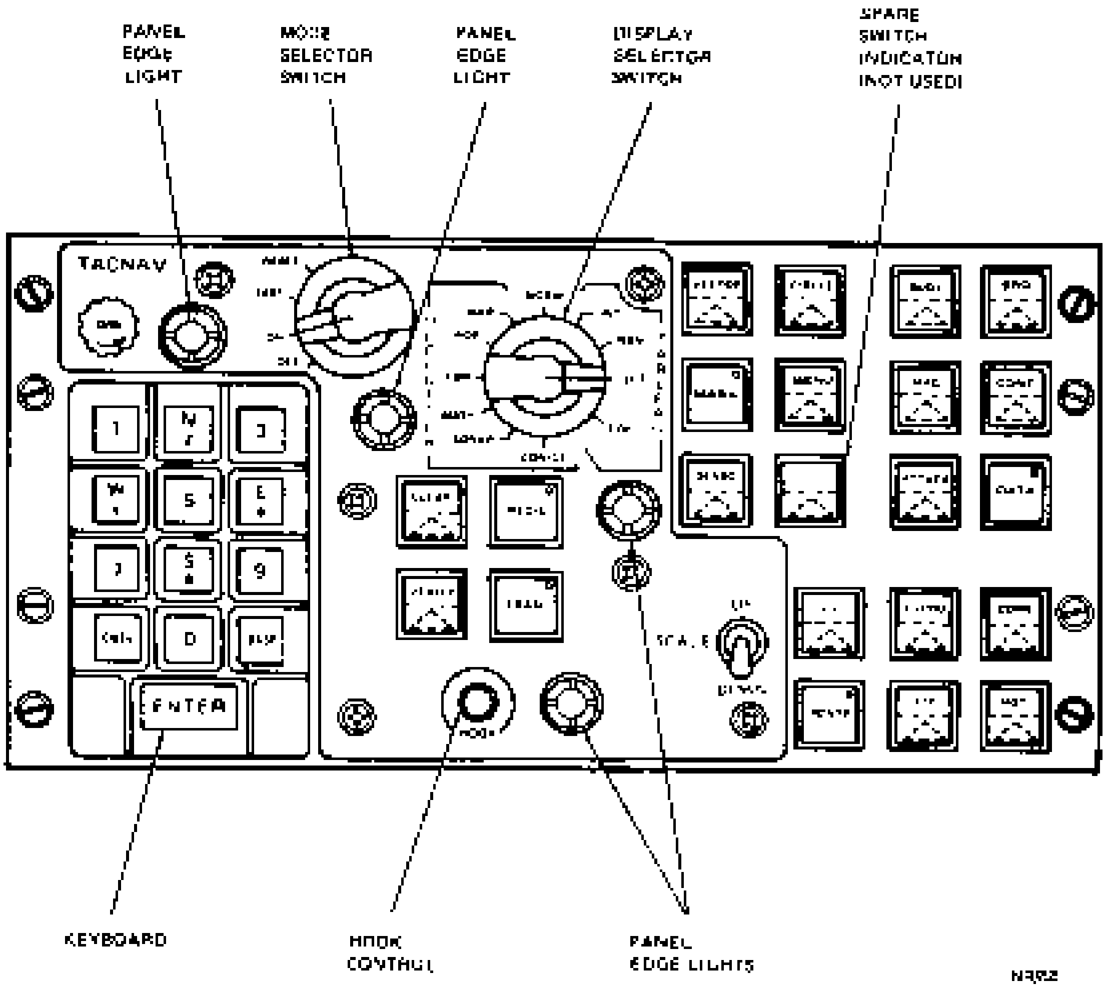


Figure 15-27. TACCO Panel Controls

15.20.5.5.3 TABLEAU. These four positions allow display of either the initialization (INT), navigation (NAV), sonobuoy launch tube (SLT), or equipment status (EQP) tableaus. Tableaus replace the tactical plot on the display.

15.20.5.6 SCALE Switch. The SCALE switch is a spring-loaded momentary toggle switch. Each UP or DOWN switch activation changes the scale by a factor of two. The TACNAV Set initializes to the 04 nm/inch scale. Scales are as follows:

0.5 nm/inch
0l nm/inch
02 nm/inch
04 nm/inch
08 nm/inch
16 nm/inch
32 nm/inch
64 nm/inch
128 nm/inch

15.20.6 DIM Control. When turned, the DIM control varies the intensity of the green lights in the cue indicators, switch indicators, and numeric display.

15.20.6.1 NUMBER Cue Indicator. When legend is illuminated green under control of computer, the number cue indicator informs operator that the computer-assigned contact number is being displayed in the numeric display.

15.20.6.2 RNG Indicator. Legend illuminates green on computer command, cuing operator to enter range of radar or sonar contact.

15.20.6.3 BRG Indicator. Legend illuminates green on computer command, cuing operator to enter bearing of radar or sonar contact.

15.20.6.4 RADAR Switch Indicator. When pressed, green indicator triangle lights and switch function enables entry of radar range and bearing via keyboard and cue indicators.

15.20.6.5 Keyboard 0 Through 9 Switches. Pushbutton switches are used to enter numeric data into the computer.

15.20.6.5.1 CNCL (Cancel) Switch. Switch function causes a complete line of entered numbers (up to four digits in the numeric display) to be canceled if pressed before ENTER switch.

15.20.6.5.2 BKSP (Backspace) Switch. Switch function causes the last single data unit to be canceled if pressed before ENTER switch.

15.20.6.5.3 ENTER Switch. When pressed, the ENTER switch permits keyed-in SENSO panel data to be displayed on the TACNAV display for acceptance by the pilot.

15.20.7 TACNAV Display. The display indicator is the viewing focal point of system operation, visually integrating all inputs to display the plot of tactical and navigation data from the TACNAV computer. The display (Figure 15-28) is on the cockpit console and displays the tactical plot from which the mission is controlled. Operator and system inputs are presented on the display to create a tactical plot depicting information required for the mission. Control of the display is provided by the TACCO panel.

15.20.7.1 Mode Selector Switch

15.20.7.1.1 TEST. Applies input power to unit, generates test pattern, and intitates built-in-test. There is a 30-second delay before high voltage is applied to the TACNAV display.

15.20.7.1.2 ON. Applies input power to unit. There is a 30-second delay before high voltage is applied to the TACNAV display.

15.20.7.1.3 OFF. Removes input power from the unit.

15.20.7.2 OVER TEMP Indicator. Momentary reset-type failure indicator appears black/white when a display overtemperature condition has occurred, causing automatic power shutdown. Power is restored when temperature has been reduced to normal limits. To regain black (normal) indication, the indicator must be manually reset by rotating clockwise and releasing.

15.20.7.3 BITE Indicator. Momentary reset-type failure indicator appears black/white when the display fails built-in test. Indicator must be manually reset to the black (normal) indication by rotating clockwise and releasing.

15.20.7.4 INTENSITY Control. When turned, the intensity control varies display brightness from beam cutoff to full intensity.

15.20.8 TACNAV Operating Procedures

1. TACNAV display – ON.
2. TACCO panel mode selector switch – RESET (if desired).
3. TACCO panel mode selector switch – ON.
4. Display selector switch – INT.
5. Enter appropriate data in the initialization tableau.
6. Display selector switch - NAV.
7. Enter appropriate data in the navigation tableau.

Note

Both the initialization and navigation tableau must be completely filled before TACNAV can begin navigation. Data in the sonobuoy launch and equipment status tableau do not affect basic navigation and may be entered at any time during a mission.

8. Display selector switch - NORM.
9. MOT button - DEPRESS. This will cue TACNAV to begin navigation.

WARNING

Pilot at controls should guard against diverting his attention to the TACNAV display or TACCO panel.

15.20.8.1 Global Positioning System. (GPS) GPS was installed on H-3 aircraft to meet the requirement to have GPS positioning systems on all Naval aircraft by 2005. GPS measures the transmission delay of radio signals from a constellation of satellites in orbit around the earth. Rough acquisition is accomplished by an internal clock, however, reception of multiple GPS signals allows the system to determine actual time delay with great accuracy. Once in synchronization, GPS provides an accurate time source. Two types of GPS position accuracy are available. Standard Positioning Service (SPS) is available to military and selected users. Precise Positioning Service (PPS) is available to military and selected Government users through the use of special receivers that utilize both GPS frequencies, and are which keyed with a GPS code to enable

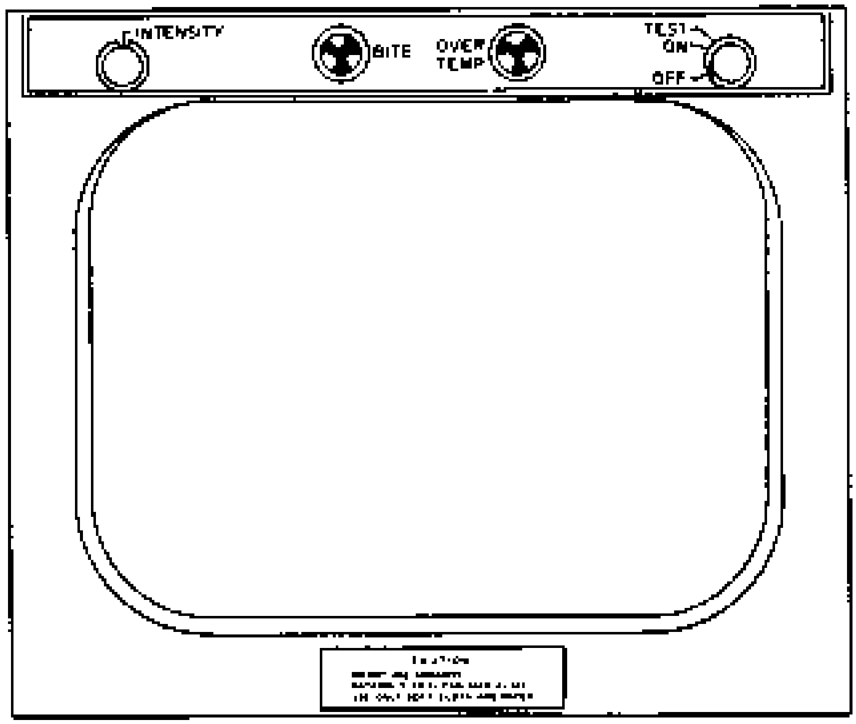


Figure 15-28. TACNAV Display

it to utilize the precise PPS signals. PPS receivers initially acquire the SPS signals, and use the SPS to obtain a course position, which is used to acquire and track the PPS signal.

Note

GPS will not be used as the primary means of navigation, but as a back-up to other existing sources of navigation information.

15.20.9 Trimble Pack. To comply with mandates to expedite GPS installation on aircraft, particularly transport and utility aircraft, a Trimble Model GPS set was temporarily installed as a stop-gap measure. The Trimble Pack, which provides SPS, is temporarily attached to the copilot's glare shield, and the antenna is affixed to the windscreen. Waypoint data is entered directly into, and navigation data is read directly from the Trimble Pack GPS.

Information on the operation of the Trimble Packs is available from the commercial operating manuals provided with each Trimble unit. The Trimble Packs are being replaced by permanent MAGR installations as part of Airframe Change AFC 495.

15.20.10 Miniature Airborne GPS Receiver. To provide integrated GPS information, an R-2512 MAGR was installed in H-3 aircraft as part of Airframe Change AFC 495. The MAGR provides GPS data to the ASN-123 TACNAV system via a Mil-Std 1553B data bus. The 1553 data bus also connects a Mission Data Loader (MDL) to load GPS Precision Positioning System (PPS) data. Without the PPS code loaded, the GPS is unable to utilize the PPS accuracy.

The MAGR provides GPS positioning data directly to the ASN-123. All other ASN-123 functions continue to operate normally. GPS operation is initialized using the normal TACNAV system initialization and crew-inserted data. Data entry is accomplished using the TACCO panel controls, and positional data is displayed via the TACNAV display. The SLT Tableau on the display provides information on the status of the GPS receiver, and the number and quality of the GPS signals being received.

Note

- Proper operation of the GPS requires the reception of four or more GPS satellites located at diverse angular displacement to provide good GPS accuracy. During ground operations, buildings and terrain can block GPS signals, therefore, to expedite GPS acquisition and optimum GPS accuracy, Ensure that the aircraft is in a clear location During GPS start-up.

- The GPS satellite provides ephemeris data on satellite locations, which the GPS receiver uses to determine a GPS position solution. This data is stored in the receiver, and is used to provide a rapid response solution. If the GPS system has not been powered up for an extended period, or if the GPS internal battery is weak, the ephemeris data is lost or not valid, and the GPS receiver must reacquire and store the data before it can provide a GPS solution. This process takes approximately 12 minutes for the satellites to transmit the ephemeris data. A planned ground warm-up time of 12-24 minutes is recommended to ensure that GPS is able to acquire or update the ephemeris data.

15.21 VISUAL COMMUNICATION - IN FLIGHT

This helicopter has the capability of signal light communications by the addition of the portable standard-type Aldis lamp with detachable colored lens covers. This lamp is attached by a length of electrical cord to the receptacle. The Aldis lamp will be used during conditions of EMCON that prohibit the use of radio communications. Its use includes plane-to-plane and plane-to-ship communications.

This Page Left Blank Intentionally

PART VIII

Weapons Systems

This Page Left Blank Intentionally

CHAPTER 16

Armament Systems

16.1 Smoke Lights. The point of datum is usually a fixed point on the ocean surface. To assist the crew in identification, datum must be marked. Smoke lights offer the best means available for marking the point of datum. The types in common use are the Mk 58 and Mk 25.

There are several uses for the smoke light other than marking datum. These include wind direction determination to assist the pilot in maneuvering his helicopter while conducting searches, pinpoint location to assist a downed pilot by marking his exact location, and marker purposes to indicate the location of practice ordnance so that it can be retrieved.

WARNING

Anytime there is a chance of igniting aviation fuel that may be in the immediate area, smoke lights shall not be used to mark survivor positions.

16.1.1 Mk 25 Marine Locator Marker. The marker is an aluminum tube about 18-1/2 inches long and 3-3/4 inches in diameter. It weighs about 4 pounds. When properly dropped, it will produce a display of white smoke and yellow flame within 15 seconds after striking the water. The marker will burn for at least 15 minutes. The marker may be carried in two configurations. The base cover can be set on safe and the base plugs intact, or it may be carried with the base cover in the ARMED position, the base plug pushed in and an adapter kit, Marine Marker Mk 34 Mod 0, attached.

To hand launch the Mk 25 without the Mk 34 adapter attached, arm the marker by turning the cover clockwise from the SAFE position to the extreme ARMED position. Push the two base plugs into the marker by applying pressure on the base plugs with the thumb and finger. The marker is now ready to be launched upon command. To launch the marker with the Mk 34 adapter installed, remove the U-pin that Secures the adapter to the marker. This permits the spring-loaded adapter to pop off the marker. The marker has already been ARMED and the base plugs pushed in. It is now ready to launch.

The following precautions must be observed when using the Mk 25 marker:

1. The markers are seawater-activated pyrotechnic devices that do not contain a safety feature after the base plugs are pushed in and therefore can be hazardous to inexperienced personnel.

2. Markers that show signs of damage, leakage, or are otherwise unserviceable shall be disposed of in accordance with current regulations for disposal of pyrotechnic materials.

3. Markers without the adapter installed shall be set on SAFE until ready for use. This prevents the base plugs from being pushed in.

4. Under no circumstances shall markers with the base plugs pushed in and the adapter not installed be placed in a position where they can contact water.

5. Markers with base plugs pushed in must be used or disposed of if not stored with the adapter kit assembled on the marker. Activation is still possible if exposed to seawater.

WARNING

Mk 25 markers should not be launched with helicopter in a hover because of possibility of upward ejection of initial plug.

16.1.2 Mk 58 Marine Locator Marker. The marker is in a tin or tern plate cylindrical can, about 21-1/2 inches long and 4-7/8 inches in diameter. This marker is designed for day and night use in any condition calling for long burning, smoke and flame reference point marking on the ocean surface. It produces yellow flame and white smoke for at least 45 minutes and up to 55 minutes that is visible for at least 3 miles under normal conditions.

This device contains two phosphorus pyrotechnic candles supported within the marker body by foamed-in-place polyurethane. The first candle is ignited by an electric squib initiated by a seawater-activated battery. When the aluminum-backed tape pull tab is removed and the marker is launched, the battery cavity is exposed to seawater that serves as an electrolyte to activate the battery. Current from the battery initiates the electric squib that ignites the starter mix. When the candle is nearly burned out, its head ignites the second candle time transfer fuse that ignites the starter mix. Each candle burns for at least 20 minutes.

To launch the marker, pull the marker pull ring and hand launch the marker from the rear of the helicopter.

WARNING

A pull on the marker pull ring exposes the battery cavity. Entrance of seawater in this cavity will immediately activate the marker. This ring must not be pulled until launching is to be accomplished.

CAUTION

The sea battery cavity must be opened by a proper pull on the marker pull ring to assure removal of the aluminum-backed tape from the top of the battery cavity. Failure to open this battery cavity will result in failure of the marker.

16.1.3 Safety Precautions.

WARNING

- The red phosphorus composition in this marker produces smoke that is highly caustic to the moist tissues of the nose and throat. Do not breathe this smoke.

- The tear strip must not be removed except as a part of actual preparations for launching. Removal of this strip destroys the sealed character of the marker and contributes to its possible deterioration and to the possibility of accidental ignition through introduction of seawater to the battery. The tape that covers the battery cavity must not be removed except as a part of launching procedures. Once the reinforced adhesive foil over the battery cavity hole is removed, the marker shall not be returned to any type of storage. The marker must be used or disposed of properly.

16.2 (NON-ET) M-60-D MACHINEGUN SYSTEM

The M-60-D is the only authorized machinegun for use with the M-93 pintle machinegun mount. Use of the M-60-A or M-60-B may cause damage to the trigger guard assembly an/or injury to firing personnel.

16.2.1 Weapon Description. The M-60-D machinegun is an air-cooled, link-belt fed, gas-operated, 7.62 millimeter automatic weapon (Figure 16-1).

The M-60-D has a front sight permanently affixed to the barrel and a rear ring sight attached to the receiver assembly. The machinegun can be easily installed and removed from the mount by use of the quick release pins. Firing stops are incorporated into the design of the mount to determine the azimuth and elevation limits of the machinegun. Figure 16-2 shows machinegun fields of fire.

16.2.1.1 Inventory.

1. Machinegun with attached barrel, sling, and bipod.

2. Equipment kit, including cleaning kit, spare barrel, and hot glove.

The primary weapon controls are the latch lever, barrel lock lever, cocking handle, safety lever, and trigger.

16.2.1.2 Latch Lever. The latch lever actuates the cover latch that is spring-loaded and is located at the right rear end of the feed cover. The function of the latch is to secure the cover in the closed position. When the lever is vertical, the cover is locked closed. Turning the lever to the horizontal position unlocks the cover.

CAUTION

Do not turn the latch lever more than required to unlock the cover as damage to the latch spring will result.

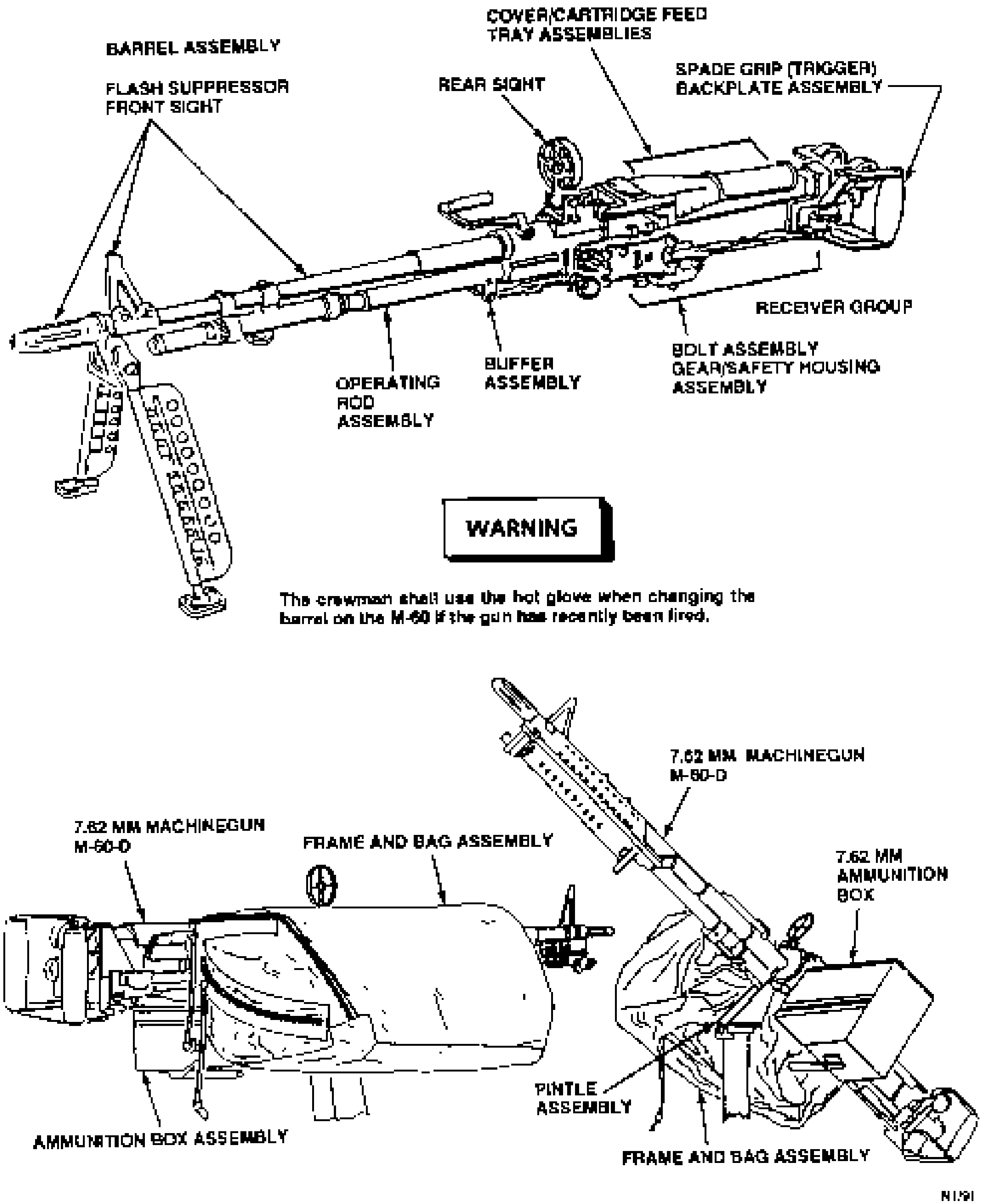
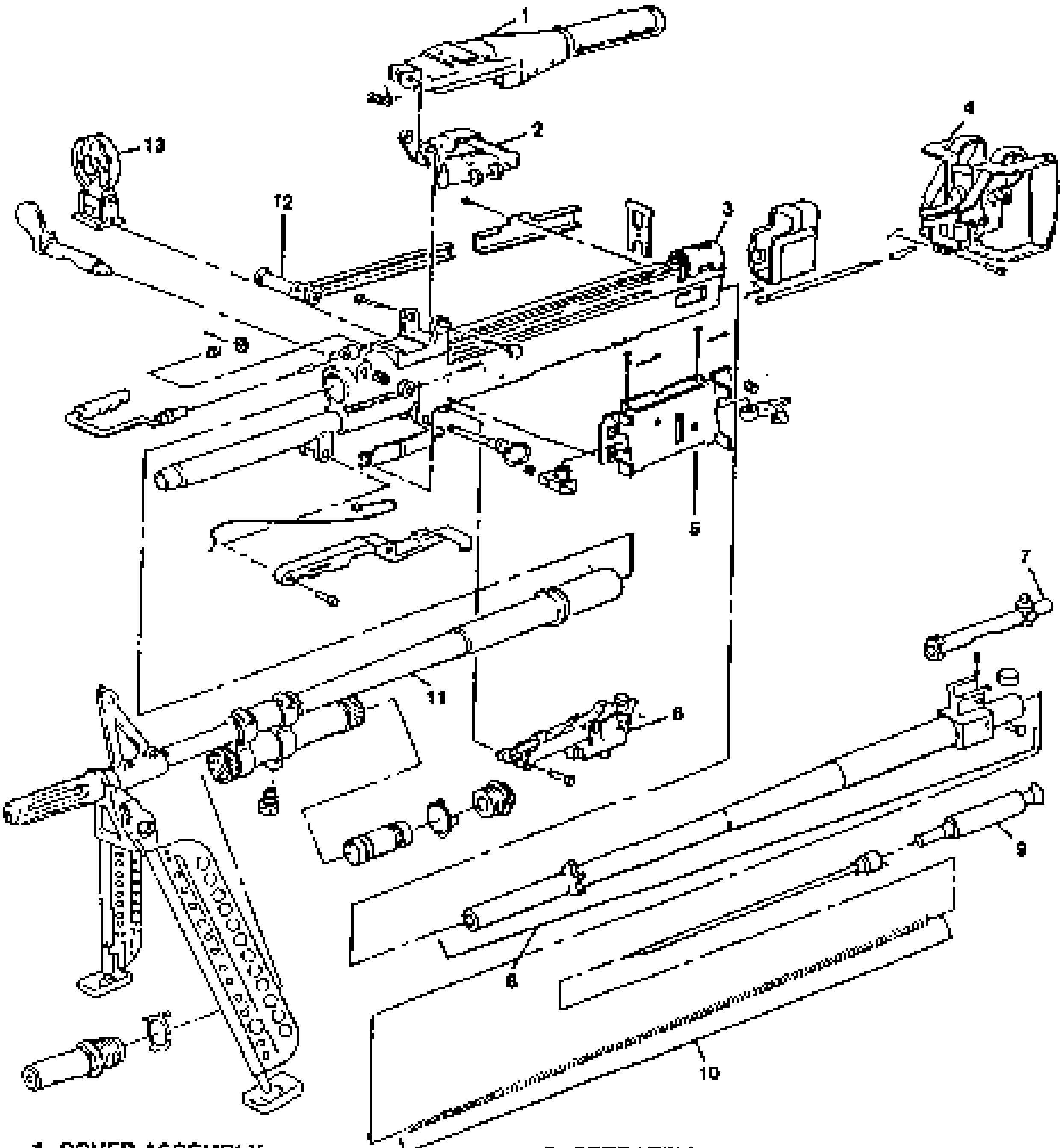


Figure 16-1. (NON-ET) M-60-D Machinegun, 7.62 Millimeter (Sheet 1 of 2)



1. COVER ASSEMBLY
2. CARTRIDGE FEED TRAY ASSEMBLY
3. RECEIVER ASSEMBLY
4. SPADE GRIP BACK PLATE ASSEMBLY
5. MAGAZINE BRACKET ASSEMBLY
6. GEAR AND SAFETY HOUSING ASSEMBLY
7. BOLT ASSEMBLY
8. OPERATING ROD ASSEMBLY
9. BUFFER ASSEMBLY
10. DRIVING SPRING GUIDE ASSEMBLY AND SPRING
11. BARREL ASSEMBLY
12. COCKING HANDLE ASSEMBLY
13. REAR SIGHT ASSEMBLY

N1/31

Figure 16-1. (NON-ET) M-60-D Machinegun, 7.62 Millimeter (Sheet 1 of 2)

16.2.1.3 Barrel Lock Lever. The barrel lock lever is located on the right front end of the receiver. The lever is secured to the barrel-locking shaft and rotates the shaft to lock and unlock the barrel. When the lever is vertical, the barrel is unlocked. When the lever is horizontal, the barrel is locked in place.

16.2.1.4 Cocking Handle. The cocking handle is located on the right side of the receiver between the cover and trigger mechanism. Cocking handle function is to charge the weapon manually. When the handle is pulled to the rear, the bolt is cocked. It shall be returned manually to its forward position each time the bolt is manually pulled to the rear.

WARNING

Before firing, the handle must be returned to the forward position.

16.2.1.5 Safety Lever. The safety lever is located on the gear and safety housing assembly. Safety lever function is to prevent the weapon from being fired accidentally. The safety lever has two marked positions: F (firing) and S (safety). In the safe position the bolt cannot be pulled to the rear or released to go forward.

16.2.1.6 Trigger. The trigger is in the spade grip back plate assembly, which is located at the end of the receiver assembly. Trigger function is to control firing of the weapon.

The machinegun can be easily installed and removed from the mount by use of the quick-release pins. Firing stops are incorporated into the design of the mount to determine the azimuth and elevation limits of the machinegun. Figure 16-2 shows machinegun fields of fire.

16.2.1.7 Weapon Parameters.

Length	44.88 inches
Weight	23.75 pounds
Maximum Range	3,725 meters
Maximum Effective Range	1,100 meters
Ammunition	7.62 millimeter, ball, tracer, armor-piercing incendiary and dummy

RATES OF FIRE

Sustained	100 rounds per minute
Rapid	200 rounds per minute
Cyclic	550 rounds per minute

16.2.2 Weapon Operating Procedures

16.2.2.1 Preflight.

WARNING

Weapon shall be treated as loaded at all times.

1. Cargo door - OPEN.

2. Gun – MOUNT AND CHECK.

Check gun for security in proper firing positions and freedom of movement throughout full travel. Refer to Figure 16-3 for system malfunctions discovered.

CAUTION

Ensure that no portion of the aircraft is in the gun field of fire.

3. Gun - STOW.

4. Ammunition - CHECK (TYPE, GRADE, AND QUANTITY).

5. Personnel harnesses - CHECK (INSTALLED, FOR SECURITY AND SERVICEABILITY).

6. Accessories - CHECK (ALL REQUIRED EQUIPMENT, INCLUDING GLOVES, BARRELS, SPRINGS, TOOLS AND BOLTS ARE ABOARD).

16.2.2.2 Arming.

1. Gun - POSITION.

Place gun on mount, insert lock pin, step on release bar, and position mount forward until mount locks.

WARNING

Gunner shall visually check chamber empty before dry firing.

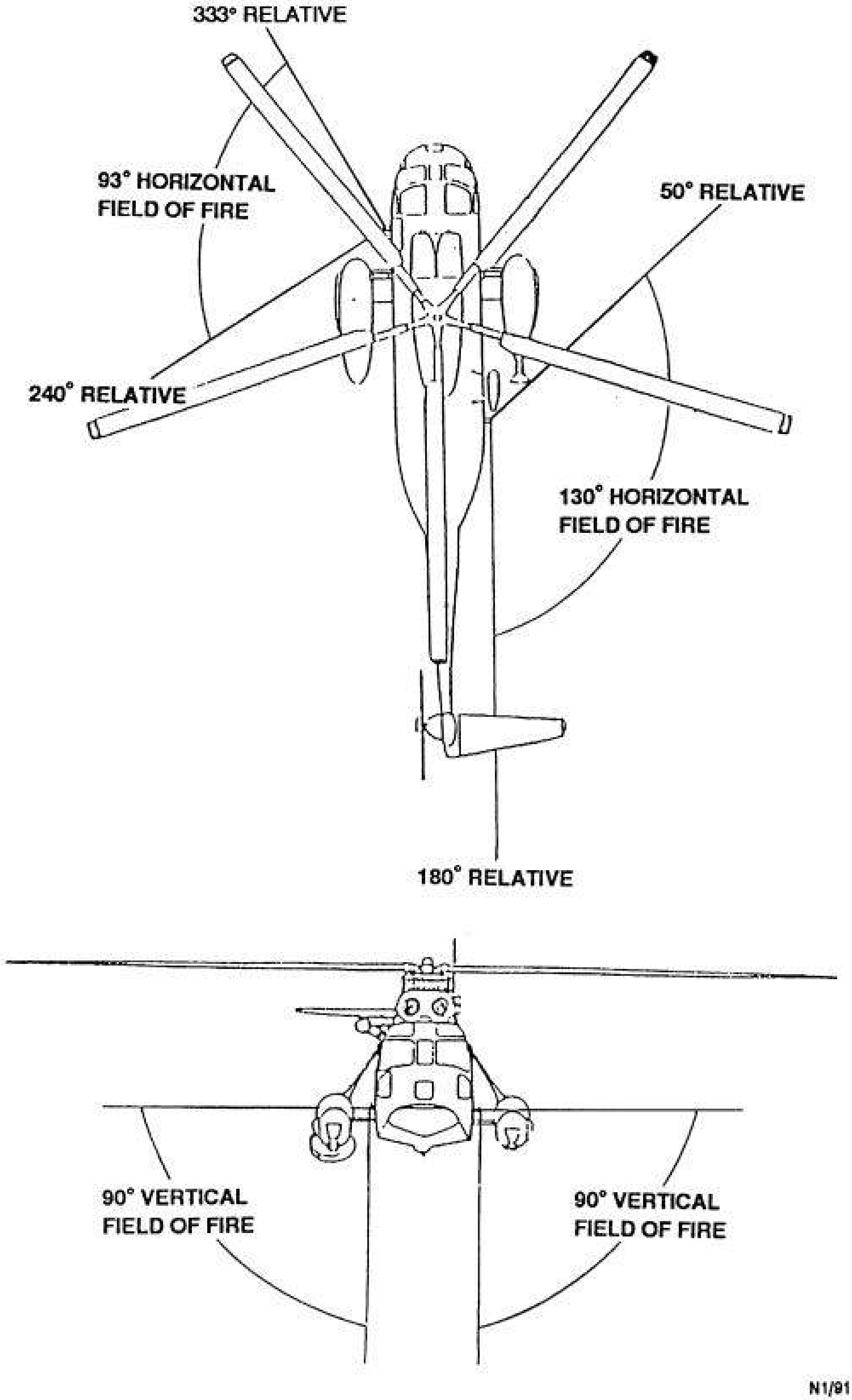


Figure 16-2. Fields of Fire

ASSEMBLY OR GROUP	PROBABLE CAUSE
BARREL ASSEMBLY WITH BIPOD ASSEMBLY.	Cracks or damage to gas piston and cylinder. Gas cylinder plug is tight and safety wired.
TRIGGER MECHANISM.	Proper fur ctioning of safety. Missing or broken swivel.
COVER ASSEMBLY AND CARTRIDGE FEED TRAY ASSEMBLY GROUPS.	Spring weakness of latch lever. Broken or damaged parts.
BUFFER ASSEMBLY AND OPERATING ROD ASSEMBLY GROUPS.	Broken or damaged condition. Freedom of movement of roller. Looseness of roller pin.
BREECH BOLT ASSEMBLY.	Sharp corners or edges on firing pin. Bent or broken firing pin spring.
RECEIVER GROUP.	Loose or damaged rear sight. Ease and operation of retracting slide assembly. Loose rivets.

Figure 16-3. M-60 Operator Inspection

2. Gun and operating controls - CHECK (controls for proper operation and dry fire).

3. Gunner - REQUEST PERMISSION TO "LOCK AND LOAD" WEAPON (arm weapon).

a. Open cover assembly.

b. Safety lever - F (fire).

c. Cocking lever - PULL COCKING LEVER FULL AFT THEN PUSH FORWARD.

d. Safety lever - S (safe).

e. Ammunition - POSITION ON FEED TRAY.

f. Close cover assembly.

4. Gunner - REPORT TO PILOT "LOCKED AND LOADED" (weapon armed).

16.2.2.3 Firing.

1. Gunner - REQUEST PERMISSION FROM PILOT TO FIRE.

2. Safety lever - F (firing).

3. Gun - FIRE AS NECESSARY.

Note

Trigger must be completely released to fire single rounds or to interrupt firing at any time.

16.2.2.4 De-arming.

1. Gun - DEARM.

a. Latch and cover assembly - OPEN.

b. Feed tray - RAISE.

c. Link belt - REMOVE.

d. Gun - CLEAR.

WARNING

Gunner shall visually check chamber empty.

e. Gun - EASE BOLT ASSEMBLY FORWARD.

f. Gun - S (safe).

2. Gun and mount - STOW.

Step on mount lock release, pull mount back, and remove gun from mount.

16.2.2.5 Postflight.

1. Check aircraft for unfired rounds, brass, and links.

16.2.2.6 Barrel Changing Procedures.

1. Ensure that breach is clear. Follow normal dearming procedures.

2. Lift barrel - LOCKING LEVER.

WARNING

Because of extreme temperatures involved, heavy-duty gloves shall be worn and proper handling procedures must be observed in order to prevent burns and fires.

3. Pull out barrel, place barrel in proper area.

4. Insert new barrel.

5. Push locking lever to locked position.

6. Rearm as necessary.

16.2.2.7 Spent Cartridge Disposition. Aircrew shall ensure that spent cartridges are collected and disposed of properly because of FOD hazard and accumulation in the bilges.

16.2.3 Emergency Aircrew Procedures

16.2.3.1 Misfire. A misfire is the complete failure of the weapon to fire. This is not dangerous but must be treated as a malfunction in the firing mechanism or a faulty round. A misfire should not be confused with a hangfire.

WARNING

- Keep the round locked in chamber for 5 seconds from the time a misfire occurs to ensure against an explosion outside of the gun if a hangfire develops.

- If the barrel is hot and a misfire stops automatic operation of the gun, wait 5 seconds with the round locked in chamber to ensure against hangfire dangers; then extract immediately by retracting cocking handle to prevent a cookoff.

- If the round cannot be extracted within 10 seconds, it must remain locked in the chamber for at least 5 minutes because of the possibility of a cookoff.

16.2.3.2 Hangfire. A hangfire is a delay in the function of the propelling charge. The amount of delay is unpredictable, but in most cases will fall within the range of a split second to several seconds. Hangfire cannot be distinguished immediately from a misfire.

16.2.3.3 Cookoff. A cookoff is the firing of the explosive components of a round because of the overheated chamber of the weapon and not the actuating of the firing mechanism.

16.2.3.4 Procedures in Case of Failure to Fire. After failure to fire, the following precautions, as applicable, shall be observed:

1. Gun - ON TARGET.

Keep gun trained on target, refer to Figure 16-4 for troubleshooting.

2. Cocking handle - AFT.

Pull cocking handle aft to attempt to eject round, ensuring that operating rod remains to rear. Weapon must be cleared and inspected along with ammunition to determine cause of stoppage.

WARNING

If the round does not eject, do not attempt to fire the gun.

3. If round is ejected - RESUME FIRING.

Return cocking handle to forward position, train, and attempt to fire.

4. If round is not ejected - RAISE COVER AND REMOVE BELT; SAFETY TO S (SAFE) POSITION.

Remove ammunition and links and inspect the receiver, chamber, and extractor.

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
FAILURE TO FEED	Insufficient gas pressure.	Clean gas port.
	Improper lubrication.	Apply lubricant as required.
	Defective link or ammunition.	Insert new ammunition or link.
	Ammunition belt installed wrong.	Reverse belt with open side of link down.
	Damaged or weak operating rod spring.	Notify organizational maintenance personnel.
	Obstruction in receiver.	Remove item blocking movements. Clean and lubricate.
FAILURE TO CHAMBER	Ruptured cartridge case.	Remove.
	Carbon buildup in gas cylinder.	Remove carbon.
	Carbon buildup in receiver.	Remove carbon.
	Damaged round.	Remove and recharge weapon.
	Dirty chamber.	Clear and clean or change barrel.
FAILURE TO FIRE	Faulty ammunition.	Remove ammunition.
	Broken or damaged firing pin.	Notify organizational maintenance personnel.
FAILURE TO EXTRACT	Gas piston installed backwards.	Install properly.
FAILURE TO EJECT	Frozen or damaged ejector spring.	Notify organizational maintenance personnel.
UNCONTROLLED FIRE	Broken or worn sear.	Notify organizational maintenance personnel.
	Worn sear notch on operating rod.	Notify organizational maintenance personnel.

Figure 16-4. M-60 Operator Troubleshooting

If a round is present in the chamber:

5. Close cover - SAFETY TO F (FIRE), ATTEMPT TO FIRE.

If weapon fires and ejects, reload, train on target, and continue to fire. If round fails to fire, inform pilot; if barrel is considered hot enough to cause cookoff (200 rounds fired within 2 minutes), wait 5 minutes with bolt in the forward position for possible cookoff before bolt is retracted.

16.2.3.5 Runaway Gun.

WARNING

Do not attempt to put gun on S (safe). Hold the fire on the target until feeding is stopped or the ammunition is expended.

Train the gun on safe area; twist and break the ammunition belt.

16.2.3.6 Ruptured Cartridge Case. In some cases of complete rupture of a cartridge case, the forward portion of the case remains in the chamber and extraction is accomplished only on the rear portion. When a rupture of this type occurs, a new round will be fed into the chamber. Incomplete chambering may result since the round being fed into the chamber cannot be fully seated.

WARNING

- The round may be compressed sufficiently to cause detonation with possible damage to the weapon, injury to personnel, or both.
- A round may be driven into the ruptured case without detonation. In this situation crewmen shall follow failure to fire procedures.

16.2.3.7 Double Feed. A double feed, with subsequent possibility of damage to the gun and injury to personnel, will occur whenever a round is fed into a chambered spent case or live round.

16.2.3.8 Double Feed Into Spent Case. When the gun fails to extract the spent case, the bolt will automatically recoil, strip the next round from the belt, and feed it into the chambered case. The force may compress the round sufficiently to cause detonation, damage to the gun, and injury to personnel.

16.2.3.9 Double Feed Into Live Round. When a round fails to fire, the bolt remains in the forward or closed position. This causes a stoppage, which must be treated as a hangfire.

WARNING

- If the gun is manually charged and the trigger is pulled, the next round will be fed into the primer of the first round causing it to fire.
- At no time will the bolt be retracted and allowed to go forward if the belted ammunition is on the feed tray and a live round remains in the chamber of the gun.
- Pilots shall notify controlling agencies (tower, ship) when returning with unexpended or jammed rounds in the chamber.

16.2.3.10 ICS Voice Procedures.

STATION	ACTION	ICS CALLS
PILOT	COMMANDS GUNNER TO LOAD WEAPON	LOCK AND LOAD
GUNNER	LOADS THE WEAPON	LOCK AND LOADED.
PILOT	COMMANDS FIRING AS REQUIRED. IDENTIFIES TARGET BY CLOCK METHOD AND DISTANCE	OPEN FIRE.
GUNNER	SIGHTS TARGET	ROGER, OPEN FIRE.
PILOT	COMMANDS GUNNER TO CEASE FIRING	CEASE FIRE.
GUNNER	CEASE FIRING	ROGER, CEASE FIRE.
PILOT	COMMANDS GUNNER TO CLEAR WEAPON, REMOVE AMMUNITION, AND SAFE WEAPON ONCE ESTABLISHED IN A SECURE AREA.	CLEAR YOUR WEAPON
GUNNER	CLEARS WEAPON REMOVES AMMUNITION, AND SAFES WEAPON	WEAPON CLEAR AND SAFED.

16.2.3.11 Lost ICS Hand Signal. Hand signals may be exchanged either outside or inside the aircraft depending on interior configuration.

Pilot to Gunner

Signal:
Thumb extended upward, index finger extended (toy pistol) repetitive upward motions of the hand signal.

Meaning: OPEN FIRE

Signal:
Inverted Toy pistol gesture with thumb pointed downward, repetitive downward motions of the hand signal.

Meaning: CEASE FIRE

16.2.3.12 Weapon Control Status.

Note

The HAC shall ensure that the crew is aware of the weapon control status at all times when the M-60-D is aboard the aircraft.

1. Weapons free - Gunners may engage any target not positively identified as friendly. This is the least restrictive control status. Clearance to fire will be granted by the HAC at a predetermined phase of flight based on available intelligence on the position of friendly troops.

2. Weapons tight - Fire only at targets positively identified as hostile. Clearance to fire shall be requested from the HAC for each target engaged.

3. Weapons hold - Do not fire except in self-defense. This is the most restrictive weapon control status. Clearance to fire shall be requested from the HAC for each engagement.

CHAPTER 17

Weapon Recovery

17.1 GENERAL DESCRIPTION

17.1.1 Purpose This chapter is intended as a reference for operators of the UH-3H helicopter with special mission requirements such as target launching and weapon and target recovery.

17.1.2 Background Prior to the development of helicopter recovery systems, range recovery work was normally accomplished by small surface craft. This method was successful; however, it had many disadvantages such as limited sighting ability and restricted operations caused by sea state conditions. In addition, the recoverable equipment was subject to damage during recovery/transport, and possible injury to personnel was a constant hazard.

Helicopter recovery systems were introduced to the ranges to overcome the disadvantages encountered during surface craft recovery. The helicopter could locate the weapons and targets, recover them, and return them to the turnaround facility in a relatively short period of time. Helicopter weapons/target recovery has demonstrated higher reliability and greater safety than surface craft in open ocean recovery.

17.2 SYSTEMS

17.2.1 MK 146 MOD 0 LAUNCH SYSTEM (USED WITH MK 30 TARGETS) The Mk 146 Mod 0 helicopter launch system for Mk 30 targets consists of four principal parts (Figure 17-1).

1. Launch rack.

2. Rigging.

3. Control cables.

4. Launch control box.

17.2.1.1 Launch Rack. The launch rack is 8 feet long, 3 feet wide, 3 feet high, and weighs 280 pounds. It consists of two main I-beams bolted to two end I-beams that rest on and are bolted to four legs, reinforced by longitudinal and corner braces.

The two main cables sling tightly underneath the vehicle and connect to the two suspension lugs of the bomb shackle. A 1/4-inch diameter nylon rope slings underneath the vehicle at the aft end of the launcher.

Swivel casters are fitted to the bottom of each leg for ease of ground handling and to allow the launcher to center itself without tipping during lift-off. Pair of 2 foot by 1-foot trim tabs is attached to the rear legs to improve flight characteristics when the launcher is unloaded (Figure 17-1).

17.2.1.2 Rigging. The system's rigging consists of two 20-foot lengths of double braid nylon. The lines are attached to the launcher at the middle of the front and rear end beams. The lines are attached at the other end to a strongback that fits the helicopter cargo hook.

17.2.1.3 Control Cables. The lower launch control cable (Figure 17-1) runs down the rear lifting line to the launcher connector. A Mk 6 A-cable connects the mobile target to the launcher connector. A pullaway lanyard is attached to the launch frame at one end and to the A-cable finger at the other end. This lanyard disconnects the A-cable from the mobile target during launch, preventing damage to the A-cable.

The lower launch control cable passes up into the helicopter and mates with the upper launch control cable (Figure 17-2). For helicopters with no sonarwell, control cables are routed from the strongback to cargo door opening. The upper launch control cable connects to the launch control box. An O-ring provides strain relief to the lower launch control cable to prevent inadvertent separation of the quick-disconnect junction. In the event of a jettison, the O-ring will break, the disconnect lanyard will take up the strain, and the connectors will separate.

The two remote control cables are mounted to the bomb shackle and routed up the rear lifting line into the helicopter, where the safe/launch handle is connected to a deck ring via a breakway O-ring. One cable controls the bomb shackle safety pin, and the other cable controls the bomb shackle release trigger. The control knobs are coupled together for simultaneous activation.

17.2.1.4 Launch Control Box. A launch control box is required for launch control of Mk 30 targets. (Refer to Figure 17-3).

Target warmup, control, and monitor signals are sent to the mobile target and returned through the A-cable. The mobile target gyro systems are erected, the pinger is activated, and circuit warmup power is applied. Resulting conditions are displayed on the launch control box.

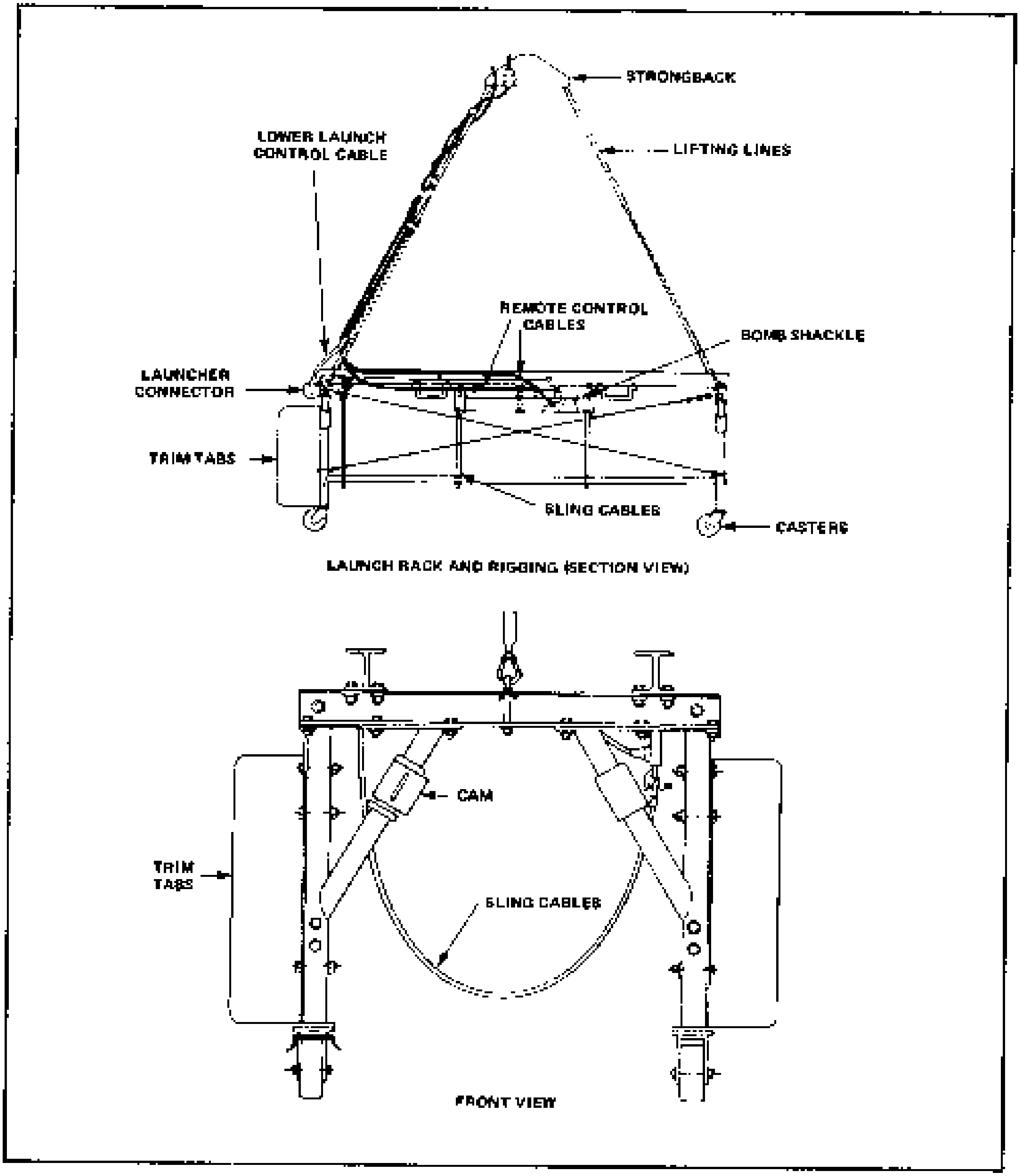


Figure 17-1. Mk 146 Mod 0 Launch Rack and Rigging

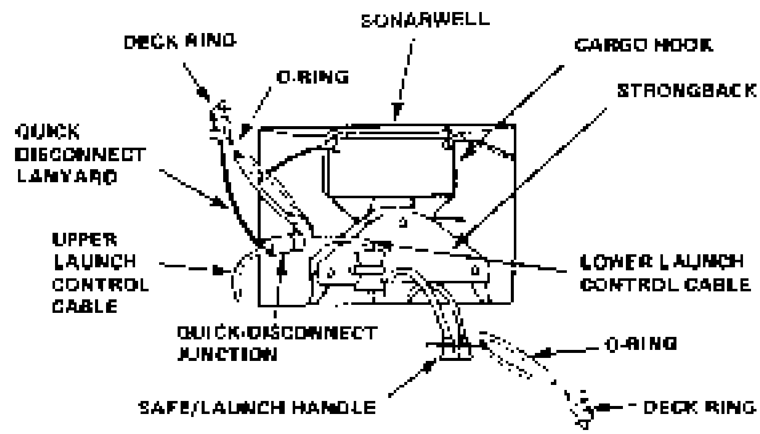


Figure 17-2. Control Cable Connection

When the READY LIGHT or the READY OPERATE and REFERENCE ESTABLISHED lights are illuminated, the mobile target is ready for launch. The mobile target is first fired electrically by operating the FIRE button on the launch control box, then the SAFE/LAUNCH handle is pulled. The bomb shackle releases the two main sling cables, and the nylon rope restrains the rear of the mobile target until it breaks (about one-fourth second), causing the mobile targets to pitch down for proper water entry.

In an emergency, the mobile target may be jettisoned from the launcher by operating the SAFE/LAUNCH handle.

17.2.1.5 Flotation. To prevent sinking of the launcher (loaded or empty) in the event of a low-altitude jettison, rigid foam flotation is mounted to the launcher. Figure 17-4 depicts the launcher with flotation. For clarity, all other figures in this manual do not show the flotation.

17.2.1.6 Mk 30 Target Description. The Mk 30 mobile ASW target is 21 inches in diameter and weighs 2,700 pounds. The underwater vehicle used to simulate submarines and operates on a programmed pattern. The Mk 30 target responds to both active and passive acoustic signals and provides signature characteristics for classification purposes. With speeds of 7 to 30 knots, maximum endurance ranges from 30 minutes to 6 hours automatically. The target can be shut down at any time during a run by its acoustic command link using either range UQC or the portable Mk 30 ESP at the end of a run, a balloon deploys either immediately or after a delay of 90 minutes if EOR select was chosen prior to launch. The target floats vertically prior to balloon deployment and horizontally after the balloon deploys.

Note

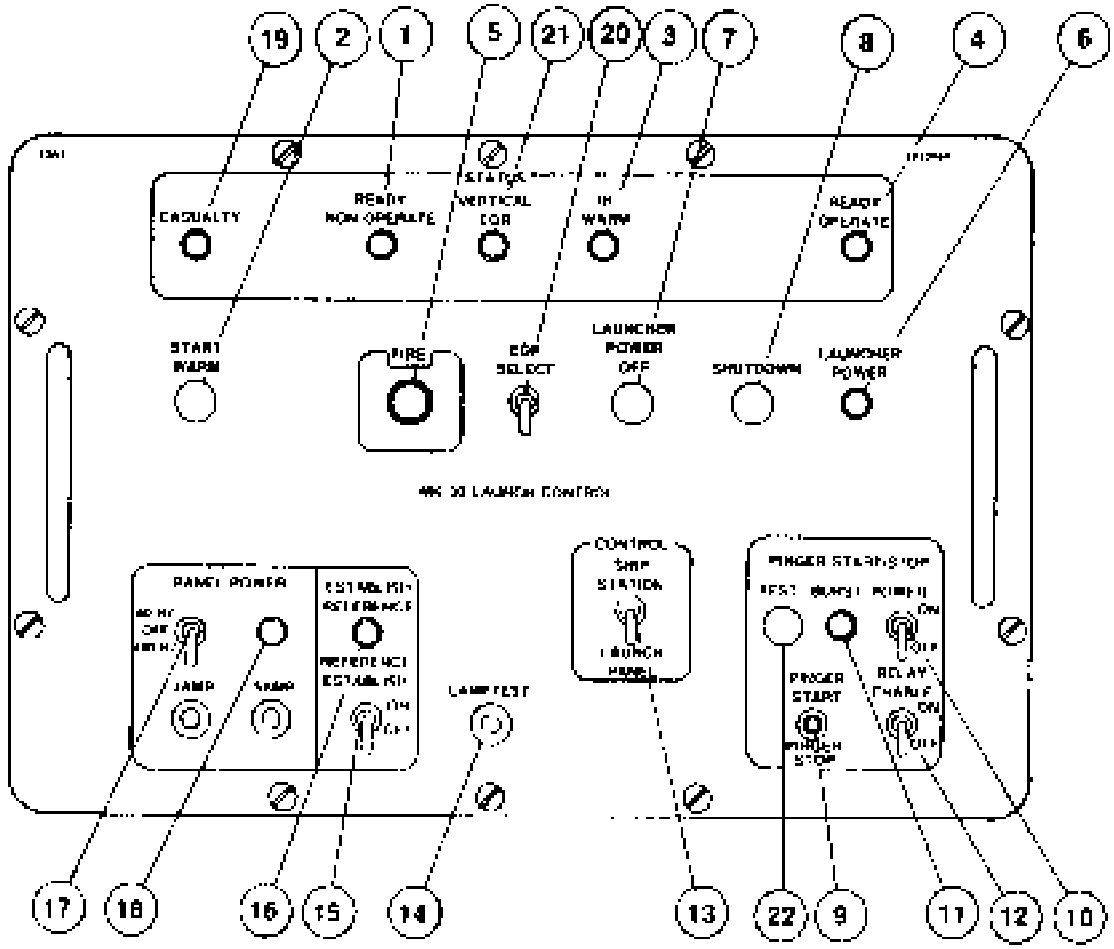
When the balloon is deployed, the unit is not recoverable with Mk 2 Mod 0 cage.

17.2.1.7 Emergency Shutdown Pinger. The ESP is a portable, self-contained unit that, when submerged in seawater, generates an acoustic signal that terminates operation of the Mk 30 Mod 1 mobile target vehicle. A tether is provided to facilitate raising and lowering the ESP into the seawater from the helicopter. The ESP is a cylindrical unit 6 inches in diameter and 18 inches long, weighing approximately 28 pounds (in air weight). When activated, the ESP repeatedly transmits a paired-tone pulse that, when received by the target over its command link, terminates all target operations and the target floats to the surface for recovery.

17.2.1.7.1 Emergency Shutdown Pinger Operation. Prior to use, inspect condition of the tether and ensure that the lifting ring is secure and the tether is securely connected to the lifting ring of the ESP and the aircraft. Once immersed, the ESP will be automatically activated causing transmission of the acoustic shutdown pulse. The ESP should be removed from the water after the mobile target vehicle floats to the surface.

CAUTION

Ensure ESP is securely connected to a tether prior to lowering.



NOMENCLATURE	FIGURE 2-4 INDEX NO.	PURPOSE
POWER switch	17	When set to 400 Hz, applies 120-volt 400 Hz A helicopter power to the launch control box. The 60 Hz position may also be used for shop checks.
POWER indicator	18	When lit, indicates power is applied to the launch control box.
LAMP TEST switch	14	Used to test the condition of all indicator bulbs on the launch control panel except for the pinger BURST indicator. It is operative when the POWER switch is set to either 60 to 400 Hz.

Figure 17-3. Mk 30 Launch Control Box Controls and Indicators (Sheet 1 of 3)

NOMENCLATURE	FIGURE 2-4 INDEX NO.	PURPOSE
READY-NON-OPERATE indicator	1	When lit, indicates power is on, but all mobile target circuits are in the quiescent state.
START WARM switch	2	When pressed, starts the mobile target guidance system gyro and initiates self check on internal circuits. Causes the IN WARM indicator to come on and the READY-NON-OPERATE indicator to go off.
IN WARM indicator	3	When lit, indicates that the mobile target internal circuits are being prepared for a live run.
READY OPERATE indicator	4	When lit, indicates that the mobile target guidance system gyro has erected. All internal systems are ready for launch.
ESTABLISH REFERENCE switch	15	When set to ON, causes the mobile target guidance system gyro to lock on to the mobile target initial-run heading.
REFERENCE ESTABLISHED indicator	16	When lit, indicates that the mobile target guidance system gyro is locked on to the mobile target initial-run heading.
CASUALTY indicator	19	When lit, indicates that the mobile target has experienced an internal circuit failure and cannot be FIRED.
Pinger POWER switch	10	Applies power to PINGER START/STOP control panel
Pinger TEST switch	22	Used to test the condition of the pinger BURST indicator bulb. Is operative when the pinger POWER switch is on.
BURST indicator	11	When blinking with the RELAY ENABLE switch ON indicates that the mobile target tracking pinger is operating. Goes out when the RELAY ENABLE switch is released, regardless of whether the pinger is operating.
READY ENABLE switch	12	Used with the PINGER START PINGER STOP switch to start and stop the mobile target tracking pinger.

Figure 17-3. Mk 30 Launch Control Box Controls and Indicators (Sheet 2 of 3)

NOMENCLATURE	FIGURE 2-4 INDEX NO.	PURPOSE
PINGER START/PINGER STOP switch	9	When pressed upwards to the PINGER START position while simultaneously pressing the RELAY ENABLE switch to ON, starts the mobile target tracking pinger. When pressed downwards to the PINGER STOP position while simultaneously pressing the RELAY ENABLE switch to ON, stops the target tracking pinger.
FIRE switch	5	When pressed, electrically fires mobile target.
LAUNCHER POWER OFF and SHUTDOWN switches	7 8	Inhibit the mobile target launch control system and remove power from the mobile target guidance system gyro when the operation is cancelled or when the gyro reference must be reestablished.
LAUNCHER POWER indicator	6	When lit, indicates that the mobile target has been electrically fired.
CONTROL switch	13	Must be in the LAUNCH PANEL position for helicopter launch.
EOR SELECT switch	20	Inhibits balloon deployment for 90 minutes after EOR to facilitate Helicopter recovery. When pressed upward and released, causes the VERTICAL EOR indicator to come on and stay on.

Figure 17-3. Mk 30 Launch Control Box Controls and Indicators (Sheet 3 of 3)

17.2.2 MK 4 MOD 0 HELICOPTER DEPLOYED LIGHTWEIGHT RECOVERY SYSTEM

The helicopter deployed lightweight torpedo recovery system Mk 4 Mod 0 (Figure 17-5) is used to recover Mk 46 and Mk 50 torpedoes. This system is capable of safe and efficient recoveries in seas through sea state 5. An alternate method for Mk 46/50 torpedo recovery utilizes a snare pole and is described later in this section. The recovery cage is a rigid cone-shaped framework constructed of aluminum rods and tubing. The cage is 10 feet long, 2 feet in diameter at the forward end, 10 feet in diameter at the aft end, and weighs 600 pounds. It is made of a nose plate and four sections that are bolted together and can be disassembled for ease of shipping or stowage. The top and bottom sections are landing frames. The port and starboard sections contain line guides.

17.2.2.1 Rigging. The rigging for this system consists of two 40-foot lines and one 30-foot main lifting line (see Figure 17-6). The 40-foot lines are attached at one end to the shackle retainers on the forward end of the cage with 1/2-inch shackles. The lines are passed through line guides at the aft end of the cage and connect to a 3/4-inch web shackle. The 30-foot main lifting line is connected to the web shackle and attaches to the helicopter cargo hook.

17.2.2.2 Vehicle Descriptions

17.2.2.3 MK 46 Torpedo. The Mk 46 torpedo (Mods 1, 2 and 5) is 102 inches long and 12.75 inches in diameter. End-of-run weight and float attitude depend on the run time. A non runner floats vertically. A full-runner floats horizontally. Partial runners will fall somewhere between these parameters.

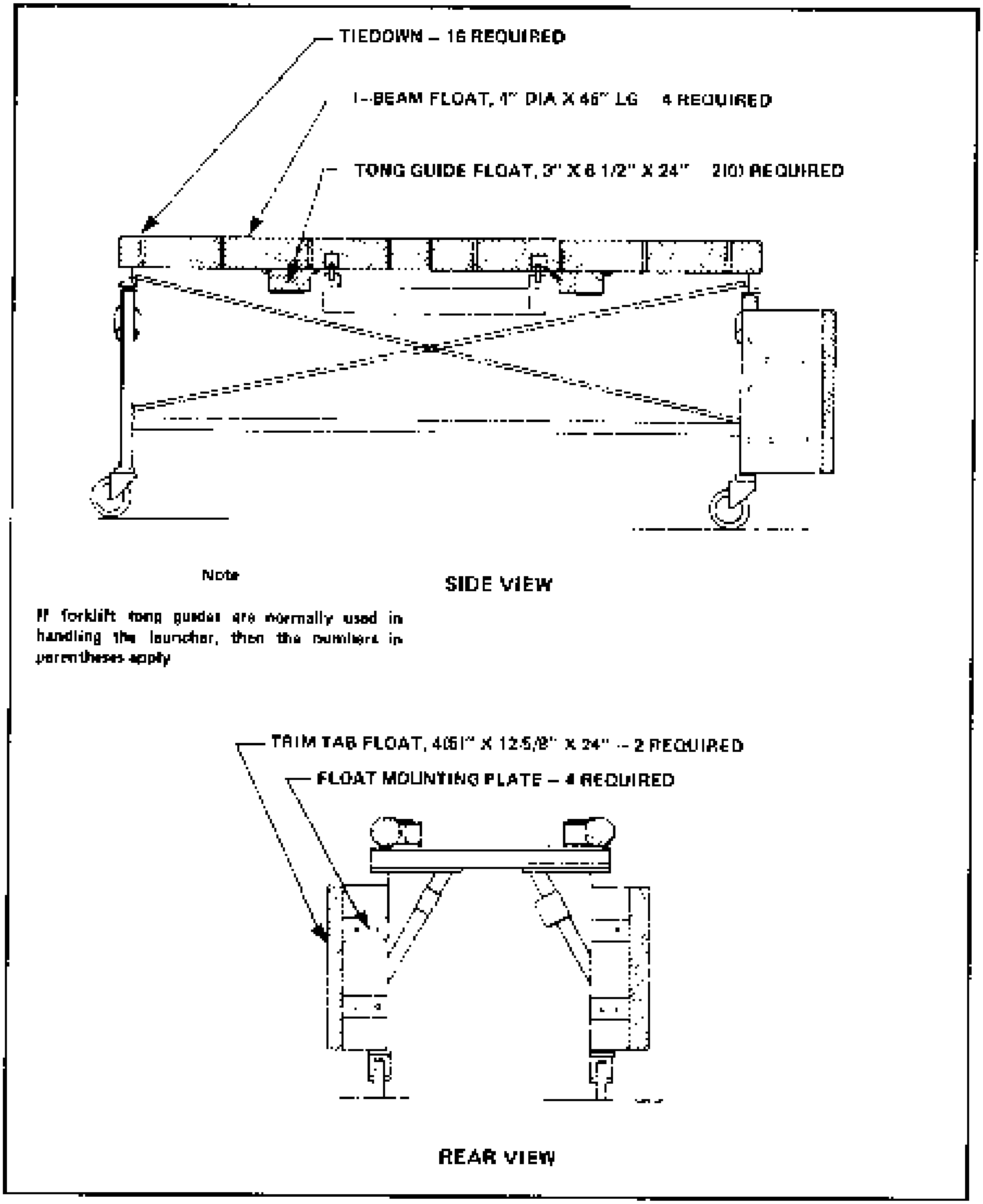


Figure 17-4. Launcher Flotation Components and Assembly

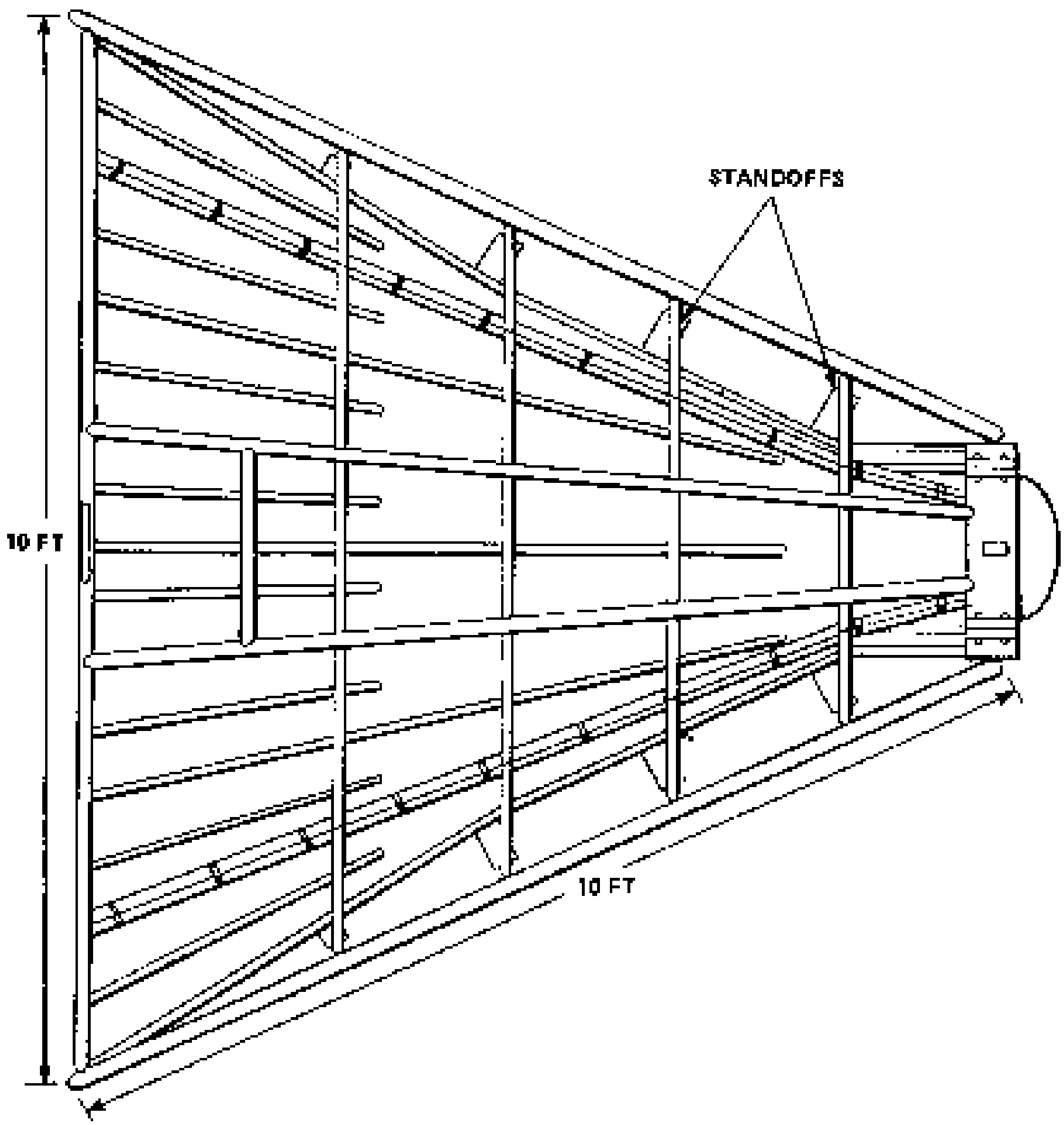


Figure 17-5. Mk 4 Mod 0 Recovery Cage Side view

17.2.2.4 MK 50 Torpedo. The Mk 50 torpedo is 113 inches long and 12.75 inches in diameter. It weighs 750 pounds and has a flotation collar that deploys at end-of-run to return the torpedo to the surface causing it to float vertically.

17.2.3 MK 2 MOD O/1 HELICOPTER WEAPON RECOVERY SYSTEM

17.2.3.1 Systems Description. The HWRS Mk 2 Mod 0 (Figure 17-8) is used to recover exercise torpedoes Mk 48 and Mk 48 ADCAP, Mk 30 mobile targets, and the EHCTV. The HWRS Mk 2 Mod 1 (Figure 17-8) is used to recover the TOTEM. The HWRS is capable of safe and efficient recoveries in seas through sea state 5. The system is currently certified for use by H-3 helicopters with an external load carrying capability. Detailed description of equipment, maintenance, and rigging requirements are found in NAVSEA manual SW59 1 - BOMMO-0 1 0/WPN RECOV SYS/NAVAIR 11-90-2 HWRS Mk 2 Mod 0/1 technical manual.

The recovery cage dimensions and weights for each of the three basic configurations are shown in Figures 17-7 and 17-8.

17.2.3.2 Safety Release System. The SRS consists of a weak link, a 60-pound anti-flyback weight, and a 25-foot pendant. The purpose of the SRS is to prevent rescue hoist cable overload, failure, and resultant recoil into the helicopter rotor system in the event of a jettison or inadvertent cargo hook release. This system is shown in Figure 17-9.

Lifting line length is 40 feet; refer to tech manual for rigging requirements. Figure 17-10 provides a general picture of the rigging.

17.2.3.3 Vehicle Description. A detailed description of procedures is provided below. For simplicity, the vehicle to be recovered is referred to as a torpedo, although application to other vehicles is the same, unless otherwise indicated. Refer to the appropriate vehicle technical manual for a detailed description.

17.2.4 TARGET TORPEDO DRONE RECOVERY

17.2.4.1 Equipment Descriptions. The pole hook/ snare drone recovery systems provide a means of recovering BQM-34 and MQM-74 drones and training shapes. Additionally these systems may be used in the recovery of Mk 46 torpedoes. This system is capable of safe and efficient recoveries through sea state 4.

17.2.4.1.1 BQM Hook/Pole (Figure 17-11). The BQM 34 hook/pole is a 15- or 20-foot hollow pole with a 24-foot, 3/8-inch cable running through the pole and a hook permanently attached to the pole. The cable is attached directly to the hook so that the pole itself does not support the target's weight. The hook is used to snag the recovery harness of the BQM-34S or recovery ring of the BQM-74C (preferred method). The hook features a spring-loaded gate that prevents the hook from unhooking. For training purposes, the gate may be taped to the open position to allow multiple hookups.

17.2.4.1.2 MQM Snare Pole (Figure 17-12). The MQM/BQM 74 snare is a T-shaped, 15- or 19-foot hollow pole with a 24-foot cable. There is a "noose" or loop of rubber coated cable at the T-end. Prior to use, the noose is either taped or banded along the crossbar to help keep it open. Only enough tape is used to ensure the noose stays open. The tape must be broken by the crew later. The noose is slipped over the nose of the recovery object and then pulled tight, breaking the tape. Tension is kept on the snare with the tagline while weight comes on the cable. In flight, the drone's weight keeps the noose tight.

17.2.4.1.3 Shackle/Swivel Assembly (Load line) (Figure 17-13). The load line is a 17-foot, 3/8-inch cable with shackle/swivel at one end and a clevis at the other end. A tagline (rope) with a minimum length of 20 feet or longer is attached to the clevis end to help maintain tension on the load line after drone "capture" or hookup. Before takeoff; the swivel end is connected to the external cargo hook and the load line is brought into the cargo door. When established in a hover near the drone ("perched"), the crewmen will start to slide the pole/ snare out the cargo door and attach it to the clevis end of the load line. With a BQM-34 on the pole in this configuration, the helicopter will require 40 to 45 feet AGL to lift the drone off the deck. Using the load line increases flexibility for recovering different targets because the right hook/pole snare can be attached or changed after takeoff.

WARNING

Personnel should remain clear of extra tagline (rope) to avoid the possibility of entanglement during emergency or inadvertent jettison.

17.2.4.2 Mk 30 Snare Pole (Figure 17-14). The Mk-30 snare pole is a 20-foot hollow pole with a 40-foot cable. There is a "noose" or loop of rubber-coated cable at the bridle end. Prior to use, arrange cable in a double wrapped loop up against the inner diameter of the hoop, with only one line crossover point at 12 o'clock position. Using 1 - inch wide tape, apply two wraps of the tape around the hoop and the lines at four places: 3, 6, 8:30, and 10:30 clock positions. Make a 3/8-inch deep cut in both sides of the tape. The tape must be broken by the crew later. The noose is slipped over the nose of the recovery object and then pulled tight, breaking the tape. Tension is kept on the snare while weight comes on the cable. In flight, the target's weight keeps the noose tight.

1. With the bridle near the bottom of the pole, connect the bridle to two door edge deck rings at any convenient time prior to pole deployment. Pass ONE weak link through each deck ring far enough to slide the bridle retainer pin through the weak link, then pull on the bridle to help secure the pin.

WARNING

Keep hands and fingers 6 to 12 inches clear of the bellmouth when feeding out line.

2. To deploy the pole, one crewman grabs the top of the pole and line, while the other crewman controls the hoop. Feed the hoop out the door, continue to feed the entire pole out the door and down through the bridle until the stop reaches the bridle. Feed the line down the pole to extend the pole to its full length. (Reverse this step if pole needs to be brought back abroad for tape repair).

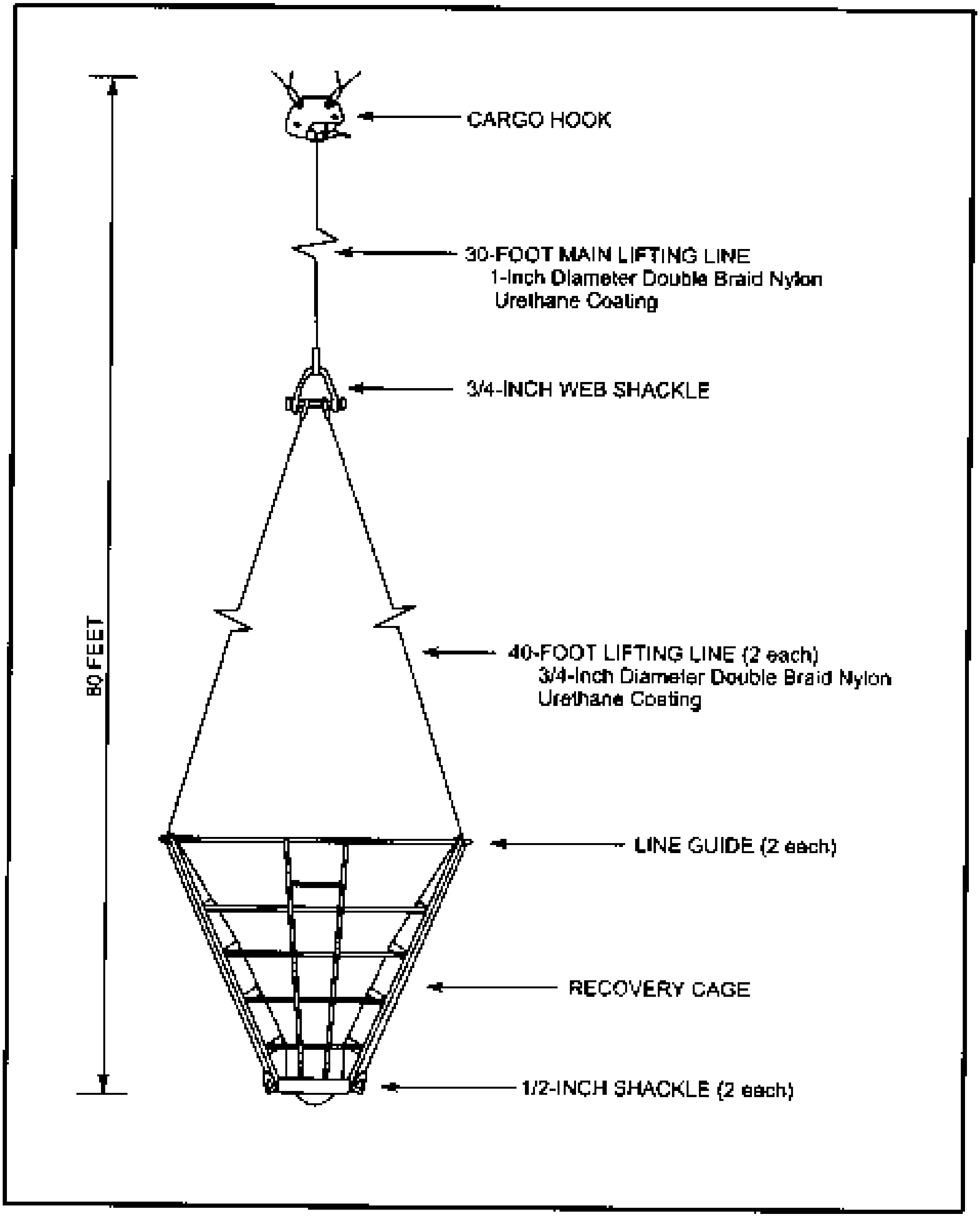


Figure 17-6. Mk 4 Mod 0 Recovery Cage Rigging

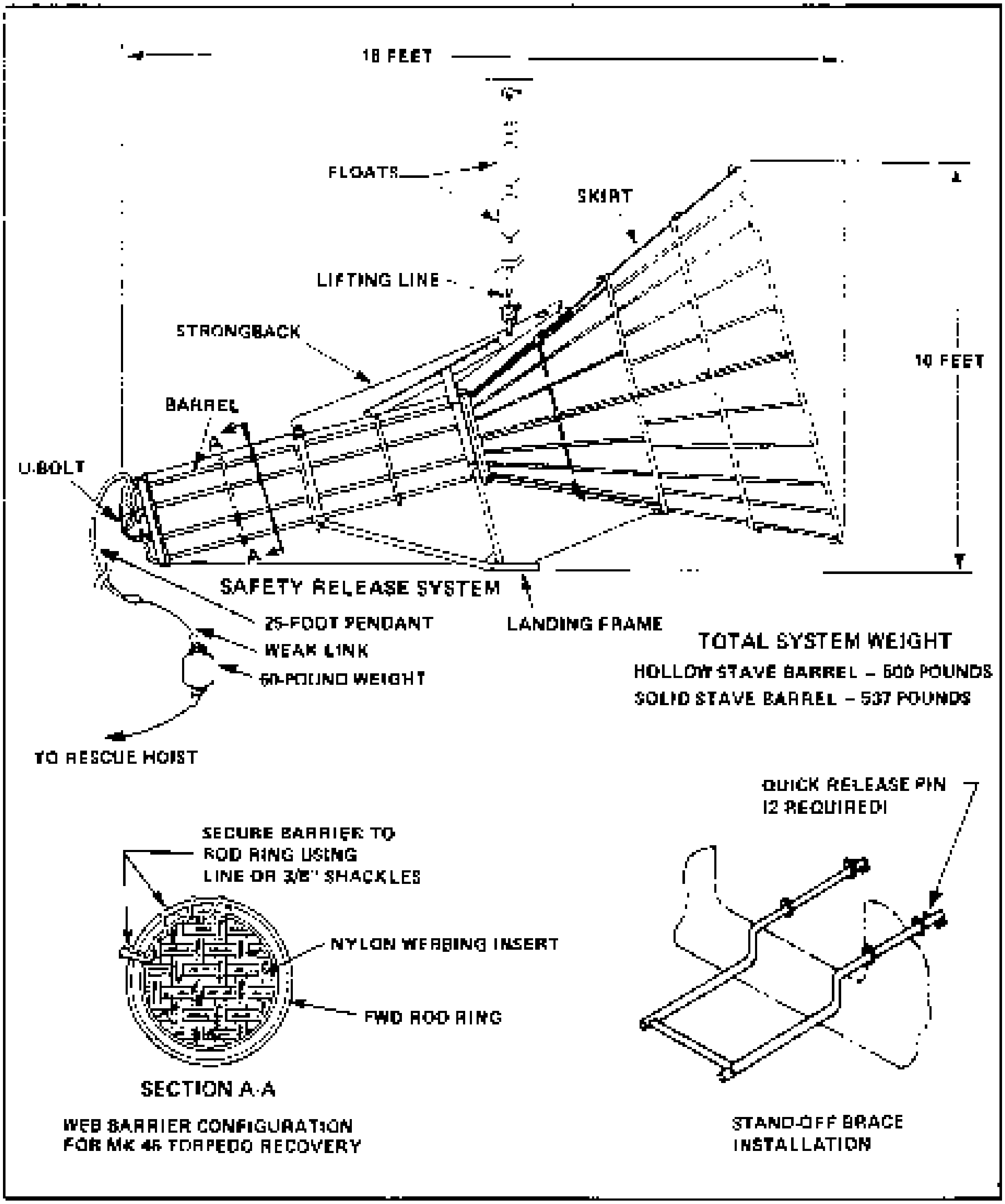


Figure 17-7. Helicopter Weapon Recovery System Mk 2 Mod 0

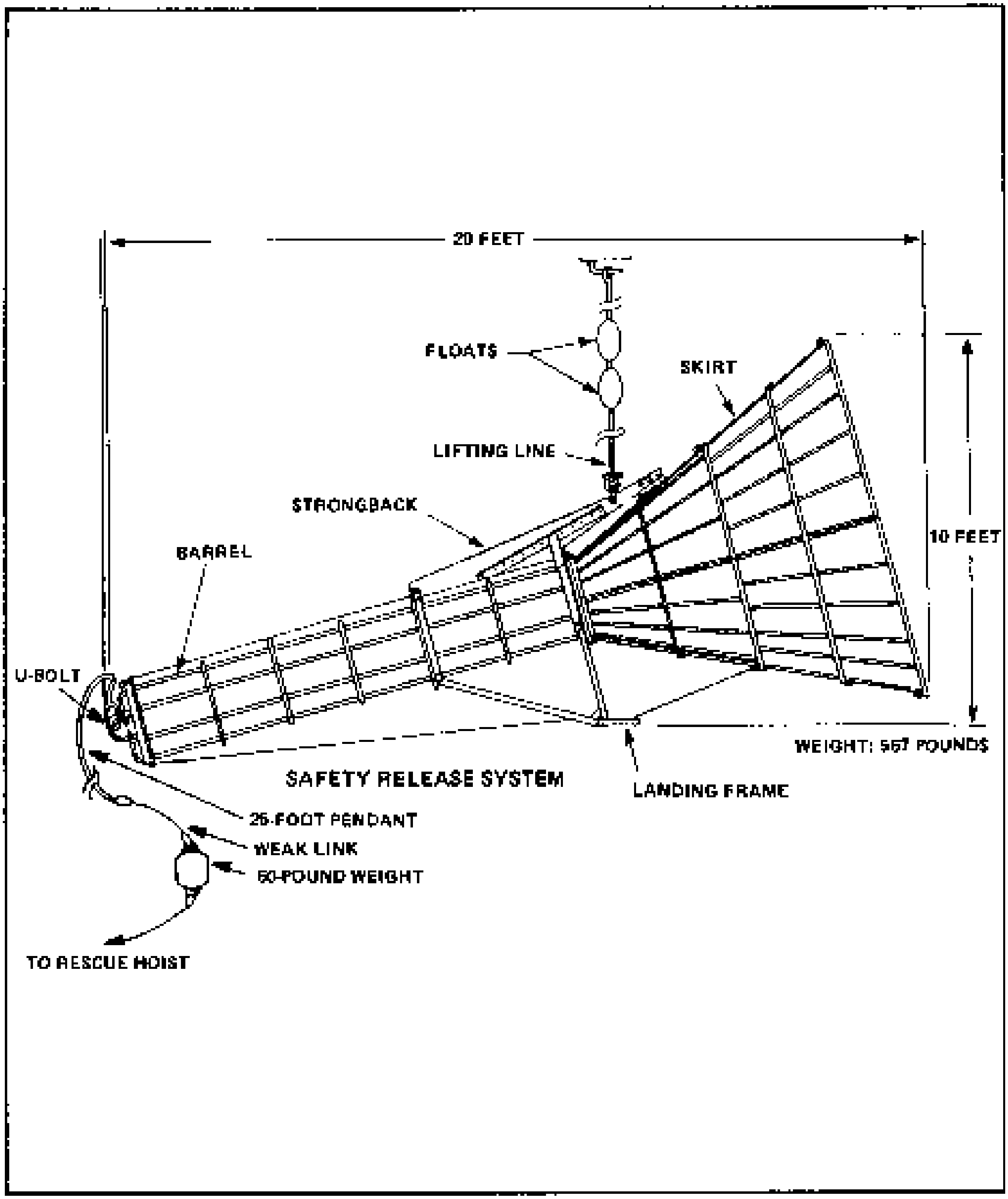


Figure 17-8. Helicopter Weapon Recovery System Mk 2 Mod 1

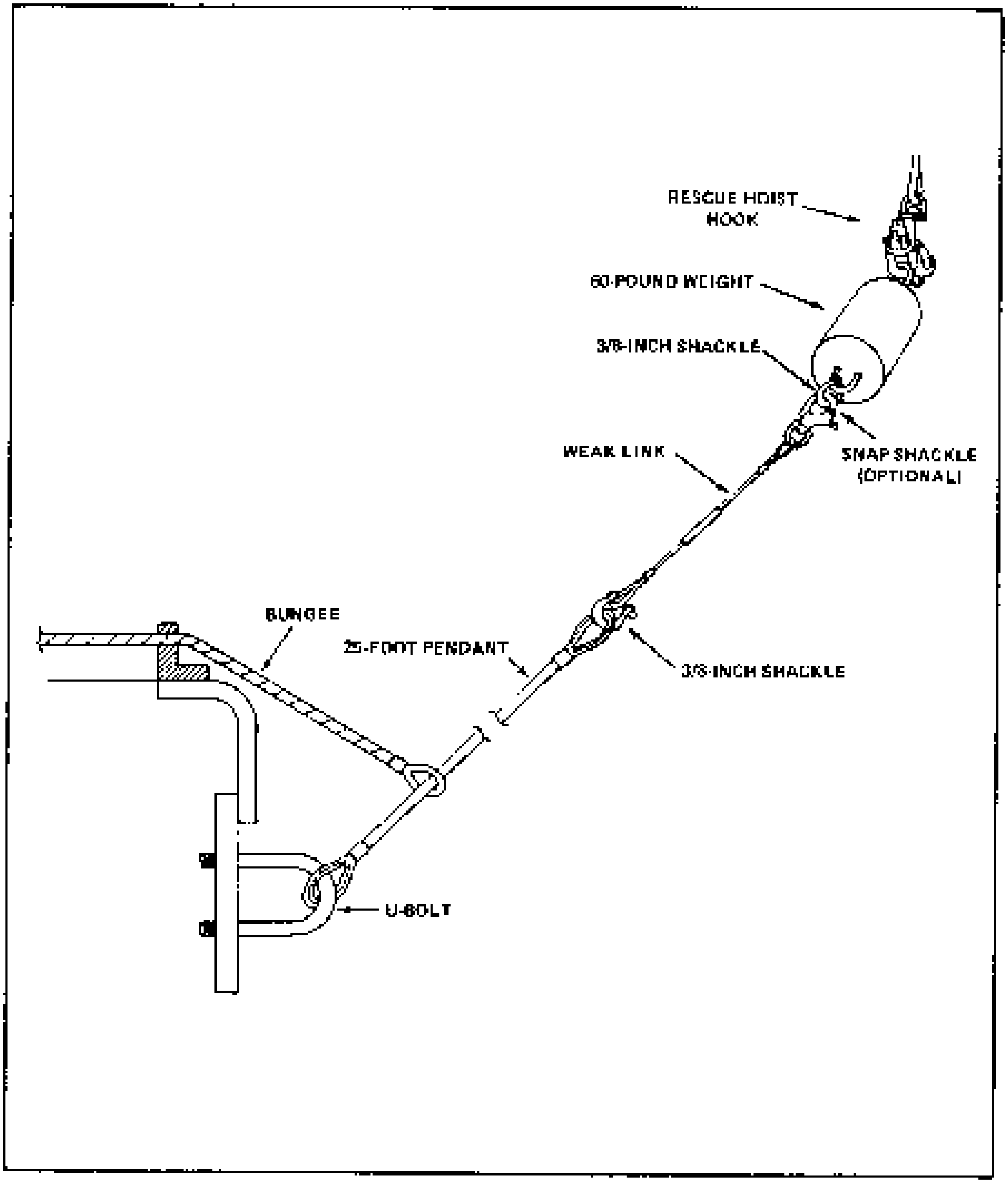


Figure 17-9. Safety Release System

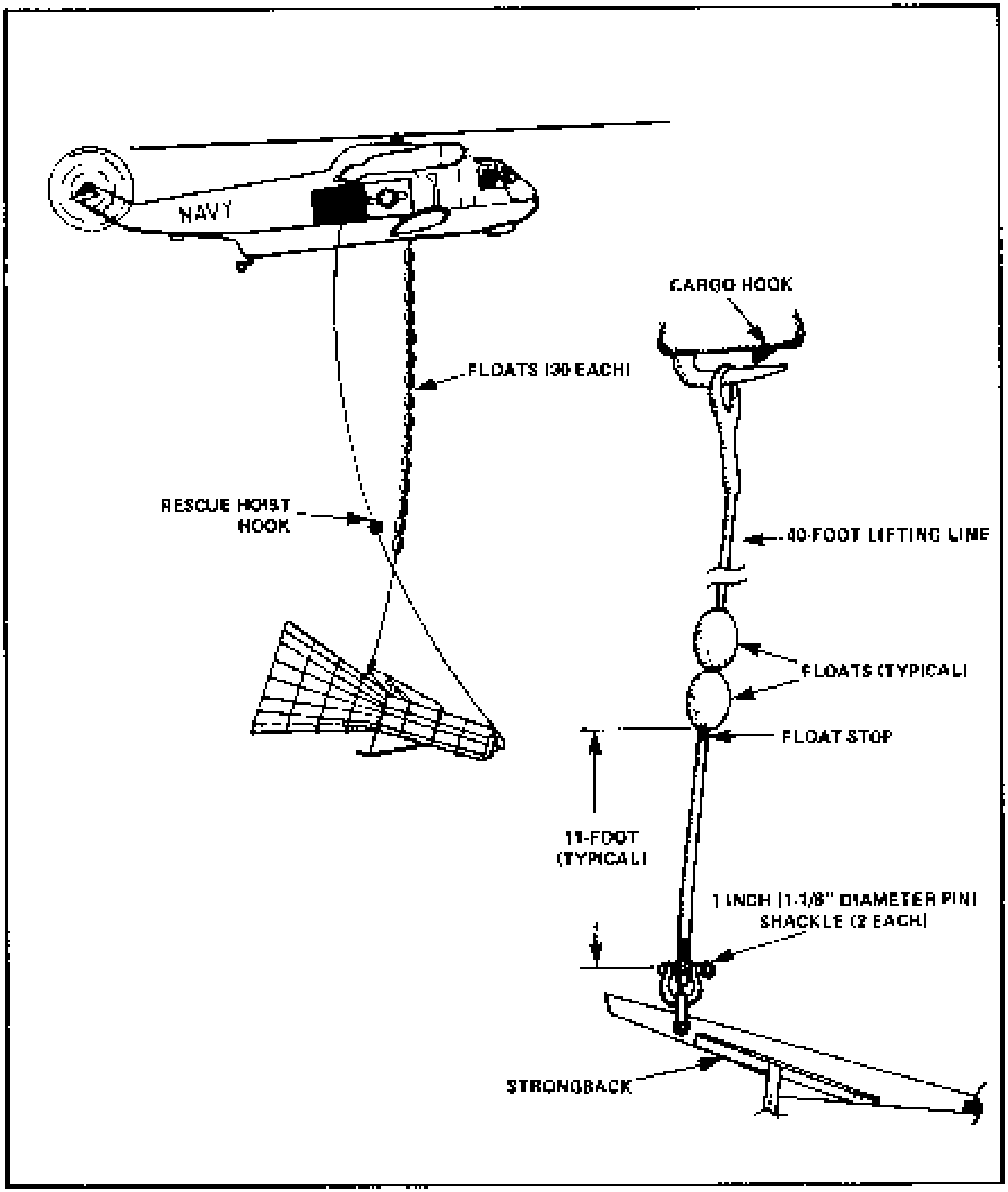


Figure 17-10. Recovery Cage Rigging (Sheet 1 of 2)

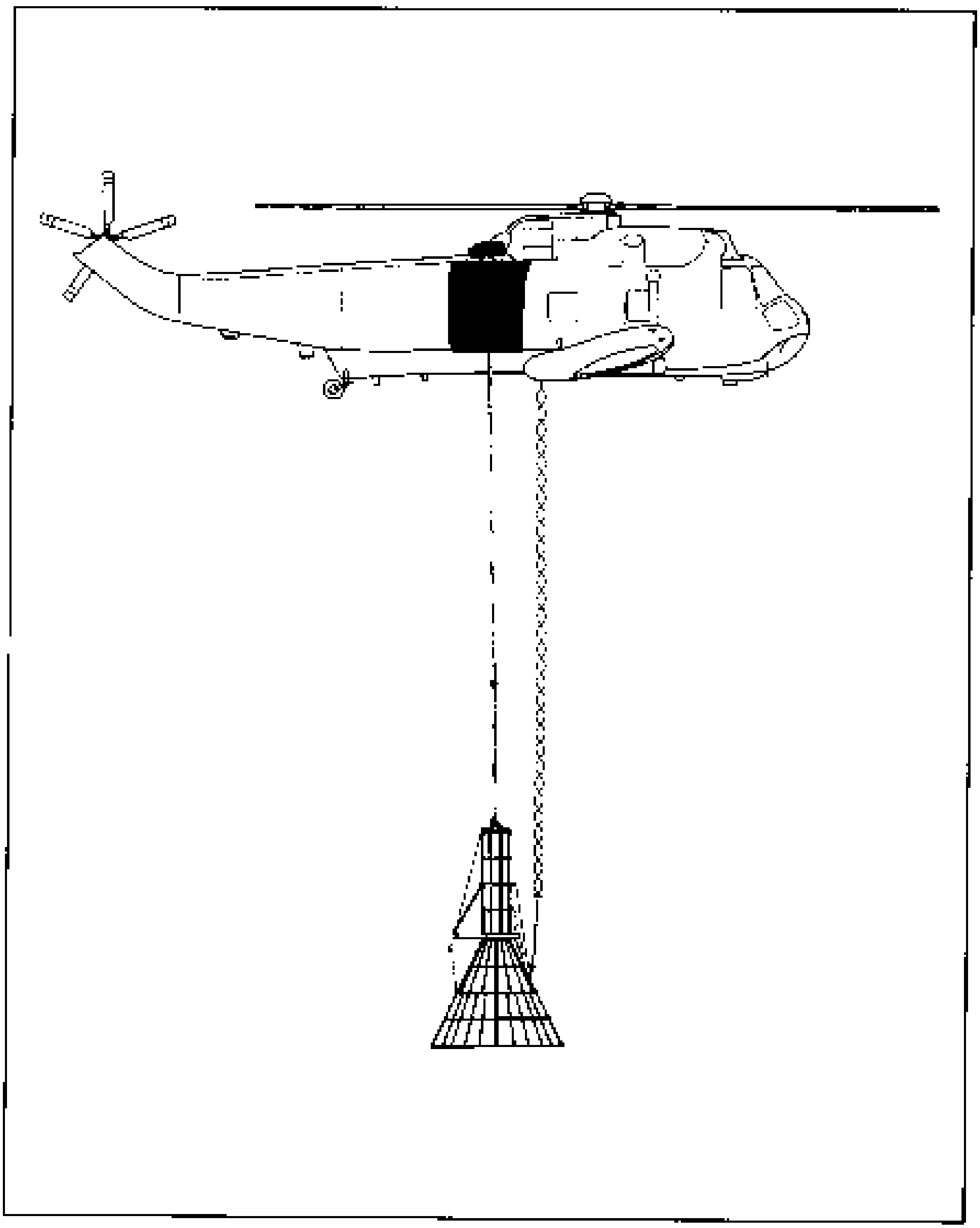


Figure 17-10. Recovery Cage Rigging (Sheet 2 of 2)

17.2.4.2.1 Recovery. Perform the following steps to recover a horizontally floating target Mk 30.

1. The talker directs the helicopter pilot while the pole operator controls the pole to pass the hoop over the nose of the target. It is recommended that the hoop be kept just above the water, using line control, until close to the target's nose.

2. When the hoop is positioned within 3 feet of the EOR balloon, the pole operator pulls hard on the line to break the tape and thereby sets the noose. It is important to confirm that the noose is between the stoppers. The stoppers are mounted on the forward and aft target joint bands to prevent the noose from slipping off the target during transit.

CAUTION

Pull the bridle retainer pins free before the helicopter ascends to allow the pole to collapse down.

3. Pull the bridle retainer pins free and then ascend the helicopter slowly to lift the target from the water. Ensure that the helicopter hovers directly over or abeam the target during the ascent to avoid pulling the noose out of position. After the target is clear of the water, confirm that a secure grip exists on the target between stoppers. If the noose is not positioned between the stoppers, or if the first wrap of the noose is seen to come against the stopper any time, return the target to the water and release the cargo hook so that the pole falls clear of the target. Return to base for a new snare pole and continue with the recovery. If the second snare pole's noose is wrapped over the first snare pole's line or hoop, the grip is acceptable; if it is wrapped over the pole, it is unacceptable. If the helicopter crew determines for any reason that the grip is unacceptable, the target should be returned to the water. If the crew determines that the target is badly fouled and a safe recovery is impossible under the present conditions, snare pole recovery attempts should be discontinued and the target should be left for TWR recovery when conditions permit.

4. For delivery to the soft pad, the towed array should be recovered if possible. It is recommended that this be accomplished in a sheltered area near the delivery site to make the recovery easier and to avoid stresses on the towed array because of load oscillations during transit. Recover the towed array using standard procedures for a HWRS Mk 2 recovery. For delivery to the TWR, towed array recovery is not required.

17.2.4.2.2 Recovery/Flight Limitations.

Sea State:	4 (8-foot seas maximum).
Airspeed:	90 knots indicated airspeed maximum.
Angle of Bank:	30 degrees maximum.
Autorotation Entry:	2 seconds minimum collective lowering.

17.2.4.2.3 Delivery. Deliver the target to the soft pad unless directed by range control to deliver it to the TWR. Set the target down, then slide over and down so the pole falls harmlessly when the cargo hook is released. For soft pad delivery, lower the bagged towed array with the grapnel.

17.2.4.3 Target/Drone Descriptions

17.2.4.3.1 BQM-34 Target Drone (Figure 17-15). The BQM-34 is a remotely controlled missile target drone capable of high subsonic speed up to 550 knots and altitudes of from 50 to 50,000 feet. Recovery sequence is initiated by means of a parachute system deployed by the controller or automatically by failure of the engine or the remote control system. The drag parachute is automatically deployed upon initiation of recovery sequence to decelerate the target. Following deployment, the main parachute lowers the target in a horizontal attitude to the surface. The main parachute is released upon contact with the ground or water by means of an impact or saltwater switch. Upon water impact, a dye marker releases a fluorescent dye to assist in target location.

The BQM-34 uses a locator beacon with a frequency preset by ground personnel prior to launch. The BQM-34, MSR configuration only, has a strobe light mounted on the vertical stabilizer to aid in target location during periods of low visibility. For further information on BQM-34, refer to NAVAIR 01-1 00TBA-2 manuals.

17.2.4.3.2 BQM/MQM-74 Target (Figures 17-16 and 17-17). The BQM/MQM-74 is capable of high-subsonic speed at altitudes from 50 to 30,000 feet and of carrying augmentation systems to simulate medium performance aircraft. The recovery sequence is initiated either by radio command or automatically if the command signal is lost. Upon recovery initiation, a small pilot parachute is deployed followed by the larger main parachute. The main parachute lowers the target drone to the surface and is released upon impact with ground or water.

Flotation is provided by the nosecone, fuel tank, oil smoke tank, and an aft flotation bag. Recovery is facilitated if the target floats horizontally and this is generally achieved by means of an aft flotation bag that inflates upon water immersion.

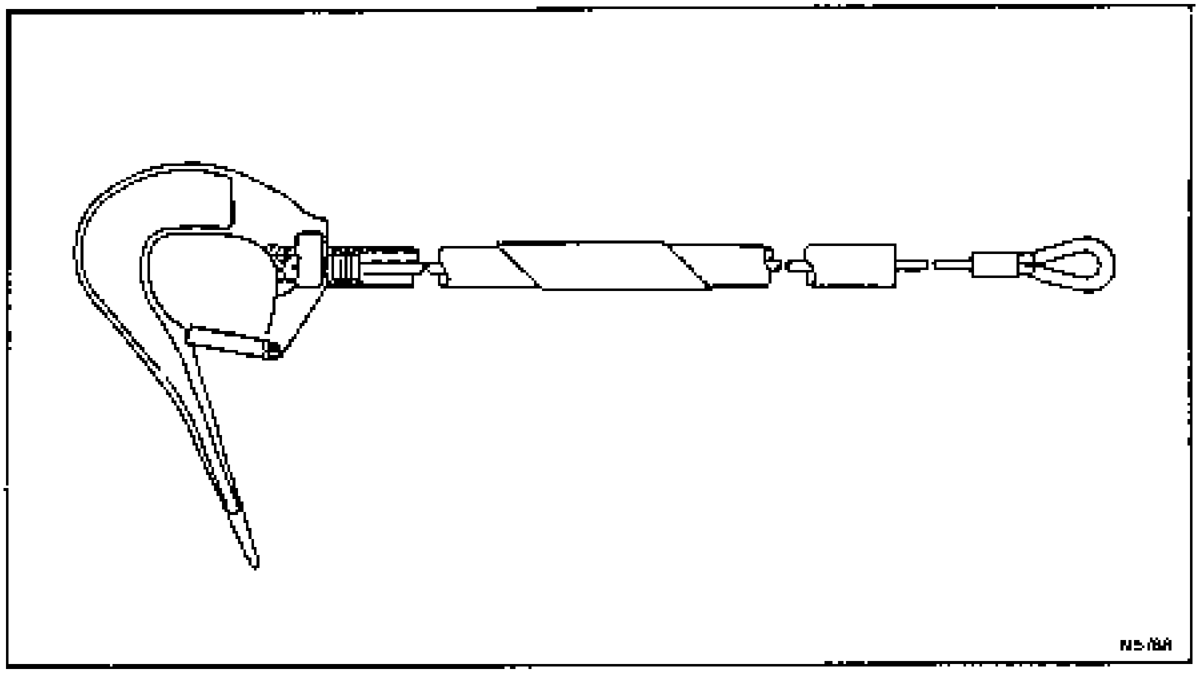


Figure 17-11. BQM Hook/Pole

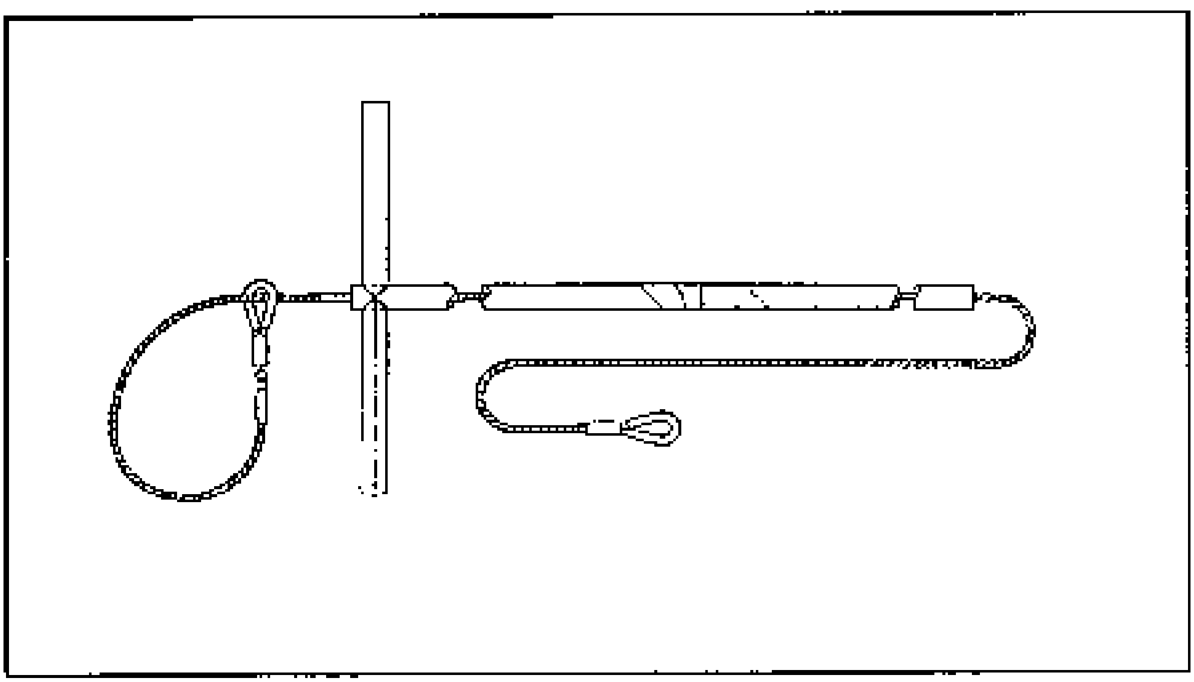


Figure 17-12. MQM Snare/Pole

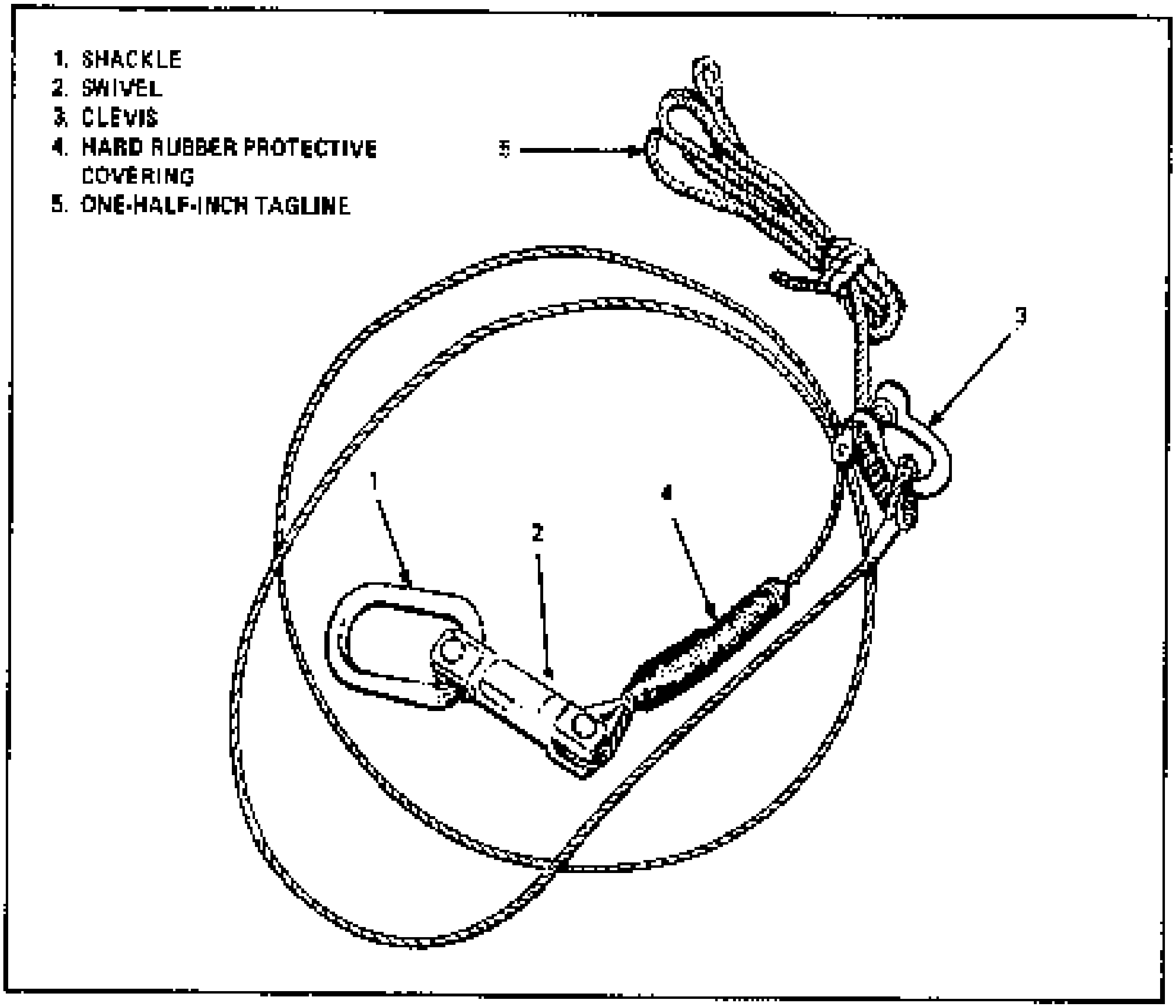


Figure 17-13. Loadline

A locator beacon in the target emits a radio frequency homing signal that can be detected by the AN/ARA-SO automatic direction finder or similar system. The signal is transmitted at 235.0 MHz and is activated 1 minute after recovery is initiated. The beacon will operate up to 10 hours and may be detected at ranges up to 8 nm by a boat or 40 nm by an aircraft, provided the antenna is not under water. In addition to the beacon, a dye marker is released upon the target drone's entry into the water.

For additional information on MQM-74, refer to NAVAIR-0 1 -MQM74C-3.

The BQM-74C is a modified MQM-740C that has an air-launch capability and includes special features that make the target drone a more realistic threat vehicle for use by the fleet. These features include a digital avionics processor control system and a low altitude radar altimeter control system.

17.3 SERVICING

Refer to appropriate technical publications for specific servicing requirements.

17.4 OPERATING LIMITS

Refer to Chapter 4.

17.5 FLIGHTCREW QUALIFICATIONS

Refer to Chapter 5.

17.6 EMERGENCY PROCEDURES

Refer to Chapter 12.

17.7 FLIGHT PREPARATION

17.7.1 Aircraft Preparation

All aircraft preparation should be completed prior to scheduled range times. During preflight, particular attention should be paid to the cargo sling and hoist. These systems must be without discrepancies.

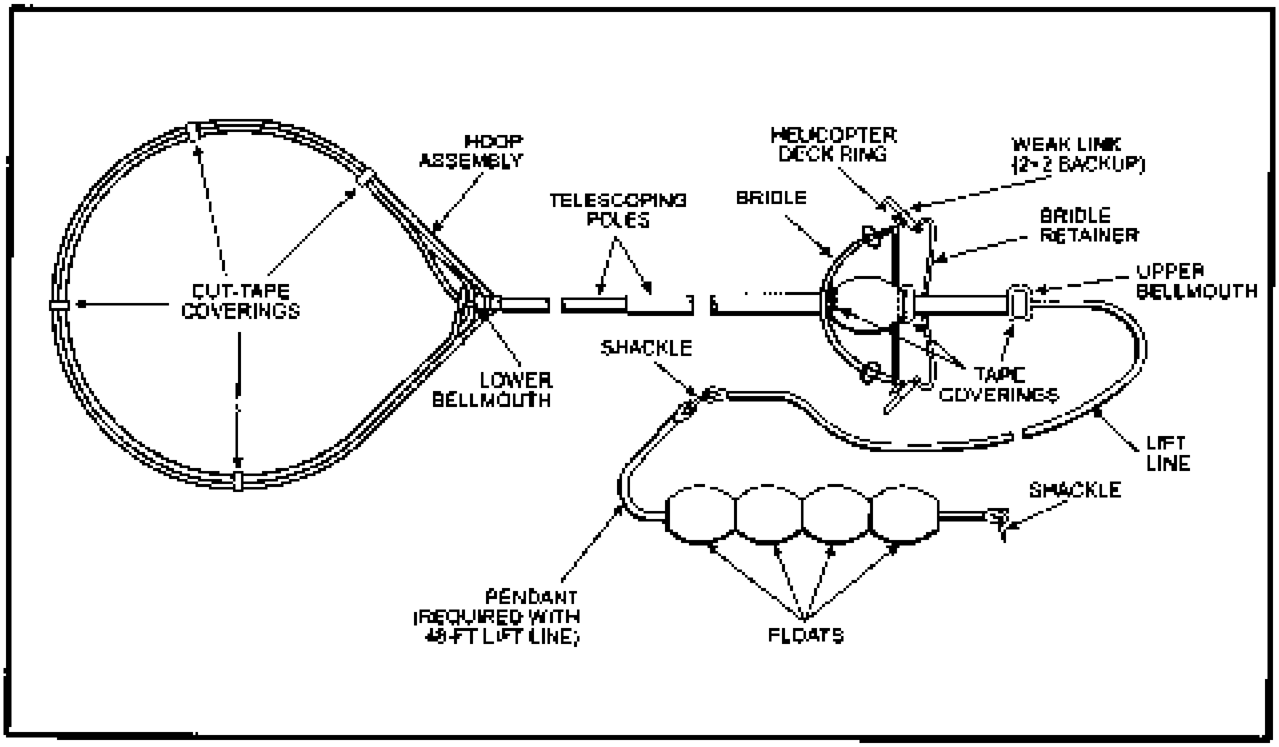


Figure 17-14. Snare Pole Assembly for Mk 30 Target

17.7.2 Crew Briefing.

In addition to the regular crew brief; the following areas are considered to be a minimum brief for external load operations:

1. Aircraft performance.

2. Weather/sea state limitations.

3. Emergency load jettison.

   a. Decision to jettison load depends on the nature of the emergency and is left to pilot discretion.

   b. During lift-off; aircrew should watch for rigging (lifting lines) entanglement. A ground crewman should be on hand to correct any problems that might arise.

   c. Certain external load configurations are prone to oscillations during flight. The launcher should be kept under observation. If oscillations become severe, immediate action to slow airspeed with a slow turn to port or starboard should be made. The particular circumstances that caused the oscillation should be noted.

   d. The cargo sling master switch should be in SLING position for pickup and delivery. The AUTO mode shall not be used.

Note

Shifting the Cargo Sling Master Switch from "SLING" to "SAFE" position after pickup has been known to activate the electrical jettison resulting in a released load in flight. It also deactivates the electrical releases leaving only the manual foot release.

4. Saltwater encrustation.

5. Post takeoff weight considerations.

   a. Helicopter fueling shall be calculated so that maximum gross weight is not exceeded when the torpedo is recovered.

   b. The combined weight of the Mk 30 target, launcher, and launch control box is 3,030 pounds.

6. Unique procedures.

   a. External load disentanglement procedures.

   b. Damaged target.

   c. Inverted drone/connected parachute/entangled drone procedures.

   d. Target/drone/cage drop off procedures.

7. Specific launch parameters within the approved window of 10 to 30 foot launcher altitude above wave crests, and 0 to 25-knot groundspeed are set by the local target IMA.

WARNING

The potential for the PNAC to inadvertently release the external cargo/ load exists if the cargo system is flown in the "SLING" position. The PNAC should use extreme caution if transmitting over the radio with the cyclic switch.

17.7.3 Preflight.

A standard NATOPS preflight inspection shall be conducted. Particular attention should be paid to the cargo hook assembly, hard points, and the rescue hoist systems. The following shall be completed during pre-flight inspection:

1. Both manual and electrical release functions of the cargo hook system shall be checked and fully operational prior to attempting recovery.

2. Functional check of the rescue hoist and cargo sling.

3. Standard safety gear shall be available as listed in paragraph 17.3.5.

4. A preflight inspection of all recovery equipment shall be performed. This shall include but not be limited to the overall condition, integrity, and operation of lines, cables, hooks, hardware, and attachment points. Any cables with broken strands shall be rejected.

5. All nonessential troop seats should be folded during snare pole and/or hook recovery operations. All loose equipment should be secured.

6. The pilot shall place the release mode switch to the cargo sling function prior to taxi or takeoff.

17.7.4 Helicopter Weapons Recovery System Preflight Procedures.

The HWRS shall be inspected prior to each planned weapon recovery. Preflight inspection procedures for the HWRS are basically visual and shall be implemented as follows:

1. Inspect barrel rings and visible (not covered by plastic) portion of staves. Inspect all visible welds for cracks.

2. Ensure the interior of cage is completely covered with cushioning (plastic tubing and cork) such that no bare metal is exposed. The plastic tubing shall be attached to cage with ordnance tape. In addition, all gaps in tubing, including tubing ends, shall be covered with ordnance tape. Ensure skirt tabs are big and are covered with tape, and ensure skirt staves are built up with tape where they join the flanged ring.

3. Ensure that rubber nose pad is in place and there is nothing protruding past surface.

4. Ensure that rubber bumpers are in place on landing frame feet.

5. Ensure lifting line is attached to the desired/ required lifting point. Ensure that lifting line shackles are tight and safety wired and inspect line for damage. If the urethane coating is damaged, the strength of the rope is not impaired unless the rope underneath is damaged also.

6. Check that all cage assembly bolts are in place and are securely tightened.

7. Inspect landing frame for cracks and distortion. Ensure cable brace running from nose of barrel to landing frame is taut.

8. Inspect strongback for evidence of cracks or metal fatigue.

9. Ensure that bungee cords are in place.

10. Inspect weak link and replace if damage is observed or suspected.

11. Inspect nose pendent for damage and corrosion and replace if damage/corrosion is severe. Remove all fishhooks. Ensure weak link shackles are tight. Safety wiring of weak shackles is optional.

CAUTION

During ground handling of recovery cage avoid excessive dragging of cage, which wears away feet. Also, ensure that the lifting line is not dragged or otherwise abused.

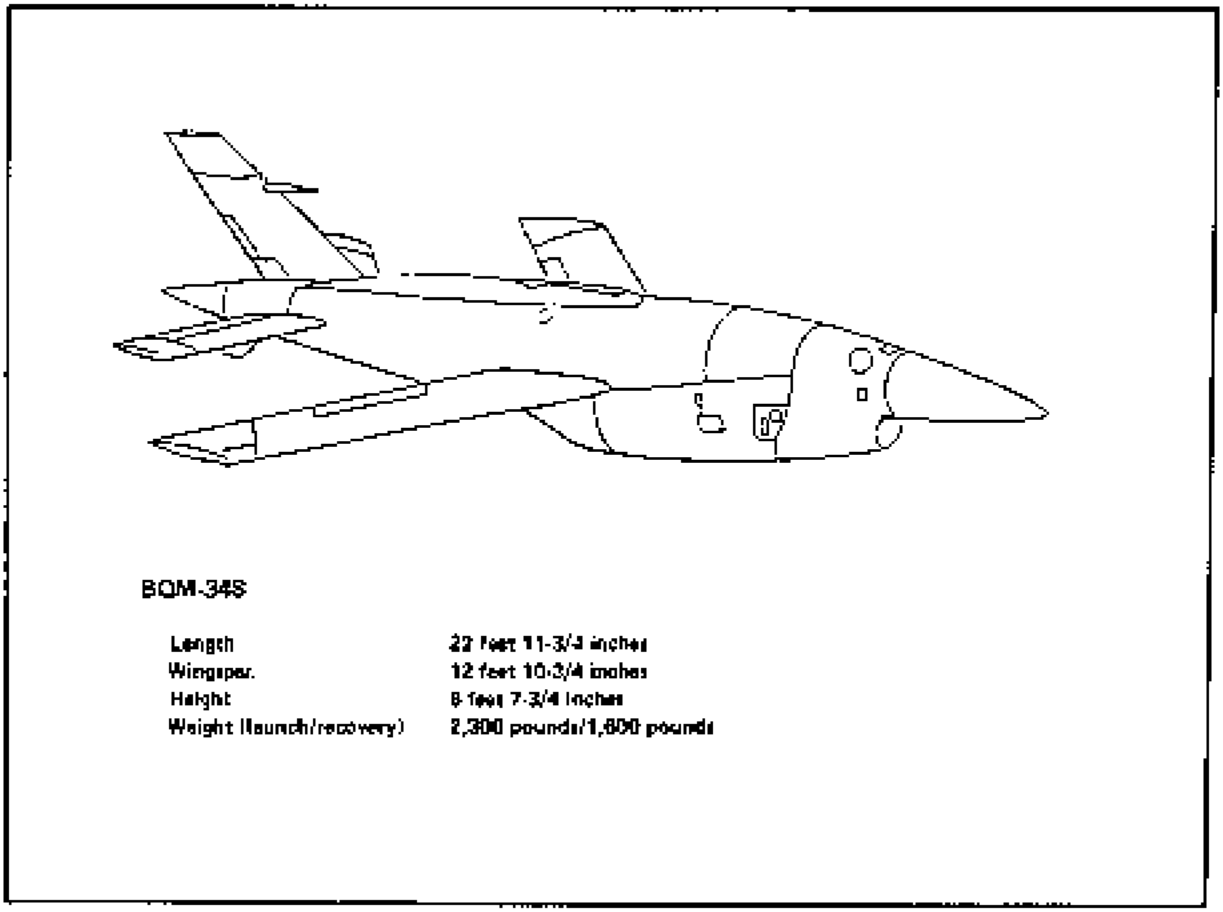


Figure 17-15. BQM-34 Missile Target

17.7.5 SPECIAL EQUIPMENT REQUIRED

The helicopter must be rigged, prior to takeoff; according to the type of recovery that is to be done.

1. Mk 25/58 marine markers.

2. Safety gloves, heavy leather welder type.

3. Launch/recovery system and related cables/ hardware.

4. Cable cutter, insulated.

5. Crewman's safety belts.

6. Mk 30 specifics.

   a. Grappling hook and line assembly.

   b. Cable restrainer (O-ring with snap hook).

   c. Cable protector (12-inch length of plastic tubing).

   d. Lowering pole/line.

17.8 SHORE-BASED PROCEDURES

17.8.1 Mk 146 Mod 0 Helicopter Launch System Procedures

17.8.1.1 Pre-hookup. The loaded launcher is positioned beside the helicopter for a cold hookup. For a hot hookup, the launcher is set down facing into the wind and the helicopter taxies beside the launcher. Either way, the launcher should be positioned on the right side of the helicopter, 5 to 8 feet from the sponson, with its cg lined up with the cargo hook position and launcher brakes locked.

17.8.1.2 Hookup. After lowering the cargo hook, slip the strongback onto the hook and verify that the hook is locked and the retaining latch is down. Ensure that the lifting lines/cables are not crossed or fouled on the launcher.

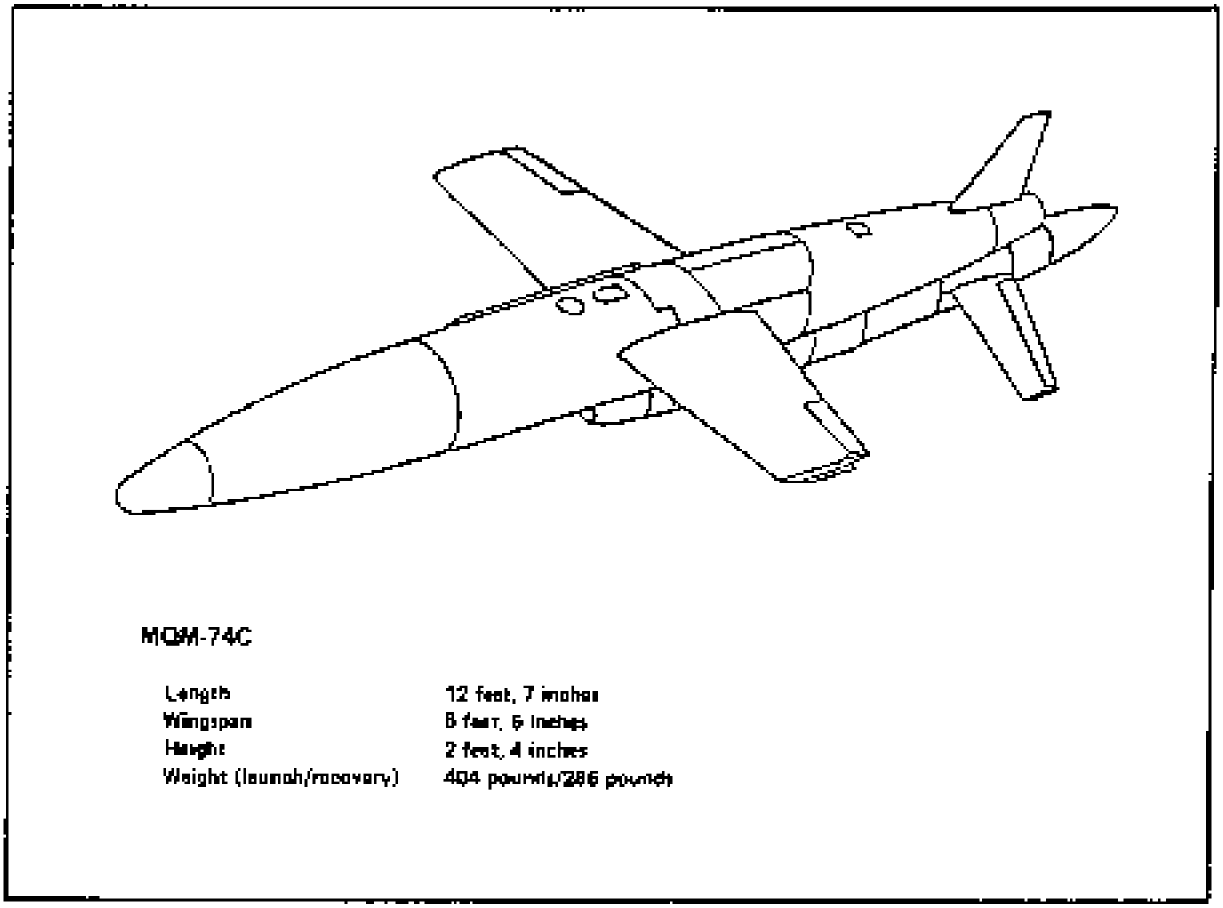


Figure 17-16. MQM-74C Missile Target

Route the lower launch control cable and the remote control cables between the two aft cargo hook support cables and up into the helicopter through the sonar well. If the helicopter has no sonar well, route the cables to the forward edge of the cargo door opening and into the helicopter. Connect the strain relief O-rings for the lower launch control cable and for the remote control cables to deck rings nearest the sonar well (if no sonar well, connect O-rings to the nearest deck ring at the forward edge of the cargo door).

Before connecting the Mk 30 launch control box to helicopter power, ensure initial switch positions are as follows:

1. PANEL POWER switch - OFF.

2. ESTABLISH REFERENCE switch - OFF.

3. CONTROL switch - LAUNCH PANEL.

4. Pinger power switch - OFF.

WARNING

To avoid possible electric shock because of in-flight static charge buildup on the launcher, the SAFE/LAUNCH handle assembly and the launch control box should have electrical contact with the helicopter frame, either by direct contact (on deck) or via a grounding strap.

CAUTION

After hookup of launcher lifting lines/cables, the crewman shall check for the free movement of all four-cargo sling swivel fittings and that cables are hanging freely. This will help to preclude the possible hang-up of cables and the shearing of fuselage hard points that could result in damage to the aircraft and/or loss of the target/launcher.

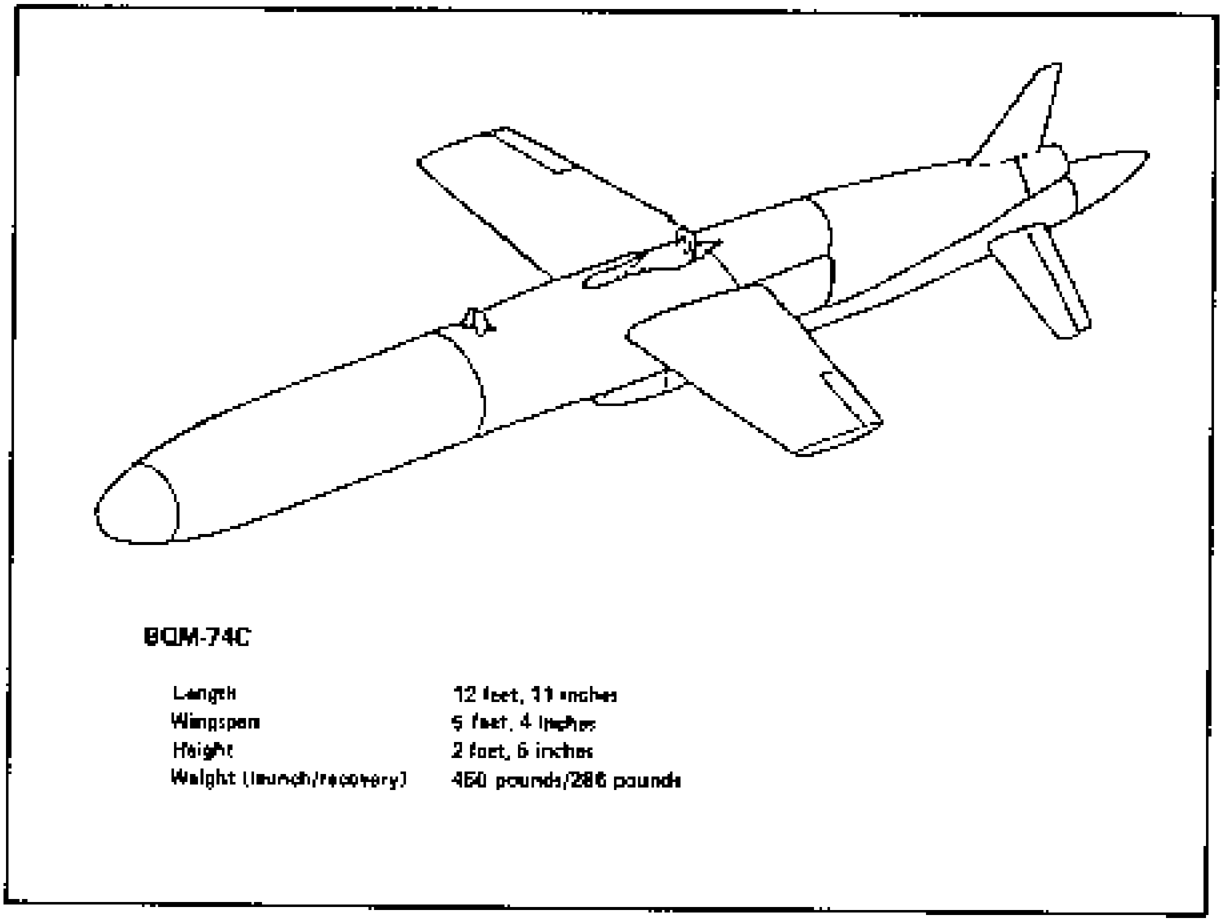


Figure 17-17. BQM-74C Missile Target

17.8.1.3 Mk 30 Flight Procedures

17.8.1.3.1 Mk 30 Target Warmup Checks. As soon as helicopter power is available, perform the following checks.

1. Set the launch control box PANEL POWER switch to 400 Hz and verify that the PANEL POWER and READY NON OPERATE indicators are illuminated.

2. Press and hold the LAMP TEST switch and verify that all indicators on the panel are lit except for the pinger BURST indicator.

3. Press and hold the START WARM switch on the launch control box until the IN WARM indicator comes on. READY NON OPERATE indicator will go out.

4. Turn pinger POWER switch to ON. Press pinger TEST switch and ensure BURST light illuminates brightly.

5. Press the pinger RELAY ENABLE switch to ON while simultaneously pressing the pinger START/STOP switch upward to the PINGER START position (BURST indicator will flash on and off). Release both switches (BURST indicator will go out).

6. Place one hand against the pinger transducer cavity located on the underside of the mobile target. Verify pinger is operating.

7. If pinger is to remain operating during helicopter transit, set pinger POWER switch to OFF. Otherwise, press the pinger relay ENABLE switch to ON while simultaneously pressing the PINGER START/STOP switch downward to the PINGER STOP position. Release both switches. Verify pinger is off by feeling pinger transducer on mobile target. Set pinger POWER switch to OFF.

Note

Decision to have mobile target pinger operating during helicopter transit is a matter of local target IMA policy.

8. After a warmup period of not less than 1 minute but no more than 7 minutes, if all systems are functioning satisfactorily press and hold SHUTDOWN button until IN WARM indicator has gone off and READY NON OPERATE indicator comes on. Remove prop lock and set control surfaces to neutral. Release launcher brakes.

17.8.1.3.2 Lift-Off. The helicopter is directed up and to the right by the aircrewman until it is directly over the launcher. The helicopter slowly ascends, lifting the launcher off the ground. At the exact moment that the launcher leaves the ground, the crewman informs the pilot, and the pilot notes the altimeter reading (it should be approximately 28 feet).

CAUTION

Failure to ensure that the cargo hook is lowered prior to hookup can result in cable fouling and/or inadvertent release of external load.

Note

Careful observation of the lifting lines and cables is required during lift-off to avoid rigging hangups on the launcher or excessive strain on the cable because of hangups or inadequate slack.

The crewman makes a visual check of the launcher suspended underneath the helicopter. The helicopter then makes a smooth transition to forward flight. Maximum speed is 90 KIAS.

17.8.1.3.3 Target Warmup. Not less than 8 or more than 30 minutes from the launch point, prepare the mobile target for launch as follows.

1. Press and hold the START WARM switch on the launch control box until the IN WARM indicator comes on. READY NON OPERATE indicator will go out.

2. If mobile target pinger is not already operating, turn on pinger as follows:

a. Turn pinger POWER switch to ON. Press pinger TEST switch and ensure BURST light illuminates brightly.

b. Press the pinger RELAY ENABLE switch to ON while simultaneously pressing the PINGER START/STOP switch upward to the PINGER START position (BURST indicator will flash on and off). Release both switches (BURST indicator will go out).

3. If helicopter recovery is planned, lift and release EOR SELECT switch and verify that the VERTICAL EOR indicator comes on. The mobile target will now float with a vertical attitude for approximately 90 minutes after end of run.

4. After a warmup period of 7 minutes or less, verify that the READY OPERATE indicator has come on.

Note

If the mobile target "Casualty" light illuminates during IN WARM, press SHUTDOWN button. Wait 3 minutes before starting IN WARM cycle again.

5. Reduce speed to allow mobile target to align with the helicopter and assume the required heading provided by range control for establishing reference.

Note

Target must be aligned with and steady on the helicopter axis prior to setting ESTABLISH REFERENCE switch to ensure proper course setting.

6. When the mobile target is aligned with the helicopter on the proper heading, set the ESTABLISH REFERENCE switch to ON and verify that the REFERENCE ESTABLISHED indicator illuminates and stays on.

Note

Between READY OPERATE and REFERENCE ESTABLISHED, the mobile target is susceptible to casualties. Changes in airspeed and heading should be made smoothly.

17.8.1.3.4 Launch. A smoke marker may be dropped to mark the launch position and provide wind information.

1. After turning into the wind, the helicopter makes a slow, smooth transition to a hover over the launch point.

2. Target launch altitude should be 10 to 30 feet, which should equate to 38 to 58 feet on the radar altimeter.

3. Launch speed is 0 to 25 knots groundspeed.

4. Remove the SAFE/LAUNCH handle locking pin.

CAUTION

RAD ALT frequently locks on target instead of water surface when approaching a hover, which results in erroneous indications. Pilots should rely on aircrewman's verbal instructions.

Note

The mobile target need not be aligned with the helicopter for a hover launch.

5. To launch, press the FIRE button, verify LAUNCHER POWER indicator illuminates, and immediately retract the SAFE/LAUNCH handle. If the LAUNCHER POWER indicator does not illuminate, do not launch mobile target.

6. The target must be electrically fired prior to mechanical release. Once the FIRE button is pressed, a limited amount of time exists for launch before the target shuts down automatically. Target requires 20-foot depth within 30 seconds. Therefore, it is desirable to mechanically release the target as soon as possible after the LAUNCHER POWER indicator illuminates.

7. The crewman shall notify the pilot when the mobile target is launched.

17.8.1.3.5 Post launch.

1. Set the PANEL POWER and ESTABLISH REFERENCE switches to off on the launch control box.

2. The helicopter is now free to return to base, with a maximum airspeed of 80 KIAS. The launcher should be kept under observation throughout the flight to avoid severe oscillations and/or close proximity to the tail of the aircraft.

3. Disconnect the lower launch control cable from the upper launch control cable and install protective cap on the lower launch control cable.

17.8.1.4 Landing and Postflight Procedures

17.8.1.4.1 Landing. A normal external load approach (approaching landing area into the wind, making a slow, smooth transition to a 60-foot hover) is initiated under verbal instructions from the crewman. With the touchdown point cleared, a slow vertical descent is made, placing the launcher gently on the ground.

WARNING

Avoid electric shock because of static discharge by allowing the launcher to contact the ground prior to ground personnel touching the launcher.

Note

Deposit the empty launcher in a suitable area (e.g., grass) so that it will not roll under the influence of the departing helicopter's rotor wash. If this is not possible, a ground crewman is required to apply launcher brakes after the launcher touches down.

17.8.1.4.2 Post flight Procedures.

1. Connect lowering line to strongback. For cargo door routing of cables, connect lowering line to launch control cable.

2. Disconnect the remote control cable strain relief 0-ring from the deck ring, and connect it to the lowering line.

3. Disconnect the lower launch control cable strain relief 0-ring from the deck ring and take the strain on the lowering pole/line.

4. The crewman directs the pilot to release the cargo hook and then gently lowers the strongback to the ground and throws out the remaining line.

17.8.1.4.3 Landing With Target in Launcher. For landing with the target in the launcher, the following procedures will prevent the target electronics from activating at touchdown:

1. Ensure the SAFE/LAUNCH handle is grounded to the helicopter by physical contact or grounding strap.

2. The helicopter makes a normal approach to a 40-foot hover. At this point, the rescue hoist is lowered to the ground to dissipate the static charge built up in the helicopter. A normal delivery can then be made. The rescue hoist is raised once the launcher is on the ground.

17.8.2 MK 4 MOD 0 HELICOPTER-DEPLOYED LIGHTWEIGHT TORPEDO RECOVERY SYSTEM PROCEDURES

17.8.2.1 Hookup. Hookup can be accomplished in one of two ways, ground hookup or low hover hookup.

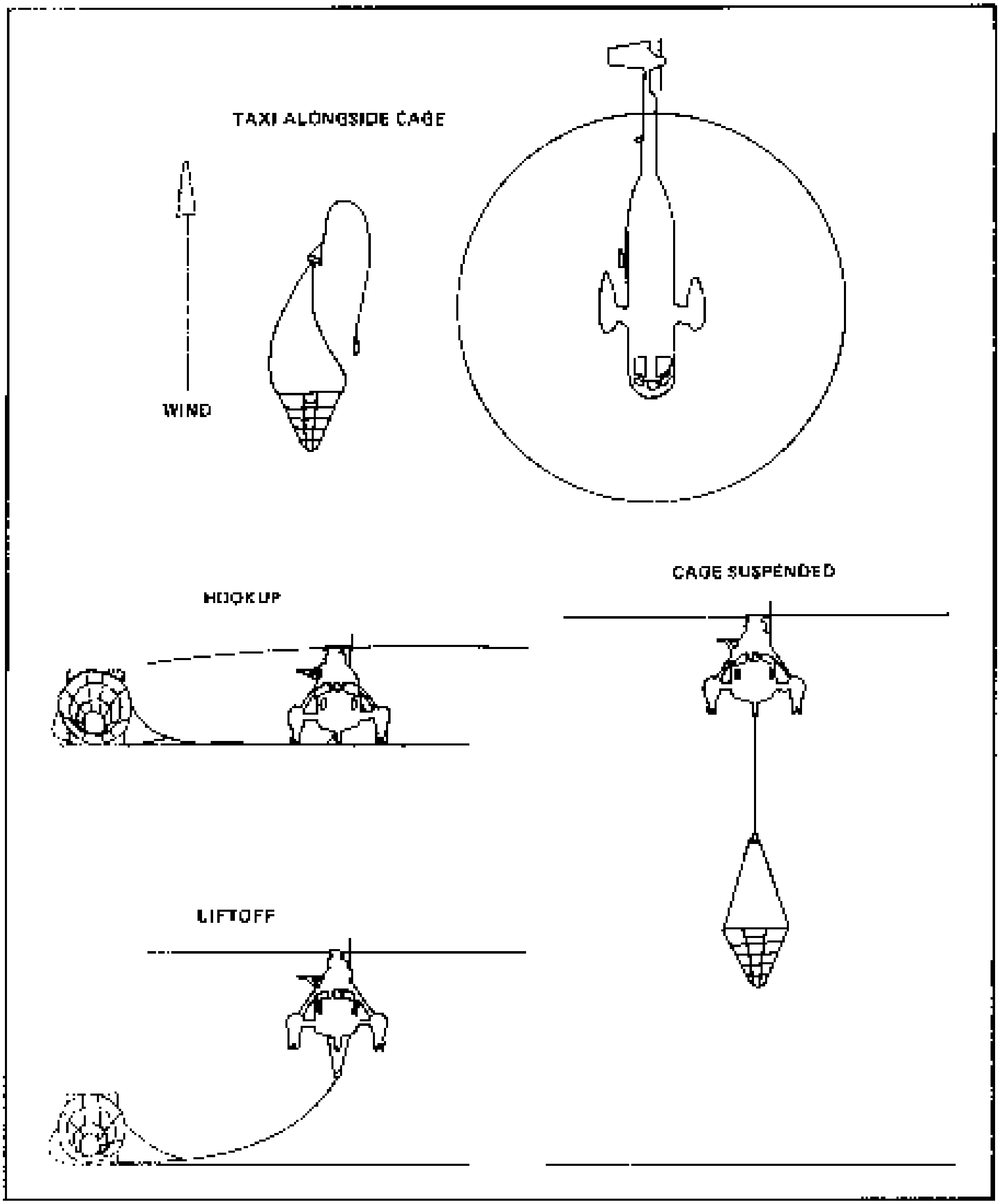


Figure 17-18. Ground Hookup and Liftoff

17.8.2.1.1 Ground Hookup.

1. Position the recovery cage at the side of the landing pad with the forward end pointing into the wind. Allow room for the helicopter to taxi to the left side of the cage (Figure 17-18).

WARNING

Skirt stands 10 feet high and may fall within rotor tip-path for hookup. Do not engage/disengage rotor head when cage is within rotor tip-path. Pilot shall visually ensure adequate cage-to-rotor clearance during approach and hookup.

2. Extend main lifting line to cargo hook and slip the free end of the line onto cargo hook. Ensure that the cargo hook is locked.

3. The groundcrew/aircrew directs the helicopter up and to the right until the helicopter is positioned directly over the cage.

4. The helicopter slowly ascends from this position until the cage is lifted clear of the ground.

5. The helicopter can proceed to the recovery site at speeds up to 90 KIAS. The crewman shall keep the cage under observation throughout the flight.

17.8.2.1.2 Low-Hover Hookup. Low-hover hookup is recommended for shipboard operations where space is limited. Use of a PVC pipe stiffener at the top of the 30-foot main lifting line enables greater helicopter standoff from the deck during low-hover hookup. Proceed as follows:

WARNING

1. Direct the helicopter to hover immediately to the left of the cage.Avoid electric shock because of static discharge by deploying the rescue hoist to ground the helicopter prior to hookup.

2. Groundcrew attaches the free end of the main lifting line to the cargo hook and ensures cargo hook is locked.

3. The helicopter slowly ascends from this position until the cage is lifted clear of the ground.

4. The helicopter can proceed to the recovery site at speeds up to 90 KIAS. The crewman shall keep the cage under observation throughout the flight.

17.8.2.2 Recovery. There are two methods used for Mk 4 Mod 0 cage recovery of Mk 46 and Mk 50 torpedoes. The drag method is employed for the recovery of Mk 46 torpedoes. The scoop method is employed when high sea states prevent the establishment of an effective drag and is the only method used for the recovery of Mk 50 torpedoes.

Proceed as follows:

1. Range personnel direct helicopter to recovery site.

2. Establish visual contact with the torpedo.

3. At discretion of the pilot, a Mk 25 marine marker may be dropped to establish wind direction and to assist in pilot orientation during recovery.

17.8.2.2.1 Drag Method. The drag method (Figure 17-19) is the preferred method for recovery of torpedo Mk 46 to minimize the chances of weapon damage. Proceed as follows:

1. The aircraft assumes a 90-foot hover about 100 yards downwind of the torpedo.

2. The cage is lowered into the water.

3. The aircraft assumes a slow creep toward the torpedo at 5 to 8 knots groundspeed and at an altitude of 30 feet. The crewman at the back door provides altitude/groundspeed corrections to keep the cage trailing smoothly and in the proper attitude. Figure 17-20 shows proper drag attitude of cage.

4. The crewman provides heading corrections to keep the cage lined up to the torpedo.

Note

Because of the phase-lag between helicopter input and cage response, more radical corrections become necessary as the cage closes on the torpedo if the lineup is off.

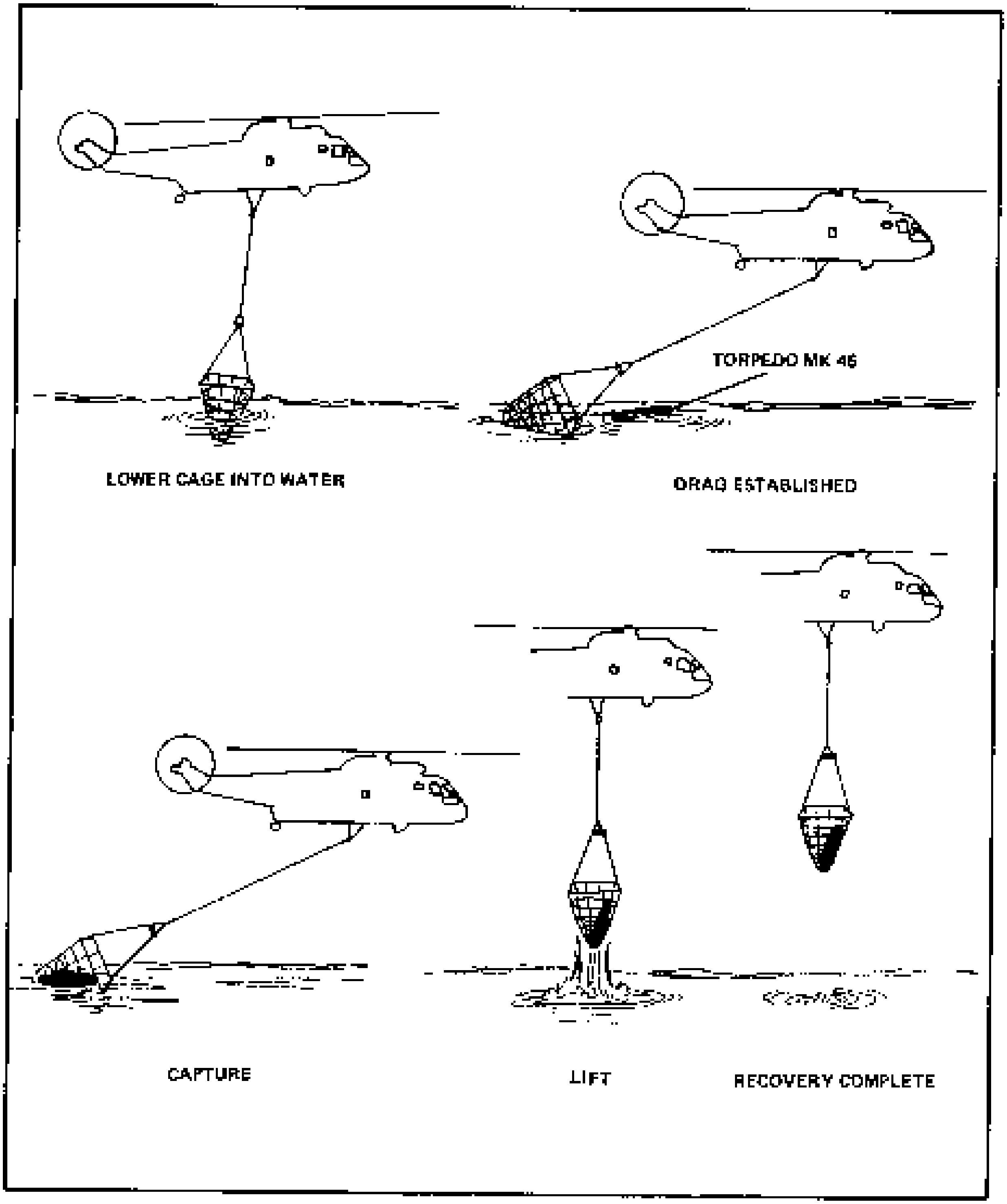


Figure 17-19. Recovery Sequence for Drag Method

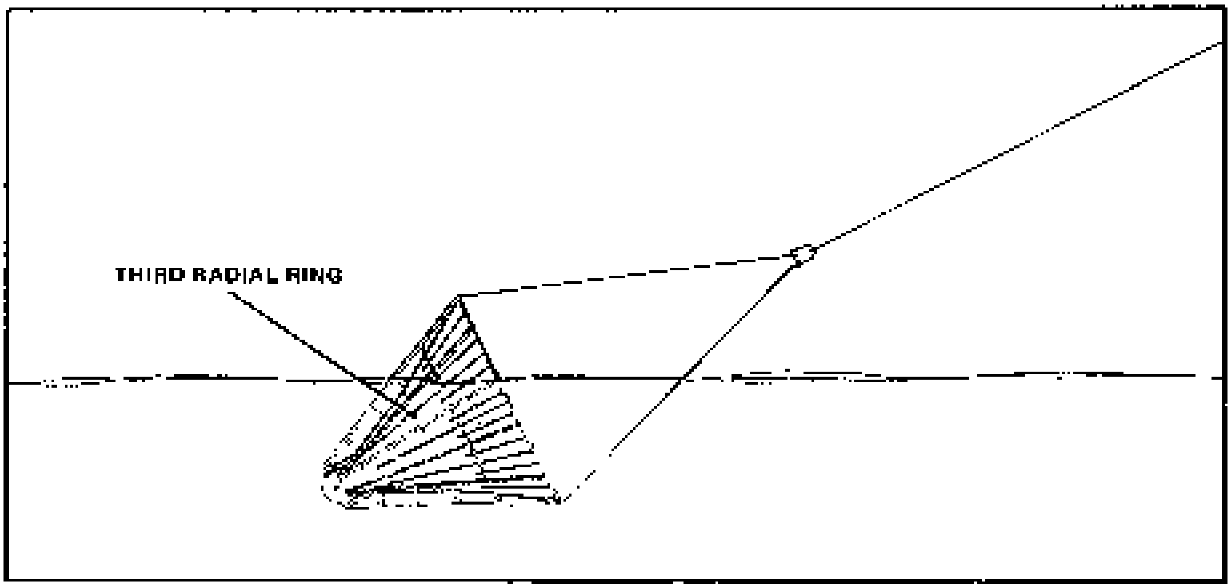


Figure 17-20. Drag Attitude

5. If the cage misses the torpedo, lift the cage out of the water and repeat the approach and drag sequence.

6. After the torpedo has entered the cage and is fully seated, the crewman directs the aircraft to ascend slowly while maintaining forward speed to ensure that torpedo remains in the cage.

7. If the torpedo is not properly seated, a decision as to whether the cage should be returned to the water to wash the torpedo into one of the landing frame sections or returned as is must be made. Considerations should be based upon the ease of recovery because of sea state and pilot/crewman experience. To reseat the torpedo, the aircraft comes to a hover and lowers cage into the water until the torpedo is buoyed by the water. The aircraft then ascends and lifts the cage from the water.

8. After the cage leaves the water, the crewman verifies that the weapon is properly seated in the cage.

Note

A properly seated torpedo is fully in the cage and leaning against one of the two landing frame sections.

9. Inspect lifting lines and cage for damage prior to forward flight. If line or cage is damaged, evaluate damage and determine if torpedo or empty cage can be safely returned to base.

17.8.2.2.2 Scoop Method. This method (Figure 17-21) is used for the Mk 50. It should be used for the Mk 46 when in high sea state or when unit floats vertically.

1. The aircraft is positioned in a hover at an altitude of 90 feet with the cage at a minimum of 10 feet lateral standoff from the weapon.

CAUTION

If the Mk 50 flotation collar is damaged by the cage, the weapon will sink. Therefore, the required lateral standoff shall be maintained.

2. Crewman directs the pilot to descend until the cage is approximately 10 feet under the surface of the water (use markers on the 40-foot lines to determine depth).

3. Using the lifting line as a guide for cage position, the crewman directs the pilot until the cage is directly under the torpedo.

4. The aircraft ascends to capture the torpedo. Ascent should be slow to avoid torpedo hang-up/damage.

5. The torpedo is checked for proper seating in the cage.

6. Lifting lines and cage are checked for damage prior to forward flight.

The helicopter can proceed to the reception site at speeds up to 100 KIAS. The crewman shall keep the cage and torpedo under observation throughout the flight.

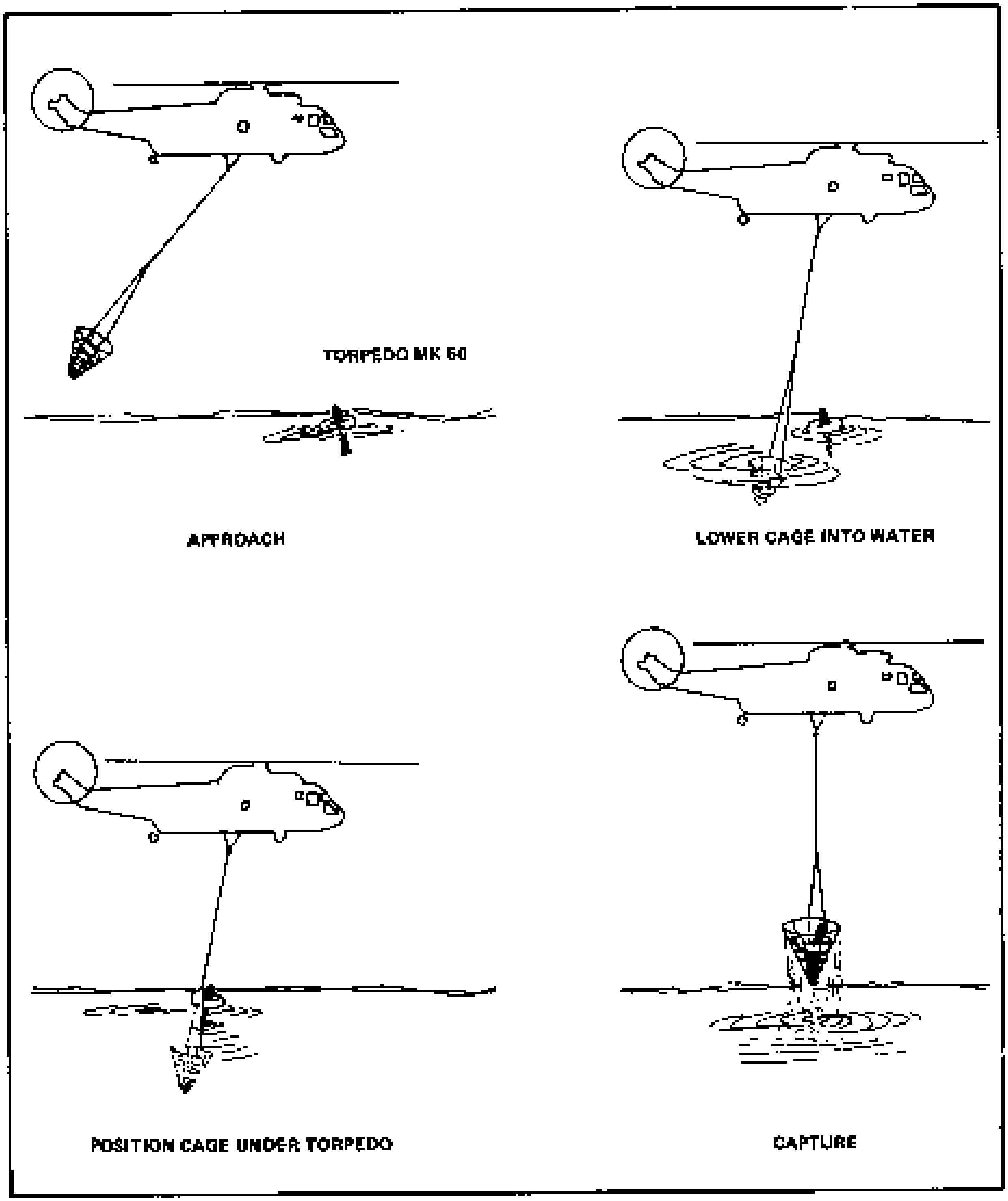


Figure 17-21. Recovery Sequence for Scoop Method

17.8.2.3 Reception/Delivery.

1. Torpedoes can be delivered to either water or land.

2. Initiate normal external load approach. Approach the landing area into the wind making a slow, smooth transition to a hover.

3. With touchdown point cleared, begin slow vertical descent until the recovery cage is gently placed on deck, or into the water.

4. The cage should be lowered into the water until the torpedo is buoyed by the water and the cage is completely below the water. The aircraft then moves to the side as directed by the crewmen so that the cage is no longer below the floating torpedo. Once the cage is clear of the torpedo, raise the cage from the water the transition to forward flight.

17.8.2.4 Disconnecting Cage. Once the cage is on the ground, the helicopter moves off to the side and releases the lifting line.

17.8.2.5 Daily Postflight Inspection. At the conclusion of the day's operations, inspect the cage in accordance with postflight inspection procedures.

17.8.2.6 Mk 46 Torpedo Recovery by Snare Pole

17.8.2.6.1 Description. An alternate method of Mk 46 torpedo recovery method is by snare pole. The snare pole and rigging procedures are similar to that of the MQM/BQM 74 listed in paragraph 2.4.2.2.

17.8.2.6.2 Procedures.

1. Rigging - reference MQM/BQM 74 rigging procedures.

2. Recovery - reference MQM/BQM 74 recovery procedures.

a. The lightweight torpedoes are recovered from a 10-foot hover using a 20-foot snare pole.

b. Once established in the 10-foot hover, the HAC passes verbal control to the talker. The talker positions the helicopter over the torpedo in position so that the crewman handling the pole can snare the torpedo.

c. When the torpedo is snared, the crewman takes tension on the snare and drops the pole. The talker keeps the pilot over the torpedo and talks the helicopter up. Once the torpedo is clear of the water, the talker informs the pilot where the snare is set. If the snare is not set around the tail of the torpedo, he may instruct the pilot to jerk the torpedo to set the snare once it is out of the water. Snared around the tail just forward of the fins is the desired result.

d. The small torpedoes are normally aerodynamically stable. Oscillations of torpedoes can be brought under control by slowing down and commencing a balanced turn. Transit speeds between 60 and 80 knots will keep oscillations to a minimum.

e. Return the torpedo to a soft landing pad for dropoff. The pilot at the controls passes verbal control to the talker on final approach. Once established in an 80-foot hover, the talker will direct the pilot to descend until the torpedo is on the pad. The helicopter should then be moved to one side in order to release the snare pole from the cargo hook without damaging the torpedo or the snare pole.

CAUTION

Water delivery of the Mk 46 torpedo with snare pole attached will cause torpedo to sink.

17.8.2.7 Mk 30 Target Recovery by Snare Pole

17.8.2.7.1 Description. An alternate method of Mk 30 target recovery is by snare pole. The snare pole and rigging procedures are listed in paragraph 17.2.4.2.

CAUTION

The target Mk 30 snare pole shall only be used to recover Mk 30 targets modified with stoppers.

17.8.2.7.2 Recovery. Perform the following steps for targets modified with only the "aft stopper", the snare pole must secure the target between the stopper and the target cg line. If the target is snared forward of the target cg line, the target and snare pole shall be returned to the water. The Mk 30 target shall not be carried as an external load using the snare pole when snared forward of the target cg line, and is modified with only the aft stopper. In this configuration, should the snare slip, the target could be lost.

Mk 30 targets modified with both a forward and an aft stopper, may be carried as an external load when the snare pole has secured the target between the stoppers. If the snare has secured the target outside the stoppers, the target and snare pole shall be returned to the water. The Mk 30 shall not be carried as an external load using the snare pole when the snare has secured the target outside the stoppers. In this configuration, should the snare slip, the target could be lost. Proceed as follows:

1. The talker directs the pilot while the pole operator controls the pole to get the hoop over the nose of the target. It is recommended that the hoop be kept just above the water, using line control, until close to the target's nose.

2. When the hoop is positioned within two feet of the E.O.R. balloon, the pole operator pulls hard on the line to break the tape and set the noose. Confirm noose is between the stoppers (for targets modified with both forward and aft stoppers) or between stopper and target cg line (for targets modified with only the aft stopper).

CAUTION

Pull the bridle retainer pins free BEFORE the helicopter ascends to allow the pole to collapse down.

3. Ascend the helicopter slowly to lift the target from the water. Ensure the helicopter stays directly over or abeam the target during the ascent to avoid pulling the noose out of position. After the target is clear of the water, confirm a secure grip on the target. If the target is hanging tail down, the target should be delivered to the TWRV to avoid landing damage to the target and soft pad.

4. Recover the towed array using the standard procedure for Mk 2 HWRS recovery. If the array cannot be recovered, the target should be delivered to the TWRV. If TWRV support is not available, the target should be flown to a more sheltered area for further towed array recovery attempts.

CAUTION

If the towed array cannot be recovered, transition to forward flight and proceed to reception area. Delivery shall be made using a slow descent from 200 feet AGL. Lower approach altitudes may cause cable to contact the ground resulting in damage to cable and target.

17.8.2.7.3 Delivery. Deliver the target as directed by the target representative to the TWRV or to the soft pad. Set the target down, and then slide over and down so that the pole falls harmlessly when the cargo hook is released. For the soft pad, lower the bagged towed array with the grapnel. For water delivery to the TWRV, release the towed array into the water.

17.8.3 MK 2 MOD 0/1 HELICOPTER WEAPON RECOVERY PROCEDURES

17.8.3.1 In-Flight Profile

17.8.3.1.1 Hookup.

1. The HWRS cage will normally be positioned to the right side of the helicopter, with the barrel pointing into the wind. Taxi next to the cage so as to split the cage in half with blade tip as the reference for lineup. Stop when the right sponson is parallel to the cage.

WARNING

Taxiing with the HWRS skirt inside the rotor arc reduces rotor tip clearance and creates the possibility of a cage strike resulting in equipment/aircraft damage and/or personnel injury.

2. The HWRS may also be positioned on the right side of the helicopter with the barrel pointing at the helicopter. Taxiing next to the cage to split the strongback of the HWRS with the blade tips will provide an additional 4 to 5 feet of rotor tip to HWRS clearance.

3. The helicopter may also be positioned in a low hover above and to the left of the cage, with aircrewman directing the pilot for proper positioning.

4. The aircrewman will then pay out the hoist cable, and the groundcrewman will connect the hoist cable to the flyback weight.

5. After the hoist is connected to the cage the groundcrewman will attach the lifting line from the cage to the cargo sling. The aircrewman will then direct the pilot to lift the helicopter vertically until the cage is clear of the ground.

6. As the cage leaves the ground, the aircrewmen will pay out the rescue hoist cable just enough to place the total weight of the cage on the lifting line and notify the pilot when the weight of the cage is coming on the aircraft. When clear of the ground he will inform the pilot "Ready for forward flight".

7. The pilot will note the indicated altitude shown on the radar altimeter when the cage becomes airborne and will set the altimeter bug on this reading for future reference. As the cage is lifted, the air-crewman will check all attachments visually for security and freedom from entanglements.

17.8.3.1.2 In Flight.

1. Smoothly transition to desired airspeed not to exceed limits. Adjust rescue hoist to ensure total weight of cage is on the lifting line.

2. The helicopter will normally be vectored to the recovery area. Altitude flown should be no lower than 500 feet above the surface.

3. The aircrewman shall continually observe the flight of the cage to ensure that no dangerous oscillations occur, that rearward movement of the cage does not bring the cage too close to the tail section of the helicopter and that the total weight of the cage remains on the lifting line.

4. Once above approximately 300 feet AGL, the cargo sling master switch should be placed in the SAFE position and the rescue master switch turned OFF once the aircrewman has trimmed the cage for forward flight.

17.8.3.2 Recovery.

1. When visual contact has been established with the torpedo, an approach will be executed into the wind. A smoke may be placed upwind and slightly to the right side of the unit to aid the pilot in orientation during the recovery operation and to define wind direction.

2. The approach should be made from a downwind position with a long, straight in final.

3. When indicated airspeed is below 40 knots, the pilot instructs the aircrewman to rotate the cage into the capture position by raising the rescue hoist, allowing the hoist to share the weight of the empty cage with the lifting line (Figure 17-10, Sheet 2).

4. Approach to the unit should be accomplished slowly and with the nose of the helicopter directly into the wind. Altitude on the radar altimeter should be approximately 3 to 5 feet above the bug reference altitude as established during the initial lift-off of the cage. Aircrewman will keep the pilot informed of altitude so as to preclude dragging the cage in the water. The cage, when properly in capture position, should have the (back) lower edge of the cage skirt approximately 2 feet off the water (slightly dragging in the water for smooth sea states and slightly higher for sea states above 3 to 4).

5. When the pilot loses sight of the torpedo he will inform the aircrewman, who then directs the pilot to position the cage directly over the unit.

6. When the cage is directly over the unit, the crewman will command, "Down, down, down", and the pilot will commence a no-drift descent to 20 to 25 feet on the radar altimeter. This capture maneuver should be made by a positive, though not necessarily rapid, reduction in collective pitch. Excessively rapid collective movements or erratic control must be avoided to eliminate the possibility of breaking the weak link.

7. The crewman must guide the pilot to stop drift and allow the unit to seat properly in the barrel section of the cage.

8. When the unit is fully seated, the crewman directs the pilot to raise the helicopter vertically, during which time he pays out the rescue hoist cable so that the total weight of the loaded cage is taken up on the lifting line. The cage is then able to rotate under the influence to its own center of gravity, adopting a slightly nosedown attitude.

9. When the cage is clear of the water, the crewman immediately takes up excessive slack in the rescue hoist cable and when satisfied that the unit is fully seated in the cage, reports to the pilot that he is ready for forward flight, or, if recovering a Mk 30 target, ready for towed transducer recovery.

10. If the unit is not adequately seated, the cage should be lowered back into the water until fully submerged and an attempt made to reseat the unit.

17.8.3.3 Towed Transducer Recovery.

1. With the cage suspended approximately 5 feet above the water, the helicopter is transitioned into slow forward flight of approximately 5 to 10 knots groundspeed while the crewman lowers the grappling hook. This maneuver will stream the transducer and cable out behind the target and place the grappling hook alongside the target.

2. The crewman will then snag the transducer cable with the grappling hook. Moving the helicopter in a left oblique direction, so that relative movement is forward and slightly left, will drag the grappling hook across the streamed out cable enabling the hook to snag the cable.

3. Once the cable is snagged, the crewman hauls up the grappling hook and the transducer cable, being careful not to damage it by dragging it over the door edge.

4. As the cable is being brought up, the helicopter continues a slow forward movement. The cable and transducer should be stowed in the appropriate container. Place container near the cargo door so that it can exit clearly if jettisoned.

WARNING

When hauling in grapnel and towed array cable, personnel should stay clear of recovered portion of rope or cable to avoid possibility of entanglement during emergency or inadvertent jettison.

CAUTION

When transiting with the towed transducer streaming, the aerodynamic drag on the cable will be applied to the aft section of the target. If the cage is at a level attitude in flight, this will increase the possibility of the target sliding aft and departing the cage.

5. If a Mk 30 target is being recovered, MAD wire trailing from the transducer should be cut at the transducer and discarded.

WARNING

If target safeguards fail, touching the MAD wire may cause electric shock.

6. Leave some slack in towed array cable to allow for cage movement.

7. Loop cable restrainer onto cable, cinch tight, and attach snare hook to suitable deck ring (Figure 17-22).

8. Install cable protector onto the cable at door's edge (Figure 17-22).

Note

If the towed array cannot be recovered, transition to forward flight and proceed to reception area. Delivery shall be made using a slow descent from approximately 200 feet. Lower approach altitudes may cause cable to contact ground resulting in damage to cable and target.

17.8.3.4 Transport to Reception Area.

1. Once recovery is complete, the helicopter may proceed to the reception site.

2. Because of the heavy weight of the loaded cage, load oscillation may occur. Load oscillations can be brought under control by decreasing airspeed and/or applying "G" loading by simultaneously making a smooth, coordinated turn either direction.

3. Utilization of cyclic mounted beeper trim to make angle of bank and airspeed changes when carrying the loaded cage is recommended to reduce the possibility of pilot-induced oscillations.

4. The crewman shall observe the cage and unit during flight to report oscillations, and tend the rescue hoist to ensure that the total weight of the loaded cage remains on the lifting line.

5. The master cargo sling switch should be placed in the SAFE position following recovery The hoist control switch shall be placed in the OFF position once the crewman is satisfied as to the position of the cage. The hoist control switch may he placed in the CREW position to adjust cage position in flight as necessary.

CAUTION

Failure to place the hoist control switch to the off position may allow inadvertent hoist actuation and possible loss of the torpedo.

17.8.3.5 Delivery at the Reception.

1. Mk 48 Torpedoes can be delivered to either the water or to land.

2. A standard external load approach will be made to the reception area. As the touchdown point is approached, crewman will direct the pilot in order to establish a stable hover at approximately 60 feet above the ground. Care must be taken during the final stages of the approach to prevent load Oscillations. Over controlling or rapid deceleration will induce large oscillations.

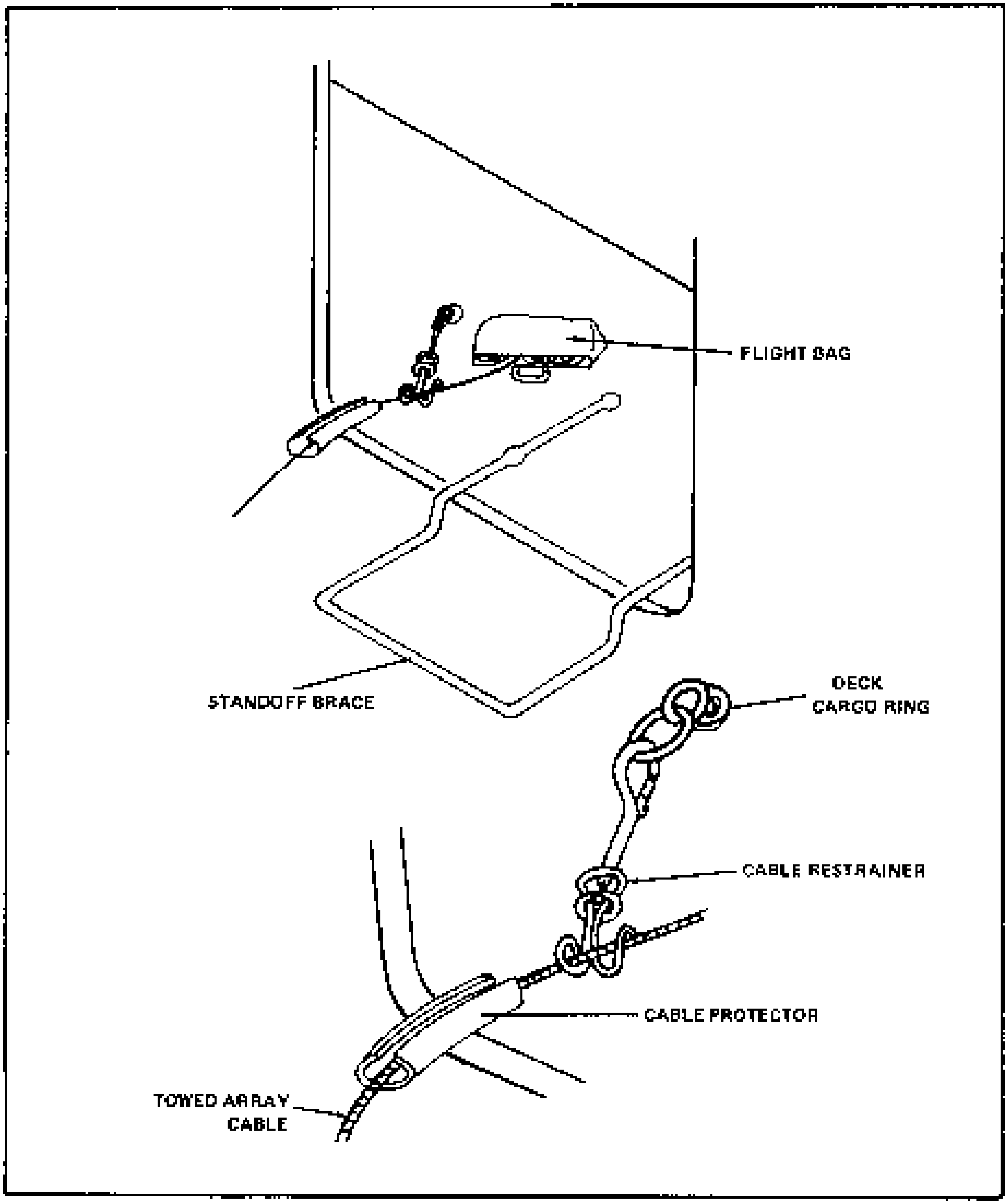


Figure 17-22. Towed Array Tie off

3. When the touchdown point is reached, the pilot will begin a slow, vertical descent until the recovery cage is placed gently on the ground, or into the water.

4. The cage should be lowered into the water until fully submerged. The cage should then be rotated to a fully vertical position. When the cage is vertical the helicopter should increase its hover altitude by 10 feet, leaving the torpedo in the water. The cage should then be rotated to the forward flight position. The helicopter is then ready for forward flight.

17.8.3.6 Disconnecting Cage. Proceed using one of following methods:

1.Method 1:

a. Pilot release lifting line and lauds aircraft alongside cage.

CAUTION

Lifting line must be slack and not over unit before release. Ensure the 60-pound weight is lowered and placed on ground to avoid hazards to ground crew and equipment.

b. Disconnect rescue hoist from weight.

c. Reel in rescue hoist, being careful not to damage the cable and hook.

2. Method 2:

a. Pilot releases lifting line.

Note

Pay out rescue hoist cable to allow ample clearance between cage and helicopter.

b. Option 1 - Groundcrew disconnects rescue hoist hook from weight, and crewman reels it in.

c. Option 2 - Crewman directs helicopter into low hover, reels in hoist cable, and disconnects weak link from weight. Use of the optional snap shackle (see Figure 2-10) facilitates release in this case.

17.8.3.7 Offloading Towed Array Cable.

When recovered vehicle is a target, the towed array cable is offloaded as follows (depending on which delivery method was employed).

1. Method 1

a. Remove cable from helicopter after landing.

Note

Ensure there is sufficient slack in towed array cable to allow helicopter to land at safe distance from cage.

2. Method 2

a. Crewman lowers coiled or bagged cable using grappling hook that may be hauled back into helicopter or left on deck.

17.8.4 TARGET DRONE RECOVERY SYSTEM OPERATING PROCEDURES

17.8.4.1 Recovery Procedures. Over water retrieval of target drones is accomplished by having the target hooked or snared by helicopter aircrewman utilizing one of the approved retrieval devices as the helicopter is hovered over the target. Once the target/drone has been hooked or snared, it becomes an external load, and the same procedures and precautions will apply.

17.8.4.2 Recovery Methods. During recovery, one air crewman (the hooker) will be lying on the deck at the cargo door in order to hook or snare the target. The other crewman (the talker) will direct the pilot over the target at the proper altitude to hook/snare to the target.

WARNING

The helicopter shall not be vectored into an area where powered aerial targets are being operated. Helicopters may be vectored into a target recovery area when targets are known to be in recovery and descending via parachute. In such cases, the helicopter shall remain upwind of the target until the target has contacted the surface. Pilots shall avoid flying under low clouds with targets in recovery when the exact location of the chuteborne target is not known. In areas with low cloud ceilings, the helicopter shall not proceed into the recovery area until the target is known to have contacted the surface.

Prior to establishing the initial 40-foot hover for target retrieval, it may be desirable to make a low, slow pass over the target to evaluate its condition, i.e., chute attached, inverted, nose low or high, damage, etc. In the event the target's presentation in the water is not such that a normal recovery can be effected, consideration may be given to deploying a qualified swimmer in an attempt to return the target to the normal recovery attitude. An alternate method of returning the drone to the normal recovery attitude is boat recovery.

WARNING

Deploying a swimmer from the helicopter is neither a normal nor an alternate target recovery procedure. It may be used, however, when all other attempts have failed to return the target to the normal recovery attitude. The helicopter aircraft commander shall be responsible for making the decision to deploy a swimmer. All other available means of target preparation for recovery shall be exhausted prior to deployment of a swimmer.

WARNING

Do not allow the aircraft to become too low during the recovery evolution. A wave could make the target/drone ride upwards causing the pole to strike the bottom, side, or hoist portion of the aircraft. It also could strike a crewman if he/she is still holding onto the pole.

1. Prior to establishing a hover, a recovery checklist shall be completed. It shall consist of but not be limited to:

a. Shoulder harness - LOCKED.

b. Cargo sling master switch - SLING.

c. Speed selector - CHECKED.

d. Cargo hook – LOWERED.

WARNING

Recovery shall not be attempted if the parachute is still attached or is located in the immediate vicinity. A range safety boat shall detach and recover the parachute.

Note

Fifteen- and twenty-foot poles or snares may be used up to and including sea state three. Only 20-foot poles and snares may be used in sea state four. Target recoveries in sea state five are prohibited.

The hooker will be lying on the deck at the cargo door in order to manipulate the recovery device. The talker shall pass the prepared recovery device out the door, hand it to the crewman lying down, and connect the pole to the clevis on the loadline. The talker should retain control of the tagline. When the talker reports properly rigged and unit in sight, the pilot at controls - passes verbal control to the talker who directs the pilot over the unit for hookup recovery, salt encrustation of the engines is a possibility.

WARNING

Because of low altitudes required for the recovery, salt encrustation of the engines is a possibility.

CAUTION

The hook/snare method necessitates a low hover, possibility as low as 5 feet. Care should be taken not to get so low as to put the tailwheel in the water or allow the drone to ride a wave and make contact with the helicopter.

Pilot then commences a slow creep forward to close the target. The hooker places the hook in target pickup loop or snares the target at a point approximately 1 foot forward of the leading edge of the drone wings and then pulls on the cable to tighten the noose.

When using the QD pole, the hooker then releases the hook from the pole and brings the pole back inside the aircraft. When using the fixed pole hook, the hooker releases the pole.

Once the target has been successfully snagged, the talker shall place tension on the tagline. Once tension is established, the hooker may release the pole.

Note

- The snare will come off the drone if tension is not kept on the tagline while the weight of the drone comes on the helicopter.

- The tagline is also used to retrieve the pole assembly in case a rerig is needed.

The talker directs the helicopter up and over the target slowly to apply tension on the loadline. The target is lifted clear of the water to allow for water drainage (approximately 15 seconds).

WARNING

- The helicopter must be centered directly over the drone prior to tension being applied to the loadline. This will eliminate any sudden attitude change of the helicopter because of an off-centered load pickup.

- Do not secure the tagline to the helicopter once the drone has been picked up as it may be necessary to jettison the drone during an emergency.

- Do not attempt jettisoning the drone if it is flying too close to the rotor system. Wait for the drone to come back downward and call for jettisoning when it is below the aircraft. If jettison is done when drone is close to the rotor system, it can get entangled in the blades with catastrophic consequences.

CAUTION

When the target is clear of the water, the crewman shall visually inspect the overall condition of the target. The pilot must be aware of any unusual control surface configuration or damage that may adversely affect flight.

When target is drained and ready for forward flight, pilot commences a slow, smooth transition utilizing beeper trim and climbs to 300 feet prior to commencing a turn.

An undamaged drone will generally present few problems after initial oscillations have stopped. A drone that is damaged, however, may never completely stabilize and extreme caution must be exercised.

WARNING

When recovering damaged drones or drones with non-faired flight control surfaces, safe flight parameters may be significantly lower than normal. Excessive oscillations may occur with high airspeeds and bank angles. If oscillations do not decrease, consider jettisoning the drone.

Note

- Drone oscillations can be dampened by gradually reducing airspeed using beeper trim while maintaining balanced flight with ASE engaged and avoiding resistive inputs.

- If a drone cannot be stabilized in flight, either set it back in the water, or, if the drone recovery boat is nearby, consideration should be given to dropping the drone next to the boat.

Upon reaching cruise flight, consideration should be given to placing the cargo sling master switch to SAFE and adjusting throttles as required. Unless otherwise required, 500 feet is a recommended cruise altitude.

During transit an aircrewman shall continue to monitor the drone for stability. Prior to establishing a hover at homebase/ship to release drone, ensure cargo sling master switch is in SLING.

Using directional information from the crewman, initiate a normal external load approach into the wind and make a slow, smooth transition to a 60-foot hover. Once over the target area, slowly and gently place the drone on the designated surface. Release the cargo hook.

CAUTION

When releasing the cargo hook, avoid dropping the target retrieval assembly on the drone.

Stow cargo hook prior to landing/forward flight.

PART IX

Flightcrew Coordination

This Page Left Blank Intentionally

CHAPTER 18

Flightcrew Coordination

18.1 Introduction

Proper crew coordination occurs only when all crewmembers know and execute their duties on any aircraft mission. It requires a clear division of tasks between crewmembers to prevent cockpit indecision and confusion. Although there is only one pilot in command, the copilot or air crewman should not allow an unsafe situation to exist without taking action. The PIC shall address the division of responsibilities among the pilot at the controls, the pilot not at the controls, and the crewchief in the permission brief.

The PAC's primary function is to fly the aircraft. The pilot shall maintain flight parameters that will safely accomplish the mission. Any cockpit duties that may detract from the PAC's ability to maintain flight within established operational parameters shall be the PNAC's.

The PNAC's primary function is to back up the PAC in the safe and orderly conduct of the flight. Additional tasks may be designated by the PIC during the crew briefing. The PNAC shall be prepared to assume any duties performed by the PAC, including physical control at any time.

The crewchiefs/aircrewmen perform essential functions as integral members of the helicopter crew. On all missions they will act as an observer, always being on the alert for other aircraft or obstacles in flight. They will supervise internal loading under the direction of the PIC and orally direct the PAC in external cargo pickups and drops. They will supervise the embarkation and debarkation of PAX during PAX transports. The crewchiefs/aircrewmen can often detect system failures before either pilot and inform them of potential malfunctions.

18.2. Crew Coordination Concepts

Definition. Flightcrew coordination is the flightcrew use and integration of all available skills and resources to collectively achieve and maintain crew efficiency, situational awareness, safety, and mission effectiveness.

18.2.1 Key Components of Flightcrew Coordination

The seven critical skills of Aircrew Coordination Training/Crew Resource Management are:

1. Mission Analysis.
2. Decision Making.
3. Assertiveness.
4. Communication.
5. Leadership.
6. Adaptability/Flexibility.
7. Situational Awareness.

Practicing ACT/CRM skills will improve mission effectiveness and reduce mishaps that result from poor crew coordination.

1. Mission Analysis - Effective mission analysis refers to the ability to make long-term and contingency plans to coordinate, allocate, and monitor crew and aircraft resources.

   a. Long-term planning deals with preparation for anticipated problems. Examples of long-term planning include NATOPS, NAVBAGS, TACAIDs, mission briefings, and crew briefings. All of these things are an attempt to present a solution to problems that may develop and could impact the mission.

   b. Contingency planning is often the response to unanticipated problems. The success or failure of a crew to respond to an unanticipated problem requires experience, skill, and teamwork.

2. Decision Making - Effective decision making refers to the ability to use logical and sound judgment based on the information available. Aircraft Commanders should encourage all crewmembers to participate in the decision making process. Group decision-making, while preferred, may not always be possible. The decision making process may be driven by the time available to decide.

3. Assertiveness - Effective assertiveness refers to the willingness to actively participate and the ability to state and maintain your position until convinced by the facts that your position is wrong. Each crewmember has an

important role in ensuring the safe completion of a mission and must have the courage to speak up if they are in doubt of the safe completion of the mission.

4. Communication - Effective communication refers the ability to (1) clearly and accurately send and acknowledge information, instructions, or commands and (2) provide useful feedback. The major barriers that impact crew communications are:

a. Sociological - Rank, experience, authority.

b. Psychological - Prejudices, assumptions, overconfidence.

c. Environment - Workload, noise, climate, comfort level.

d. Methodology - Nonstandard terminology, over/under communication, speech pattern.

5. Leadership - Effective leadership refers to the ability to direct and coordinate the activities of other crewmembers and to stimulate the crew to work together as a team. If aircrew coordination effectiveness is to be maximized, all crewmembers must develop their leadership potential and authority. The ultimate responsibility for safety of flight rests with the pilot in command, but each crew-member has a responsibility towards safety of flight and compliance with applicable directives. The two types of leadership are:

a. Designated - Position based on rank and experience that is usually in writing (i.e., designation as HAC, crewchief, etc.).

b. Functional - Temporary and based on knowledge or experience with a particular task.

6. Adaptability/Flexibility - Effective adaptability/ flexibility refers to the ability to alter a course of action to meet situational demands, to maintain constructive behavior under pressure, and to interact constructively with other crewmembers.

7. Situational Awareness - Effective situational awareness refers to awareness of what is happening in the aircraft and in the mission and knowledge of how that compares with what is supposed to be happening. The entire crew must be kept aware of the situation at all times. A crew's ability to respond to routine or emergency situations is dependent upon teamwork and accurate information. False assumptions by any crewmember during any evolution from preflight to postflight can be hazardous.

18.2.2 Loss of Flightcrew Coordination. Loss of flightcrew coordination is identified by the following factors:

1. Fixation on one task

2. Confusion.

3. Violation of NATOPS/flight minimums.

4. Violations of SOP.

5. No one in charge.

6. No lookout doctrine.

7. Failure to meet mission/planning milestones.

8. Absence of communication.

18.3 DESCRIPTION OF AIRCREW POSITIONS

1. Helicopter aircraft commander (HAC). - The pilot designated as the mission commander on his particular aircraft or the pilot in command.

2. Copilot (CP).- The pilot not at the controls. During start, engagement and taxi implies the pilot in the left seat.

3. Mission commander/flight leader (MC).- Pilot responsible for safe and effective execution of the mission or formation flight.

4. Right-seat pilot (RS). - Self-explanatory.

5. Left-seat pilot (LS). - Self-explanatory.

6. Pilot at controls (PAC). - Self-explanatory.

7. Aircrew (AC). - Implies assigned aircrewmen.

18.4 SPECIFIC RESPONSIBILITIES

18.4.1 Mission/Flight Planning

MC: Promulgate all information necessary for effective completion of assigned mission.

HAC: When a specific MC is assigned, the HAC assists as required. Ensure completion of all required performance charts, flight logs, navigation computations, and crew brief for assigned aircraft/crew.

18.4.2 Brief

HAC: Ensure that all crewmembers attend proper NATOPS brief. Conduct brief according to Part 3, including weather, NOTAM information, and appropriate Parts 5 and 11 chart computations; and ensure that aircrew conducts appropriate passenger brief.

18.4.3 Preflight

HAC: Ensure that crew has properly reviewed ADB and is familiar with all performance parameters calculated for the briefed mission. Ensure that crew are equipped with all necessary survival gear. Ensure that each pilot understands individual areas of responsibility during preflight.

RS: Should inspect the cockpit, No.2 engine, and starboard transmission areas.

LS: Should inspect the cabin area, No. 1 engine, and port transmission areas.

AC: Shall conduct preflight in accordance with the NATOPS Crewman's Pocket Checklist.

These specific preflight recommendations do not override HAC prerogative to reassign individual crew responsibilities.

18.4.4 Start and Engagement

RS: Call for checklist and ensure completion of all items. Respond and complete all items in the order read by the LS.

LS: Read all appropriate checklist items according to NATOPS Pilot's Pocket Checklist. Assist the RS in completion of checklist items as necessary.

AC: Complete all items in NATOPS Aircrew's Pocket Checklist including hoist checks.

18.4.5 Taxi

RS: Exercise control of the aircraft and call for appropriate checklists.

LS: Complete checklists called for by the RS. Maintain appropriate lookout.

AC: Ensure that all crew and passengers in cabin are properly strapped in. Maintain appropriate lookout.

18.4.6 Takeoff

PAC: Ensure completion of all pretakeoff and takeoff checklists. Verify acceptable engine performance following takeoff. Comply with appropriate departure instructions, course rules, and external communications.

CP: Back up PAC on performance and flight instruments.

AC: Back up pilots by scanning those instruments within view. Ensure that crew and passengers remain strapped in.

18.4.7 Departure

PAC: Ensure that aircraft achieves and maintains proper altitude, airspeed, and heading. Call for appropriate checklists.

CP: Back up PAC with power calls and confirm appropriate rate of climb. Read and ensure completion of checklists called for by PAC. Monitor compliance with departure procedures.

AC: Execute applicable portions of checklists and report completion to pilots. Ensure security of passengers, internal stores, and cargo.

18.4.8 En Route

PAC: Execute safe control and navigation of aircraft. Monitor flight performance and fuel usage.

CP: Assist PAC in navigation/communications and monitoring of flight performance and fuel usage.

AC: Maintain lookout for hazards and scan cabin for leaks, fumes, etc. Ensure that mission-required equipment properly tested prior to arriving on station. Assist pilots as required.

18.4.9 Instrument Procedures

PAC: Maintain control of the aircraft within briefed parameters. Report when "on gauges." Notify CP if any disorientation is encountered.

CP: Assist PAC in navigation and monitoring of flight performance and fuel usage. Maintain internal and external scan. Advise PAC when aircraft is approaching or has exceeded a briefed parameter. In the event PAC encounters disorientation or vertigo, verbally assist PAC or monitor/assume flight controls as briefed.

AC: Assist pilots as required.

18.4.10 Arrival/Return

PAC: Comply with course rules or assigned navigation route.

CP: Back up PAC as required with navigation, approach procedures, and scan of flight performance instruments and fuel usage.

18.4.11 Descent /Approach

PAC: Call for landing and other required check lists. Ensure that ATIS or equivalent weather and airport information is obtained. Comply with approach procedures.

CP: Complete checklists called for by PAC. Brief PAC on anticipated instrument approach. Monitor compliance with approach procedures. Copy all information provided by controlling agency and advise PAC that all information copied.

AC: Complete and respond to all appropriate checklist items. Ensure that all passengers and cargo are secure for landing. Ensure security of all internal stores. Advise pilots to check gear and power on final.

18.4.12 Landing

PAC: Execute appropriate landing procedures.

CP: Ensure that all checklist items are complied with. Monitor flight performance instruments.

AC: Respond to checklist items as required.

18.4.13 Post-landing/Taxi/Shutdown

RS: Call for required checklists. Control aircraft during taxi. Comply with and respond to checklist items called for by LS. Ensure that aircraft is properly chocked and chained (as required) prior to rotor disengagement.

LS: Read and comply with checklists as required. Assist RS as required.

AC: Comply with and respond to checklist items as required. Ensure that all passengers remain strapped in or are clear of rotors prior to disengagement.

18.4.14 Postflight

HAC: Comply with postflight requirements according to Chapter 7.

CP: Assist HAC as required.

AC: Shall conduct postflight in accordance with the Crewman's Pocket Checklist.

18.4.15 Debrief

HAC: Ensure that NAVFLIRS/CANDE and required maintenance action forms are completed. Debrief CP and aircrew on conduct of flight.

CP: Assist HAC as required.

AC: Assist HAC as required.

18.5 MISSION/SPECIAL CONSIDERATIONS

18.5.1 Functional Checkflight Procedures. The HAC shall ensure that the crew is familiar with the specific requirements for each flight to be conducted and conduct a brief that thoroughly covers items discussed in Part 3 including anticipated functional checkflight procedures.

18.5.2 Formation. The MC shall ensure that all planned maneuvers are thoroughly briefed and complied with according to Part 3.

18.6 TRAINING

HAC: Ensure that each crewmember is aware of the parameters within which all training shall be conducted. Brief all crewmembers on required actions should an emergency occur during a training scenario.

18.7 NIGHT / INSTRUMENT FLIGHT RULES ALTERNATE / AUTOMATIC APPROACHES AND DEPARTURES

PAC: Call for appropriate checklists. Monitor D mode on the hover indicator. Call for coupler engagement and ensure safe control of the aircraft during descent to a hover. Stabilize aircraft according to procedures in this chapter. Ensure that crew is aware of who has control of aircraft (i.e., hover trim, verbal control, etc.). Advise crew if conducting simulated/hooded instrument flight.

CP: Complete checklists called for by PAC. Provide instrument scan backup for PAC. Provide calls to PAC when aircraft approaches or exceeds briefed parameters. Monitor A mode on hover indicator. During hover departure, back up PAC with call confirming positive rate of climb on VSI, barometric altimeter, and radar altimeter.

AC: Report rigged for rescue, as required, during approach. Confirm acceptance of verbal/hover trim control from PAC. Keep pilots advised of hoist position. Relinquish control when called for by PAC and report aircraft ready for forward flight.

18.8 SEARCH AND RESCUE

HAC: Collect data concerning assigned SAR mission and brief CP and aircrew on specific responsibilities per SAR section, paragraph 18.12, NWP 3-22.5-SAR-TAC, and NWP 3-50.1. Continue to update data and inform CP and aircrew of changing requirement

PAC: Comply with briefed procedures for search and rescue. Monitor flight performance and fuel usage. Comply with requests from on-scene commander, as able. Call for appropriate checklists.

CP: Maintain lookout. Back up PAC on flight performance and fuel usage. Assist PAC with navigation and communication during the search and rescue phase. Comply with all checklist requirements.

AC: Assist pilots, as required. Maintain lookout. Ready aircraft for rescue according to paragraph 18.12.

18.9 EMERGENCIES

PAC: Perform NATOPS immediate action items. Call for CP to back up procedure completion with NATOPS Pilot's Pocket Checklist. Ensure that aircrew is aware of emergency and that crew completes all necessary procedures.

CP: Back up PAC in the diagnosis of the malfunction and in the performance of immediate action items. Read applicable portions of NATOPS Pilot's Pocket Checklist in order to ensure completion of all required actions. Switch IFF to emergency position and make mayday as required. Lower landing gear handle in the event of an overland ditching scenario.

HAC: Ensure that both pilots are aware of who has positive control of the aircraft following the completion of all immediate action items. Ensure that all NATOPS Pilot's Pocket Checklist items are properly complied with. Ensure that crew is aware of specific responsibilities/required actions during the emergency scenario.

AC: Comply with all required NATOPS immediate action items. Assist pilots as required. Ensure security of all passengers/cargo. Report condition of aft station to HAC. Advise pilots to check landing gear in the event of an overland ditching scenario.

18.10 APPROACH TO A HOVER

18.10.1 GENERAL. Operation of the Doppler system is dependent upon the radar return from the reflecting surfaces beneath the helicopter. When operating over a smooth sea state, the radar return may not be enough for an automatic approach, and an alternate approach must be made. The automatic approach to a hover can be done at various combinations of speed and altitude. To obtain proper programming, engage the coupler within the shaded area of Figure 18-1. The recommended start position is about 150 feet and 40 to 80 knots groundspeed.

WARNING

The pilot at controls shall call all uncoupled descents below 500-foot AGL during night/IFR conditions. Both pilots shall then monitor flight instruments until level at the new altitude.

18.10.1.1 Automatic Approach

Note

The helicopter will require about 75 +/- 20 seconds to achieve a hover commencing from 150 feet and 60 knots groundspeed.

The accelerometer nulls cannot be checked adequately aboard ship because of the accelerations generated by ship movement. When setting nulls aboard ship, center DRIFT and SPEED knobs as approximate settings during first hover. Speed and drift settings can be effectively nulled during a cyclic coupled hover. With the meter selector switch in coupler, monitor A mode to center both bars with the speed and drift pots, while the copilot monitors helicopter hover stability.

The helicopter should be headed into the wind at the proper gate altitude and groundspeed before engaging the coupler. Upon engagement of the coupler, the helicopter will assume a slightly nose-high attitude. Should either the existing groundspeed or altitude at gate be other than that previously prescribed but within the limitations delineated in the approach profile limitations, the coupler will commence correction to establish the helicopter in the proper approach envelope. These corrections normally will be completed at about 80 feet. A slight delay in descent may be experienced at that altitude because of this correction. Normally, the helicopter will pass through 80 feet at 30 knots ground speed and thereafter follow the programmed pattern. The tolerances in altitude and attitude that determine if a waveoff is justified during an automatic approach are a 10-foot undershoot, 4 degrees right roll, 6 degrees left roll, and 5 degrees nosedown or 10 degrees noseup.

18.10.1.2 AUTOMATIC APPROACH

1. The automatic approach is a means of transitioning the helicopter from flight at 150 ft AGL and 40-80 kts ground speed to a hover using the coupler/doppler system:

a. Complete the automatic approach checklist.

b. Establish the aircraft at the "gate" position (150 ft AGL, 40-80 kts ground speed, and D-mode vertical bar centered/150 ft AGL, 60 KIAS, and best estimate of windline).

c. When the helicopter is wings level and headed inbound to the survivor, the copilot reports, "Standby for coupler," engages coupler, and then reports, "Coupler engaged." The PAC monitors the controls (feet off the pedals), without inhibiting coupler inputs to the cyclic and collective channels as the coupler system decreases collective, raises the nose, and rolls the aircraft to fly a programmed approach to a hover

d. As the helicopter passes through approx. 60 ft AGL and 20 kts ground speed, the coupler raises the collective (to increase power) and coordinates nose and wing positions to continue decelerating on glidepath to the selected hover height with no lateral drift.

e. The tolerances in attitude/altitude which determine if a wave-off is justified during an automatic approach are 10 feet of undershoot, 4 degrees right roll, 6 degrees left, 5 degrees nose down pitch, or 10 degrees nose-up. The non-flying pilot should monitor A-mode for ASE pitch and roll saturation.

f. As the helicopter flies the approach to a hover, direct the pilot not flying the aircraft to use the drift pot to correct for lateral drift as registered on the D-mode indicator.

g. As the helicopter arrives in a hover, the coupler system increases power to stop the descent, rolls the wings, and positions the nose to obtain a hover. Direct the PNAC to adjust the drift/ speed pots to correct for any lateral/fore-and-aft drift as noted on the D-mode presentation.

WARNING

Do not recycle a failed generator in a hover at night. Depart the hover and recycle the generator at a safe altitude to lessen adverse coupler inputs and preclude the chance of pilot disorientation.

Note

If the No. 1 generator fails while hovering with coupler engaged, transient down signal may be introduced into the coupler causing a momentary loss of 10 to 12 feet of altitude. If this condition occurs, do not shut off ASE as the No. 2 generator will take over the load and return the helicopter to the original altitude. The transient signal will disappear about 2 seconds after the No. 2 generator takes over.

18.10.1.3 Automatic Approach Checklist

1. Collective friction - FREE.
2. BAR ALT - ENGAGED.
3. Doppler selector knob - SEA.
4. Cyclic coupler switch - DOPPLER.
5. ALTITUDE coupler switch - RDR ALT/VA.
6. SPEED and DRIFT knobs - SET.
7. Altitude knob -40 FEET.
8. CG TRIM - SET (PITCH BAR CENTERED TO LOWER HALF OF CIRCLE).
9. Radar altimeter limit - 30 FEET.
10. Vertical gyro indicators – SET AND CROSSCHECKED.
11. Pilot hover indicator – D MODE.
12. Copilot hover indicator – A MODE.
13. Speed selectors – CHECKED.
14. Aft station report – RIGGED FOR RESCUE.
15. Establish condition – 150 FEET RADAR ALTITUDE, 40 TO 80 KNOTS GROUNDSPEED.
16. Altimeters – MATCHED (READJUST CG WHEN INTO THE WIND IF NECESSARY).

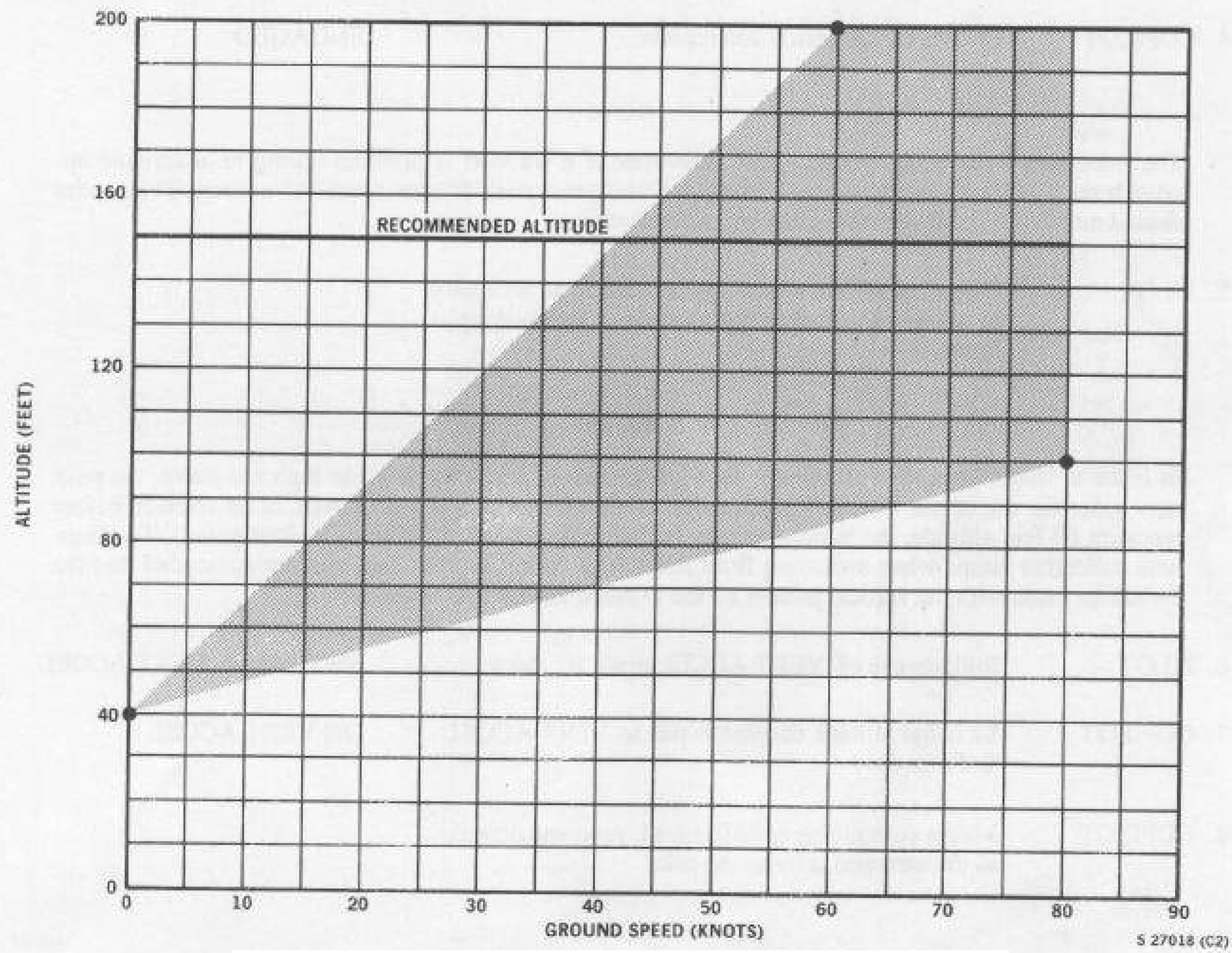


Figure 18-1. Approach Profile for Automatic Approach to a Hover

Note

The CG TRIM is set initially (step 8) without regard to helicopter attitude, groundspeed, or position relative to the wind. With the hover indicator in A mode, move the CG TRIM knob on the ASE control panel in either direction as necessary until the horizontal bar on the hover indicator is approximately centered to lower half of circle, beeping the cyclic as necessary to maintain a constant groundspeed. When established at 150 feet radar altitude and 60 knots groundspeed into the wind, readjust the cg as necessary to approximately center the horizontal bar on the hover indicator (A mode). Beep the cyclic as necessary to maintain the 60 knots ground-speed. Once in a stable Doppler hover, consideration should be given to centering the cg to allow maximum ASE range of authority.

18.10.1.4 Alternate Approach

Note

Several trim adjustments may be required to compensate for the normal stick gradient. Collective to cyclic coupling is apparent at low speeds. If the nose of the helicopter is allowed to drop below 5 degrees nose-high attitude, the collective to cyclic coupling will tend to flatten the attitude, resulting in helicopter acceleration. This condition should be carefully observed during daylight conditions for familiarization before night flying.

If flown properly, the approach profile should be similar to an automatic approach. The exceptions are a high rate of descent (500 to 600 fpm) and the loss of about 70 feet of altitude during the first 10 seconds of the approach. Alternate approach procedures are necessary if the water surface is too smooth for reliable Doppler operation. Indications of insufficient Doppler signal return are the intermittent or sustained memory operation and unreasonable Doppler velocity indications.

It is recommended that pilots take advantage of VFR during poor Doppler conditions to practice alternate approaches. The procedures differ in that the pilot must manually control the attitude of the helicopter using beeper trim to achieve a hover. The automatic altitude and power control will be available. In order to preclude conflicting inputs, the CYC CPLR switch is left at OFF until such time as Doppler return may be obtained from the rotor downwash disturbance. During periods that alternate approach procedures will be required, normal airspeed indications will be approximate groundspeeds and must be used in lieu thereof.

The forward velocity (groundspeed) is controlled by pitch attitude. Upon initiation of the approach, power will be reduced automatically by the collective coupler. After the collective moves down, utilizing beeper trim, beep the nose back to approximately a 5 to 10 degree noseup attitude. The pilot will control the nose attitude by beeping in the required direction to maintain the desired attitude until a stable hover is achieved and CYC CPLR switch is placed to DOPP. It is difficult to establish an airspeed versus trim direction for maintaining the 5 degree noseup attitude. The pilot must simply beep in the required direction to maintain hover attitude until the CYC COUPLER switch is placed to DOPP. If the nose is allowed to drop below 5 degrees noseup at about 10 knots, the airspeed immediately increases and it becomes increasingly difficult to maintain the desired attitude. If the pilot and copilot airspeed indications differ, the helicopter may be drifting and the indicated forward speed on both indicators will be incorrect. During the approach, the copilot hover indicator is in the A mode to monitor ASE. If ASE saturates, the pilot should be prepared to abort. If the approach is aborted because of pitch channel saturation, return to 150 feet and 60 KIAS. Note the position of the pitch bar and adjust it (cyclic and CG TRIM) one additional division opposite to the direction of saturation.

The pilot’s D mode is the primary instrument for determining lateral drift during approach. In the event of an unreliable Doppler signal, the VGI (roll attitude with indices centered) and both airspeed indicators are used to determine lateral drift. If the helicopter is headed directly into the wind, the drift experienced during the approach will be slight. If the approach is started out of the wind, the pilot must beep laterally to eliminate drift. In either case, the pilot must beep the cyclic laterally to wings level and maintain this attitude until the Doppler operates reliably. As the helicopter continues to slow and power increases to hover torque, beep the cyclic to assume the hover attitude (approximately 2 to 3 degrees noseup, 3 degrees left wing low) and keep airspeed matched. If the pilot airspeed reads high (right drift), beep left. If the copilot airspeed reads high (left drift), beep right. At 10 knots indicated on D mode indicator, check Doppler to ensure out of memory and check the pilot hover indicator to ensure that the drift bar is not hardover, then place the CYC CPLR switch to DOPP. It is important to satisfy the conditions mentioned previously: pilot hover indicator (D mode) shows no off flag (out of memory) and hover indicator (D mode) indicates drift/groundspeed less than 10 knots. If these conditions are not met, uncomfortable attitude changes may occur when the cyclic coupler is engaged.

Altitude and power are controlled automatically by the coupler collective channel. In these helicopters, the Doppler vertical velocity is not used for the approach portion of the maneuver. A substitute vertical velocity signal is derived from the vertical accelerometer and is fed to the coupler collective channel. This is done by selecting VERT ACCEL on the ASE control panel. Since the accelerometer signal is not affected by smooth water, successful alternate approaches can be expected in these helicopters, regardless of how poor the Doppler return might be. Just before reaching hover, the Doppler velocities will become reliable and are then fed to the coupler cyclic channel by selecting DOPP with the CYC CPLR switch.

18.10.1.5 ALTERNATE APPROACH

1. The alternate approach is a maneuver that requires the pilot to manually position the cyclic to control drift and rate of deceleration throughout the approach to the hover. Altitude and power are controlled automatically by the coupler’s collective channel. This approach is normally used for all Night/IFR scenarios.

a. Complete the alternate approach checklist.

b. Establish the aircraft at the “gate” position (150 ft AGL, 40-80 kts ground speed, and D-mode vertical bar centered/150 ft AGL, 60 KIAS, and best estimate of windline).

c. When the helicopter is wings level and headed inbound to the survivor, the PNAC reports, "Standby for Coupler" engages coupler and reports "Coupler engaged". The PAC places feet on deck (clear of rudder pedal microswitches) and then beeps the cyclic to maintain approximately 10 degrees nose-up while maintaining wings level. As the nose comes up, the coupler cyclic channel will decrease power and the helicopter will commence to descend and decelerate. If the D-mode presentation is reliable, beep the cyclic to eliminate lateral drift (1-3 degrees wing-down should suffice). Beep the cyclic to maintain the nose attitude and wings level/vertical D-mode bar centered throughout the approach.

d. Use the airspeed presentation to approximate ground speed when the doppler presentation is unreliable.

e. At approximately 60 ft AGL, the collective coupler increases collective (power) to slow the rate of descent preparatory to obtaining a hover. As power increases, the nose must be beeped down to maintain a 5-8 degrees nose-up attitude.

f. Continue making cyclic adjustments until hover indicator D-mode indicates drift and ground speed less than 10 kts. Ensure:

(1) No off-flags in hover indicator D-mode.

(2) No ASE hardovers in hover indicator A-mode.

g. As these conditions are met, beep the nose and wings to the hover attitude (approximately 2-3 degrees nose-up and 3 degrees left wing down). When this attitude is set, call for the non-flying pilot to switch the cyclic coupler switch to doppler by commanding "On doppler."

h. Direct the non-flying pilot to adjust drift and speed pots as necessary to obtain a steady hover (no lateral or fore-and-aft drift).

i. The correct response for a subsequent alternate approach is, "Cyclic coupler – Off, on VA (or RAD/ALT), pots set, in SEA/LAND ALT".

j. If the alternate approach is conducted because of poor or unreliable doppler return, the doppler must be in the "LAND ALT" position as it will permit acquisition of the doppler signal created by rotor downwash as the aircraft approaches the hover. If the doppler is in the "SEA" position, it will not reacquire a signal if the aircraft's ground speed is below 35 kts.

k. When conducting an alternate approach with good doppler return, use groundspeed to establish gate airspeed. During the approach, beep cyclic to correct for drift indicated on the hover indicator in D-mode. If poor/unreliable doppler conditions exist, use indicated airspeed to establish gate and maintain wings level during the approach. Correct for drift after a reliable doppler signal is acquired.

l. In certain conditions of low winds, glassy sea state, or a poorly adjusted doppler, the doppler may go into sidelobe lock-on. While the doppler will appear to be functioning normally (no memory light, no off-flag on hover indicator), the D-mode bars may be centered (or pegged) when in reality the aircraft is still in forward flight. These indications may persist throughout the approach.

m. If a sidelobe lock-on is suspected, cycling the doppler selector to STANDBY, then back to LAND ALT may break the lock or at least provide definite indications of bad doppler return (memory light on and off-flag). Use other available cues (rotor downwash, drift, indicated airspeed) to determine doppler reliability during the approach.

18.10.1.6 Alternate Approach Checklist

1. Collective friction - FREE.

2. BAR ALT - ENGAGED.

3. Doppler selector knob - LAND ALT.

4. Cyclic coupler switch - OFF.

5. ALTITUDE coupler switch - RDR ALT/VA.

Note

RAD ALT mode should not be used unless a proper Doppler return is received.

6 SPEED and DRIFT knobs - SET.

7. Altitude knob - 40 FEET.

8. CG TRIM - SET (PITCH BAR CENTERED TO LOWER HALF OF CIRCLE).

9. Radar altimeter limit - 30 FEET.

10. VGIs - SET AND CROSSCHECKED.

11. Pilot hover indicator - D MODE.

12. Copilot hover indicator - A MODE.

13. Speed selectors - CHECKED.

14. Aft station report - RIGGED FOR RESCUE.

15. Establish condition - 150 FEET RADAR ALTITUDE, 40 to 80 KNOTS GROUNDSPEED.

16. Altimeters - MATCHED (READJUST CG WHEN INTO THE WIND IF NECESSARY).

18.10.1.7 MANUAL APPROACH TO A COUPLED HOVER (Day VFR)

1. The manual approach provides the fastest means of positioning the helicopter in a stable hover prior to coupler engagement. It is used for Day VFR rescue scenarios.

a. Complete alternate approach checklist.

b. Determine surface wind speed and direction.

c. Maneuver the helicopter to a point into the wind, 150 ft AGL, 65-70 KIAS, and 200-250 yards downwind of the intended hover position.

d. Decrease power by 25% torque while raising the nose to approximately 8-10 degrees nose-up attitude. Allow the ASE to hold heading.

e. Coordinate power so as to descend through 80 ft AGL at approximately 30 kts ground speed.

f. At 60-70 ft AGL, commence increasing power to slow the rate of descent. Use visual references and the D-mode presentation to determine drift correction and ground speed. Keep the nose at 8-10 degrees nose-up attitude.

g. On final, at 30 ft altitude, pilot commands, "Standby to deploy swimmer".

h. Approaching the smoke marker/survivor, pilot establishes a 10-ft/10 kts creep or a 15 ft hover and commands, "Jump, Jump, Jump".

i. Pilot shall maintain altitude until the crewman reports, "Swimmer away, clear to come up." After the rescue swimmer exits the helicopter and the crewman reports "Swimmer away, clear to come up", establish a 40 ft hover.

j. After crewman reports "swimmer OK", position the helicopter back and left under crewman's verbal direction. Engage coupler if desired, and pass verbal control to the crewman.

18.10.2 Erroneous Doppler Indicators.

This phenomena is best described as erroneous ground-speed and drift indications displayed on the D mode and GSDA. It may or may not be a result of "sidelobe lock-on" or just inadequate Doppler return, but does pose a problem that affects mission capabilities.

The problem usually occurs during weather conditions having a smooth sea state and little or no wind. Sometime during a coupled approach, the D mode and GSDA will prematurely indicate hover indications. The aircraft, however, will still be in an approach; noseup, minor drift, and descending. If night/IFR, the pilot will only have the VGIs, radar altimeters, and the airspeed indicators for approximate aircraft conditions. The approach may be continued and usually the Doppler will reacquire approaching a hover. The flood/hover lights or controllable spotlight may be used for visual reference to attain a hover attitude.

Note

If a memory light illuminates while the Doppler is in SEA mode, the copilot should switch to LAND/ALT mode since airspeed will probably be less than 35 knots.

18.10.3 Departure From a Coupled Hover. Upon release of the coupler, the pilot should monitor the collective stick to prevent overtorqueing until the original cruise altitude of 150 feet is attained. As the helicopter reaches 55 to 60 knots, the nose must be beeped back to the 60-knot attitude and the climb continued to 150 feet. The BAR ALT will maintain 150 feet during subsequent acceleration to cruise airspeed without the necessity to reset by use of the momentary BAR ALT release. Small errors in altitude may be eliminated by use of the momentary BAR ALT release during cruising flight.

Note

Should the barometric reference be lost, the pilot should be prepared to manually fly the helicopter to cruising altitude.

18.10.3.1 COUPLED HOVER DEPARTURE

1. This maneuver is used to transition from a coupled hover to 150 ft AGL and a minimum of 60 KIAS.

a. When ready to depart a coupled hover, report, "On D-mode, breaking hover".

b. Beep the nose down to the horizon allowing airspeed to build while the coupler is still engaged. As the aircraft reaches approximately 10 kts groundspeed (use D-mode for groundspeed indication), the PAC disengages the coupler and beeps the nose further down to 5-8 degrees below the hover attitude while monitoring the collective to prevent an overtorque condition.

c. Ensure three positive rates of climb (RAD ALT, BAR ALT, and VSI).

d. Allow the ASE to maintain heading throughout this maneuver.

e. Beep the cyclic to maintain wings level throughout the maneuver.

f. Climb out and accelerate to original cruise altitude. (150 ft and 60 KIAS).

g. Primary scan is the VGI while the RAD ALT and torque indicators are secondary. As the collective raises (power comes in), collective to cyclic coupling will lower the nose further.

h. The proper nose and wing attitude must be maintained throughout this maneuver.

i. When releasing the coupler, monitor the collective to ensure power increases until approaching 150 ft.

j. As the BAR ALT controller reduces collective to level off the aircraft at 150 ft AGL; the cyclic must be beeped forward to maintain airspeed.

k. Be aware that the only signal that is causing the helicopter to transition to 150 ft AGL is the BAR ALT signal, which was set prior to commencing either the automatic or alternate approach. If this signal is lost, there will be no "up" signal. Prepare to manually apply collective to reach 150 ft on climb-out.

18.10.4 SAR FREESTREAM RECOVERY

1. This maneuver is used to safely respond to situations where the helicopter must be flown out of a night/IFR coupled hover with a person on the rescue hoist.

a. Situations that require a freestream:

(1) Loss of RAD ALT.

(2) Loss of ASE.

(3) Disorientation/unstable hover.

b. Pilot at the controls announces, "Executing freestream recovery". Set and maintain hover attitude on the VGI. Scan D-mode to control drift. The AI is the primary scan instrument. The crewchief continues to raise the hoist.

c. For ASE on freestreams, the pilot at the controls disengages coupler, beeps cyclic to maintain hover attitude on the AI, and allows collective to raise, thereby increasing power 5% above hover power to initiate a vertical rate of climb not to exceed 500 fpm.

d. During the vertical climb, scan the VGI, RAD ALT, D-mode, BDHI, and torque indicators to maintain a constant heading vertical climb-out.

e. When the Aft Station reports, "Survivor/swimmer clear of water". maintain heading and adjust collective to continue climbing to an altitude of 100-150 ft AGL. If forward airspeed becomes necessary to maintain controlled flight, do not exceed 40 KIAS with a survivor/swimmer on the hoist in the trail position.

f. When the Aft Station reports, "Swimmer/survivor in the door". beep the nose 5 degrees below the hover attitude and transition to forward flight to attain 60 KIAS.

g. The freestream is complete when the hoist is stowed and the aircraft is at 60 KIAS and 100-150 ft AGL.

18.11 SAR LOST ICS PROCEDURES

Note

- Lost communication procedures require intense aircrew coordination. Procedures may be tailored by individual pilots and aircrew; however, strict adherence to briefed procedures is critical.
- The swimmer should not be jumped in a lost-ICS scenario. They should be deployed from a stable 40-foot hover down the rescue hoist.
- Wave-Off is always an option; however, consideration should be given to the phase of the approach in order to prevent the swimmer from being deployed from an unsafe altitude.
- During the SAR portion of the brief, lost comms should be discussed for the four different phases of flight to include Day (Before and After) and Night (Before and After) swimmer deployment.

Recommendations to aid in Lost Communication scenarios are:

1. Troubleshoot: Check switches, cords, ALT 1,2; UHF radio and ICS Emergency mode.

2. Continue the approach and establish a 40 foot coupled hover. Use either hand signals or hover trim to deploy the swimmer.

3. Wave-off and trouble shoot at altitude before making the decision to descend to a coupled hover lost comm. Conducting an aircrew coordination brief prior to swimmer deployment is critical for the safety of the swimmer.

4. If ICS is lost in the hover, or if hover was established after ICS failure at altitude; establish a stable coupled hover with cyclic coupler/ doppler engaged and proceed as follows:

a. PNAC engages hover trim and monitors SAR evolution. When swimmer/survivor are clear of water, PNAC disengages hover trim.

b. If hover trim does not engage, or if unreliable, directional signals from the crewman will be used to perform the rescue. Signals should be given inside the aircraft; the right seat pilot should take the controls. The left seat pilot will observe the hand signals of the crewman through the cabin and relay these signals to the right seat pilot by pushing/pulling the right seat pilot's shoulder. The push/pull will be in the direction the crewman wants the pilot to fly. No pressure means hold position (steady).

c. Do not depart a hover with lost communications until a crewman indicates that the Aft Station is ready for forward flight.

18.12 SEARCHES AND RESCUE

Note

- For SAR mission and equipment information, refer to NWP 3-50.1, Search and Rescue.
- Wet suit shall be worn by rescue air crewmen if water temperature is 60 ^{0}F or below and OAT is 32 ^{0}F (wind chill factor corrected) or below. Wet suit top shall be worn by rescue aircrewmen on all overwater rescues.
- Where SAR/plane guard is briefed as a primary mission or when it becomes primary mission, the rescue aircrewmen shall be prepared for immediate water entry.

When an emergency or emergencies occur, the lives and safety of personnel are often jeopardized unless immediate assistance is available. In the event the designated SAR helicopter is unavailable and/or additional assistance is required, a helicopter equipped with a rescue hoist or having the capability of emergency water landing may be directed to perform SAR duties.

18.12.1 Lookout Doctrine. Good lookout doctrine is mandatory for successful search and rescue operations. Because the pilots must involve themselves with the actual operation of the helicopter, especially at night when actual instrument flight is required, the efficiency of pilot lookout doctrine is degraded and the importance of the aircrewman as lookout becomes paramount. The crewmen should be assigned specific lookout stations, one at the aft station and the other at the personnel door or aft port window. Both crewmen shall use crewman safety belts because an inadvertent opening of the personnel door is an ever-present possibility. Crewmen must be specifically briefed as to the nature of the objects for which the search is being conducted.

18.12.2 Safety Precautions. Helicopters are susceptible to storing up static electricity. Therefore, it is of the utmost importance that before the pickup is commenced the crewman shall cause the rescue cable to contact the surface, thus discharging static electricity. It may be assumed that the surface in the immediate vicinity of the crash area shall be covered with aviation fuel. Therefore, caution must be taken to discharge static electricity in an area not contaminated with fuel/fumes. The pilot shall keep the crash scene on his right side to enable the crewman to use the hover-trim control capability.

WARNING

- Heavy-duty gloves shall be worn during all rescue hoist operations. Keeping the swimmer on the hoist cable during a SAR mission is extremely hazardous and is not recommended.
- Deploying the rescue swimmer among pieces of floating composite material wreckage may result in injury to the swimmer. Deploy the swimmer only as necessary to effect the rescue of personnel.

Note

Naval aircraft with composite components include the AV-8B, F/A-18, A-6, H-53, H-60, F-14, S-3, H-46, and V-22.

18.12.3 Procedures. When ordered to "rig for rescue", report, "Unstrapping to rig for rescue". Before opening the cargo door, plug into the hoist station ICS and put on the crewman safety belt and heavy-duty glove.

1. Open cabin door; maintaining physical control of the hoist hook, lower the hoist hook into the helicopter and affix the rescue sling to the hook. When ready, report to the pilot, "After station rigged for rescue".

CAUTION

Opening of the sliding cabin door in excess of 90 knots may result in loss of the escape window. Once the door is open, observe normal airspeed limitations.

Note

Rescue hook may be lowered from the stowed position with the helicopter traveling in excess of 60 knots as long as physical control is maintained with the hoist hook.

2. When the survivor/signaling device is in sight, report to the pilot, "I have the man/signaling device in sight".

3. Make manual or hover trim approach.

4. When the survivor is clear of the water, report, "Survivor is clear, pilot you have Control".

18.12.4 Assisting Survivor. Conditions at the scene of the rescue (i.e., water temperature, sea state, condition of the survivor, proximity of other units, etc.) will dictate procedures to be followed and the final decision shall rest with the pilot in command.

Where immediate assistance must be provided to the survivor, the most expeditious procedure may require a water landing. If the decision is made to have the crewman jump into the water, the following procedures should be used.

WARNING

The effects of hydrostatic squeeze (pressure exerted on the body when submerged in water) allows blood to pool in the lower extremities intensifying the effects of shock and possibly resulting in death when vertical hoisting (D-ring, rescue strop) is used. The effects and potential for death are increased in hypothermic survivors. Every effort should be made to recover the hypothermic survivor in a horizontal position via the rescue litter.

18.12.5 Manual Approach Procedures. When the survivor/spot is in sight, report to the pilot, "I have the survivor/spot in sight." The pilot may continue his approach without assistance from the crewman until he loses sight of the survivor/spot, at which time pilot will give crewman verbal control to direct helicopter over survivor by use of the standard terms listed in paragraph 18.12.7. These directions must be given in a calm, clear voice, keeping the pilot informed of the situation at all times. Combinations of terms may be used when making diagonal approaches, (i.e., forward and right).

WARNING

Practice live hoisting shall be done over the water or at no more than 10 feet above a hard surface, unless safety belay line procedures listed in NWP 3-50.1 are utilized. Practice live hoists shall not be done using rescue hoist manual override valve.

Note

Rescue swimmer may enter the water during daylight/VFR simulated rescue operations at sea with a secondary rescue vehicle specifically assigned to the area of operations. Consideration must be given to sea state, water/air temperature, predatory marine life, and other environmental factors.

If the decision is made to perform a water landing, consideration should be given to having the crewman in the personnel door utilizing a crewman safety belt. The crewman opens the personnel door and utilizes it as a support for recovering the survivor. The crewman will need the use of the ICS and/or hand signals to effect a rescue from the personnel door safely. The left seat pilot should have the controls so that the right pilot can relay hand signals as needed.

18.12.6 Day VFR

1. Pilot in command commands, "Rig for rescue".

2. Copilot completes alternate approach checklist and pilot begins approach into windline to survivor.

3. Rescue swimmer sits in cargo door, crewman safety harness on, while first crewman grasps back of swimmer harness.

4. Crewman reports, "After station rigged for rescue".

5. When established on final approach course to the survivor at 30 feet, pilot commands, "Stand by to deploy swimmer".

WARNING

The crewman shall maintain a hold on the rescue swimmer harness with one hand as the other hand is used to tap on the swimmer's chest. This is to avoid inadvertent rescue swimmer deployment.

6. Crewman taps the rescue swimmer on the chest to signal swimmer that the crewman safety harness will be removed. Swimmer removes the crewman safety harness.

7. Crewman reports, "Swimmer ready”.

8. Pilot establishes a l0-foot/l0-knot creep or a 15-foot hover and commands, "Jump, jump, jump".

WARNING

- It is extremely difficult to accurately judge height above the water; the crewman therefore shall not give the signal to the swimmer to jump into the water until the pilot commands, "Jump, jump, jump" over the ICS. Pilot shall maintain altitude until the crewman reports, "Swimmer away, Clear to come up”!
- A weak or fatigued survivor or survivor without flotation gear may have difficulty breathing or remaining afloat in rotor wash.
- When a parachute is in the rescue area, it shall be approached to keep the parachute outside the rotor wash area. Inflating the parachute can cause damage to or loss of aircraft should it blow into the rotor system. Sinking the parachute could result in the entangled survivor being towed under.

9. On the third jump, crewman simultaneously checks area clear of debris; taps the rescue swimmer three times on the shoulder, releases handhold on rescue harness, and the rescue swimmer jumps.

10. Pilot shall maintain altitude until the crewman reports, “Swimmer away, clear to come up”. After the rescue swimmer exits the helicopter and the crewman reports “Swimmer away, clear to come up”. establish a 40 ft hover.

11. After water entry swimmer signals, "I am all right".

12. Crewman observes "I am all right" signal from the rescue swimmer and reports, "Swimmer O.K." The crewman then directs left and back until rotor wash does not interfere with the swimmer and survivor.

Note

Do not lose sight of swimmer and survivor.

13. Attach the desired rescue device to double rescue hook and lower rescue hoist down (discharge static electricity).

14. "Stop left, stop back, steady”.

Note

Keep pilot informed of swimmer progress, cable position, debris, etc.

15. When pilot or hoist operator observes ready for pickup, he reports, "I have a pickup signal".

16. Hoist operator directs aircraft, "Forward and right".

17. "Stop forward, stop right, steady".

18. "Swimmer approaching rescue hook".

19. "Survivor hooked up/swimmer hooked up".

Note

If second survivor is not in the immediate vicinity, hoist swimmer and fly or air taxi to the next pickup point. Swimmer will be hoisted with last survivor in case of multiple rescue situations.

20. "Clear of water".

21. "Survivor and swimmer halfway up”.

22. "Approaching aircraft".

23. "Survivor and swimmer aboard".

24. "After station secured, ready for forward flight".

25. Report survivor injuries to pilot and treat for shock, bleeding, etc.

18.12.7 Standard Terms. The following is a list of standard terms and their meanings. Terms are in relation to the helicopter axis.

1. Forward	Direction of movement -Straight ahead.
2. Back	Direction of movement -Straight back.

3. Right	Direction of movement -Slip to the right, maintain present heading.
4.Left	Direction of movement - Slip to the left, maintain present heading.
5.Up	Direction of movement - Gain altitude, maintain relative position.
6. Down	Direction of movement Lose altitude, maintain relative position.
7. Steady	Hold present position.
8. Easy	An indication of rate of movement - Precedes the basic command.
9. Stop	Self-explanatory -precedes direction of movement.

Note

The following terms are used during confined area, slope, and unprepared terrain landings

10. Main and tail, clear right:	Rotary wing and rudder tip paths and A/C, clear on the right side from the 12- to 6-o'clock position of all terrain/obstacles.
11. Main and tail, clear left:	Rotary wing and rudder tip paths and A/C. Clear on the left side from the 12- to 6-o'clock position of all terrain/obstacles.
12. Clear to land :	Area below the A/C, rotary wing, and rudder tip paths are clear of all terrain/obstacles.

18.12.8 Swimmer Rescue Hand Signals

18.12.8.1 Rescue Crewman Hand Signals

18.12.8.1.1 Day

Signal	Meaning
1. Raised arm.	I am all right.
2. Raised arm, thumb up.	Move in for pickup.
3. Vigorous waving of one arm.	In trouble, need assistance.
4. Clenched fists, arms crossed overhead.	Deploy raft.
5. Hand held to ear.	Deploy radio.
6. Clenched fist, arm pumping motion.	Deploy pneumatic webbing cutter.
7. One arm raised with open palm, fingers extended other arm raised over swimmer's head and touching first arm at elbow.	Deploy rescue litter.
8. Both arms raised, palms open, fingers extended extended at a 45° angle to side of swimmer's head.	Deploy rescue net.

AFTER SWIMMER AND SURVIVOR ATTACHED TO HOIST

Signal	Meaning
9. Arm raised, thumb up.	Ready to be hoisted.
10. Arm raised, clenched fist.	Stop hoisting.
11. Arm raised, thumb down.	Lower cable.
12. Clenched fist over clenched fist, thumbs down.	Failed hoist.

18.12.8.1.2 Night/Low Visibility

SIGNAL	MEANING
1. Swimmer's lighting device on, arm raised	I am all right.
2. Wave signal device.	Ready for pickup.
3. Blue strobe on .	In trouble, need assistance.

4. Normal day hand signals are utilized after the swimmer and survivor are attached to the hoist.

18.12.8.1.3 Loss of ICS

Note

Recommended hand signals are used for relaying interior or exterior signals. The right arm is used for exterior signals, left arm for interior. A chemlight is used at night. The HAC shall brief which hand signals are to be used based on the model aircraft and/or personal preference.

SIGNAL	MEANING
1. Arm extended, bent upward 90 degrees at elbow, palm forward, fingers extended, held steady	Forward
2. Arm extended, bent downward 90 degrees at elbow, palm backward, fingers extended, held steady	Back
3. Exterior - Right arm extended straight out, palm forward, fingers extended, held steady Interior - Left arm extended bent upward 90 degrees at elbow, palm forward, fingers extended, waving from side to side	Right
4. Exterior - Right arm extended, bent upward 90 degrees at elbow, palm forward, fingers extended, waving from side to side Interior – Left arm extended straight out, palm forward, fingers extended, held steady	Left
5. Arm extended, bent upward 90 degrees at elbow, clenched fist	Steady

WARNING

Do not ignite flare if fuel is present.

18.12.9 Inform Pilot. Always try to keep the pilot informed of the pickup position and of any possible danger to the helicopter, using the above terminology and any other words that are concise and clearly understandable.

WARNING

All occupants of the aft station shall be strapped in a troop seat unless assigned duties that require freedom of movement. When not strapped in a troop seat, the crewman shall utilize the crewman safety belt. The crewman safety belt must be thoroughly checked for security of attachment to the airframe.

18.12.10 Use of Hot Mike. If hot mike is used, be sure to turn the hot mike switch off after the pickup is aboard.

18.12.11 Jammed Rescue Hoist. For emergency procedures, refer to RESCUE HOIST MALFUNCTION, paragraph 12.27.

18.12.12 Guillotine. The rescue hoist is equipped with a cartridge-actuated guillotine for emergency use. Cartridge information and safety procedures are prescribed in NAVAIR OP-2606, the governing directive for such devices.

18.12.13 Rescue Situation. The following is a rescue situation with the reports and action required to make the pickup, with or without the use of the hover trim control.

THE SITUATION	THE REPORT
Shift Control	“Roger I have control”.
Helicopter is to the left and aft of the pickup	“Easy…Forward”.
Hoist is halfway down	“Hoist is halfway down”.
Hoist is on deck	“Hoist is on deck”.

Hoist is even but to the left of the pickup	"Easy…Right". "Stop…Right". "Steady".
Hoist is in a good position	"Steady..Steady. Steady".
Survivor is in the sling	"Survivor is in the hoist".
Plane is ahead of the pickup	"Easy back…Stop back, Steady".
Hoist is coming up	"Hoist is coming up".
Swimmer/survivor is clear	"Swimmer/survivor is clear".
Shift control	"Pilot you have control".
Swimmer/survivor is halfway up	"Swimmer/survivor is halfway up".
Swimmer/survivor is safely aboard	"Swimmer/survivor is safely aboard".
After station secured	"Ready for forward flight".

18.12.14 Night/IFR Search and Rescue Procedures. The night/IFR rescue pattern described below permits the helicopter crew to effect a rescue in minimal time and, in addition, provides proper margins for flight safety. So as not to preclude sound judgment on the part of the pilot in command and to compensate for varying degrees of adverse weather, the altitude and airspeed shown for the search phase, as well as entry into the rescue pattern (150 feet, 60 knots), should be considered a recommended optimum, rather than mandatory.

Note

One hundred and fifty feet provides a safe altitude from which objects on the surface of the sea can still be seen using helicopter flood/hover lights. Sixty knots indicated airspeed is within the single-engine capability of this helicopter yet slow enough to permit an efficient search.

Upon notification that a night/IFR search and rescue mission must be performed, the following will be accomplished.

18.12.14.1 Night/IFR Search Procedure

Pilot: Assume control of helicopter and report on instruments.

Copilot: Complete alternate approach checklist.

Pilot:

1. Descend to no lower than 150 feet on the RADALT. Search patterns should be flown at 60 knots groundspeed and desired ground tracks. Depending on the search pattern, the first leg should be oriented into the wind. Timing must be adjusted on downwind legs to ensure that aircraft does not drop below 60 KIAS. Altitude may be modified as ceiling and visibility dictate.

2. Commands, "Rig for rescue".

Crewmen:

1. Comply with briefed lookout doctrine.

2. Crewmen at cargo door – Rig after station for rescue and standby with smoke marker(s) or matrix light(s) to mark survivor immediately upon sighting. Crew report, "After station rigged for rescue".

3. Flood, hover, and controllable spotlights, as desired.

Note

Maximum time for hover/floodlights is 15 minutes. Allow 10 minutes cooling cycle after 15 minutes use.

Commence search in accordance with available reports on location, number, and condition of survivors. It is recommended that the orientation of the search pattern to the windline be carefully considered before beginning the search phase. This will reduce the possibility of irregularities in the pattern caused by drift encountered in strong winds. It should be noted, however, that pattern entry and in relation to the wind in the windline rescue procedure is not critical.

18.12.14.2 Night/IFR Rescue Procedure. Upon positive sighting and passing over the survivor (on-top position), the following procedures should be followed.

Note

Marking the survivor position in the water quickly and accurately is an extremely critical phase in this or any rescue pattern conducted under night IFR conditions, and crew coordination is of paramount importance. Since the use of this particular procedure will be performed under conditions of limited visibility, it is likely that the helicopter will be very close, if not directly over the survivor when he is sighted. The first person to see the survivor, either pilots or crewmen, should immediately call, "On top, smokes away".

1. Crewman at cargo door releases smoke marker(s) or matrix light(s) to mark the survivor's position in the water.

WARNING

- Anytime there is a chance of igniting aviation fuel that may be in the immediate area, smoke markers shall not be used to mark survivor position.
- Rescue swimmers shall not enter the water during night/lFR simulated rescue operations in an open ocean environment.

2. Pilot simultaneously turns downwind in the direction requiring the least amount of turn to enter the windline rescue procedure pattern. See example diagrams. At the same time, in the on-top position, the copilot marks position on the TACNAV (if navigator equipped, turn to RUN position). The elapsed time clock is actuated either when the helicopter is established 45º to the downwind line or abeam the survivor heading downwind, depending on the entry angle.

Note

A combination of wind velocity and time downwind totaling 25 usually suffices (i.e., wind velocity 10 knots, time downwind 15 seconds, and wind velocity 25 knots or greater, maintain a standard rate turn until headed into the wind).

Rescue swimmer with a crewmember safety belt on puts on the rescue strop, attaches it to the hoist hook, and assumes a sitting position in the doorway.

Note

The rescue swimmer and the rescue hook both shall be illuminated by a chemical light before lowering.

Crewman reports, "Swimmer ready."

3. After the proper time has elapsed, the pilot commences a turn inbound to the survivor. Depending on the direction of turn, the copilot or crewman keeps sight of the lights marking the survivor, establishes orientation of the survivor to the lights, informs the pilot as to whether more or less turn is required, and indicates the survivor to marker orientation. The warning command "Stand by to roll out" shall be given by the copilot before intercepting the windline. When orientation and lineup are achieved, the copilot calls to the pilot, "Roll out".

4. When the helicopter is wings level and headed inbound to the survivor, the copilot reports, "Stand by for coupler," engages coupler, and simultaneously reports, "Coupler engaged." The pilot flies an alternate approach following the copilot directions. Crewman reports, "Survivor in sight," and keeps survivor in sight awaiting hover trim engagement. Hover altitude should be attained at a point no less than 100 yards downwind of the survivor to preclude the possibility of overshooting (Figure 18-4). Pilot establishes a creep (approximately 10 knots groundspeed) following copilot directions until copilot commands, "Establish steady hover." This point is approximately 50 yards downwind of the survivor. Pilot establishes a steady hover and commands, "On Doppler," the pilot ensures that a steady hover is being maintained and adjusts pilot pots to ensure the same. The pilot then commands "Engage hover trim" and the first crewman responds "I have a light". Pilot passes control to the first crewman by stating "You have control". The first crewman responds, "I have control," then adjusts their BIAS control knobs as required and flies the helicopter to a position over the survivor using standard recovery phraseology and procedures.

5. Hoist operator positions helicopter over survivor and reports, "Permission to lower swimmer".

6. Pilot establishes desired altitude and commands, "Lower swimmer".

7. Hoist operator taps the rescue swimmer on the chest to signal to the swimmer that the safety belt should be removed. Rescue swimmer removes the safety belt. The hoist operator then takes slack out of the cable and performs final checks of the swimmer equipment and lights.

8. Hoist operator lowers swimmer and reports, "Swimmer on the way down".

9. Hoist operator observes swimmer clear of rescue sling and swimmer lighting device "On," and reports, "Swimmer OK".

10. Hoist operator, using hover trim, positions the helicopter so the rotor wash does not interfere with swimmer and survivor.

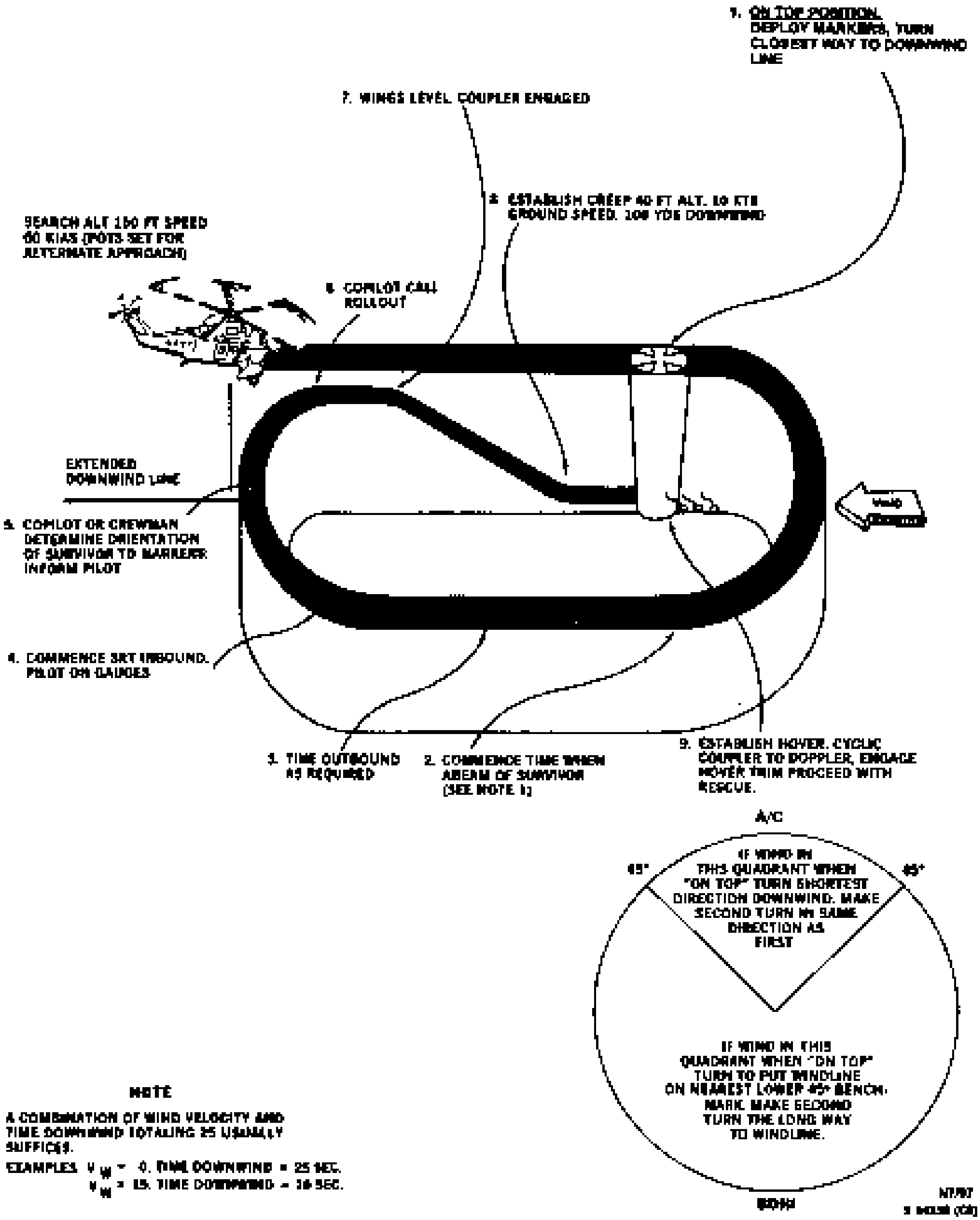


Figure18-2. Windline Rescue Procedure Pattern (Typical) (sheet 1 of 2)

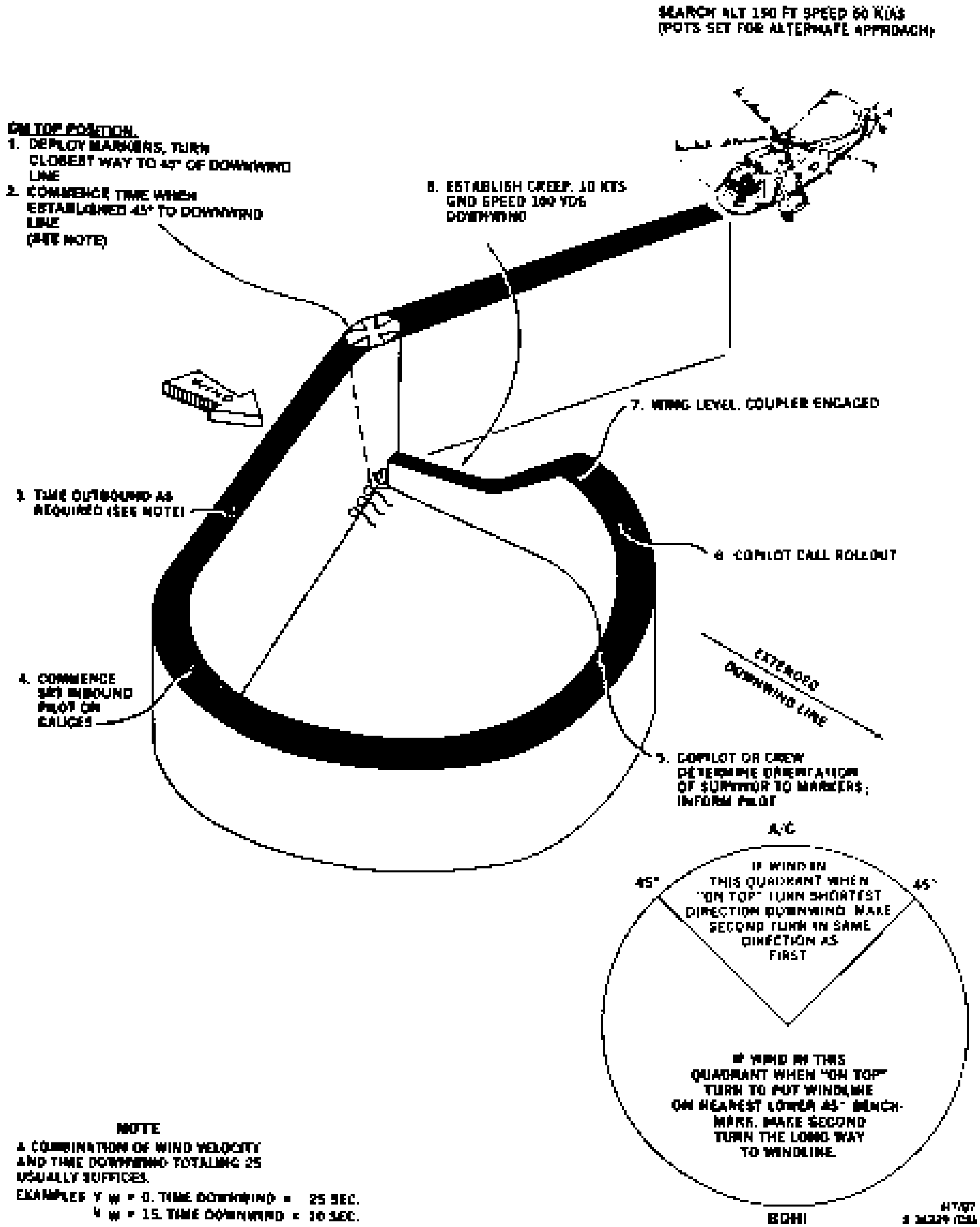


Figure18-2. Windline Rescue Procedure Pattern (Typical) (sheet 2 of 2)

WARNING

In the event of loss of visual contact with swimmer and/or survivor, the helicopter aircraft commander shall cycle the flood/hover lights. The swimmer and/or survivor shall illuminate the strobe light or ignite the Mk 13/Mk 124 Mode 0 flare to aid in reestablishing visual contact.

Note

- Keep pilot informed of swimmer progress, cable position, debris, etc.

- Rescue swimmer shall not enter the water during night/IFR simulated rescue operations in an open ocean environment.

11. Swimmer raises one arm overhead when ready for pickup for day and waves signal device at night.

WARNING

Do not ignite Mk 13 flare when fuel is present in the water; use chemlight.

12. Crewman operates hover trim forward and right.

13. "Stop forward, stop right. Steady".

14. Swimmer approaching hoist.

15. Swimmer attaches survivor by D-ring or places survivor in rescue device.

Note

If second rescue is not in the immediate vicinity, hoist swimmer and fly or air taxi to the next pickup point. Swimmer will be hoisted with the last rescue in case of multiple rescue situations.

16. Survivor hooked up/swimmer hooked up.

17. "Clear of the water".

18. "Pilot, you have control" - "Roger, I have control". Copilot cycles cyclic coupler switch off, then back to Doppler.

19. "Man halfway up".

20. "Approaching aircraft".

21. "Survivor and swimmer aboard".

22. "Afterstation secure. Ready for forward flight".

23. Report survivor injuries to pilot and treat for shock/bleeding, etc.

WARNING

The rescue hoist shall not be operated with the Chicago grip installed.

18.13 CARGO SLING OPERATIONS

External load operations require either a crewman aboard, and in verbal control of the aircraft, or a plane director on the deck to direct the helicopter over the load. The crewman/plane director shall be in a position to maintain a clear view of the load and operating zone during the entire pick up/drop off evolution. Figure 18-5 shows a recommended position for the plane director on deck. Forward flight will be conducted at an airspeed commensurate with the aerodynamic stability of the load and effort on flight characteristics. Flying over personnel, buildings, or equipment will be avoided when practical. Lighting for night cargo operations is shown in Figure 18-6.

CAUTION

Particular care must be taken during cargo pickup because of the increased rotor downwash and its effect on loose equipment and debris near the helicopter. It is recommended that ground personnel wear approved-typed goggles to protect the eyes and ear protective devices.

18.13.1 Cargo Pickup. Check windline, aircraft weight, and power required curves. If necessary, a decrease in load or aircraft weight may be required for safe takeoff because of power requirements. Approaches should be made to arrive in an air taxi condition short of the pickup point and into the windline. The heights and movement to the pickup point will be accomplished by visual reference to the load and plane director. On entering the windline, the feet may be held lightly on the rotary rudder pedals when ASE is engaged. The pilot can best control the approach until the pickup point can no longer be observed. When the pickup can no longer be observed, the plane director will use proper hand signals to relay the helicopter position, relative to the pickup point, and direct the pilot to a position to accomplish the hookup. 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 and the director will notify the pilot that the load is ready to lift. Lift the aircraft vertically until the weight of the load is felt, then lift the load vertically until the cargo is clear of the deck and the aircraft is in a stable hover. Check engine (N_G) percentage, T_5, torque, and rotor (Nr) rpm. If N_F/N_R are drooping, do not attempt forward flight. Hover altitude should be approximately 20 to 40 feet depending on load size and shape.

The director will then give the takeoff signal to indicate to the pilot that the load is clear of the deck and properly suspended. To transition from a hover to forward flight, smoothly apply forward cyclic and up collective and allow the aircraft to fly out of the hover. Do not use excessive nosedown attitude because of cargo suspension beneath the helicopter.

18.13.2 Cargo Delivery. The approach to the drop point should be slightly high to prevent dragging the load on the ground. The helicopter is hovered when the cargo is approximately 6 to 8 feet above the ground. A vertical descent is then made until the load is resting on the surface; at which time, it is released electrically, automatically, or in case of emergency, by use of the mechanical release.

18.13.3 Pilot Procedure for External Cargo Sling Operation. The following pilot procedures are for flights involving cargo lifts.

18.13.3.1 Attaching Cargo

1. Release cargo hook from stowed position.

2. CARGO SLING MASTER switch - SLING.

3. Groundcrew attach load to hook or fly hook through ring attached to load.

4. Fly the mission with the cargo sling master switch in the SAFE or SLING position until approaching intended release point.

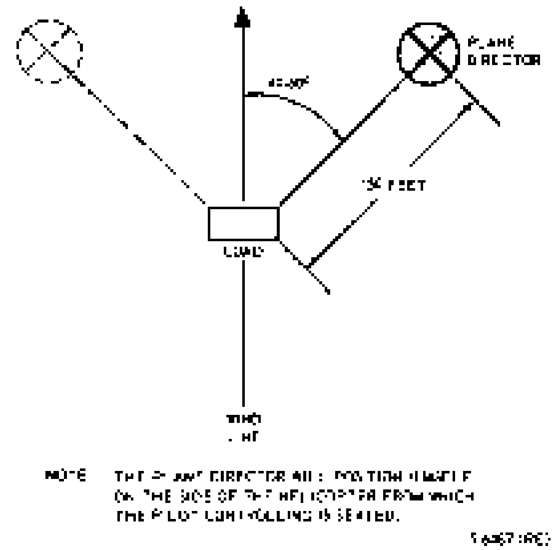


Figure 18-5. Cargo Sling Pickup Procedure

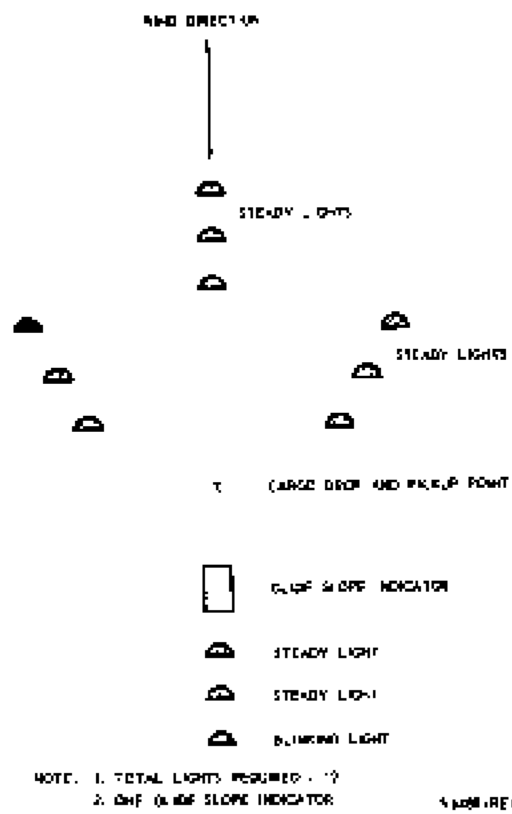


Figure 18-6. Cargo Sling Lighting Pattern

WARNING

- External loads may have aerodynamic characteristics that cause oscillations to the extent that the load may oscillate into rotor blades and/or fuselage.

- Should excessive load oscillations develop, an immediate reduction in airspeed is mandatory to prevent loss of control or imposing excessive loading of the helicopter. ASE is capable of damping most oscillations. Applying excessive manual control inputs when attempting to stabilize oscillations may increase their severity.

18.13.3.2 Automatic Release of Load

1. CARGO SLING MASTER switch – AUTO (prior to touchdown).

2. Descend slowly with no forward speed or drift. Cargo will release upon ground contact.

CAUTION

When carrying loads of less than 200 pounds, the CARGO SLING MASTER switch should never be in AUTO position. The cargo sling hook would open immediately if a gust of air momentarily lightens the load.

18.13.3.3 Normal Release of Load

1. CARGO SLING MASTER switch - SLING.

2. CARGO hook release button – Depress (to release load).

18.13.3.4 Mechanical Release of Load

1. Cargo release foot pedal - DEPRESS.

If pilot releases load or if load is to be released by ground personnel, open hook with release arm on hook.

18.13.3.5 ICS Voice Signals

TERM	MEANING
1. External cargo operations	
a. Right, left, forward, back	Move helicopter in this direction.
b. Easy down	Cargo hook too high for hookup crew.
c. Hooked up	Sling pendant attached.
d. Easy up	Long pendant, keep coming up.
e. Weight coming on	Tension coming on aircraft.
f. Load clear	Cargo clear of the deck and obstructions.
g. Down, down, down	Descend quickly (for target/weapon recovery).
h. Cleared for forward flight	Self -explanatory.
2. At delivery point	
a. Spot in sight	Delivery visualized.
b. Right, left, forward, back	Near delivery point, move easy in this direction.
c. Easy down	Self-explanatory.
d. Load on deck	Cargo on deck.
e. Release hook	Release pendant.
f. No release, hold	Cargo not released, try manual release.
g. Net fouled	Net is hung up on counter-weights, etc.
h. Hook clear	Sling pendant and cargo clear of hook, clear to depart.
i. Hook stowed	Self-explanatory.

j. Cleared for forward flight	Self-explanatory.
j. Pickle, pickle, pickle	Immediate emergency jettison.

18.14 BAMBI BUCKET OPERATIONS

The Bambi Bucket used to fight fires is a 324 gallon, 2820 LB heli-borne bucket, when full. It is attached to the helicopter via the cargo hook utilizing a standard shackle attached to the bucket dump valve control head. Braided steel cables are attached to the control head, which lead down to the bucket. The bucket hangs thirty feet below the helicopter. The dump valve is actuated by a solenoid in the control head and dump valve support line. Power is provided for the solenoid via the aircraft DC electrical system and is actuated with a pickle switch by the aircrewman. The dump valve opens downward producing a concentrated column of water. The bucket empties in 3 seconds when fully loaded. Once the water has passed through the dump valve, the valve automatically closes.

18.14.1 ATTACHING BUCKET

1. Release cargo hook from stowed position.

2. CARGO SLING MASTER switch – SLING.

3. Bucket is attached to the cargo hook prior to take off and extended to the right side of the aircraft.

18.14.2 APPROACH

When performing approach over the ocean, little consideration need be given to approach and departure obstacles as the pilot has great flexibility in selecting his route. Pick-ups from a confined water source require greater consideration and should be performed to ensure that sufficient amount of space is left for the departure. Due consideration should be given to the possibility of vortex ring state, settling with power, and aircraft malfunctions. Additionally, wave-off capabilities and obstacles must be taken into account just as if a confined area landing were being performed. The approach should be performed into the wind and over the lowest obstacles with consideration being given to the size and shape of the lake for the best total combination of all factors.

18.14.3 PICKUP

18.14.3.1 CREEPING PICKUP

The approach should terminate with the Bambi Bucket touching the water with slight forward drift. As the bucket touches the water, continue to lower the bucket into the water by descending and at the same time starting a slow creep forward. This will tip the bucket forward allowing the water to fill the bucket and will expedite the process. This also reduces the twisting effect of the bucket. Continue the slow creep forward until the bucket is full. At that point, begin a very slow climb until the bucket breaks away from the water. If this is the initial pickup, you should perform an operational check of the bucket.

Note

Ensure that adequate power is available when lifting the bucket out of the water. If required, the bucket may be partially filled to reduce weight.

CAUTION

Continued use of the release switch (machine gunning) can cause the solenoid to burn out and malfunction.

18.14.3.2 ZERO AIRSPEED TECHNIQUE

Perform an approach to a hover over the water source. Lower the collective until the bucket sinks and fills. Once it is full, lift the bucket out of the water and depart.

Note

In some instances the spring reel that rewinds the trip line is not strong enough to reseat the valve after a drop. Therefore, if the bucket is not filling on the pickup, the crewman should push the release button one time as the bucket is sinking into the water. The water rushing into the bucket through the valve will allow the trip line to retract fully into the control head and reset.

18.14.4 WATER DROPS

Fighting fires with the Bambi Bucket requires good technique and control to be most effective and remain safe. Three criteria dictate the method of water drop: type of substance burning, amount of heat generated, and size of the burning area.

Consideration of the effects of rotor wash should be taken into account when planning drop speeds and altitudes. In some cases, a low speed drop will actually spread the fire as the rotor wash scatters the embers and redirects flames over a wide area. The addition of fresh air only aggravates the fire. A low altitude drop may have the same result with the additional effect of causing a "black out" situation as ash is blown up by the rotors.

Faster drop speeds will cause a narrow, long drop pattern with high water dispersion and small droplets. This is an effective technique for light fuels such as a grass fire. However, higher altitudes will magnify this effect and may actually make the drop worthless. Additionally, wind effects on the water will distort the pattern due to the decreased density.

The following procedures are recommended:

1. Long and Narrow Flame Front: Low Level, High Speed: 60-70 ft AGL, 60-70 KIAS.

WARNING

Given the minimum safe ground clearance, it is incumbent on the aircraft commander to determine the best altitude. Recommend no lower than 30 feet AGL (bucket height). (This is about 60-70 feet AGL for the helo).

2. Long and Wide Flame Front: Normal Level, Normal to High Speed: 100-130 ft AGL, 50-70 KIAS.

Note

The increase in altitude will create a wider lateral spread of the water to compensate for the increased width of the fire line.

The speed, intensity, and fuel of the fire, in addition to crew experience, will more specifically dictate the best combination of altitude and airspeed. Evaluate the effectiveness of each drop and adapt accordingly. In all cases, the drop will decrease the load on the helicopter and subsequently cause an increase in altitude as the water drops. Maintain altitude by reducing collective in order to ensure the most effective drop.

This Page Left Blank Intentionally

PART X

NATOPS Evaluation

This Page Left Blank Intentionally

CHAPTER 19

NATOPS Evaluation

19.1 GENERAL

The standard operating procedures prescribed in this manual represent the optimum method of operating the helicopter. The NATOPS evaluation is intended to evaluate compliance with NATOPS procedures by observing and grading individuals and units. This evaluation is tailored for compatibility with various operational commitments and missions of both Navy and Marine Corps units. The prime objective of the NATOPS evaluation program is to assist the unit commanding officer in improving unit readiness and safety through constructive comment. Maximum benefit from the NATOPS program is achieved only through the active vigorous support of all pilots and flight crewmembers.

19.1.1 Implementation. The NATOPS evaluation program shall be carried out in every unit operating naval helicopters. The various categories of flight crewmembers desiring to attain/retain qualification in the helicopter shall be evaluated in accordance with OPNAVINST 3710.7. FRSs shall ensure that pilots and naval aircrewmen have successfully completed a NATOPS evaluation prior to their completion of the course of instruction. All pilots and naval aircrewmen must hold a current evaluation in the model aircraft. Renewal evaluations may be accomplished within 60 days preceding expiration of a current evaluation and are valid for 12 months from the last day of the month in which the current evaluation expires. Otherwise, NATOPS qualifications shall be valid for 12 months from the last day of the mo nth of the evaluation. Unit NATOPS evaluations will be conducted periodically; however, instructions in and observation of adherence to NATOPS procedures must be on a daily basis within each unit to obtain maximum benefits from the program. The NATOPS coordinators, evaluators, and instructors shall administer the program as outlined in OPNAVINST 3710.7 series.

19.1.2 Definitions. The following terms, used throughout this section, are defined as to their specific meaning within the NATOPS program.

1. NATOPS evaluation - A periodic evaluation of individual flight crewmember standardization consisting of an open-book examination, a closed-book examination, an oral examination, and a flight evaluation. A maximum of 60 days may elapse between the date the initial ground evaluation was commenced and the date the flight evaluation is satisfactorily completed.

2. NATOPS reevaluation - A partial NATOPS evaluation administered to a flight crew member who has been placed in an unqualified status by receiving an Unqualified grade for any of his ground examinations or the flight evaluation. Only those areas in which an unsatisfactory level was noted need be observed during a reevaluation.

3. Qualified – That degree of standardization demonstrated by a very reliable flight crewmember who has good knowledge of standard operating procedures and a through understanding of helicopter capabilities and limitations.

4. Conditionally Qualified – That degree of standardization demonstrated by a flight crewmember who meets the minimum acceptable standards. He is considered safe enough to fly as a pilot in command or to perform normal duties without supervision but more practice is needed to become qualified.

5. Unqualified – That degree of standardization demonstrated by a flight crewmember who fails to meet minimum acceptable criteria. He should receive supervised instruction until he achieves a grade of Qualified or Conditionally Qualified. Flight crewmembers who receive a grade of Unqualified on a ground or flight evaluation shall be allowed 30 days in which to complete a reevaluation.

6. Area – A routine of ground operations, normal flight operations, emergency operations, coupler operations, and SAR operations.

7. Subarea - A performance subdivision within an area that is observed and evaluated during an evaluation flight.

8. Critical area/subarea - Any area or subarea that covers items of significant importance to the overall mission requirements, the marginal performance of which would jeopardize safe conduct of the flight.

9. Emergency - A helicopter component, system failure, or condition that requires instantaneous recognition, analysis, and proper action.

10. Malfunction - A helicopter component or system failure or condition that requires recognition and analysis, but that permits more deliberate action than that required for an emergency.

19.2 GROUND EVALUATION

The purpose of the ground evaluation is to measure the pilot/crewmember knowledge of appropriate publications and the helicopter. Before beginning the flight evaluation, an evaluee must achieve a minimum grade of qualified on the open-book and closed-book examinations. The oral examination is also part of the ground evaluation but may be conducted as part of the flight evaluation.

19.2.1 Open-Book Examination. The open-book examination shall contain 40 questions.

19.2.2 Closed-Book Examination. The closed-book examination shall consist of 80 questions.

19.2.3 Oral Examination. The questions may be taken from this manual and drawn from the experience of the instructor/evaluator. Such questions should be direct and positive and should in no way be opinionated.

19.2.4 Operational Flight Trainer/Weapon Systems Trainer Procedures Evaluation (If Applicable). An OFT may be used to assist in measuring crewmember performance in the execution of prescribed operating procedures and his reaction to emergencies and malfunctions. In areas not served by these facilities, this may be done by placing the crewmember in a helicopter and administering appropriate questions.

19.2.5 Grading Instructions. Examination grades shall be computed on a 4.0 scale and converted to an adjective grade of Qualified or Unqualified.

19.2.5.1 Open-Book Examination. To obtain a grade of qualified, an evaluee must obtain a minimum score of 3.5.

19.2.5.2 Closed-Book Examination. To obtain a grade of qualified, an evaluee must obtain a minimum score of 3.3.

19.2.5.3 Oral Examination and OFT Procedure Check, If Conducted. A grade of Qualified, Conditionally Qualified, or Unqualified shall be assigned by the instructor/evaluator.

19.3 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 flight. Not more than one pilot or aircrewman shall be scheduled on the same event for a NATOPS flight evaluation. However, combining a pilot and an aircrewman evaluation on the same event is encouraged. The flight 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 may be outlined here with the critical areas/subareas marked by an asterisk).

Note

> The NATOPS instructor/evaluator on flights in which unusual attitudes or simulated emergencies are being conducted should be considered the pilot in command (HAC) and sign for acceptance of the aircraft at the discretion of the commanding officer.

19.3.1 Flight Evaluation Grading Criteria. Only those subareas provided or required will be graded. The grades assigned for a subarea shall be determined by comparing the degree of adherence to standard operating procedures with adjectival ratings listed below. Momentary deviations from standard operating procedures should not be considered as unqualifying provided such deviations do not jeopardize flight safety and the evaluee applies prompt corrective action. An individual shall be considered "qualified" in areas I through V if standard NATOPS procedures were executed in accordance with the provisions of this manual. A grade of Conditionally Qualified or Unqualified shall be assigned utilizing the guidelines provided for each area.

19.3.2 Pilot Evaluation

19.3.2.1 Area I - Ground Operations.

Conditionally Qualified - Did not fully instruct or debrief the crew. Flight equipment improperly worn or in marginal condition. Did not fully examine flight records. Minor omissions or errors on preflight or postflight. Improper or incomplete use of checklists. Nonstandard procedures. Inattention or misinterpretation of visual signal. Rough or erratic start, engagement, disengagement, or shutdown.

Unqualified - Did not conduct brief or debrief. Flight equipment missing, not worn, or in an unsafe condition. Failed to sign for aircraft or accepted aircraft with grounding discrepancy. Failed to note or record downing discrepancy after flight. Any omission or error on preflight or postflight that would affect safety of flight. Exceeded published limitations during start, engagement, disengagement, or shutdown. Did not utilize checklist or perform required systems checks. Marginal control of helicopter while taxiing. Ignored visual signal. Did not use pretakeoff checklist.

19.3.2.2 Area II - Normal Flight Operations.

Conditionally Qualified - Incomplete use of takeoff; post takeoff; or landing checklists. Application of power erratic but did not exceed limitations. Unable to maintain altitude within ±50 feet of assigned altitude. Maintained airspeed within ±10 knots. Heading control varied ±5° between final approach and landing. Hover altitude 15 ±5 feet. Unable to fully explain aircraft systems or limitations.

Unqualified - Did not use checklist. Did not check instruments prior to leaving hover. Failed to use sufficient power or exceeded aircraft or engine limitations. Safety precautions not observed. Leveled off in excess of 50 feet from assigned altitude. Airspeed tolerance ±10 knots exceeded. Hover in excess of 15 ±5 feet, excessive nose attitude or lateral drift on touchdown. Running landings/takeoffs in excess of 40 knots, yaw in excess of 10° or lateral drift on touchdown/takeoff. Unsatisfactory knowledge of aircraft systems or limitations.

19.3.2.3 Area III - Emergency Operations.

Conditionally Qualified - Did not prebrief copilot on autorotations. Airspeed, N_r, and heading control erratic. Groundspeed exceeded 15 knots or slight drift at recovery. Did not establish and maintain minimum safe single-engine speed on landings or wave offs. Minor difficulty in controlling N_r during single engine. Power, heading, and altitude control erratic during AUX or ASE off flight. Did not fully comply with emergency procedures but did not jeopardize aircraft or crew.

Unqualified - During autorotation did not call for full power. Airspeed, N_r, and heading control beyond safe limits. Implemented techniques that would have jeopardized the successful completion and recovery of the autorotation. Failed to call for full power during single engine. Failed to note or correct low/unsafe N_r conditions during single engine. Exceeded rate-of-descent limits during single-engine approach or engine limits. ASE off and AUX off flight unsafe or excessive lateral drift/rate of descent on touchdown. Failed to comply with established emergency procedures that resulted in jeopardizing aircraft/crew or exceeded engine/airframe limitations.

19.3.2.4 Area IV – Coupler Operations (Hooded).

Conditionally Qualified - Minor deviations from established checklist and voice procedures. Erratic control of aircraft during automatic, alternate approach, and climb out. Erratic altitude control at 150 ±20 feet. Reacted slowly to emergencies. Unable to fully explain systems or limitations.

Unqualified - Checklist not used or unsafe/improper procedures utilized. Allowed aircraft to descend through 30 feet in hover without attempting to correct. Made omissions or errors in emergency procedures that could jeopardize aircraft or crew. Attempted to hover downwind without correcting. Unsatisfactory knowledge of systems or procedures. Unable to consistently maintain 150 ±30 feet while hooded.

19.3.2.5 Area V - Search And Rescue Operations (Hooded).

Conditionally Qualified - No coordination of visual lookout doctrine. Used nonstandard voice, approach, pattern, or hoist procedures but none that would seriously affect the mission. Did not fully or properly utilize copilot/crew and systems in accomplishing rescue.

Unqualified – Could not follow windline rescue pattern. Hovered downwind without correcting. Unable to consistently maintain prebriefed altitude ±30 feet. Allowed aircraft to descend below 30 feet during approach/hover without correcting. Exceeded aircraft limitations or procedures that would have jeopardized aircraft or crew.

19.3.3 Pilot Oral Emergency Worksheet.

Note

*Asterisk indicates critical areas.

GRADE

1. Fires ____
   a. Engine fire * ____
   b. Fuselage/heater fires ____
   c. Electrical fires ____
   d. Post shutdown engine fire ____
2. Fuel systems malfunctions ____
   a. Fuel boost pumps ____
   b. Fuel filter bypass ____
   c. Fuel dump ____

3. Engine malfunctions ____
   a. Engine failure * ____
   b. Engine shutdown in flight ____
   c. Engine restart in flight ____
   d. Compressor stall ____
   e. Loss of N_g signal ____
   f. Loss of P3 signal ____
   g. Lube pump shaft failure ____
   h. High speed shaft failure ____
   i. Flexible drive shaft failure ____
   j. Fuel control contamination ____
   k. Single instrument indications ____
4. Main gearbox system malfunctions ____
   a. Chip light ____
   b. Pressure loss * ____
   c. Emergency lubrication system ____
   d. Overheat ____
   e. Tail takeoff ____
   f. Torque system ____
5. Rotary rudder malfunctions ____
   a. Tail rotor control loss * ____
   b. Tail rotor drive loss * ____
   c. IGB/TGB chip light * ____
6. Electrical malfunctions ____
   a. Generator failure ____
   b. Transformer/rectifier failure ____
   c. Battery overheat ____
7. Hydraulic malfunctions ____
   a. Auxiliary/primary pressure loss ____
   b. Utility pressure loss ____
   c. Caution light ____
8. Flight control malfunctions ____
   a. Servo hardover * ____
   b. ASE malfunctions ____
9. Rotor brake malfunctions ____
   a. Caution light ____
   b. Manual rotor brake failure ____
10. Water operations ____
    a. Ditching * ____
    b. Fuel dumping ____
    c. Takeoff ____
    d. Shutdown/abandon ____
11. Discussion items ____
    a. Settling with power * ____
    b. Vortex ring state * ____
    c. Blade stall * ____
    d. Dynamic tip over * ____
    e. Vibrations ____
    f. Rescue hoist malfunctions ____
    g. Limitations ____
    h. Systems knowledge ____
    i. Other items ____
    j. Cargo sling (as appropriate) ____

19.3.4 Pilot Evaluation Worksheet

AREA 1: GROUND OPERATIONS ____

1. Brief/debrief/flight gear ____
2. Records check * ____
3. Preflight/postflight * ____

4. Checklist procedures/systems check ____
5. Start/engagement ____
6. Taxi/lookout * ____
7. Disengagement/shutdown ____
8. General ____

AREA 2: NORMAL FLIGHT OPERATIONS * ____

1. Checklist procedures * ____
2. Transition/climb ____
3. Cruise flight * ____
4. Systems knowledge/usage ____
5. Normal landings/takeoffs * ____
6. Hover/low work ____
7. Shipboard operations (when embarked) ____
8. General ____

AREA 3: EMERGENCY OPERATIONS * ____

1. Autorotations * ____
2. Single-engine landings/waveoff * ____
3. Auxiliary off landings ____
4. ASE off landings/takeoffs ____
5. Emergency procedures * ____
6. General ____

AREA 4: COUPLER OPERATIONS (HOODED) * ____

1. Checklist/voice procedures ____
2. Automatic approach * ____
3. Alternate approach * ____
4. Climb out ____
5. Coupler emergencies * ____
6. Systems knowledge/usage ____
7. General ____

AREA 5: SEARCH AND RESCUE OPERATIONS * ____

1. Navigation ____
2. IFR procedures (hooded) * ____
3. VFR procedures * ____
4. Crew/cockpit coordination ____
5. General ____

19.3.5 Crewman Evaluation

19.3.5.1 Area 1 – Briefing.

Qualified – Arrived at scheduled time for mission planning and briefing. Obtained all information pertinent to the successful completion of the mission.

Conditionally Qualified – Met the criteria for qualified except for minor omissions not affecting successful completion of the mission.

Unqualified – Present, but offered little assistance in planning. Major omissions that could affect the successful completion of the assigned mission. Failed to attend.

19.3.5.2 Area 2 - Personal Flight Equipment.

Qualified - Crewmember equipped with flight equipment as set forth in OPNAVINST 3710.7. The equipment is in proper condition and is worn as prescribed.

Conditionally Qualified - All required equipment is worn or carried but the manner of wearing it is in error or the condition of equipment is marginal.

Unqualified - Crewmember not fully equipped or equipment is in an unsafe condition.

19.3.5.3 Area 3 - Flight Line Procedures.

Qualified - Examined and completed NAVFLIRS. Examined daily preflight inspection sheets. Briefed utility crewman. Observed flight line safety.

Conditionally Qualified - Did not fully examine all forms.

Unqualified - Failed to complete Discrepancy portion of Aircraft Discrepancy Book. Failed to notice grounding discrepancy. Complete lack of concern for line safety.

19.3.5.4 Area 4 – Preflight.

Qualified – The required inspections accomplished in the proper sequence as outlined in the NATOPS manual and pocket checklist without omissions or deviations (exterior and interior).

Conditionally Qualified - The required inspections accomplished with no more than three minor omissions or deviations. A minor omission is one that will not tend to jeopardize mission success or safety of flight even if undiscovered by a later check.

Unqualified - The omission of any item or check that will jeopardize the mission success by increasing the possibility of an abort or affecting safety of flight. More than three minor omissions.

19.3.5.5 Area 5 – Rescue Hoist/HEELS Check.

Qualified – The required inspections accomplished in the proper sequence as outlined in the NATOPS manual and pocket checklist without omissions or deviations (exterior and interior.)

Conditionally Qualified - The required inspections accomplished with no more than three minor omissions or deviations. A minor omission is one that will not tend to jeopardize mission success or safety of flight even if undiscovered by a later check.

Unqualified - The omission of any item or check that will jeopardize the mission success by increasing the possibility of an abort or affecting safety of flight. More than three minor omissions.

19.3.5.6 Area 6 – Post takeoff Security Check.

Qualified – Performance checks and inspections as outlined in the NATOPS manual. Made proper reports.

Unqualified – Failure to do inspections. Failed to report.

19.3.5.7 Area 7 - Rescue Operations.

Qualified - Used accepted techniques and procedures outlined in the NATOPS manual and pertinent survival instructions.

Conditionally Qualified - Completed rescue mission but deviated from NATOPS procedures. Excessive delay. Failed to use the hover trim controls/verbal directions effectively.

Unqualified - Failed to complete rescue mission. Deviated from standard procedures to the point that safety of the helicopter or personnel was endangered.

19.3.5.8 Area 8 - Prelanding Check.

Qualified - Secured equipment, and locked shoulder harness, all before reporting.

Conditionally Qualified - Made minor omissions or slow in completing.

Unqualified - Made major omissions or failed to complete.

19.3.5.9 Area 9 – Postflight.

Qualified - The required inspections were accomplished in the proper manner as outlined in the NATOPS manual. Made necessary reports.

Conditionally Qualified - Made required inspections with minor errors and/or failed to report discrepancies.

Unqualified - Failed to inspect equipment. Failed to report major discrepancy.

19.3.5.10 Area 10 – Safety.

Qualified - Paid strict adherence to all prescribed safety procedures during both ground and flight evolutions.

Unqualified - Safety not observed in any one subarea.

19.3.5.11 Area 11 – Debrief.

Qualified - Attended the debrief at scheduled time and offered material and data pertinent to the mission.

Conditionally Qualified - Attended the debrief but failed to divulge information or material pertinent to the execution of the mission.

Unqualified - Failed to attend debrief.

19.3.6 Crewman Oral Examination

Note

Asterisk (*) indicates critical areas.

1. General aircraft knowledge ____
2. Aircraft limitations ____
3. Lookout procedures ____
4. Passenger/cargo transfers ____

5. Shipboard operations ____

6. Fueling/HIFR procedures ____

7. Fuel dumping responsibilities ____

8. Rotor brake caution light * ____

9. Functional checkflight/equipment/procedures ____

10. Fires ____

  a. Engine fire ____

  b. Fuselage/heater fires * ____

  c. Electrical fires * ____

  d. Smoke/fumes/noxious gasses elimination ____

11. Ditching/egress/survival techniques ____

12. Rescue equipment ____

13. Smokes/ordnance ____

14. Communication ____

15. Rescue hoist malfunctions ____

REMARKS:

19.3.7 Crewman Evaluation Worksheet

Note

Asterisk (*) indicates critical areas.

INSTRUCTION: A complete description of all performance during the mission is required. All in-flight notes to be used for critique and grading will be recorded on worksheets. The remarks space provided is not to be regarded as a limit to necessary comments, notes, or remarks. Discrepancies will be noted as they occur. Use this worksheet both in flight and at debrief as a critique outline.

Only one aircrewman shall be evaluated per flight. The NATOPS evaluation flight is intended to measure performance with regard to knowledge of and adherence to prescribed procedures. Any tendency to extend the evaluation into areas of aircrew proficiency, weapons readiness, or technique must be avoided. Crew Chief or Utility aircrewman designation flights shall not be confused with nor combined with annual NATOPS evaluation flights.

AREA 1: BRIEFING

1. Attended ____

2. On time ____

3. Nearest land ____

4. Weather/sea state ____

5. Units in exercise ____

6. Water conditions ____

7. Layer depth ____

8. Predicted ranges ____

REMARKS:

AREA 2: PERSONAL FLIGHT EQUIPMENT

1. Helmet ____

2. Flight suit ____

3. Flight gloves ____

4. Flight boots ____

5. Exposure suit (as required) ____

6. Flotation equipment/HEEDS bottle ____

7. Identification tags ____

8. Survival vest (fully equipped) ____

9. Flashlight ____

10. Pocket checklist ____

11. Pistol (when required) ____

REMARKS:

AREA 3: FLIGHT LINE PROCEDURES

1. Records check (NAVFLIRS) ____

2. Daily preflight (conducted) ____

3. Brief (crewman to crewman) ____

REMARKS:

AREA 4: HELICOPTER PREFLIGHT

1. Wheel chocks, tiedowns, and landing gear lockpins ____

2. Nose section ____

3. Right front of fuselage ____

4. Right engine ____

5. Right transmission, rotor wing head ____

6. Right bottom hull ____

7. Right rear of fuselage ____

8. Right side of tail cone and pylon ____

9. Left side of tail cone and pylon ____

10. Left rear of fuselage ____

11. Left bottom hull ____

12. Right engine ____

13. Right transmission, rotary wing head ____

14. Left front of fuselage ____

15. Cockpit area ____

16. Cargo area ____

17. SAR checklist ____

18. Tail pylon, rotary rudder cables ____

19. Used checklist ____

REMARKS:

AREA 5: RESCUE HOIST/HEELS CHECK

1. Operation ____

2. Condition ____

3. Used heavy duty glove * ____

4. Reported completion ____

REMARKS:

AREA 6: SECURITY CHECK

1. Request permission to make check ____

2. Security of equipment ____

3. Abnormal vibrations ____

4. Doors closed and latched ____

5. Hydraulic/oil leaks ____

6. Reported condition ____

REMARKS:

AREA 7: RESCUE OPERATIONS

1. Demonstrated knowledge and use of rescue equipment ____

2. Utilized prescribed ICS terminology ____

3. Demonstrated accepted techniques for verbal approach ____

4. Demonstrated accepted techniques for swimmer (day VFR) deployment ____

5. Demonstrated accepted techniques for hover trim approach ____

6. Demonstrated accepted techniques for swimmer (night/IFR) deployment ____

7. Demonstrated control of situation with speed and accuracy ____

8. Observed safety rules * ____

9. Completed mission ____

10. Hoist emergencies * ____

REMARKS:

AREA 8: PRELANDING CHECK

1. Checked prescribed items on checklist

   (a) Harness/lap belts (crewman and passengers) * ____
   (b) Landing gear rechecked * ____

(c) Reported completion to pilot ____

REMARKS:

AREA 9: POSTFLIGHT

1. Equipment security ____
2. Equipment condition ____
3. Report of discrepancies found during entire flight evolution ____

REMARKS:

AREA 10: SAFETY

1. Observed flight line safety precautions ____
2. Observed safety precautions in aircraft ____
3. Observed personal safety procedures ____

REMARKS:

AREA 11: Debrief

1. Attended ____
2. On time ____
3. Information for NAVFLIRS ____
4. Completed VIDS/MAFS ____

REMARKS:

19.3.8 Flight Evaluation Grade Determination. The following procedure shall be used in determining the flight evaluation grade. A grade of Unqualified in any 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. Only the numerals 0, 2, or 4 will be assigned in subareas. No interpolation is allowed.

Unqualified - 0.0

Conditionally qualified - 2.0

Qualified - 4.0

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.

0.0 to 2.19 - Unqualified

2.2 to 2.99 - Conditionally qualified

3.0 to 4.0 - Qualified

Example: (Add subarea numerical equivalents)

$$\frac{4+2+4+2+4}{5} = \frac{16}{5} = 3.20 \text{ Qualified}$$

Note

> In areas where numerous checklist items are involved, the deviation from or omission of three minor checklist items will constitute a conditionally qualified for that area item.

19.4 FINAL GRADE DETERMINATION

The final NATOPS evaluation grade shall be the same as the adjective grade assigned to the flight evaluation. An evaluee who receives an Unqualified on any ground examination or the flight evaluation shall be placed in an unqualified status until he achieves a grade of Conditionally Qualified or Qualified on a reevaluation.

19.5 RECORDS AND REPORTS

A NATOPS evaluation report, OPNAV Form 3710/7 (Figure 19-1), shall be completed for each evaluation and forwarded to the evaluee's commanding officer.

This report shall be filed in the individual flight training record and retained therein in accordance with OPNAVINST 3710.7. In addition, an entry shall be made in the pilot/NFO flight log book under Qualifications and Achievements as shown in Figure 19-2.

19.5.1 Forms and Records

19.5.1.1 Worksheets. A worksheet will be used by NATOPS instructors and evaluators to record results of observed procedures and techniques. Significant discrepancies will be recorded on NATOPS evaluation report form, OPNAV Form 3710/7. Worksheets may then be discarded upon completion of routing of evaluation report form.

NATOPS EVALUATION REPORT

OPNAV 3710/7 (4-90) S/N 0107-LF-009-8000 REPORT SYMBOL OPNAV 3710-2

NAME (Last, first, initial)		GRADE	SERVICE NUMBER
SQUADRON/UNIT	AIRCRAFT MODEL		CREW POSITION
TOTAL PILOT/FLIGHT HOURS	TOTAL HOURS IN MODEL		DATE OF LAST EVALUATION

NATOPS EVALUATION

REQUIREMENT	DATE COMPLETED	GRADE		
		Q	CQ	U
OPEN BOOK EXAMINATION				
CLOSED BOOK EXAMINATION				
ORAL EXAMINATION				
*EVALUATION FLIGHT				

FLIGHT DURATION	AIRCRAFT BUNO	OVERALL FINAL GRADE

REMARKS OF EVALUATOR/INSTRUCTOR

☐ CHECK IF CONTINUED ON REVERSE SI

GRADE, NAME OF EVALUATOR/INSTRUCTOR	SIGNATURE	DATE
GRADE, NAME OF EVALUEE	SIGNATURE	DATE

REMARKS OF UNIT COMMANDER

RANK, NAME OF UNIT COMMANDER	SIGNATURE	DATE

*WST, OFT, COT, or cockpit check in accordance with OPNAVINST 3710.7 (effective edition)

Figure 19-1. NATOPS Evaluation Report

PART XI

Performance Data

This Page Left Blank Intentionally

CHAPTER 20

Standard Data

20.1 INTRODUCTION

The performance section is arranged by type of chart with each type of chart comprising a separate part of the section. Each part and the charts contained within each part are arranged in the order that reflects the sequence of operational use. Each part is preceded by a page containing explanatory text that describes for each chart the functions indicated, conditions assumed in chart preparation, and guidelines to permit adjustments of the solution attained. The sample problem, typical of the normal mission of the helicopter, includes the sample problem data shown on each chart contained within the part. Each chart, except those in Emergency Operations, contains a part title located under the section designation that identifies the chart with a particular section. The charts under Emergency Operation contain a designation, in lieu of the part title, that identifies the appropriate phase of flight applicable to the chart. Each chart under Emergency Operations is further identified by a broken black border. If conditions are less than the lowest value shown on the chart, use the lowest value shown. Limitations that should not be exceeded are identified on appropriate charts. Part XI is divided into seven chapters: Chapter 20 contains information that is needed to enter charts found in subsequent parts; Chapter 21 provides the necessary information concerning takeoff performance; Chapter 22 provides the necessary climb performance; Chapter 23 presents range data; Chapter 24 presents endurance data; Chapter 25 provides performance data associated with emergency or nonstandard conditions; and Chapter 26 in not applicable.

20.1.1 Sample Problem. A sample problem typical of normal mission is included with each type chart in applicable chapters of Part XI. For consistency and continuity, the chart values shown on the charts are actual chart values that are used in the sample problem explanatory text. The explanatory text for each type chart used in computing the sample problem contains a graphic illustration that explains how that chart is used.

The following factors were used for sample problem computations:

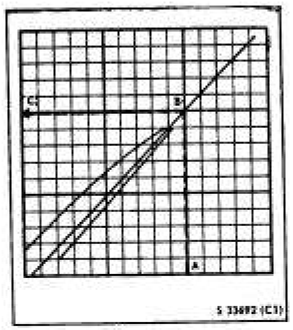
TAKEOFF CONDITIONS:	
Operating weight	16, 475 pounds
Fuel	2,525 pounds
Cargo	
Gross weight	19,000 pounds
Pressure altitude	Sea level
OAT	28 °C
Headwind	10 knots
EN ROUTE CONDITIONS:	
Pressure altitude (cruise)	4,000 feet
OAT	20 °C
LANDING CONDTIONS:	
Pressure altitude	Sea level
OAT	28 °C
Headwind	10 knots

20.1.2 Ice Shield Installation. Performance charts show available power with AFC 321 ice shield installed. With AFC 247 ice shield installed and based on rated power, reduce torque values by 2-percent indicated torque.

20.2 AIRSPEED CALIBRATION CHART

The airspeed calibration chart (Figure 20-1) provides KCAS when the KIAS is applied to a level flight, climb, or a descent parameter.

20.2.1 Sample Problem for Use of Airspeed Calibration Chart (Figure 20-1).

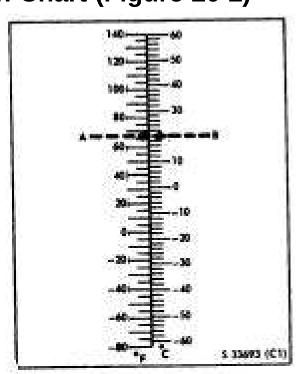


1. Enter bottom of chart at 109 KCAS (point A), trace up to level flight time (point B), then trace left to the indicated airspeed scale (point C) and read 107 KIAS.

20.3 TEMPERATURE CONVERSION CHART

The temperature conversion chart (Figure 20-2) provides a conversion of temperature scales that will permit conversion between Fahrenheit and Celsius temperatures.

20.3.1 Sample Problem for Use of Temperature Conversion Chart (Figure 20-2)

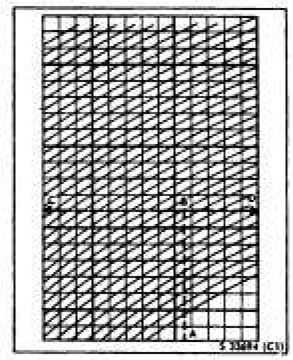


1. Enter left side of chart at 68 °F (point A), then trace right to the Celsius scale (point B) and read 20 °C.

20.4 DENSITY ALTITUDE CHART

The density altitude chart (Figure 20-3) provides a density altitude when ambient temperature is applied to pressure altitude. The chart also contains an airspeed conversion factor that, when used to multiply a calibrated airspeed, provides a true airspeed.

20.4.1 Sample Problem for Use of Density Altitude Chart (Figure 20-3).



1. Enter bottom of chart at 20 °C (point A) and trace up to 4,000-foot pressure altitude line (point B).

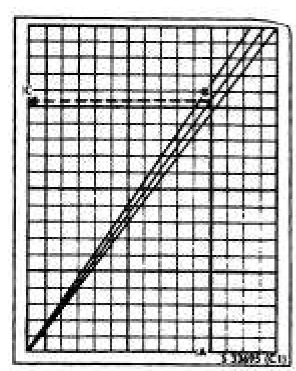
2. From point B, trace left to the density altitude scale (point C) and read 5,800 feet density altitude.

3. From point B, trace right to the airspeed conversion scale and read 1.085.

20.5 TORQUE VERSUS ENGINE HORSEPOWER CHART

The torque versus shaft horsepower chart (Figure 20-4) provides conversion of indicated torque and shaft horsepower at 100-percent N_r.

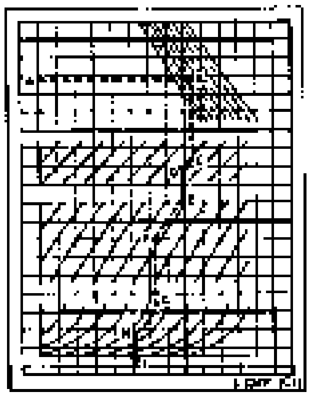
20.5.1 Sample Problem for Use of Torque Versus Engine Horsepower Chart (Figure 20-4).



1. Enter bottom of chart at 97-percent torque (point A), trace up to 100-percent N_r line (point B), then trace left to the shaft horsepower scale and read 1,180 shp.

20.6 BLADE STALL CHART

The blade stall chart (Figure 20-5) represents speeds of about 15 knots above blade tip stall. At these speeds, reasonable maneuvers or mild turbulence can be tolerated. Sever turbulence or abrupt control maneuvers at this point will increase the severity of the stall and the helicopter will become more difficult to control. If blade stall is allowed to fully develop (about 40 knots beyond blade tip stall), a complete loss of control will be experienced and the helicopter will pitch up and to the left. The use of forward cyclic to correct this pitch up may aggravate the stall as it increases the angle of attack of the retreating blade.



20.6.1 Sample Problem for Use of Blade Stall Chart.

Given:

Gross weight 18,000 pounds

Angle of bank 30°

Pressure altitude 4,000 feet

OAT 20 °C

Rotor speed 97 percent

Determine: Maximum recommended indicated airspeed.

Solution:

1. Enter chart at 4,000 feet pressure altitude (point A).

2. From point A, move horizontally to 20 °C OAT (point B).

3. From point B, move downward to datum line, 100-percent N_r (point C).

4. From point C, move parallel to the rotor speed influence lines to 97-percent N_r (point D).

5. From point D, proceed downward to point E on the gross weight influence graph.

6. From point E, move parallel to the gross weight influence lines to 18,000 pounds (point F).

7. From point F, proceed downward to 0° angle of bank (point G).

8. From point G, move parallel to the angle of bank influence curves to a 30° angle of bank, (point H).

9. From point H, move downward through calibrated airspeed scale to indicated airspeed scale (point I).

10. The indicated airspeed for the above conditions would be 86 knots.

20.7 MINIMUM ACCEPTABLE INDICATED TORQUE AND ENGINE PERFORMANCE CHARTS

The minimum acceptable indicated torque and the engine performance charts (Figure 20-6 and 20-7) provide a torque at specified T_5 temperatures when ambient temperature is applied to pressure altitude. Engine limitations that should not be exceeded are appropriately identified on the charts.

20.7.1 Engine Performance – 727 °C T_5 Chart.

See Figure 20-6.

20.7.2 Engine Performance – 691 °C T_5 Chart.

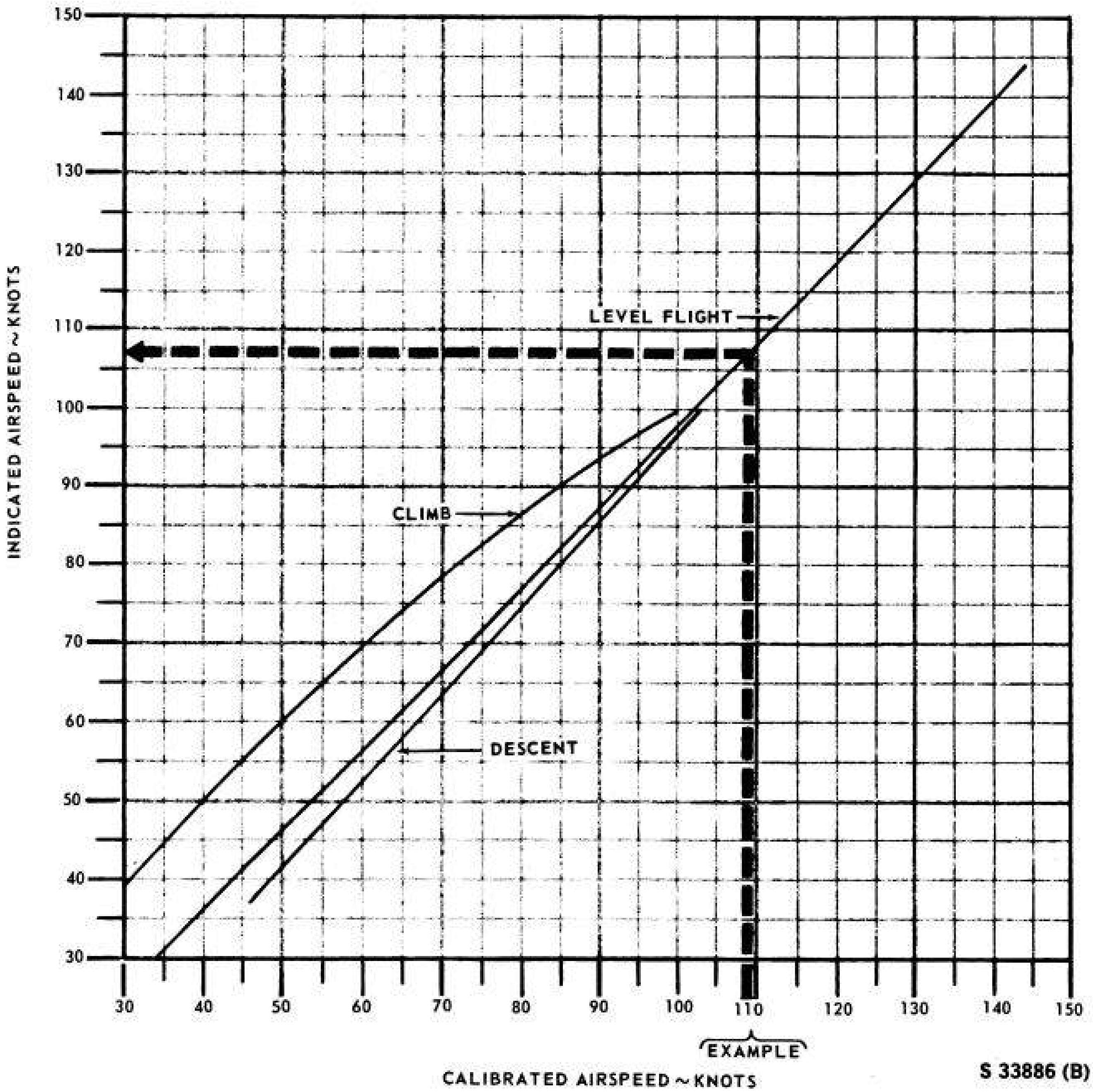
See Figure 20-7.

PORT AND STARBOARD PROBE
AIRSPEED SYSTEM

LEVEL FLIGHT

MODEL: SH-3H
DATA AS OF: 22 JUNE 1973
DATA BASIS: FLIGHT TEST

ENGINES: (2) T58-GE-10
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL



S 33886 (B)

Figure 20-1. Airspeed Calibration

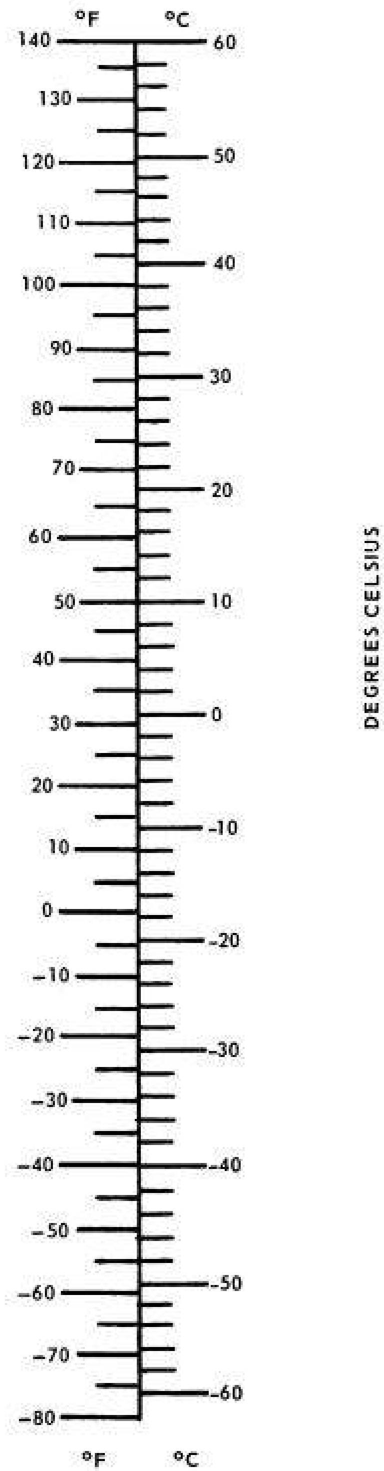


Figure 20-2. Temperature Conversion

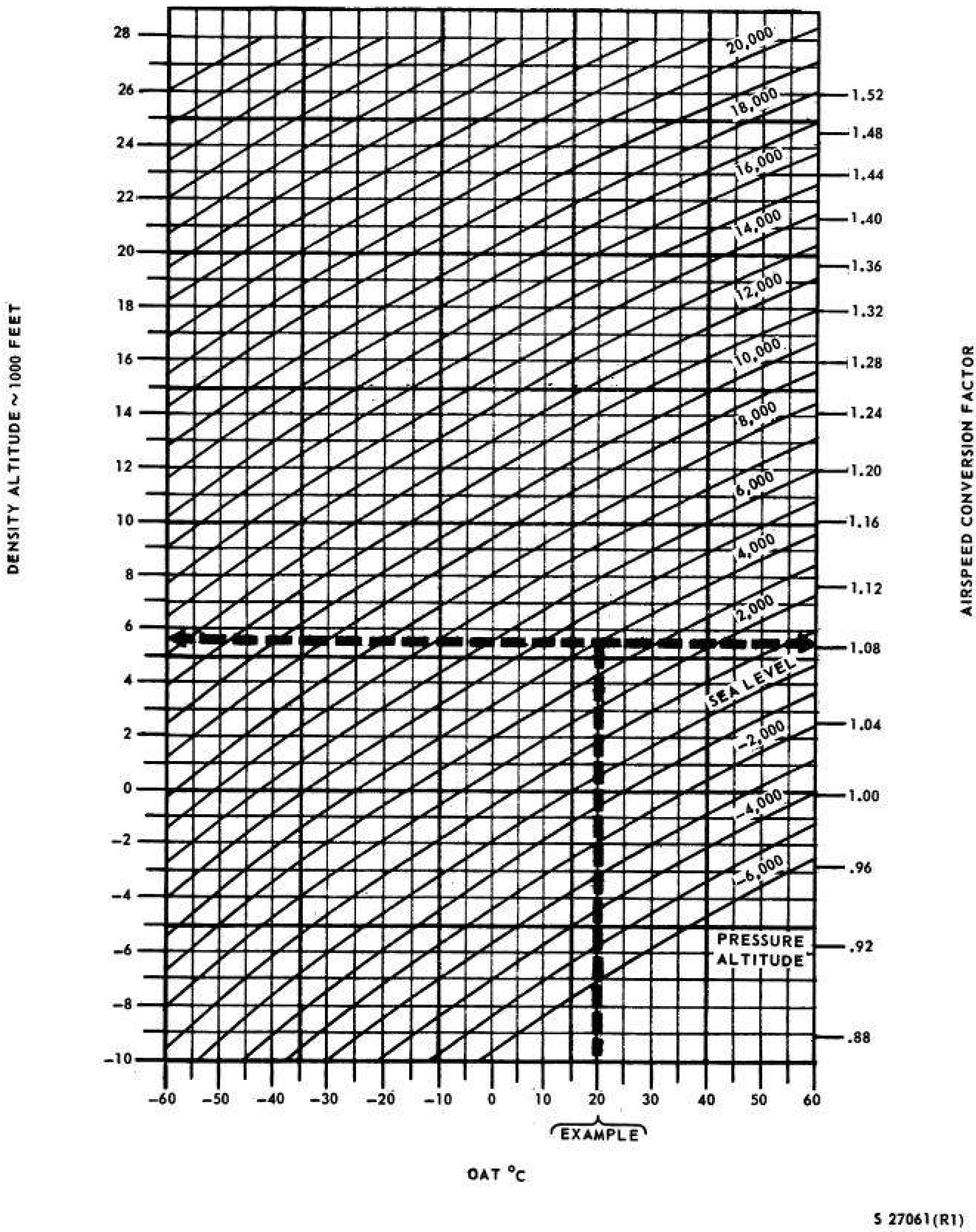


Figure 20-3. Density Altitude

MODEL: SH-3H
DATA AS OF: 22 JUNE 1973
DATA BASIS: FLIGHT TEST

ENGINE: (2) T58-GE-10
(2) T58-GE-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

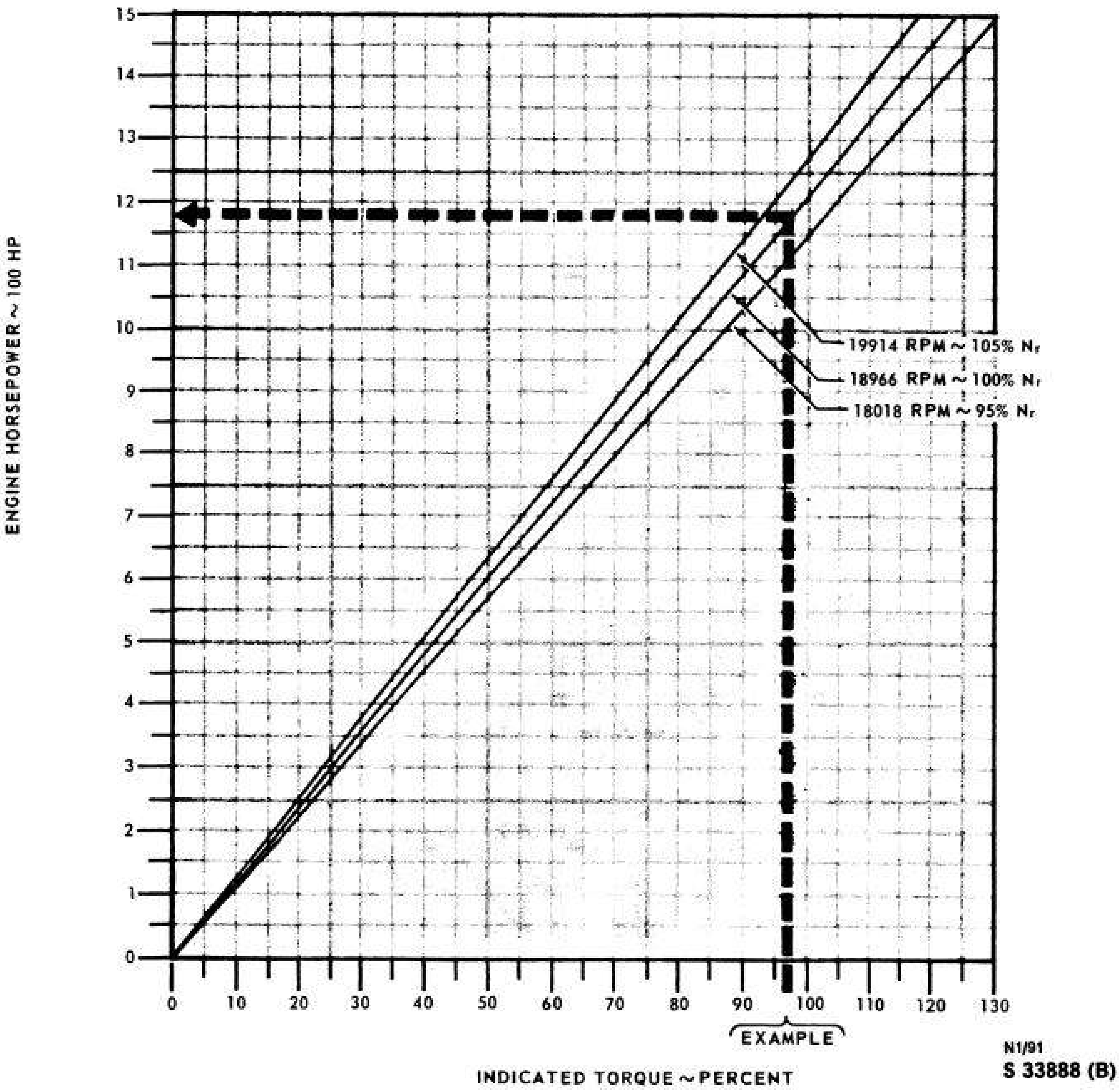


Figure 20-4. Torque Versus Engine Horsepower

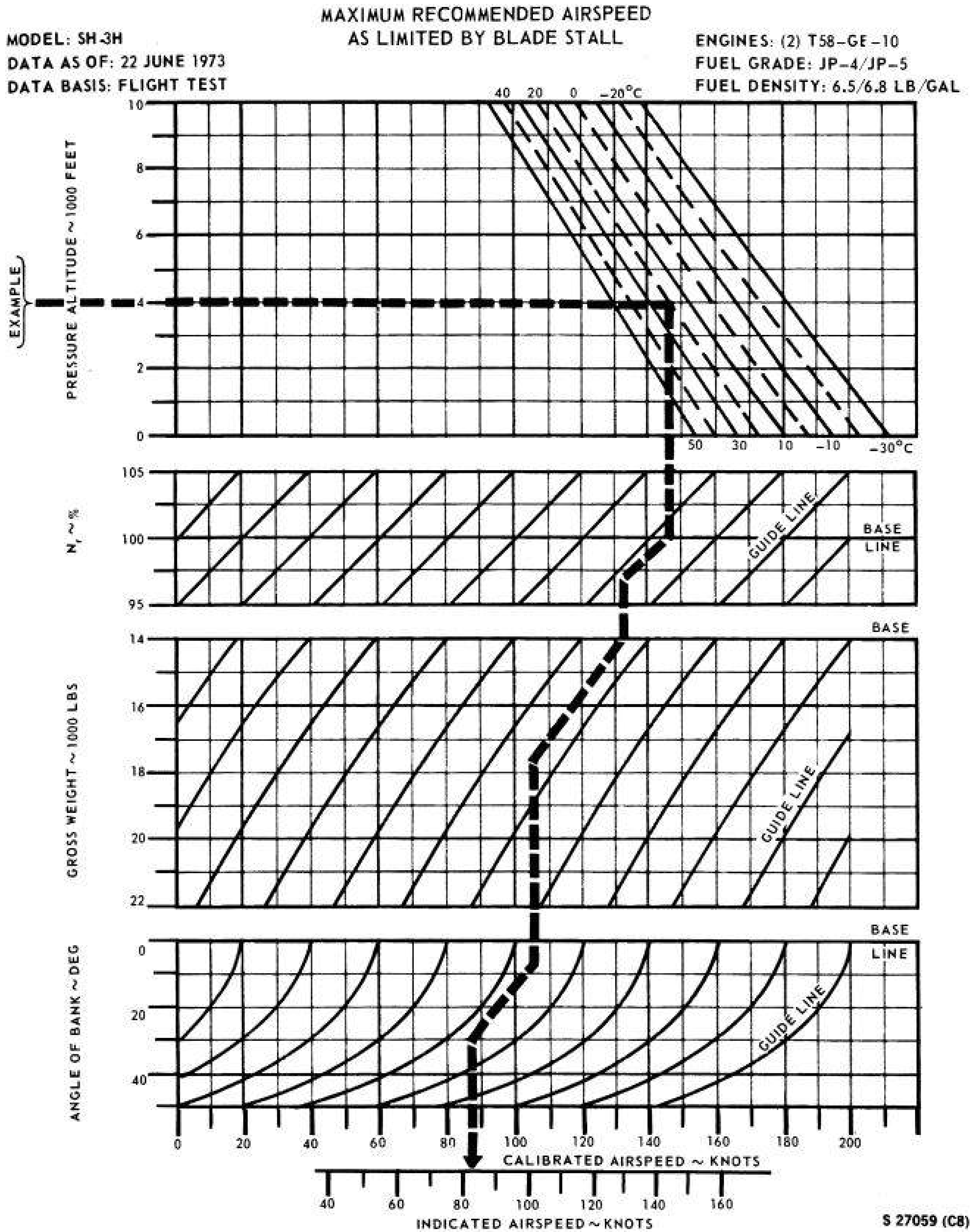


Figure 20-5. Blade Stall

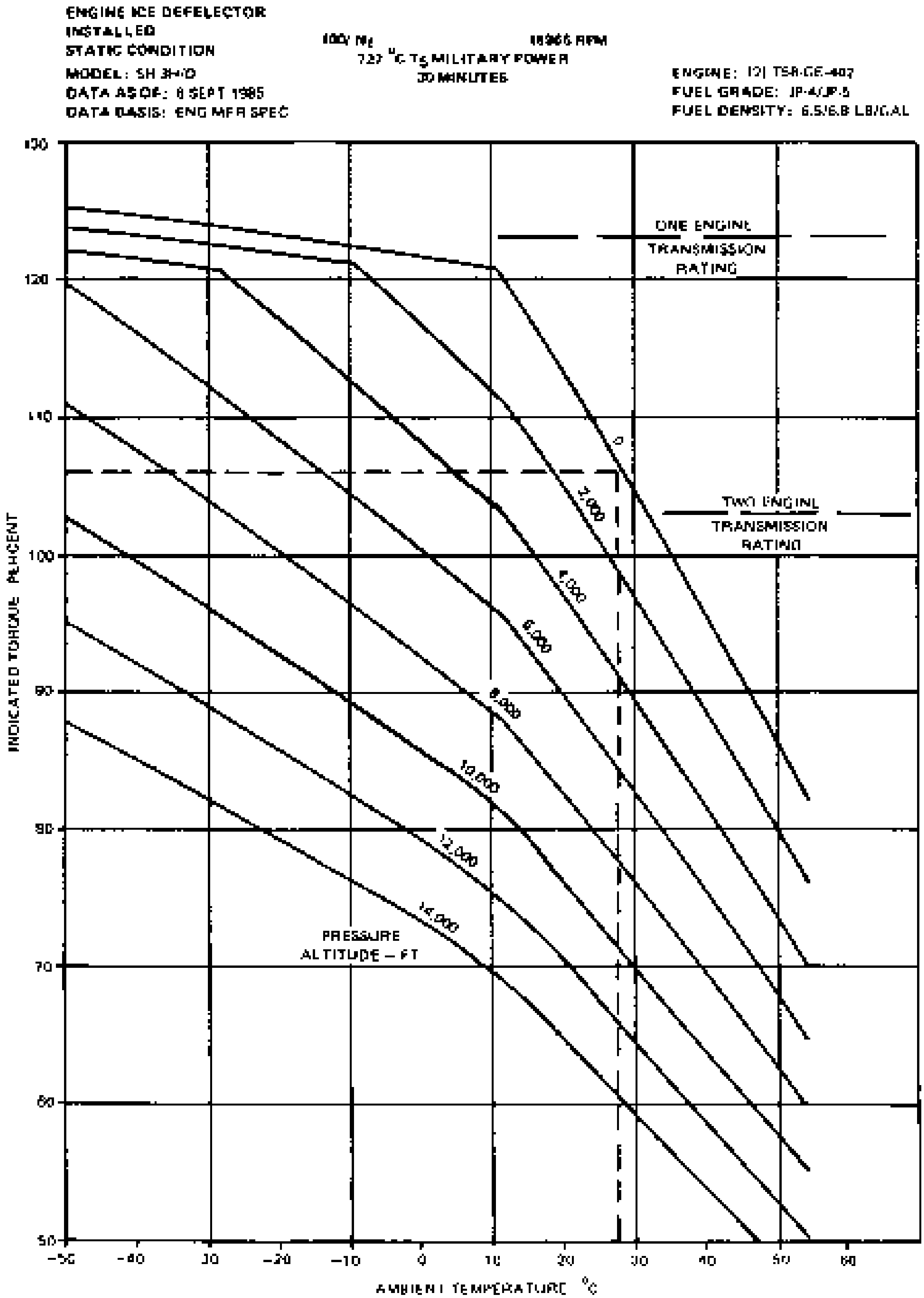


Figure 20-6. Engine Performance — Military Power (727 °C T5)

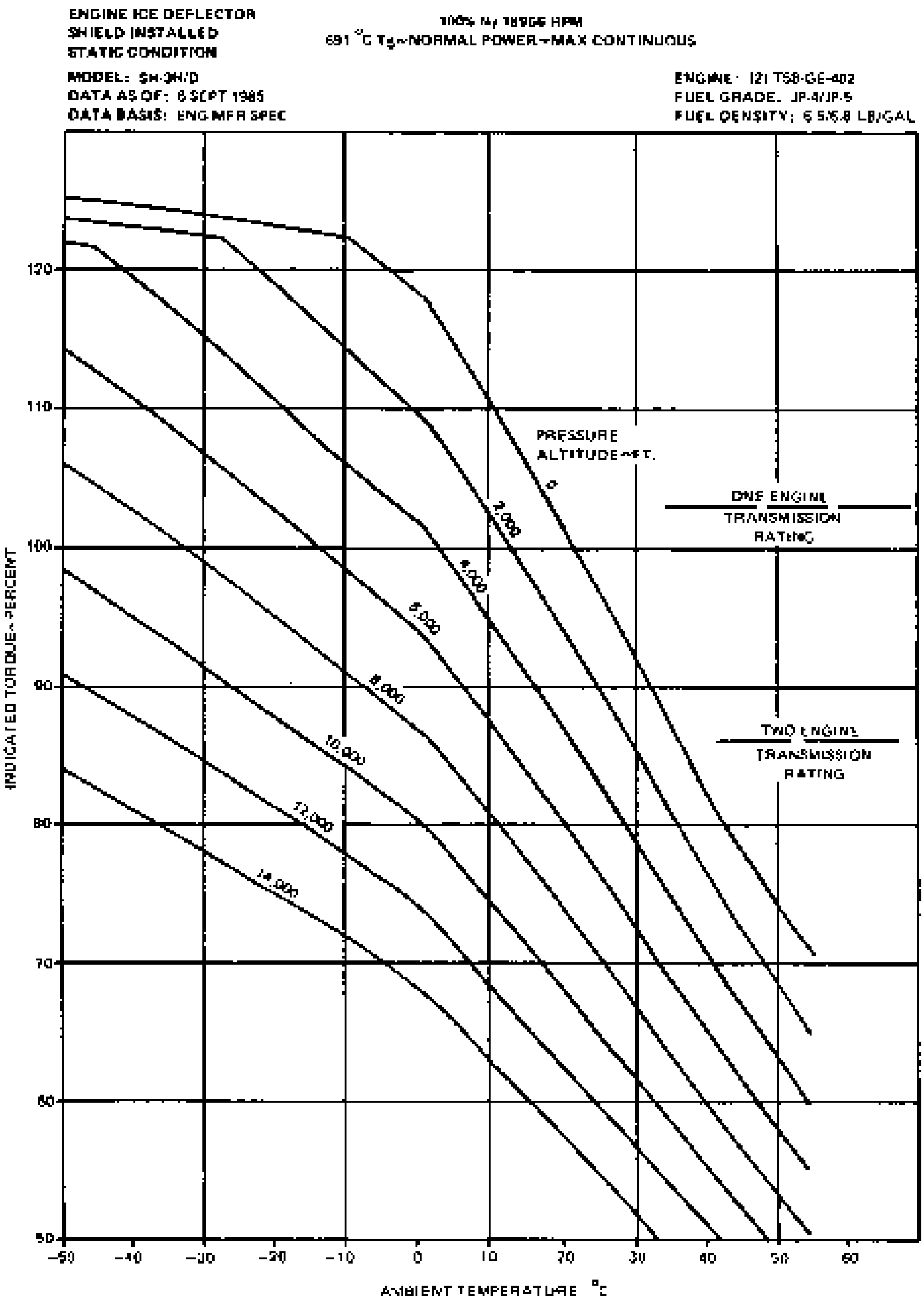


Figure 20-7. Engine Performance — Normal Power (691 °C T5)

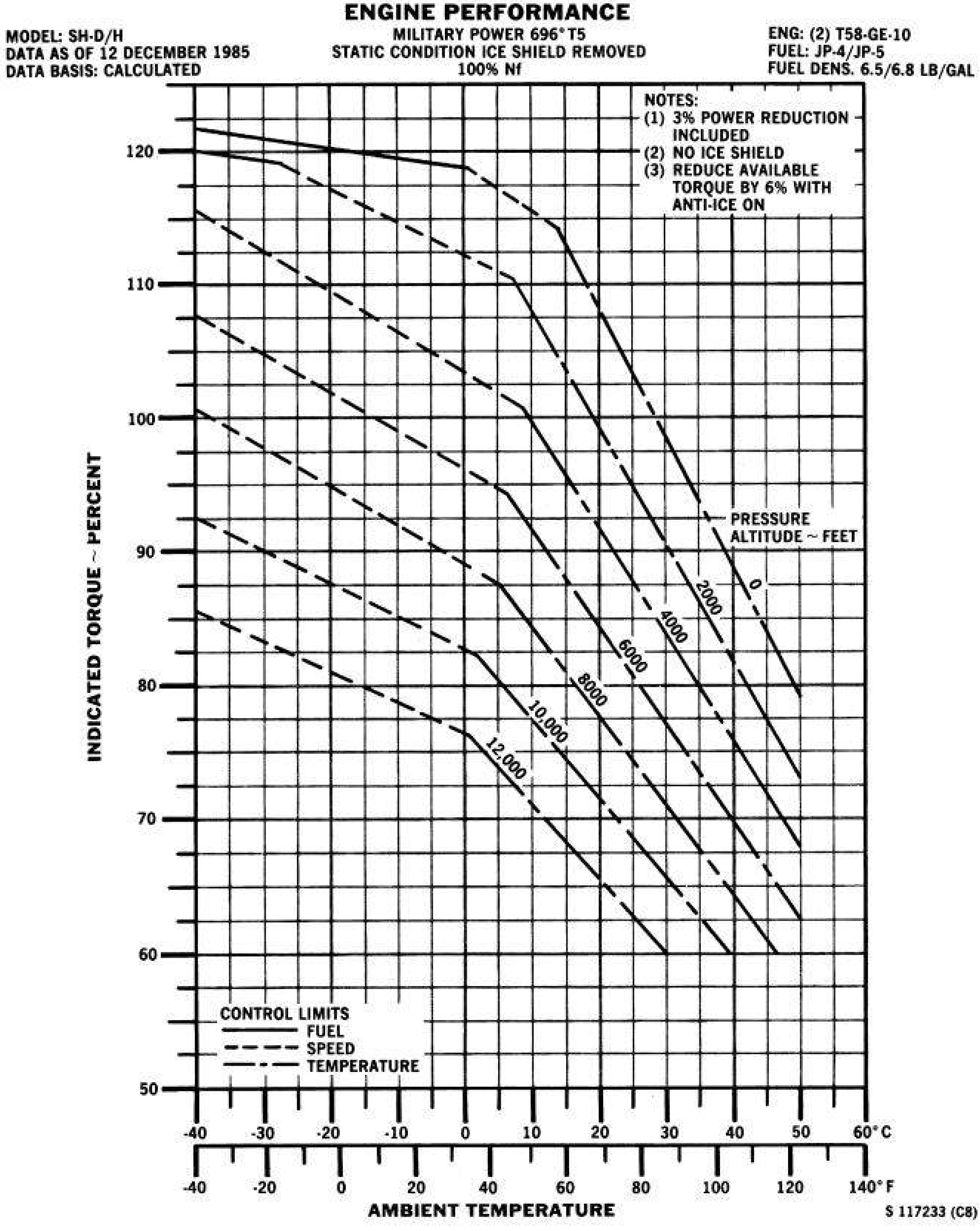


Figure 20-7. Engine Performance — Military Power (696 °C T5) (Ice Shield Removed)

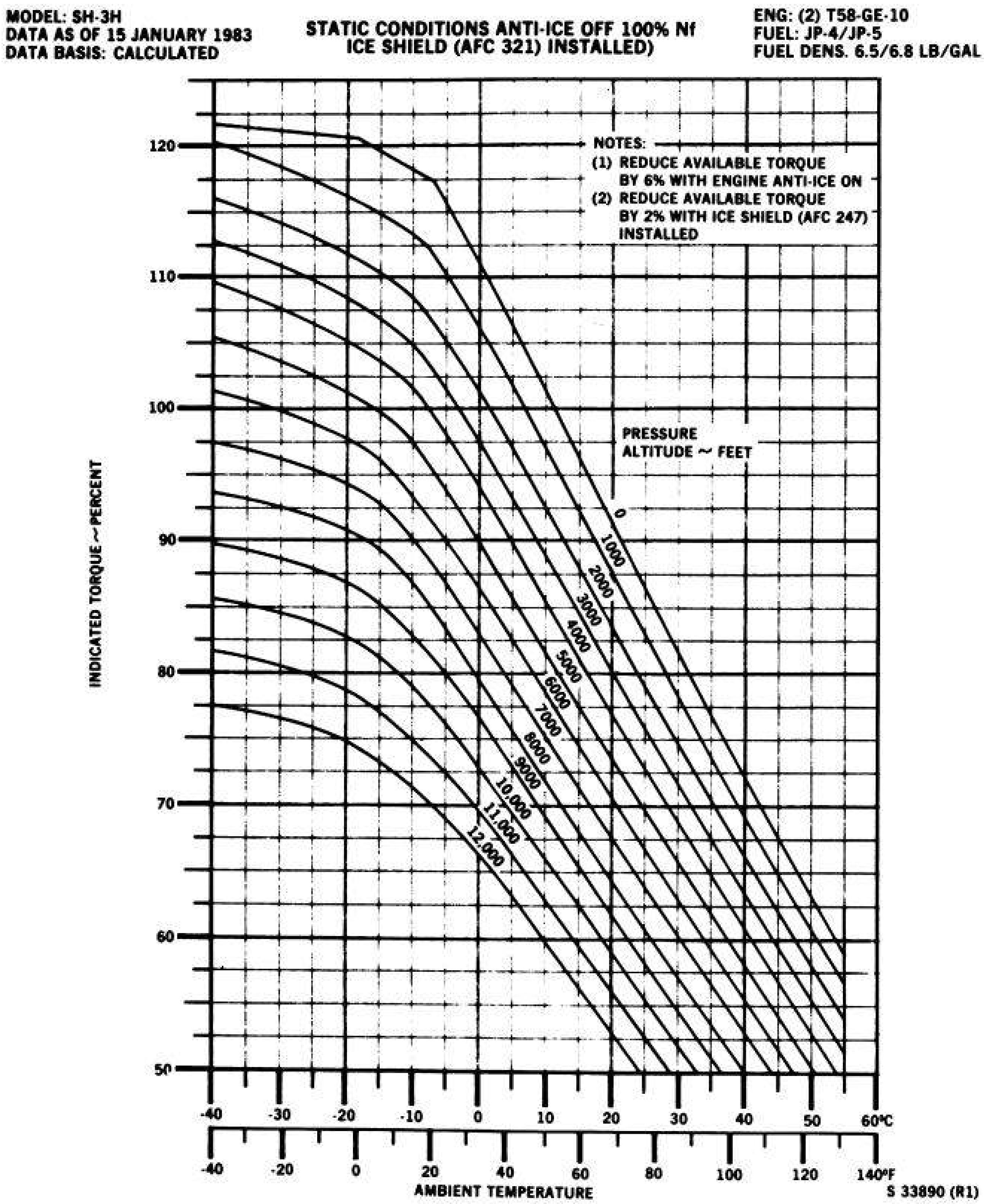


Figure 20-8. Engine Performance — Normal Power (660 °C T5)

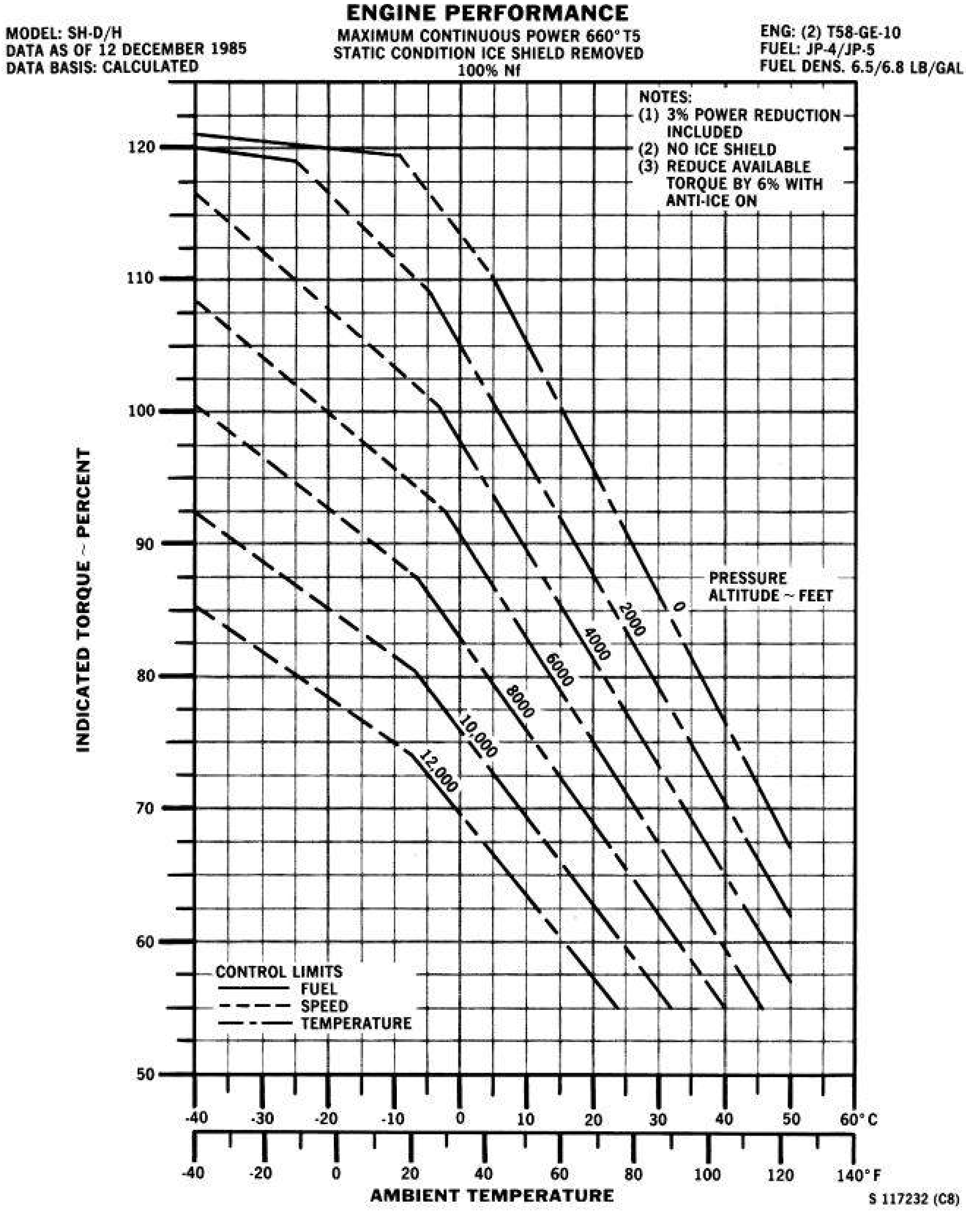


Figure 20-9. Engine Performance — Maximum Continuous Power (660 °C T5) (Ice Shield Removed)

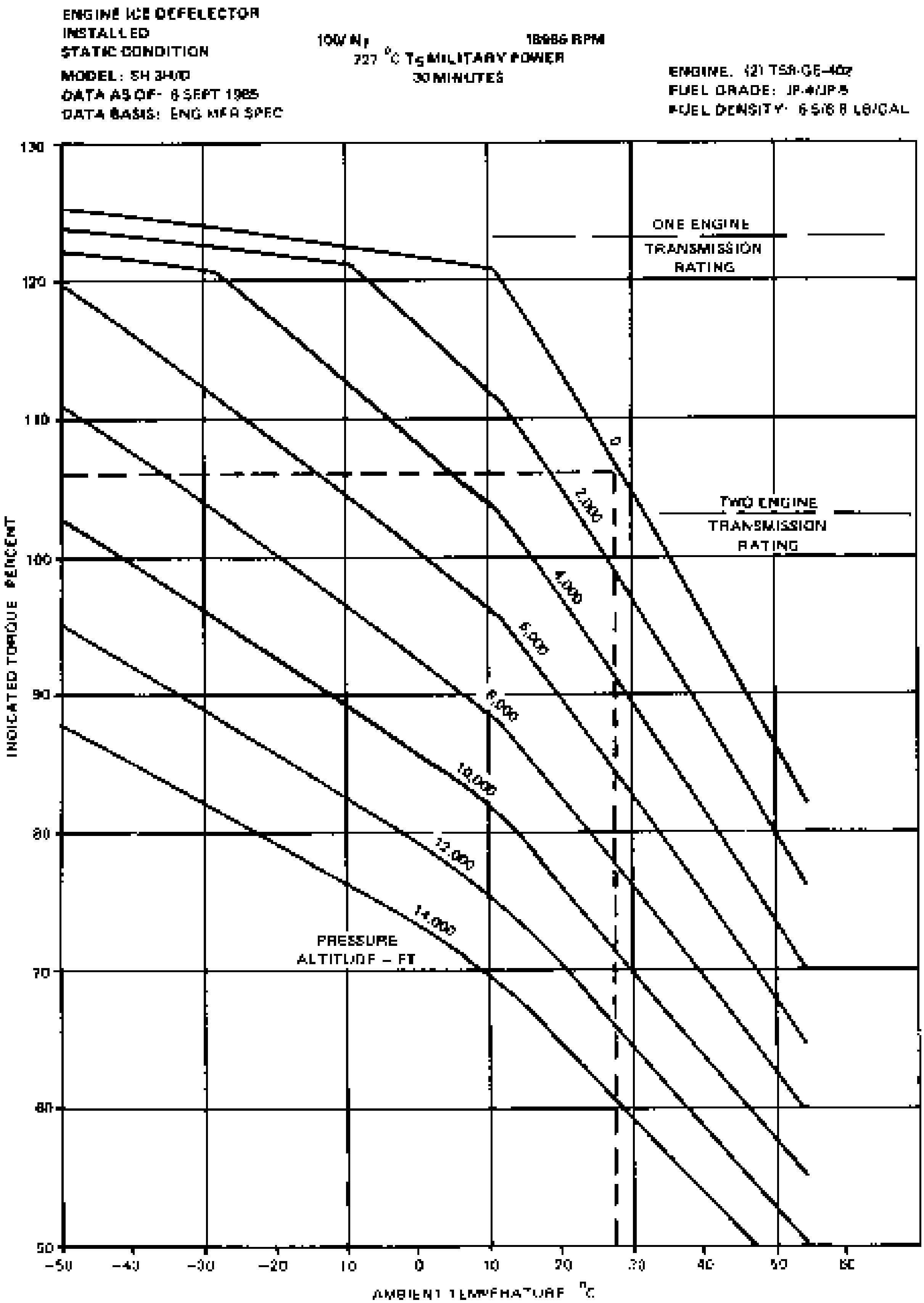


Figure 20-10. Engine Performance — Military Power (727 °C T5)

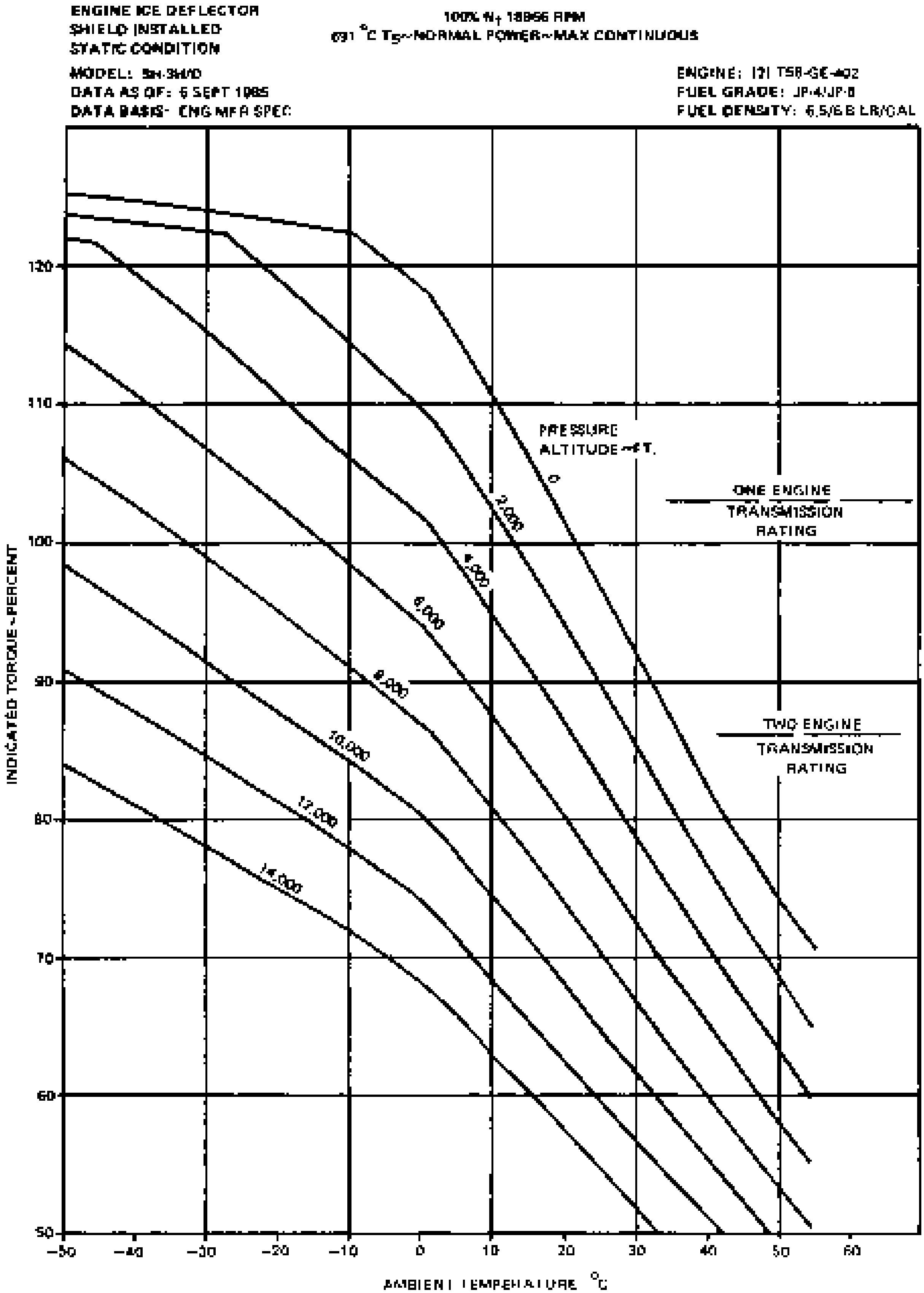


Figure 20-11. Engine Performance — Normal Power (691 °C T5)

This Page Left Blank Intentionally

CHAPTER 21

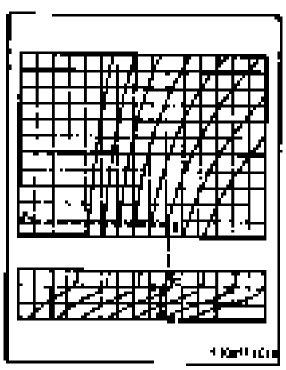
Takeoff

21.1 HOVER CHARTS

The indicated torque required to hover charts (Figure 21-1 and 21-2) provide the indicated torque required to hover at a 10-foot wheel height and out of ground effect when density altitude is applied to gross weight and headwind factors. The ability to hover out of ground effect at various rotor speeds (N_r) chart (Figure 21-3) provides the gross weight that can be hovered out of ground effect when pressure altitude is applied to OAT and rotor speed factors.

21.1.1 Indicated Torque Required to Hover In Ground Effect – 10-Foot Chart. The indicated torque required to hover in ground effect – 10-foot chart (Figure 21-1) provides the indicated torque required to hover at a 10-foot wheel height when density altitude is applied to gross weight and headwind factors.

21.1.1.1 Sample Problem for Use of Indicated Torque Required to Hover In Ground Effect – 10-Foot Chart (Figure 21-1).



1. Enter left side of chart at 800 feet density altitude (point A), then trace right to the 19,000-pound gross weight line (point B).

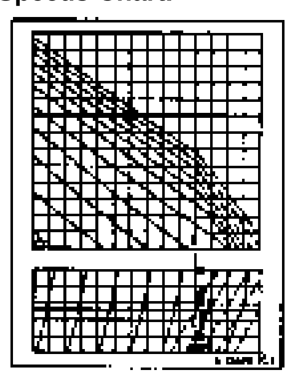
2. From point B, trace down to the headwind baseline (point C).

3. From point C, follow the guideline to the 10-knot headwind line (point D), then trace to the torque scale (point E), and read 77-percent torque.

21.1.2 Indicated Torque Required to Hover Out of Ground Effect Chart. The indicated torque required to hover out of ground effect chart (Figure 21-2) uses like factors in the same manner as Figure 21-1 to provide the indicated torque required to hover out of ground effect. The height established for out of ground effect is about 100 feet between the wheels and the takeoff surfaces.

21.1.3 Ability to Hover Out of Ground Effect at Various Rotor Speeds Chart. The ability to hover out of ground effect at various rotor speeds (N_r) chart (Figure 21-3) provides the gross weight that the helicopter can hover out of ground effect when pressure altitude is applied to OAT and rotor speed factors.

21.1.3.1 Sample Problem for Use of Ability To Hover Out of Ground Effect at Various Rotor Speeds Chart.



1. Enter left side of chart at sea level pressure altitude (point A), then trace right to 28 °C OAT (point B).

2. From point B, trace down to the rotor speed baseline (point C).

3. From point C, follow the guideline up to the 103-percent N_r line (point D), then trace down to the gross weight scale (point E), read 19,250 pounds gross weight.

STANDARD TEMPERATURE
100% Nr

MODEL: SH-3H
DATA AS OF: 22 JUNE 1973
DATA BASIS: ESTIMATED

ENGINE: (2) T58-GE-10
(2) T58-GE-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

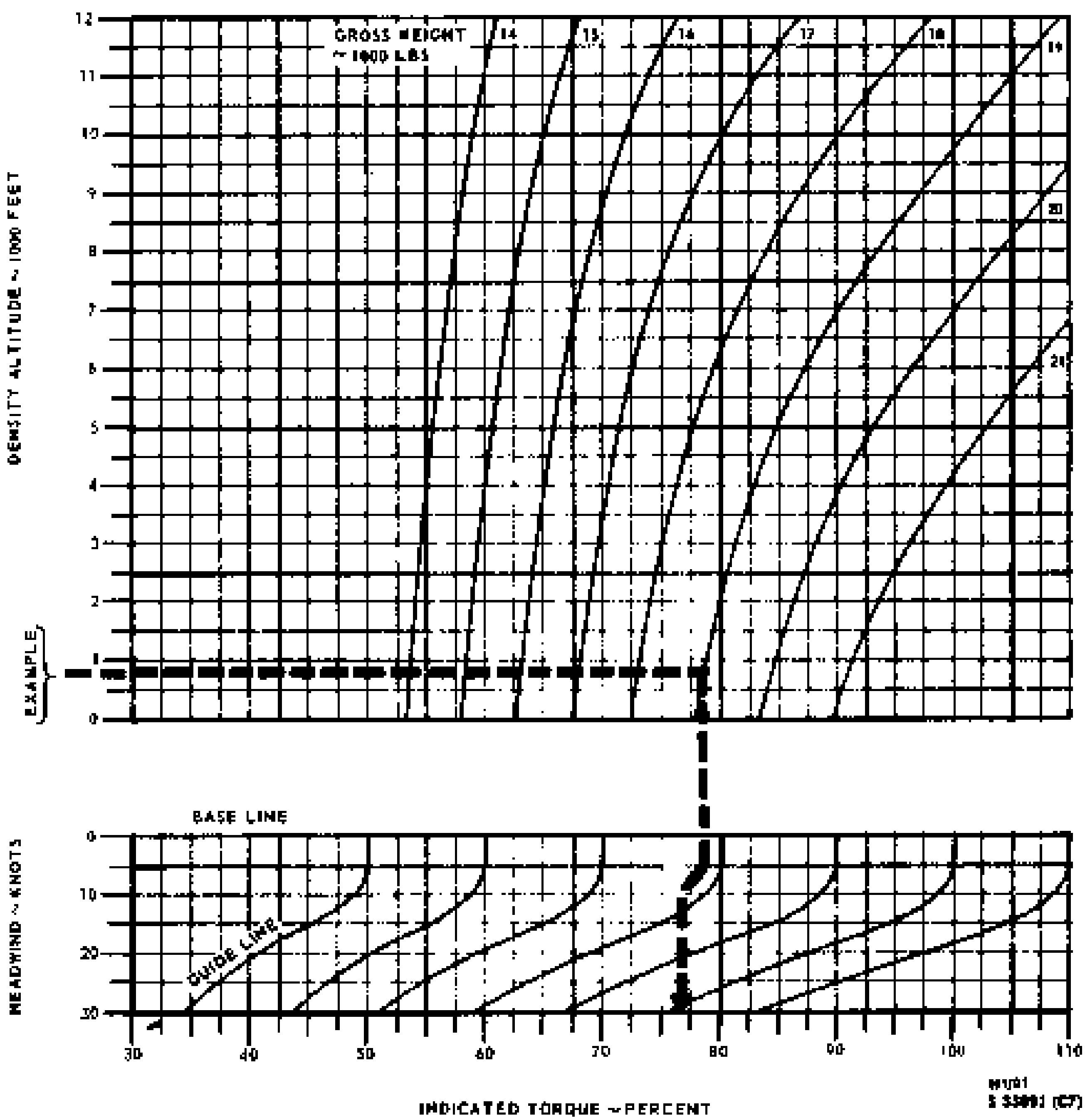


Figure 21-1. Indicated Torque Required To Hover in Ground Effect — 10-Foot Chart

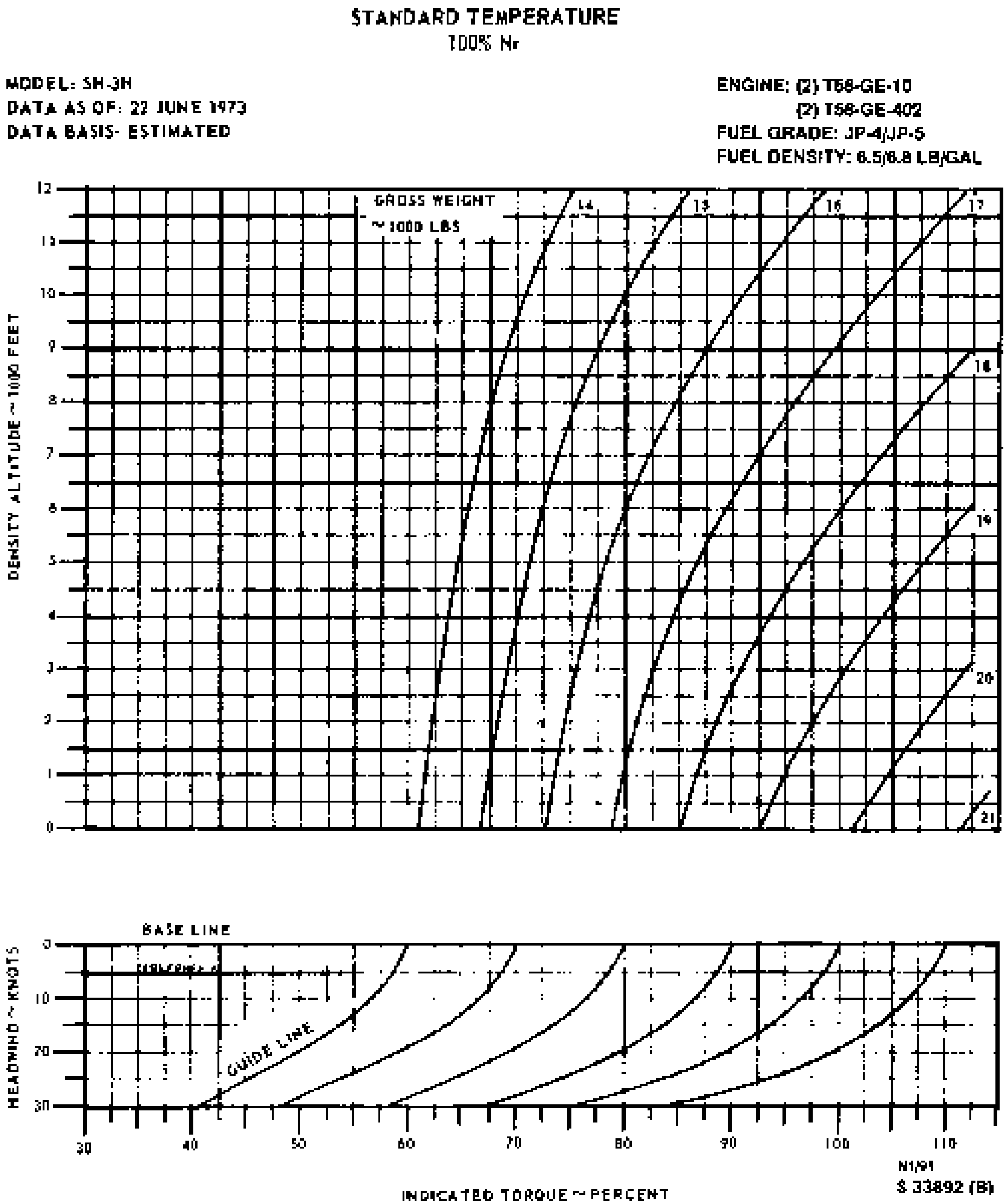


Figure 21-2 Indicated Torque Required To Hover out of Ground Effect

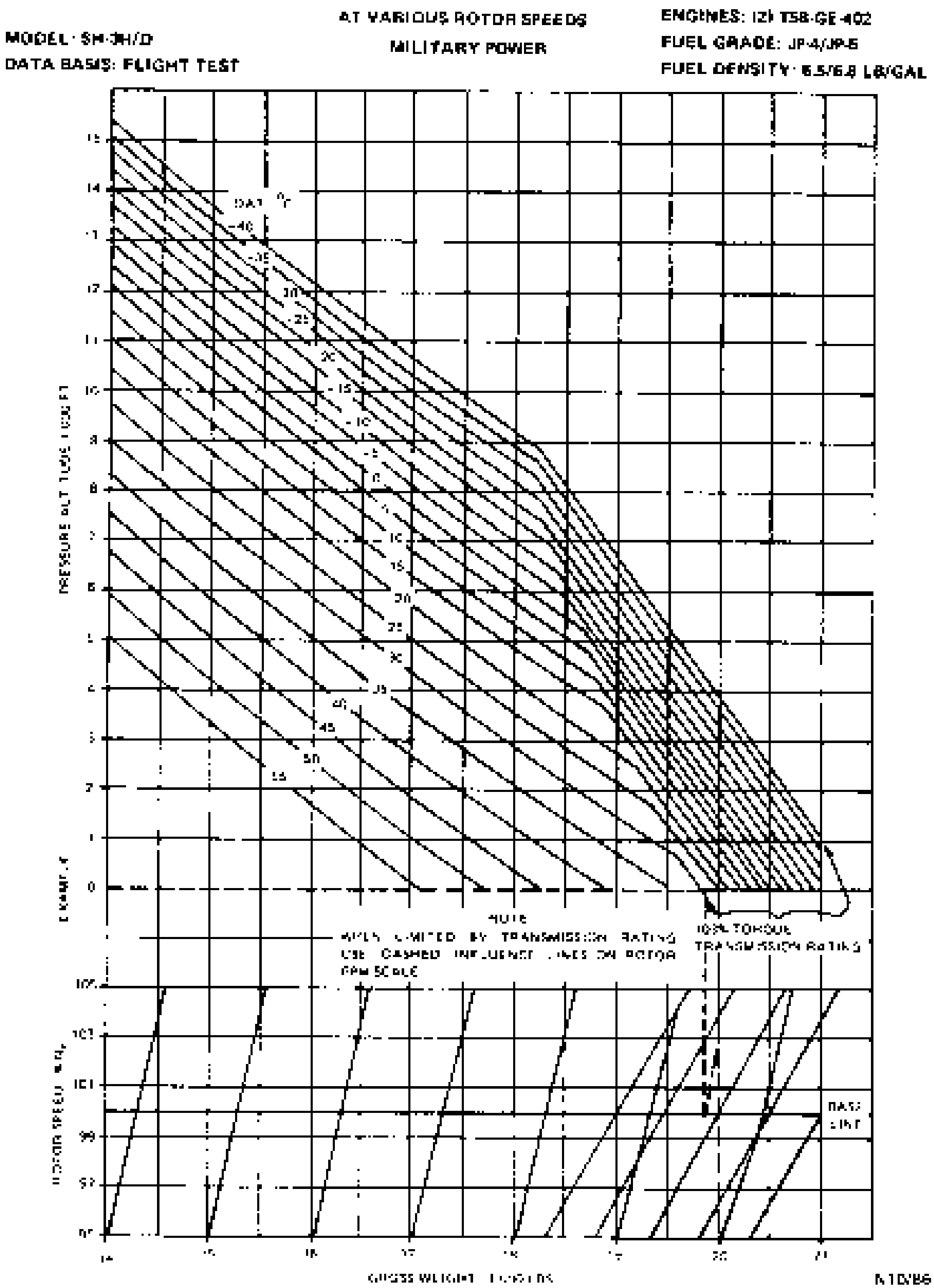


Figure 21-3. **Ability To Hover out of Ground Effect at Various Rotor Speeds (N_r)**

CHAPTER 22

Climb

22.1 CLIMB CHARTS

The climb charts (Figure 22-1 and 22-2) provide a means of computing the time to climb, the horizontal distance covered, the fuel consumed, and the rate of climb for various gross weights. These values are computed by applying the gross weights to various conditions of pressure altitude and temperature. The fuel used includes approximately 150 pounds used for warm up and takeoff from sea level. For takeoffs above sea level, add 150 pounds for warm up, taxi, and climb. Also included is a climb speed schedule to provide the climb speed for various pressure altitudes. A temperature scale is also provided to relate the OAT at various pressure altitudes. The temperature scale is either based on a warm day (0 to 60 °C) or a cold day (-60 to 0°C).

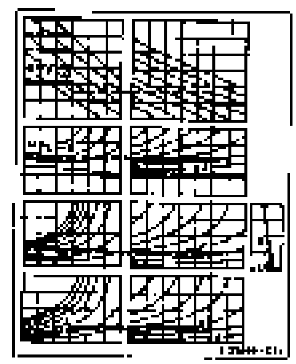
22.1.1 Climb – Normal Power Chart (Cold Day). The climb – normal power (cold day) chart (Figure 22-1) uses like factors in the same manner as Figure 22-2 to provide climb data for the helicopter on a cold day.

22.1.2 Climb – Normal Power (Warm Day). The climb – normal power (warm day) chart (Figure 22-2) provides the time to climb, horizontal distance covered, fuel consumed, and rate of climb, at various gross weights for the helicopter on a warm day.

Note

When the takeoff is from above a sea-level pressure altitude, it will be necessary to determine climb data from sea-level pressure altitude to the takeoff pressure altitude and from sea-level pressure altitude to the cruise-level pressure altitude. The difference between the data necessary to climb to both altitudes will then be the data necessary to climb from takeoff pressure altitude to cruise-level pressure altitude.

22.1.2.1 Sample Problem For Use of Climb Normal Power (Warm Day) Chart (Figure 22-2).



1. Enter bottom of chart at 19,000 pounds gross weight (point A), trace up to 4,000-foot pressure altitude in the time parameter block (point B), the trace left to the temperature baseline (point C). From point C, follow the influence line to the 20 °C line (point D), then trace left and note that time to climb to 4,000-foot pressure altitude is 2.7 minutes (point E).

2. Enter bottom of chart at 19,000 pounds gross weight (point A), trace up to 4,000-foot pressure altitude in the distance parameter block (point F), then trace left to the temperature baseline (point G). From point G, follow the influence line to the 20 °C line (point H), then trace left and note that distance covered in a climb to 4,000-foot pressure altitude is 3nm, (point I).

3. Enter bottom of chart at 19,000 pounds gross weight (point A), trace up to 4,000-foot pressure altitude in the fuel parameter block (point J), then trace left to the temperature baseline (point K). From point K, follow the influence line to the 20 °C line (point L), then trace left and note that fuel consumed in a climb to 4,000-foot pressure altitude is 220 pounds (point M).

4. Enter bottom of chart at 19,000 pounds gross weight (point A), trace up to sea-level in the rate-of-climb parameter block (point N), then trace left to the temperature baseline (point O). From point O, follow the influence line to the 28 °C line (point P), then trace left and note 1,450 fpm initial rate of climb (point Q). Follow the same procedure to determine that the final rate of climb at 4,000-foot pressure altitude and 20 °C is 1,125 fpm. The average rate of climb is 1,287 fpm.

Note

The rate-of-climb sections of the climb charts have both solid and dashed guidelines with a note indicating the dashed line is to be used when operating at a transmission limit. To determine if performance will be limited by maximum continuous transmission torque (86 percent), refer to Figure 20-10, engine performance – normal power (660° T_5). Apply the ambient temperature to the pressure altitude and proceed to the left side and read torque available under these conditions. If the value is over 86 percent, the climb will be transmission limited. On the same chart, locate the intersection of the relevant pressure altitude and the 86-percent torque lines, then proceed to the bottom and read the temperature at which the transmission becomes torque limited. With this value, return to the rate-of-climb section of the climb chart and proceed from the temperature baseline. Parallel the solid guideline until intersecting the temperature at which the transmission is limited, then trace parallel to the dashed line and, on the left side, read the rate of climb.

5. Enter the left side of climb speed schedule at 4,000-foot pressure altitude (point R), trace right to the best climb speed curve (point S), then trace down and read best climb speed of 68 KIAS (point S). Follow the same procedures to determine that the best climb speed for sea-level pressure altitude is 70 KIAS.

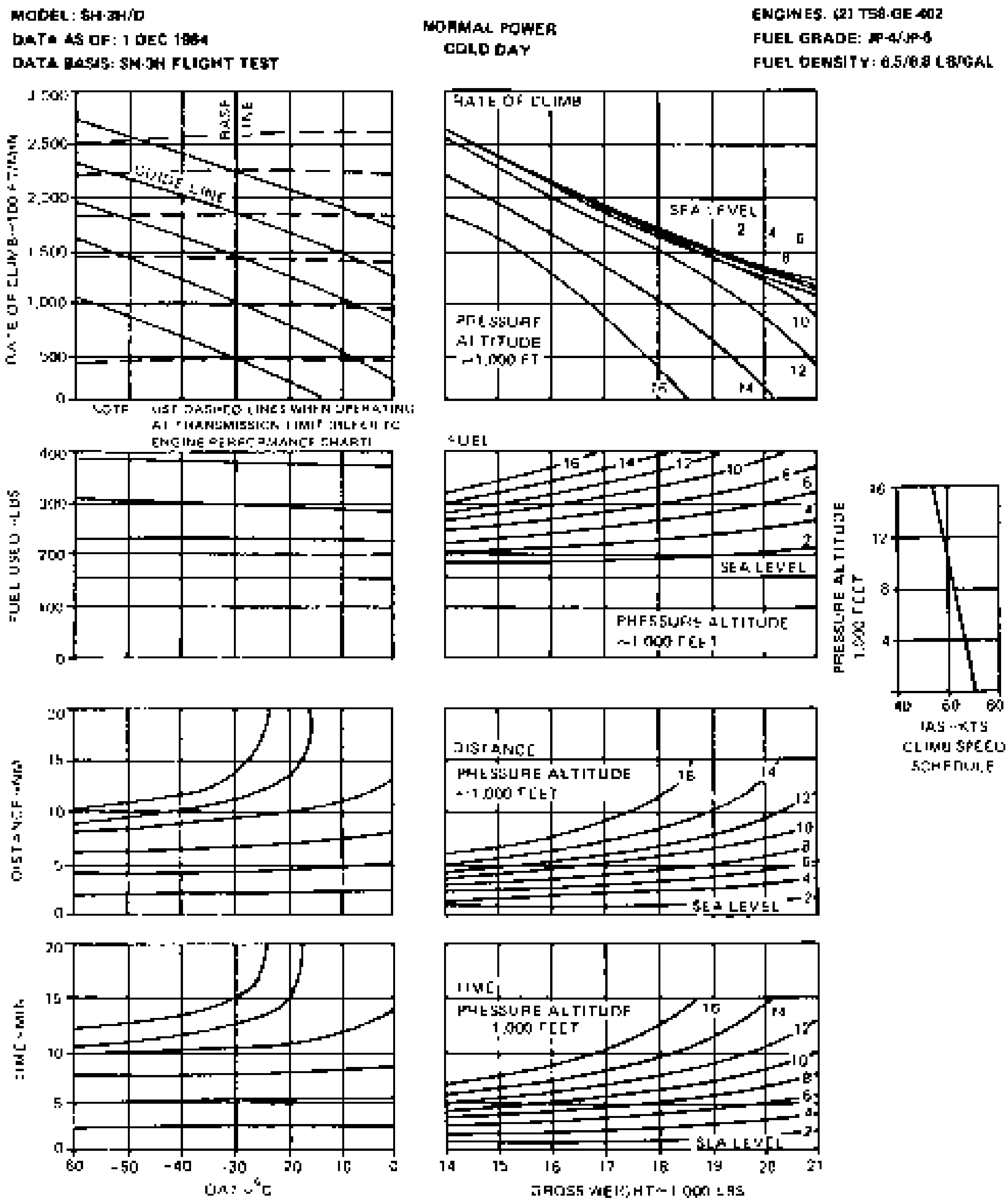


Figure 22-1. Climb — Normal Power Chart (Cold Day)

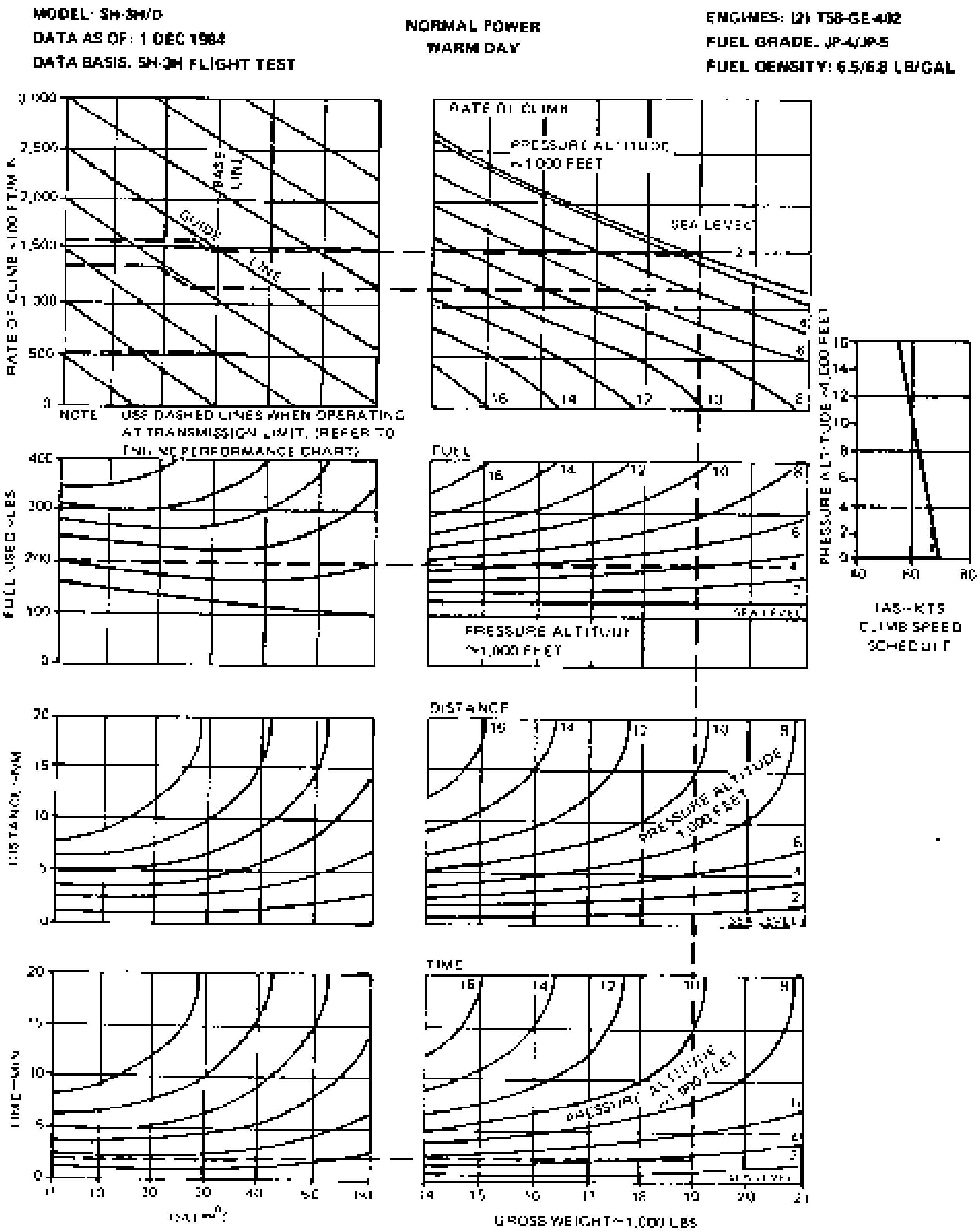


Figure 22-2. Climb — Normal Power Chart (Warm Day)

CHAPTER 23

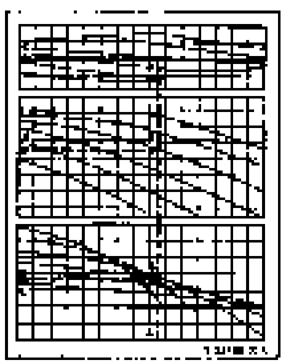
Range

23.1 RANGE CHARTS

The range charts (Figure 23-1 and 23-2) provide unit range, indicated and calibrated airspeed, and approximate torque when gross weight is applied to pressure altitude.

23.1.1 Maximum Range (-10) – Two-Engine Chart. The maximum range – two engine chart (Figure 23-1) provides the unit range, indicated and calibrated airspeed, and approximate torque when gross weight is applied to pressure altitude to produce maximum range for the helicopter at slower airspeeds than Figure 23-2.

23.1.1.1 Sample Problem for Use of Maximum Range (-10) – Two Engine Chart (Figure 23-1).



1. Enter bottom of chart at 18,000 pounds gross weight (point A), trace up to 4,000 foot pressure altitude line (point B), then trace left to the unit range scale (point C) and read 0.109 nm per pound of fuel.

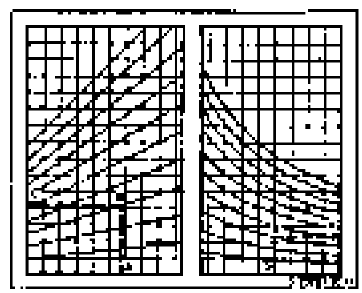
2. From point B, continue to trace the gross weight line up to the 4,000-foot pressure altitude line in the next block (point D), then trace left to the airspeed scale (point E) and read 109 KCAS and 107 KIAS.

3. From point D, continue to trace the gross weight line up to the 4,000-foot pressure altitude line in the next block (point F), then trace left to the torque scale (point G), and read 58-percent torque.

23.1.2 Optimum Cross-Country Chart. The Optimum cross-country chart (Figure 23-2) uses like factors in the same manner as Figure 23-1 to produce maximum range at normal power. This chart will give higher airspeeds and torque values and less range than Figure 23-1.

23.1.3 Unit Range and Fuel Flow Conversion Chart. The unit range and fuel flow conversion chart (Figure 23-2) provides the factors necessary to convert unit range to total range and fuel flow to endurance hours. The unit range conversion portion of the chart provides total range, in nautical miles, when unit range is applied to the amount of fuel. The fuel flow conversion portion of the chart provides endurance hours when fuel flow is applied to the amount of fuel.

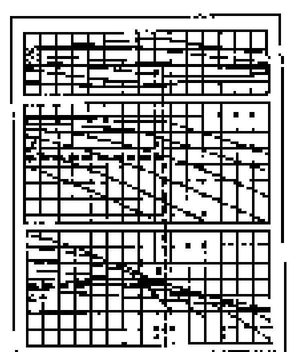
23.1.3.1 Sample Problem for Use of Unit Range and Fuel Flow Conversion Chart (Figure 23-3).



1. For a range problem, enter bottom of chart at 0.109 nm per pound of fuel (point A), trace up to the 1,525-pound fuel line (point B), the trace left to the total range scale (point C) and 165 nm.

2. For an endurance problem, enter bottom of chart at 870-pph fuel flow (point D), trace up to the 1,525-pound fuel line (point E), then trace right to the endurance hours scale (point F) and read 1 hour and 42 minutes.

23.1.4 Sample Problem for Use of Maximum Range – (-402) Two-Engine Chart (Figure 23-4).



1. Enter bottom of chart at 18,000 pounds gross weight (point A), trace up to 4,000 foot pressure altitude line (point B), then trace left to the unit range scale (point C) and read 0.116 nm per pound of fuel.

2. From point B, continue to trace the gross weight line up to the 4,000-foot pressure altitude line in the next block (point D), then trace left to the airspeed scale (point E) and read 116 KCAS and 114 KIAS.

3. From point D, continue to trace the gross weight line up to the 4,000-foot pressure altitude line in the next block (point F); then trace left to the torque scale (point G) and read 63-percent torque.

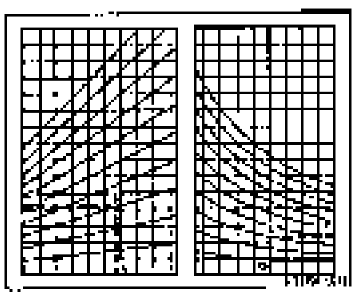
23.1.5 Maximum Range (-402) – Normal Power Two-Engine Chart. This chart (Figure 23-5) is used like Figure 23-4 to produce maximum range at normal power.

23.1.6 Unit Range and Fuel Flow Conversion Chart (-402). This chart (Figure 23-6) shows the factors for converting unit range, total range, and fuel flow to endurance hours. The unit range conversion portion of the chart provides total range, in nautical miles, when unit range is applied to the amount of fuel. The fuel conversion portion of the chart shows endurance hours when fuel flow is applied to amount of fuel.

23.1.7 Sample Problem for Use of Unit Range and Fuel Flow Conversion Chart.

1. For a range problem, enter bottom of chart at 0.109 nm per pound of fuel (point A), trace up to the 1,525-pound fuel line (point B), then trace left to the total range scale (point C) and read 165 nm.

2. For an endurance problem, enter bottom of chart at 870-pph fuel flow (point D), trace up to the 1,525-pound fuel line (point E), then trace right to the endurance hours scale (point F) and read 1 hour and 42 minutes.



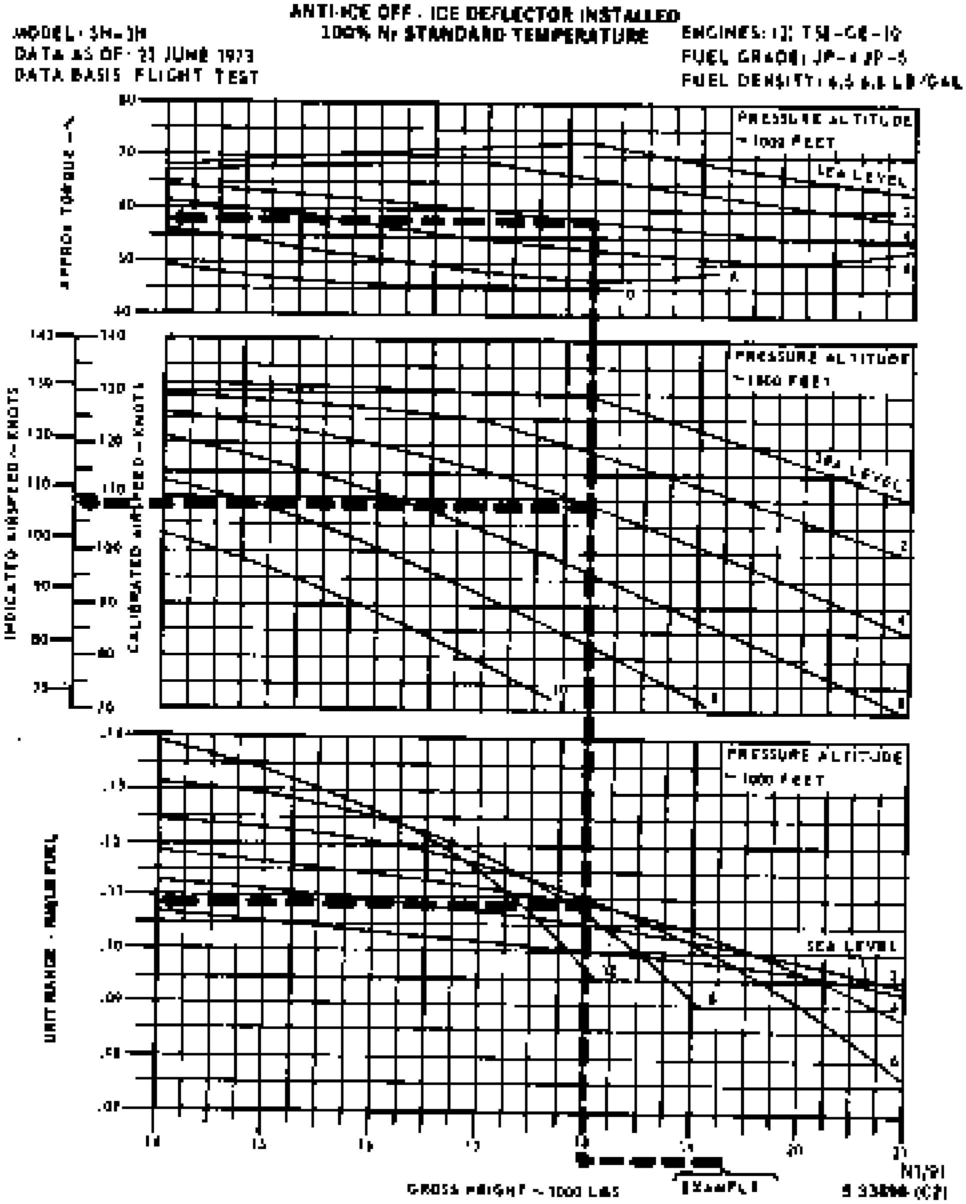


Figure 23-1. Maximum Range — Two Engines

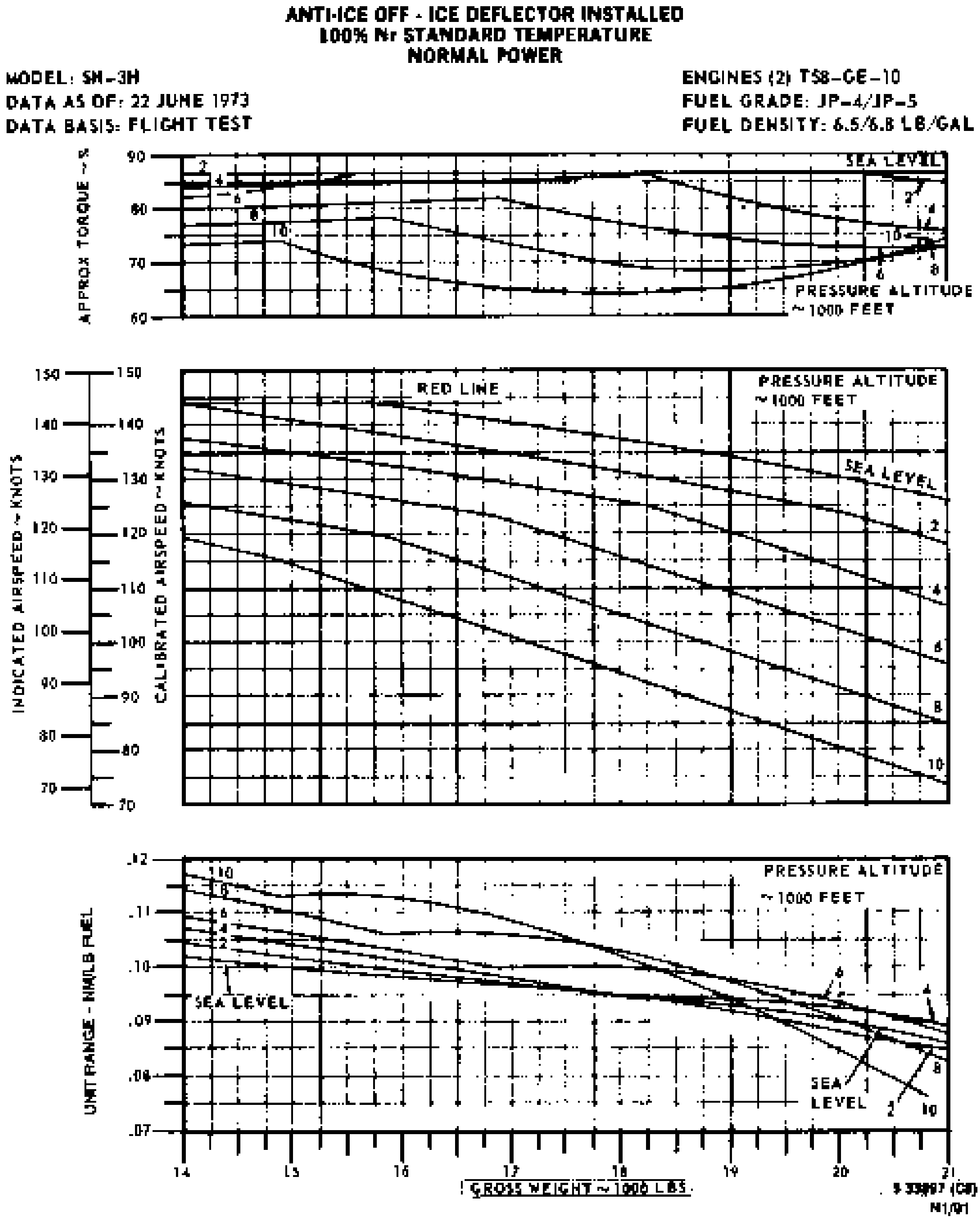
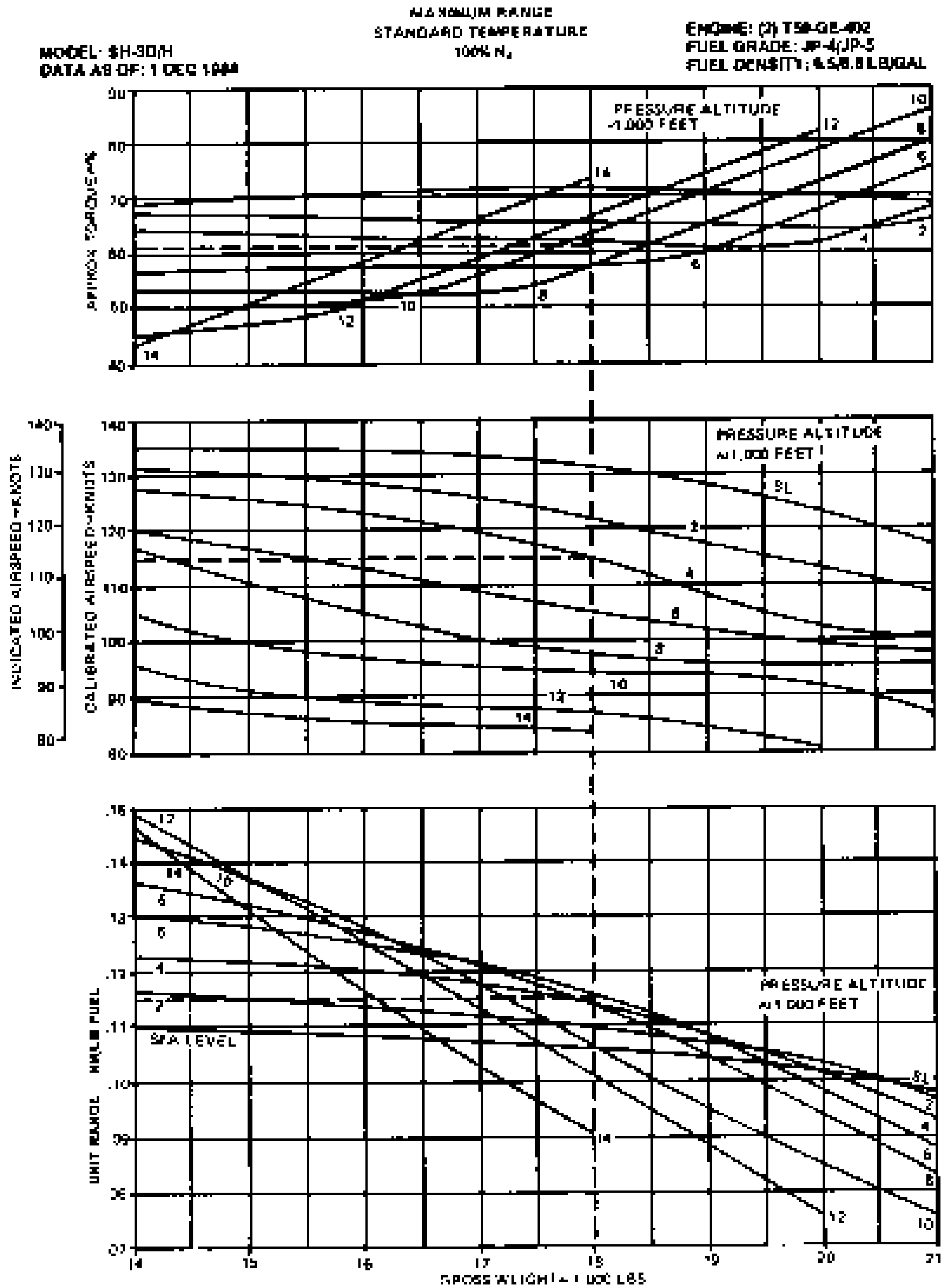


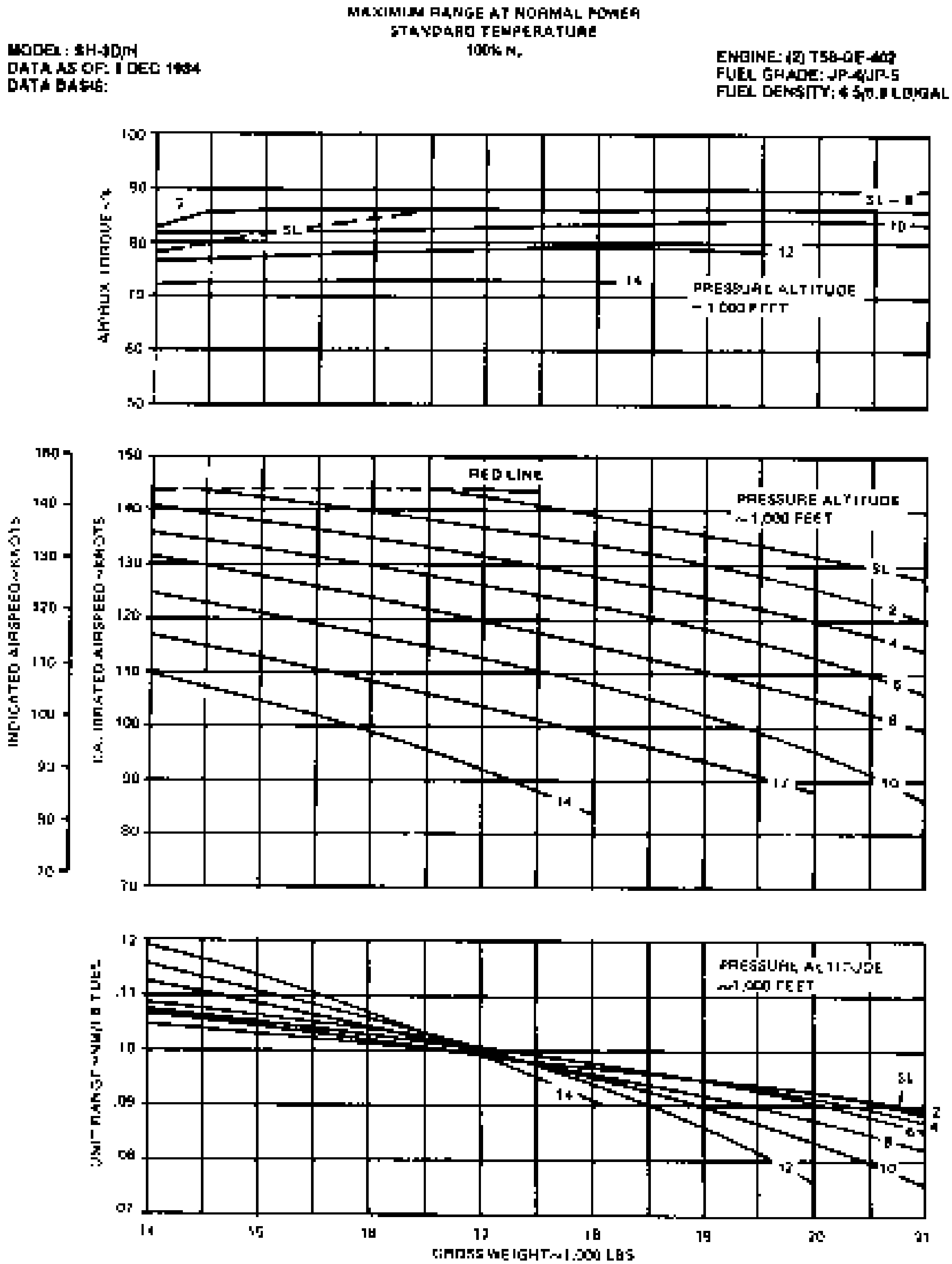
Figure 23-2. Optimum Cross-Country



NOTE: DECREASE RANGE BY 2 PERCENT OR .002 NM/LB BECAUSE OF INCREASE IN FLAT PLATE AREA OF SH-3D/H OVER THAT OF VH-3D, FOR WHICH DATA BASE WAS GENERATED.

N1/91

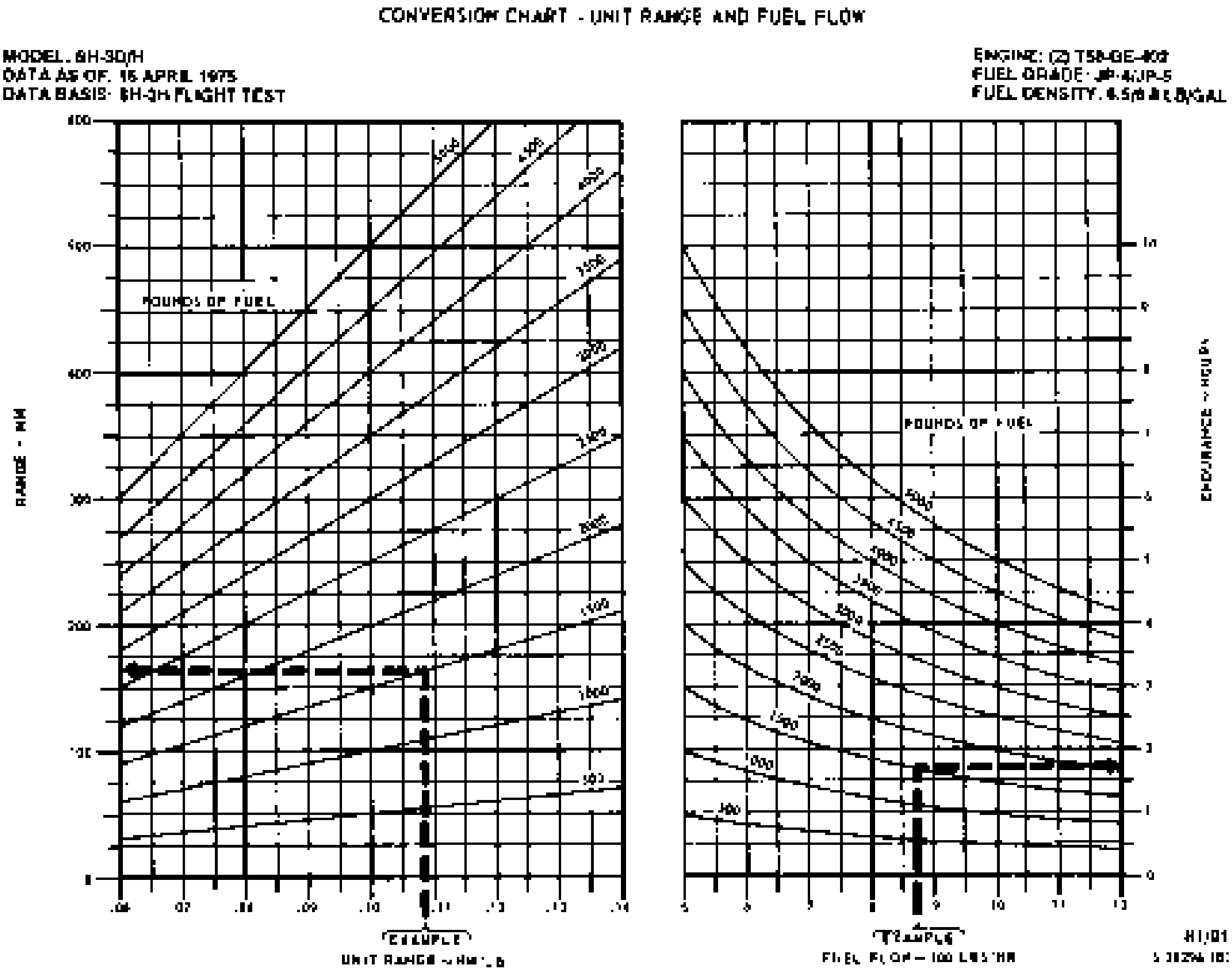
Figure 23-4. Maximum Range — Two Engines (-402)



NOTE: DECREASE RANGE BY 2 PERCENT OR .002 NM/LB BECAUSE OF INCREASE IN FLAT PLATE AREA OF SH-3D/H OVER THAT OF VH-3D, FOR WHICH DATA BASE WAS GENERATED.

N1/91

Figure 23-5. Maximum Range — Normal Power — Two Engines



NOTE: DECREASE RANGE BY 2 PERCENT OR .002 NM/LB BECAUSE OF INCREASE IN FLAT PLATE AREA OF SH-3D/H OVER THAT OF VH-3D, FOR WHICH DATA BASE WAS GENERATED.

Figure 23-6. Unit Range and Fuel Flow Conversion

This Page Left Blank Intentionally

CHAPTER 24

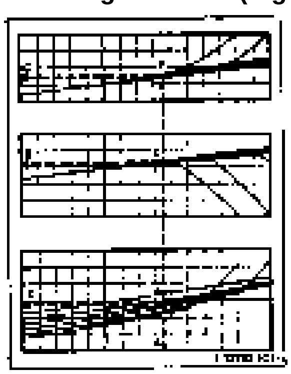
Endurance

24.1 ENDURANCE CHARTS

The maximum endurance charts (Figure 24-1 and 24-2) provide fuel flow, indicated and calibrated airspeed, and approximate torque when gross weight is applied to pressure altitude to produce maximum endurance.

24.1.1 Maximum Endurance – Two-Engine Chart. The maximum endurance – two-engine chart (Figure 24-1) provides the fuel flow, indicated and calibrated airspeed, and approximate torque when gross weight is applied to pressure altitude to produce maximum endurance for the helicopter.

24.1.1.1 Sample Problem for Use of Maximum Endurance – Two Engine Chart (Figure 24-1).



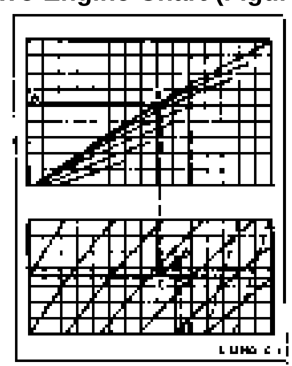
1. Enter bottom of chart at 18,000 pounds gross weight (point A), trace up to 4,000 foot pressure altitude line (point B), then trace left to the fuel consumption scale (point C) and read 870 pounds of fuel per hour.

2. From point B, continue to trace the gross weight line up to the 4,000-foot pressure altitude line in the next block (point D), then trace left to the airspeed scale (point E) and read 66 KCAS and 62 KIAS.

3. From point D, continue to trace the gross weight line up to the 4,000-foot pressure altitude line in the next block (point F), then trace left to the torque scale (point G), and read 44-percent torque.

24.1.2 Hover Endurance – Two-Engine Chart. The hover endurance – two-engine chart (Figure 24-2) provides the fuel flow when gross weight is applied to pressure altitude and OAT to provide hovering endurance.

24.1.2.1 Sample Problem for Use of Hovering Endurance – Two-Engine Chart (Figure 24-2).



1. Enter left side of chart at 18,000 pounds gross weight (point A), trace right to sea-level pressure altitude line (point B), then trace down to the OAT baseline (point C).

2. From point C, follow the guideline to the 20 °C OAT line (point D), then trace down to the fuel-flow scale (point E) and read 1,475 pounds of fuel per hour.

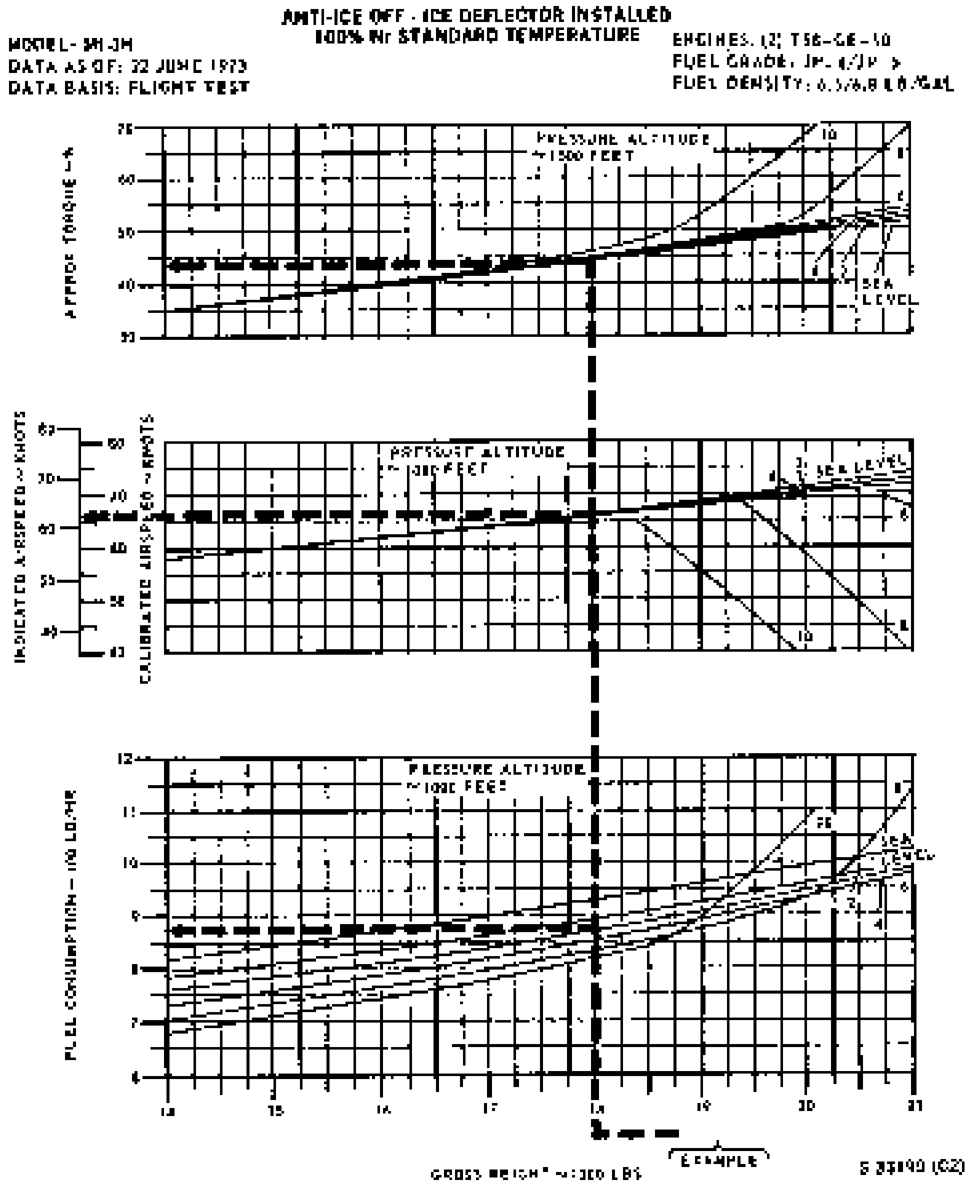


Figure 24-1. Maximum Endurance — Two Engines

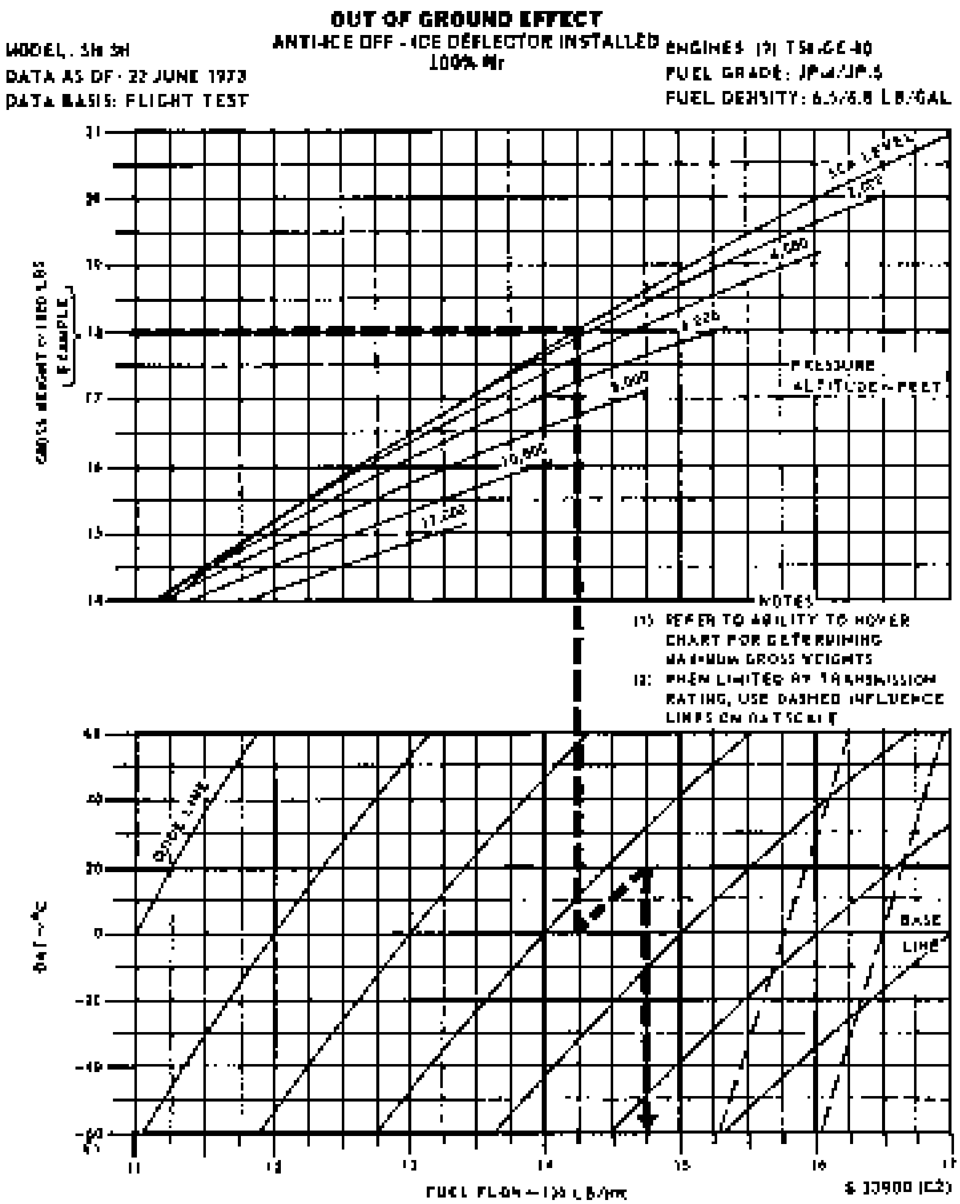


Figure 24-2. Hovering Endurance — Two Engines

This Page Left Blank Intentionally

CHAPTER 25

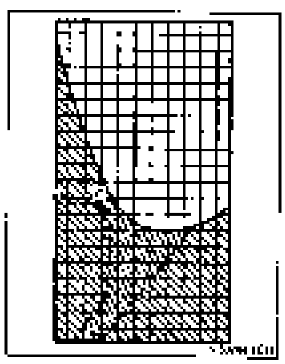
Emergency Operation

25.1 HEIGHT VELOCITY DIAGRAMS

The height velocity diagrams (Figure 25-1 and 25-2) provide the limiting altitude and corresponding airspeed combinations for a safe landing after one or both engines have failed.

25.1.1 Height Velocity Diagram – Two-Engine Failure Chart. The height velocity diagram – two engine failure chart (Figure 25-1) is based on a gross weight of 17,000 and 19,000 pounds, 100-percent N_r, and a standard day temperature at sea level.

25.1.1.1 Sample Problem for Use of Height Velocity Diagram – Two-Engine Failure Chart (Figure 25-1).



1. Enter left of chart at 300-foot altitude (point A) and bottom of chart at 40 KIAS (point B).

2. Trace right from point A and up from point B until the lines intersect at point C and note that sink rate limit of the landing gear may be exceeded.

25.1.2 Height Velocity Diagram – One-Engine Failure Chart. The height velocity diagram – one-engine failure chart (Figure 25-2) is based on gross weights of 15,000, 17,000, and 19,000 pounds; 100-percent N_r; and standard day temperature at sea level. Except for the additional gross weight parameters, the chart uses like factors in the same manner as Figure 25-1.

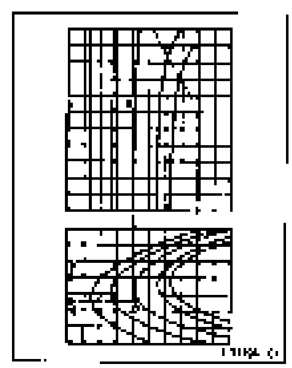
25.2 CLIMB CHARTS

The climb charts – one engine (Figure 25-3 and 25-4) are based on military power and provide one-engine climb data for the helicopter on cold and warm days. The chart uses like factors in the same manner as the climb charts in Chapter 22; therefore, explanatory test and sample problem data are not included.

25.3 ABILITY TO MAINTAIN LEVEL FLIGHT – ONE-ENGINE CHART

The ability to maintain level flight – one-engine chart (Figure 25-5) provides the speed range wherein one-engine level flight may be maintained at various density altitudes and gross weights at a torque value the engine is actually producing.

25.3.1 Sample Problem for Use of Ability To Maintain Level Flight – One-Engine Chart (Figure 25-5).



1. Convert 4,000-foot pressure altitude and 18 °C to 5,800-foot density altitude, then enter left side of chart at 5,800-foot density altitude (point A) and trace right to 18,000 pounds gross weight (point B).

2. From point B, trace down to the airspeed baseline (point C).

3. From point C, follow the influence line down to intersect the 90-percent torque line (point D).

The 90-percent torque available value is provided by Figure 20-6. Enter bottom of chart at 18 °C, proceed upward to intersect the 4,000-foot pressure altitude line, then trace to the left side and read 90-percent torque.

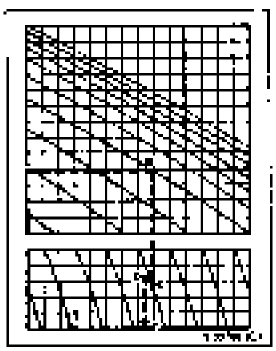
4. From point D, trace left and read V_{min} of 56 KIAS (point E).

5. From point C, follow the influence line up to intersect the 90-percent torque line and read V_{max} at 75 KIAS.

25.4 ABILITY TO MAINTAIN 70 KNOTS AT VARIOUS ROTOR SPEEDS – ONE ENGINE CHART

The ability to maintain 70 knots at various rotor speeds (N_r) – one-engine chart (Figure 25-6) provides the gross weights at which the helicopter can maintain level flight at various pressure altitudes, temperatures, and rotor speeds.

25.4.1 Sample Problem for Use of Ability To Maintain 70 Knots at Various Rotor Speeds – One-Engine Chart (Figure 25-6).



1. Enter left side of chart at 4,000-foot pressure altitude (point A), trace right 20 °C OAT (point B), then trace down to the rotor speed baseline (point C).

2. From point C, follow the influence line to 102-percent N_r (point D), then trace down to the gross weight scale (point E) and read 17,750 pounds.

25.5 RANGE CHART

The maximum range – one-engine chart (Figure 25-7) is based on military power to provide maximum range for the helicopter during one-engine operation. The chart uses like factors in the same manner as the range charts in Chapter 23; therefore, explanatory text and sample problem data are not included.

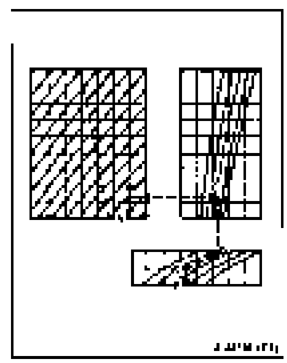
25.6 ENDURANCE CHART

The maximum endurance – one-engine chart (Figure 25-8) provides maximum endurance for the helicopter during one-engine operation. The chart uses like factors in the same manner as the endurance charts in Chapter 24; therefore, explanatory text and sample problem data are not provided.

25.7 LANDING DISTANCE GROUND ROLL – POWER-OFF

The landing distance ground roll – power-off chart (Figure 25-9) provides the landing distance ground roll when pressure altitude, temperature, gross weight, and headwind components are introduced into the chart.

25.7.1 Sample Problem for Use of Landing Distance Ground Roll – Power-Off Chart (Figure 25-9).



1. Enter bottom of chart at 28 °C (point A), then trace up to sea level pressure altitude (point B).

2. From point B, trace right 18,000 pounds gross weight (point C).

3. From point C, trace down to the headwind baseline (point D).

4. From point D, follow the influence line to the 10-knot headwind line (point E).

5. From point E, trace down and read 160 feet ground roll (point F).

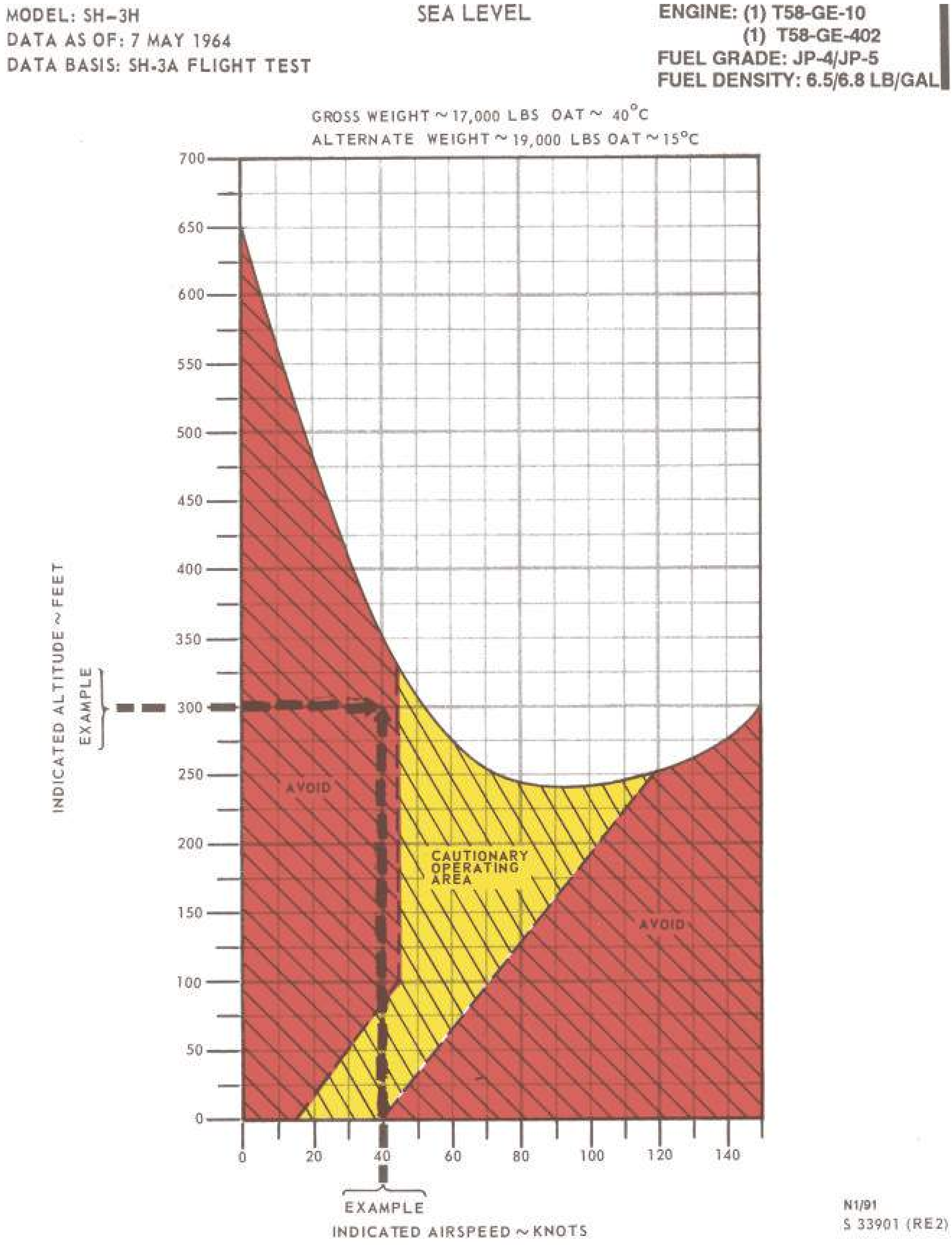


Figure 25-1. Height Velocity Diagram – Two-Engine Failure

SEA LEVEL

MODEL: SH-3H
DATA AS OF: 7 MAY 1964
DATA BASIS: SH-3A FLIGHT TEST

ENGINE: (1) T58-GE-10
(1) T58-GE-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

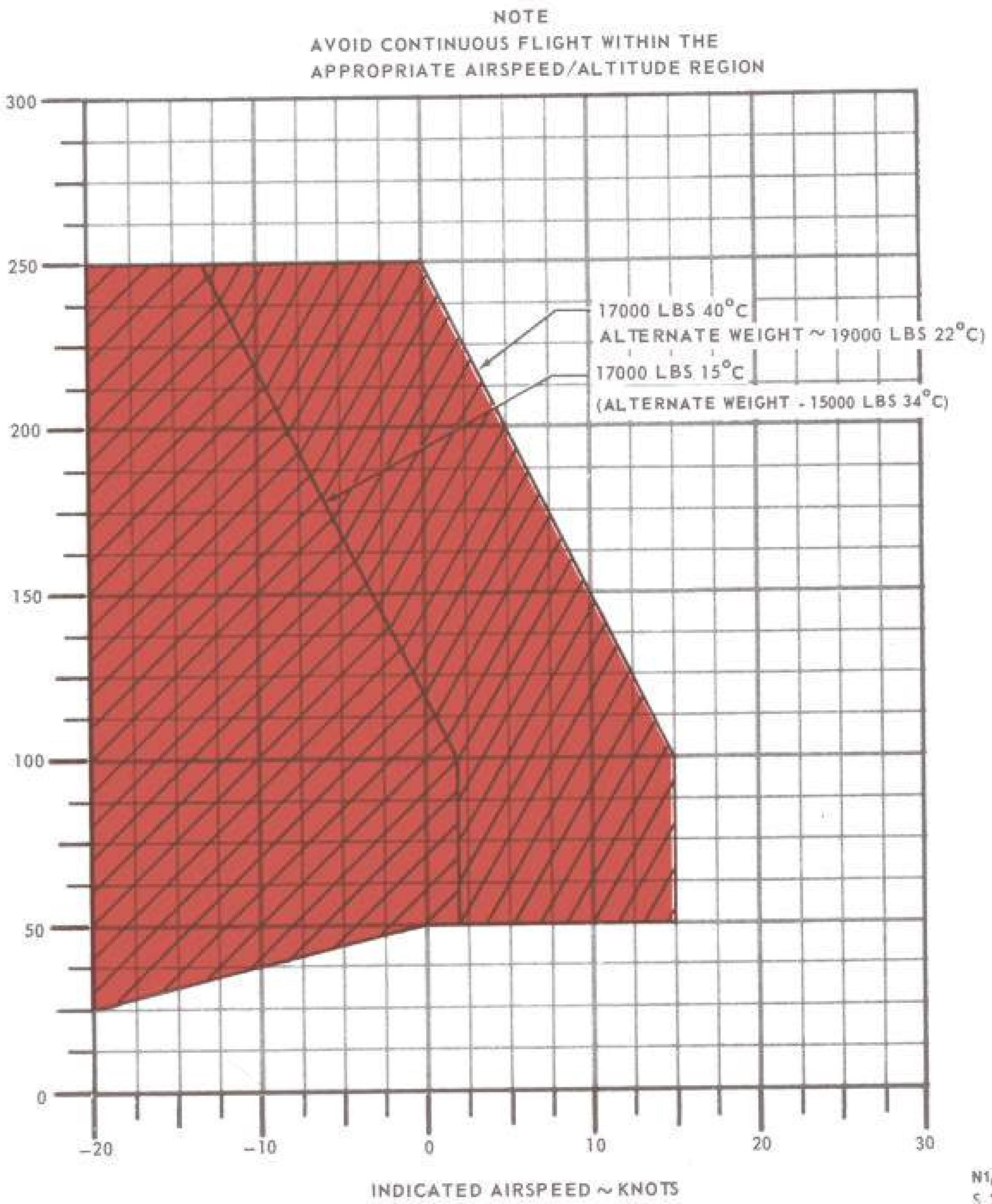


Figure 25-2. Height Velocity Diagram – One-Engine Failure

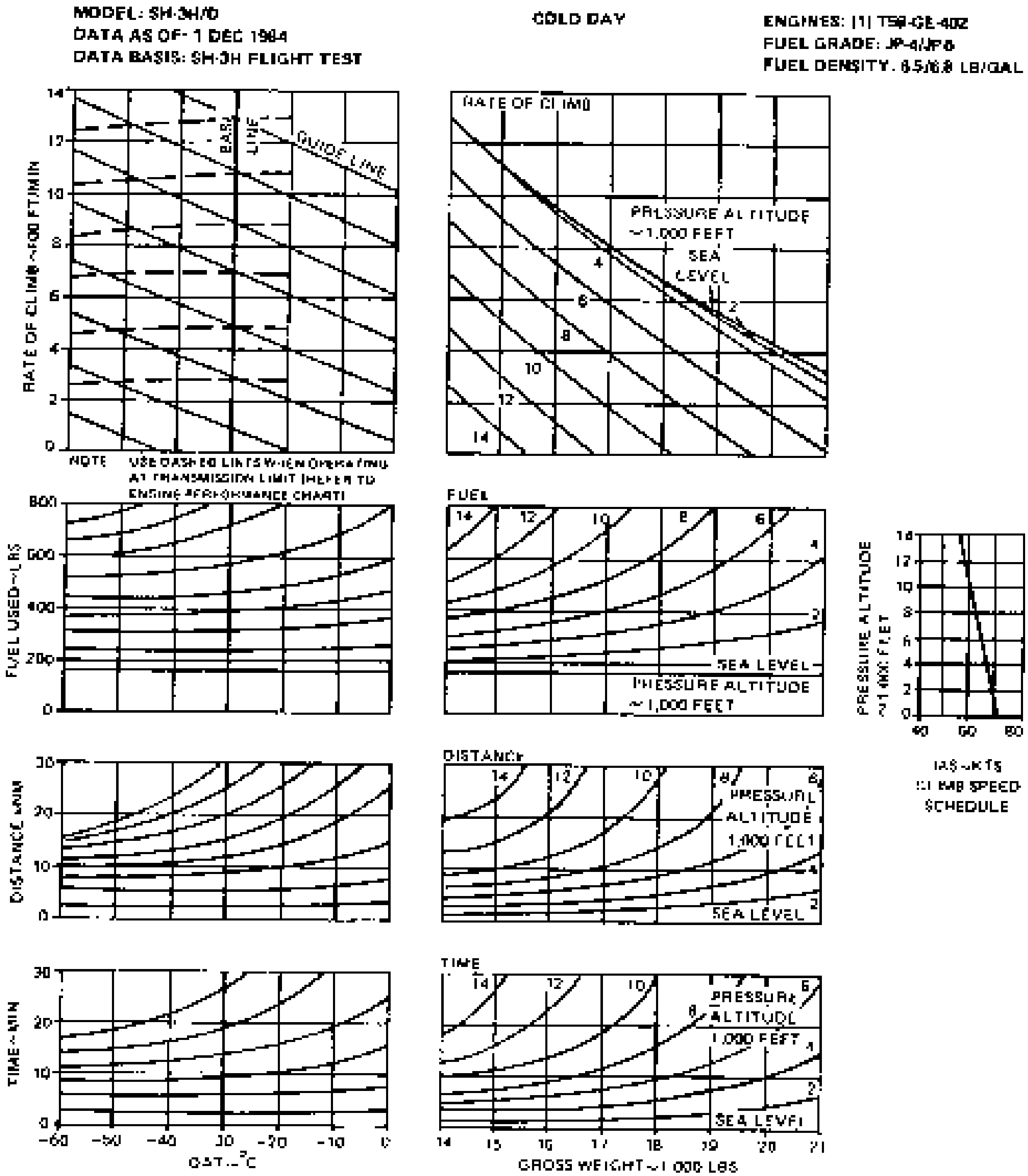


Figure 25-3. Climb — Military Power — One Engine (Cold Day)

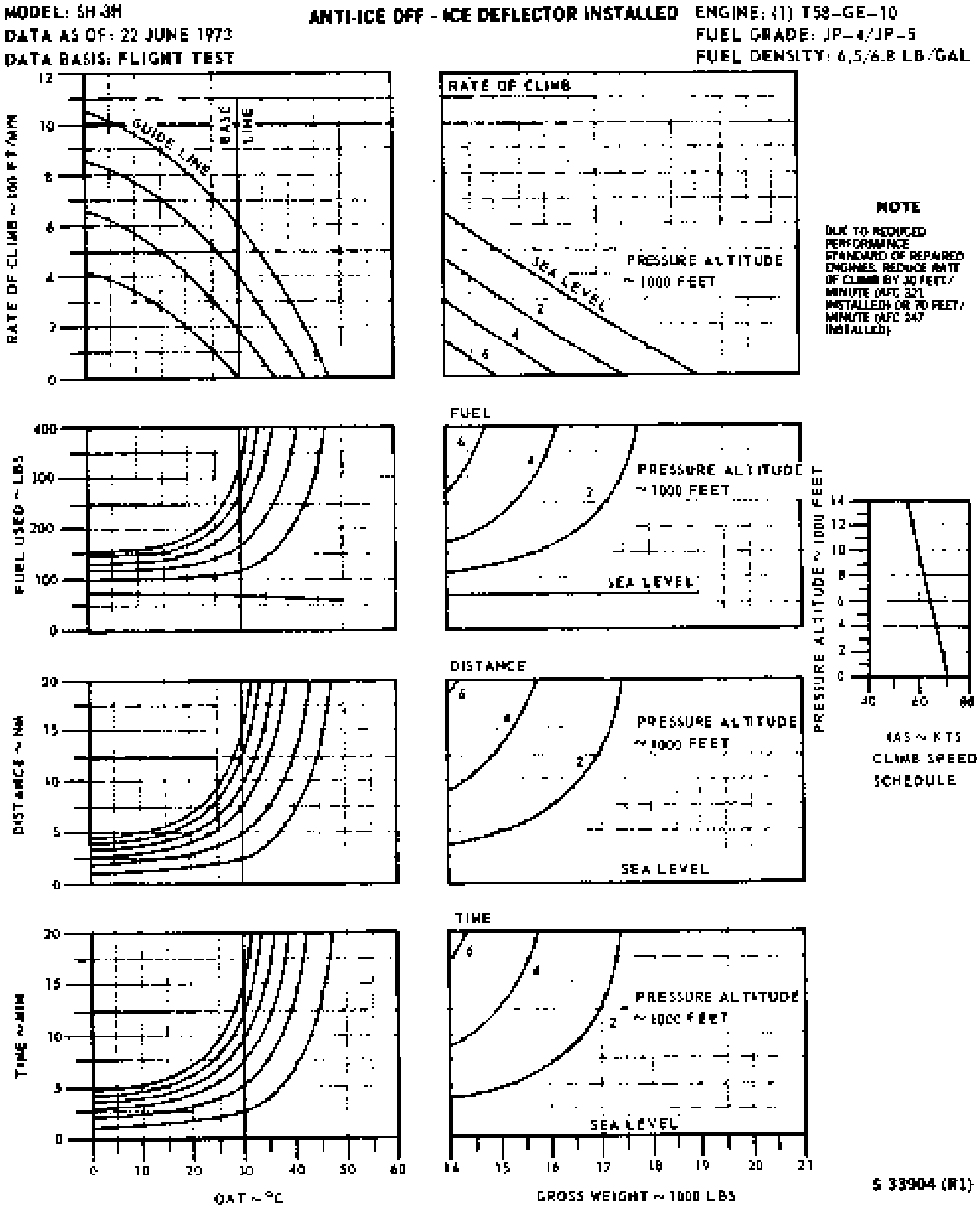


Figure 25-4. Climb — Military Power — One Engine (Warm Day) (Sheet 1 of 2)

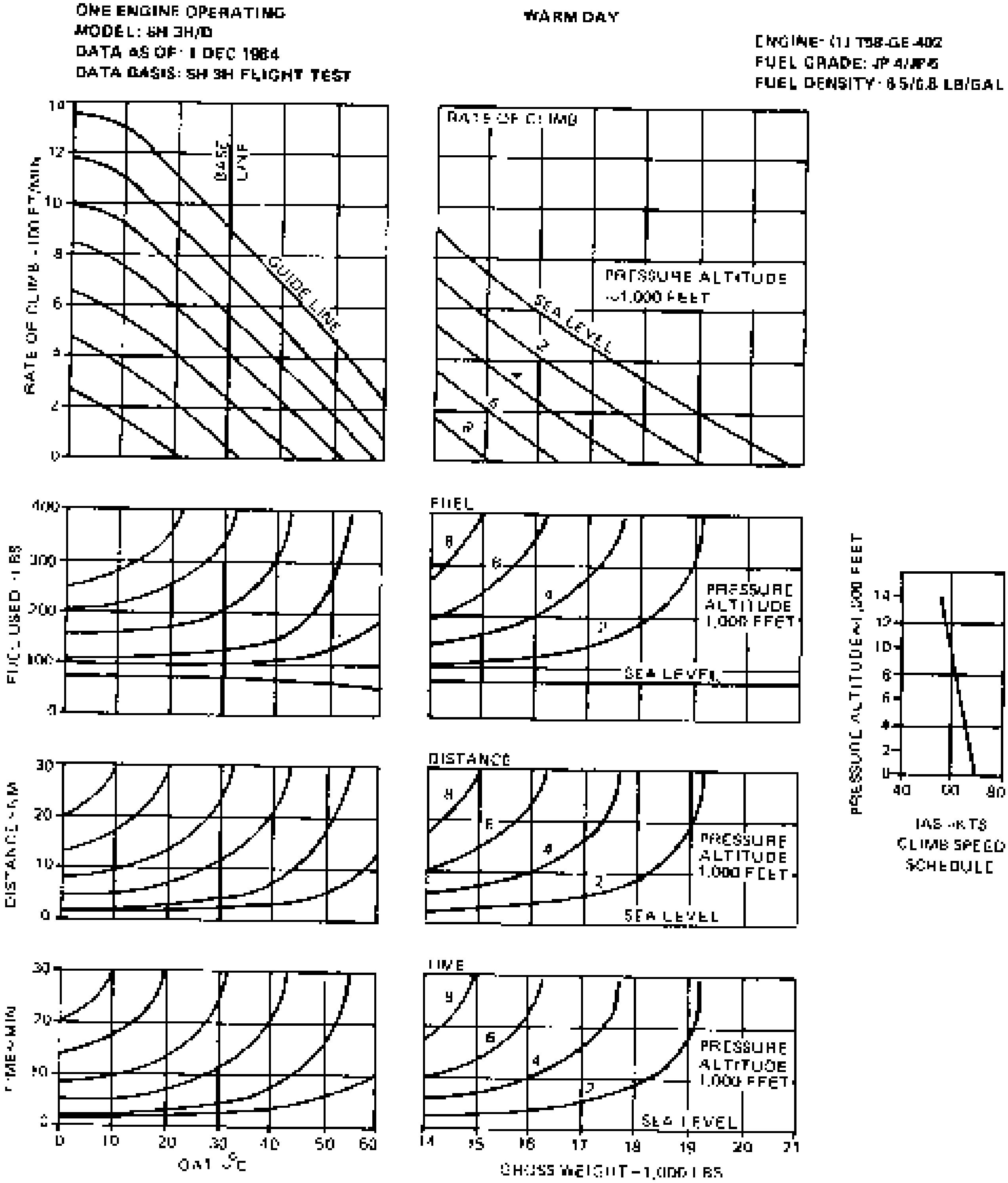


Figure 25-4. Climb — Military Power — One Engine (Warm Day) (Sheet 2 of 2)

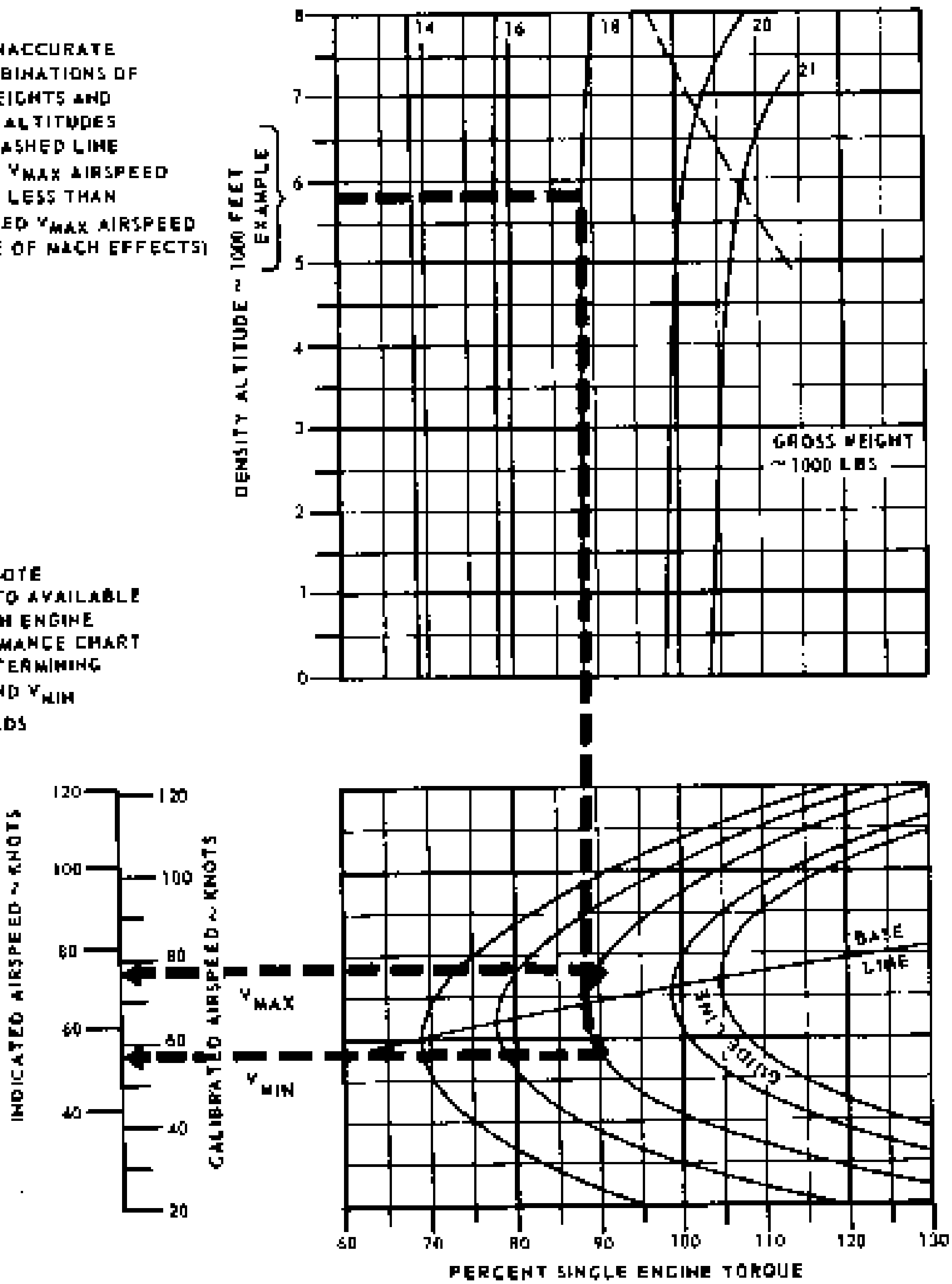
ANTI-ICE OFF - ICE DEFLECTOR INSTALLED
ONE ENGINE OPERATING
100% Nr

MODEL: SH-3H
DATA AS OF: 22 JULY 1973
DATA BASIS: FLIGHT TEST

ENGINE: (1) T58-GE-10
(1) T58-GE-402
FUEL GRADE: JP-4/JP-5
FUEL DENSITY: 6.5/6.8 LB/GAL

CHART INACCURATE FOR COMBINATIONS OF GROSS WEIGHTS AND DENSITY ALTITUDES ABOVE DASHED LINE (ACTUAL V_{MAX} AIRSPEED WILL BE LESS THAN PREDICTED V_{MAX} AIRSPEED BECAUSE OF MACH EFFECTS)

NOTE
REFER TO AVAILABLE POWER IN ENGINE PERFORMANCE CHART FOR DETERMINING V_{MAX} AND V_{MIN} AIRSPEEDS



S 33890 (B

Figure 25-5. Ability To Maintain Level Flight — One Engine

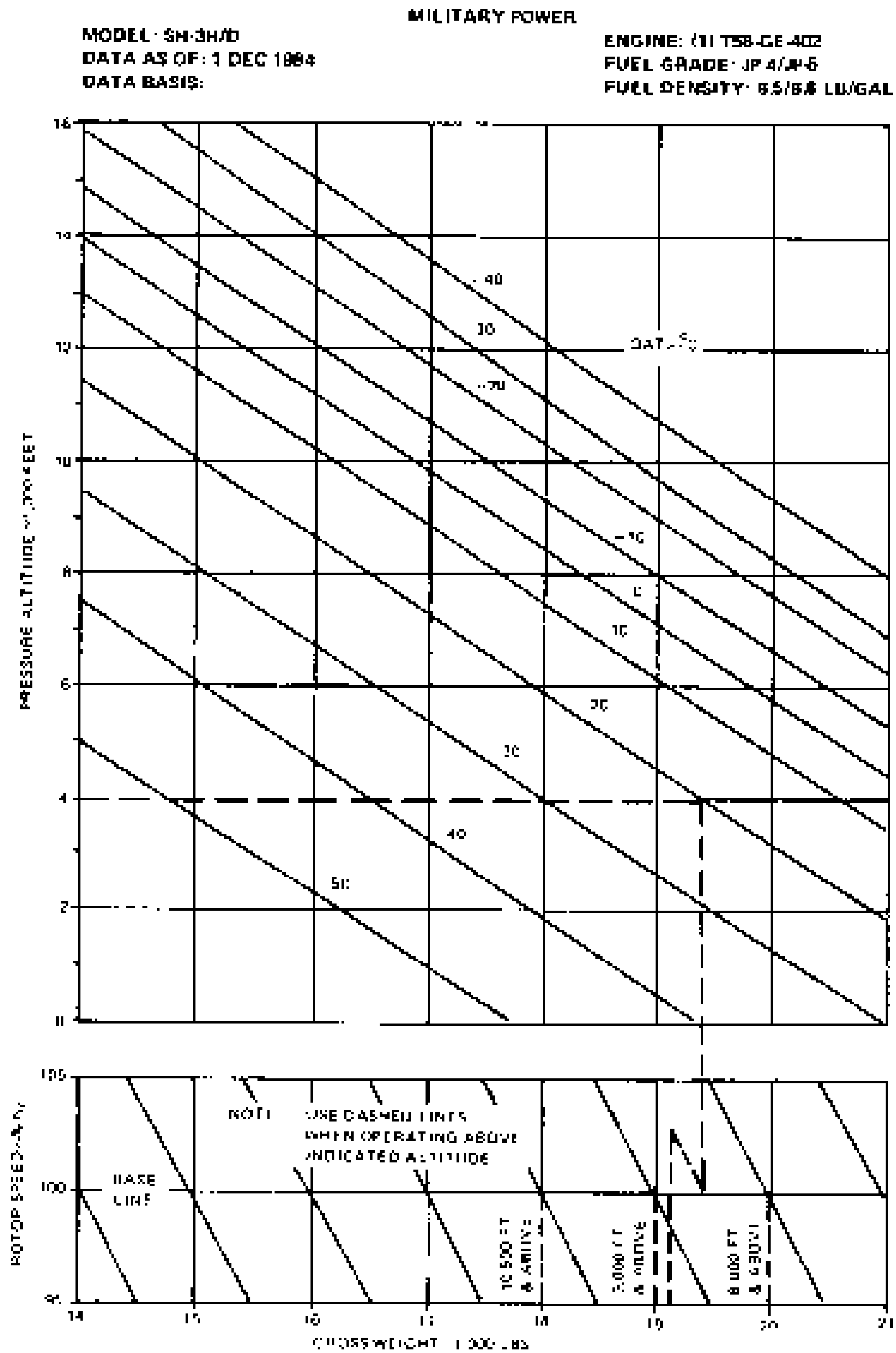


Figure 25-6. Ability To Maintain 70 Knots at Various Rotor Speeds (Nr) — One Engine

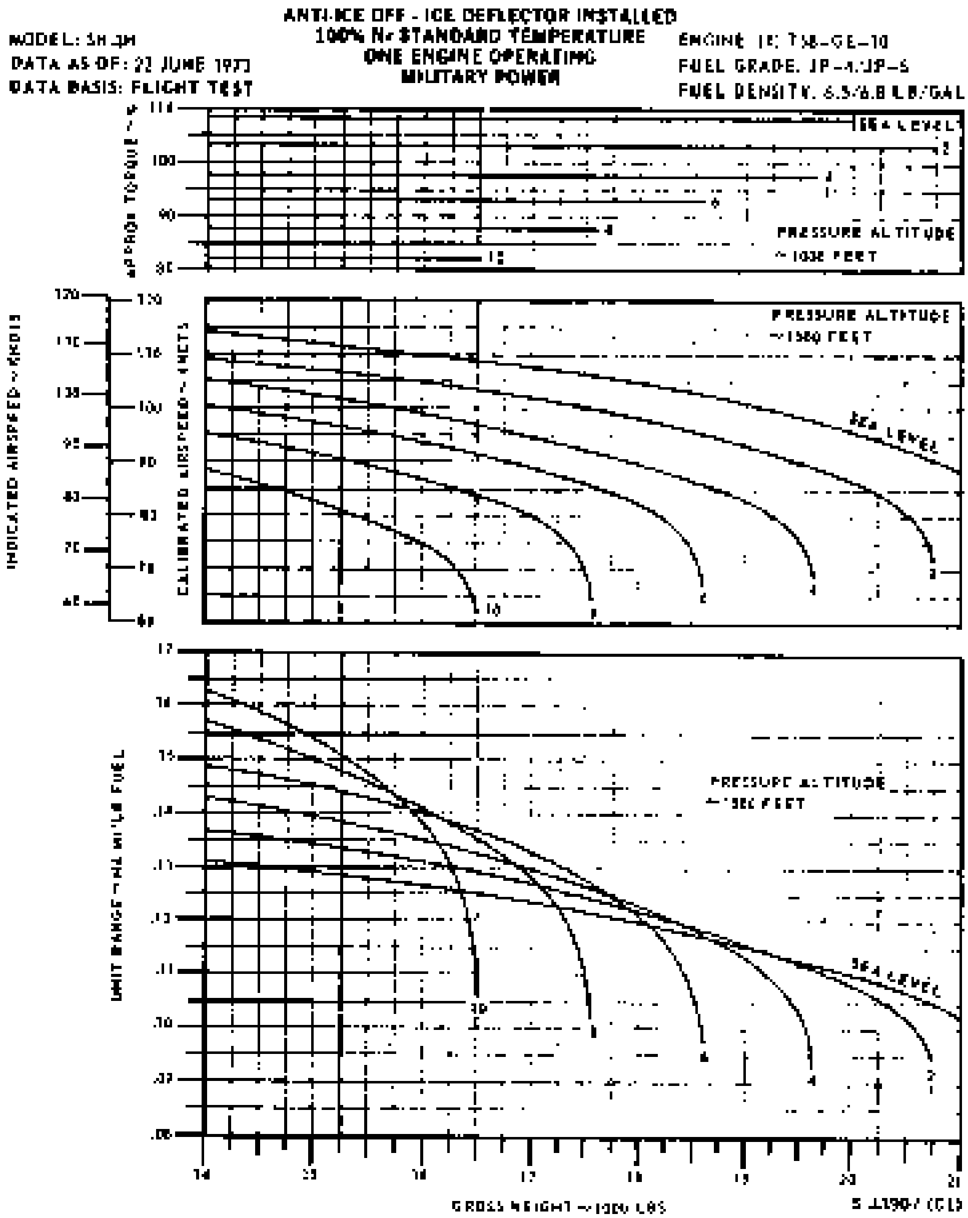


Figure 25-7. Maximum Range — One Engine

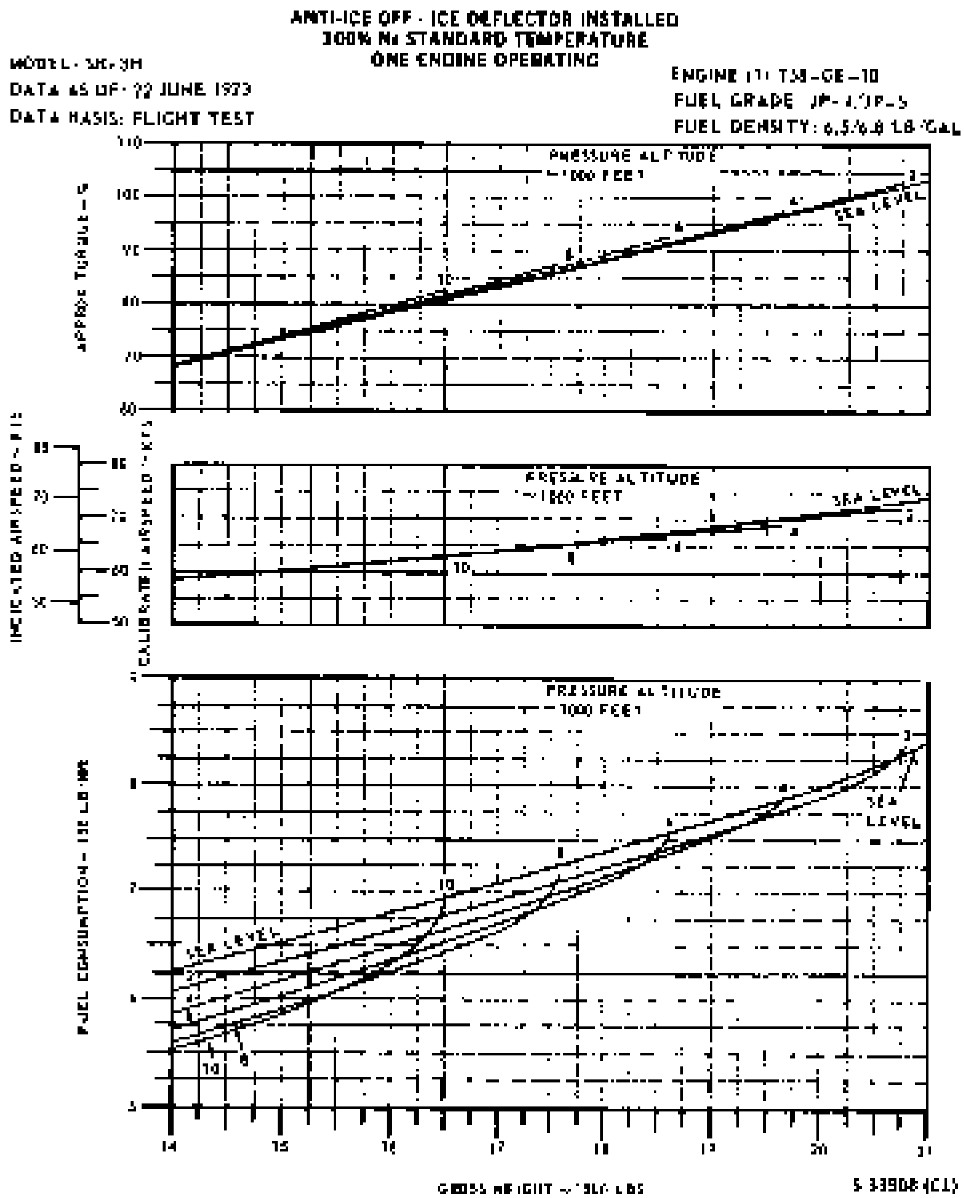


Figure 25-8. Maximum Endurance — One Engine

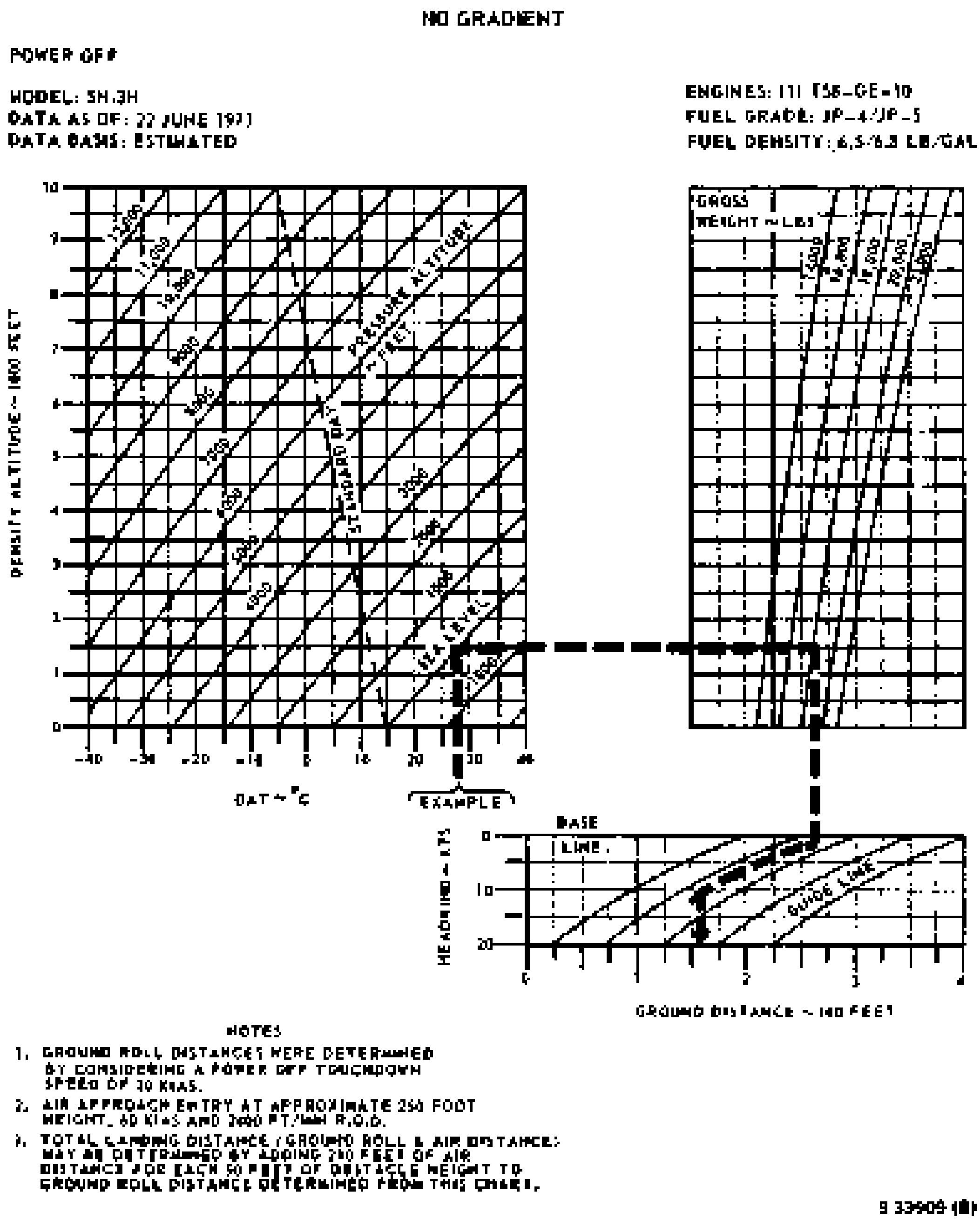


Figure 25-9. Landing Distance Ground Roll – Power-Off

CHAPTER 26

Special Charts

Not applicable.

This Page Left Blank Intentionally

INDEX

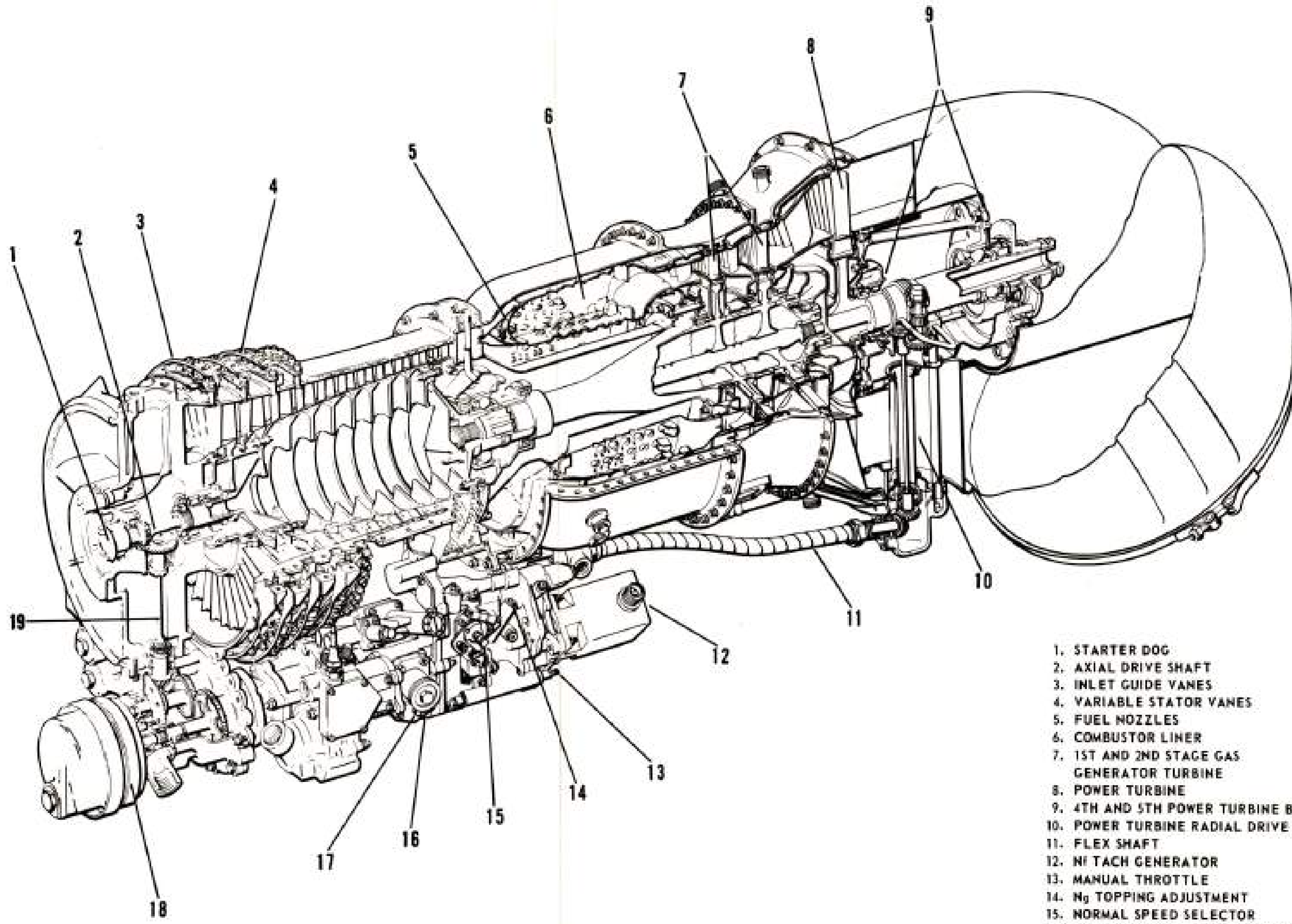
F

S

T

U

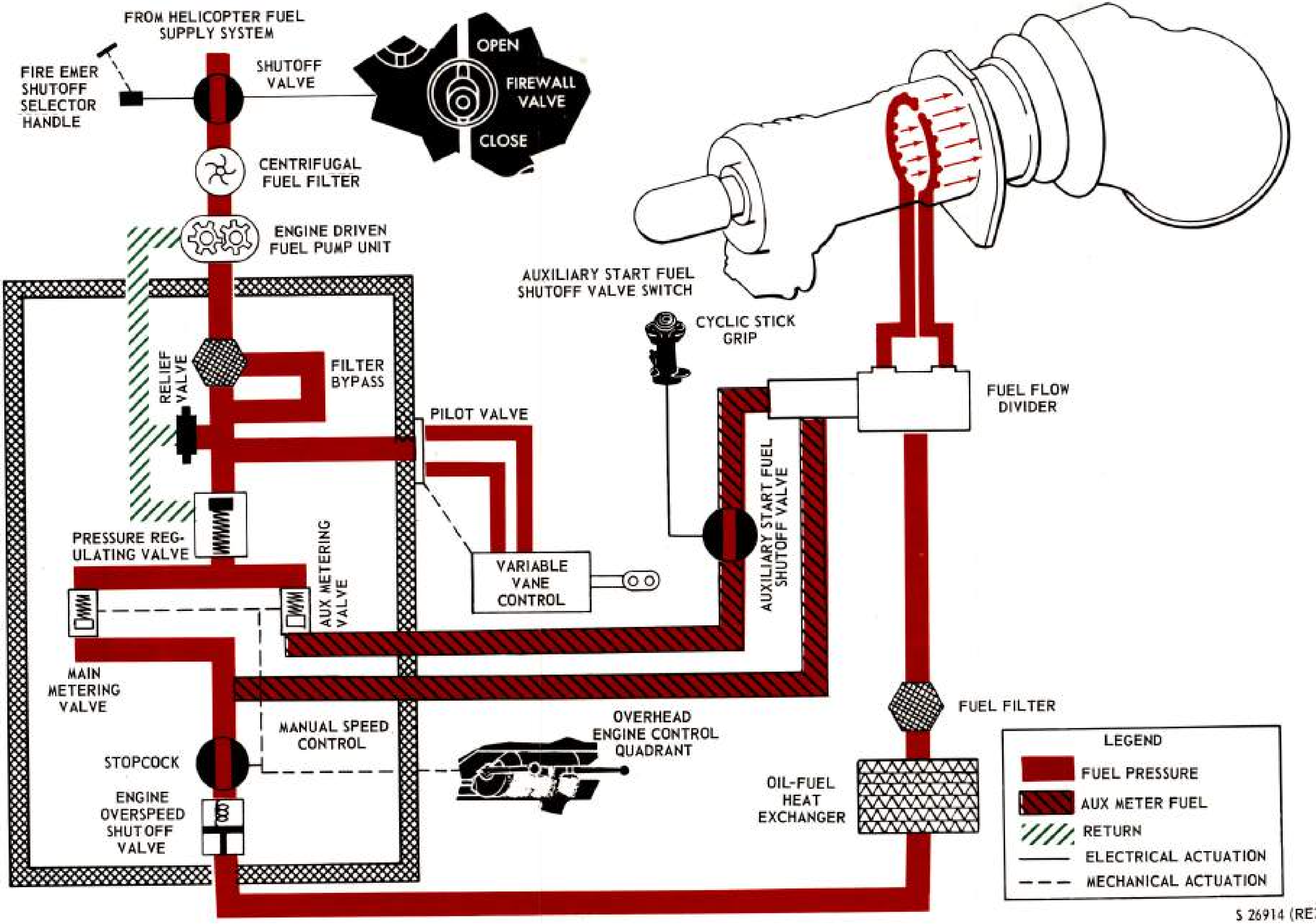
This Page Left Blank Intentionally



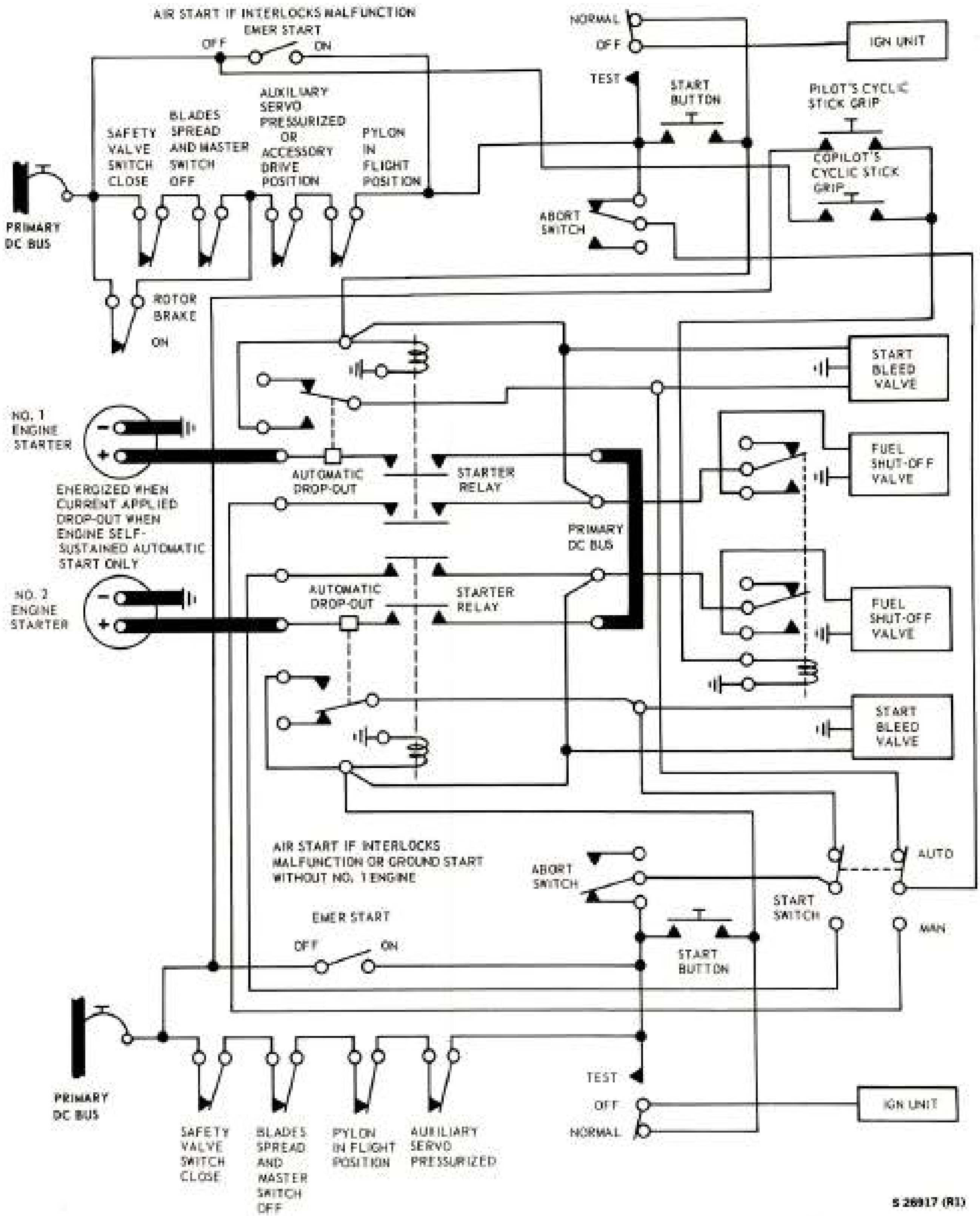
1. STARTER DOG
2. AXIAL DRIVE SHAFT
3. INLET GUIDE VANES
4. VARIABLE STATOR VANES
5. FUEL NOZZLES
6. COMBUSTOR LINER
7. 1ST AND 2ND STAGE GAS GENERATOR TURBINE
8. POWER TURBINE
9. 4TH AND 5TH POWER TURBINE BEARINGS
10. POWER TURBINE RADIAL DRIVE SHAFT
11. FLEX SHAFT
12. Nf TACH GENERATOR
13. MANUAL THROTTLE
14. Ng TOPPING ADJUSTMENT
15. NORMAL SPEED SELECTOR
16. FUEL CONTROL DENSITY ADJUSTMENT
17. FUEL CONTROL FUEL INLET FILTER
18. CENTRIFUGAL FILTER
19. FRONT FRAME RADIAL DRIVE SHAFT

S 28167 (B)

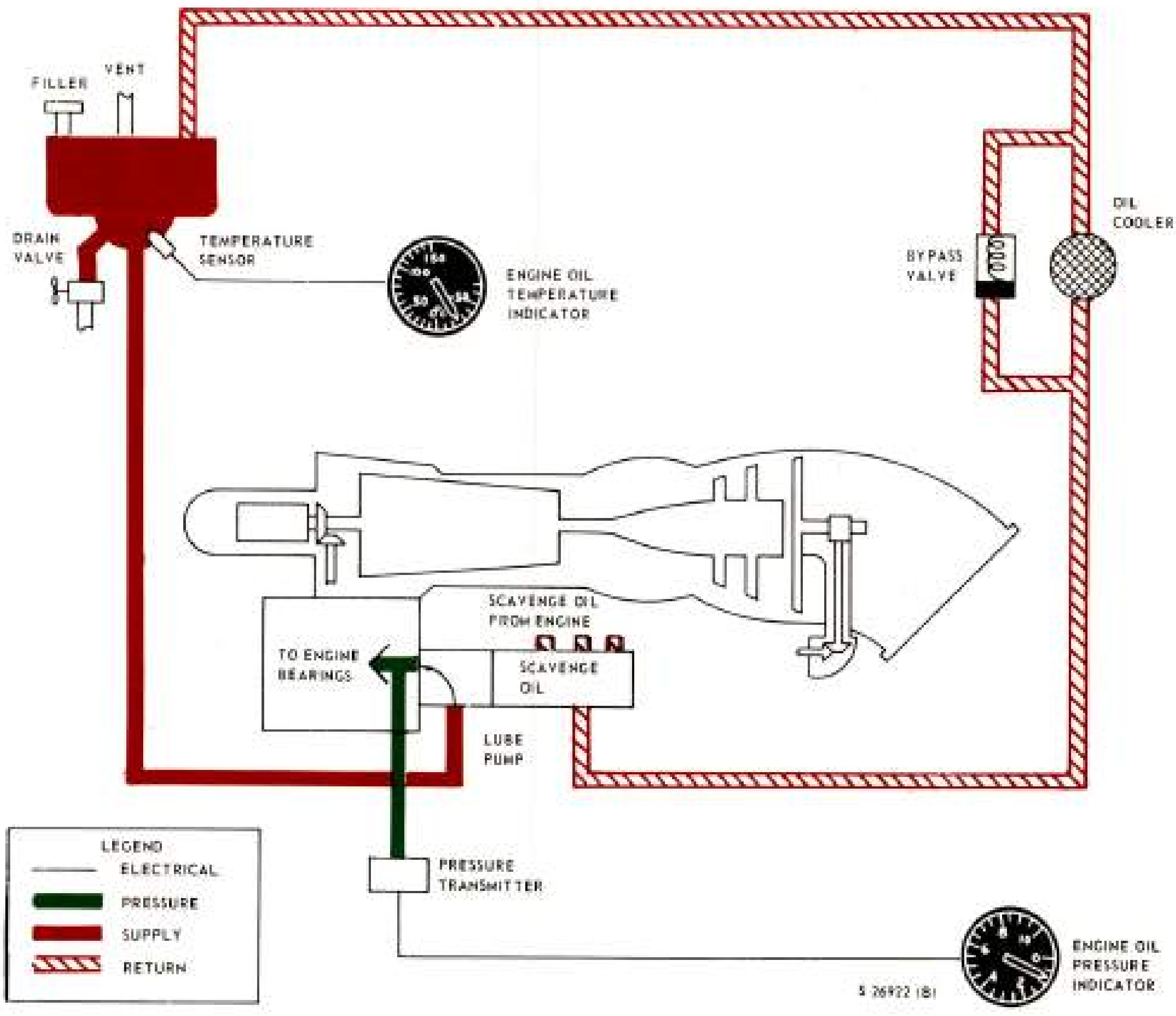
Engine Cutaway View



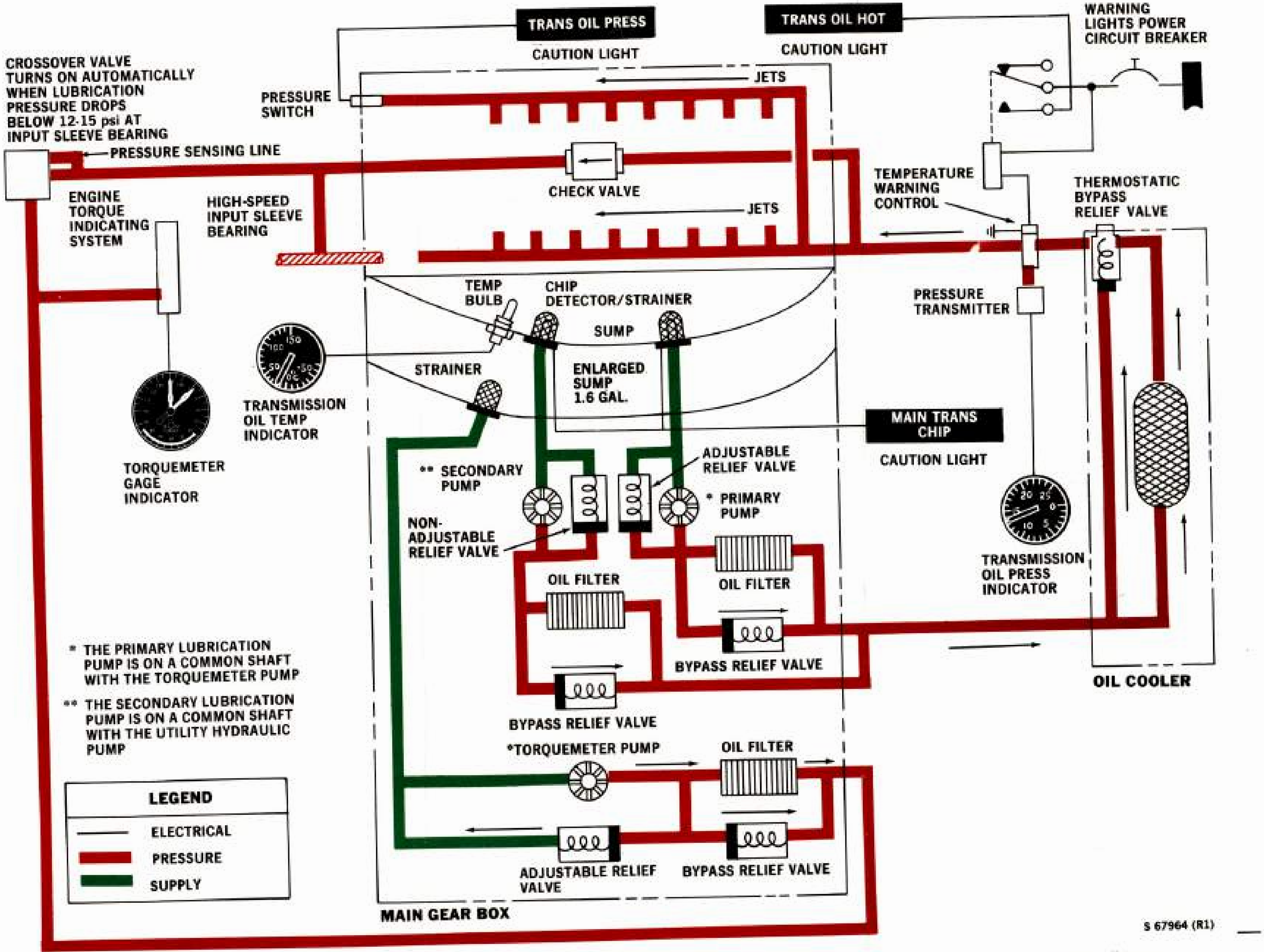
Engine Fuel System



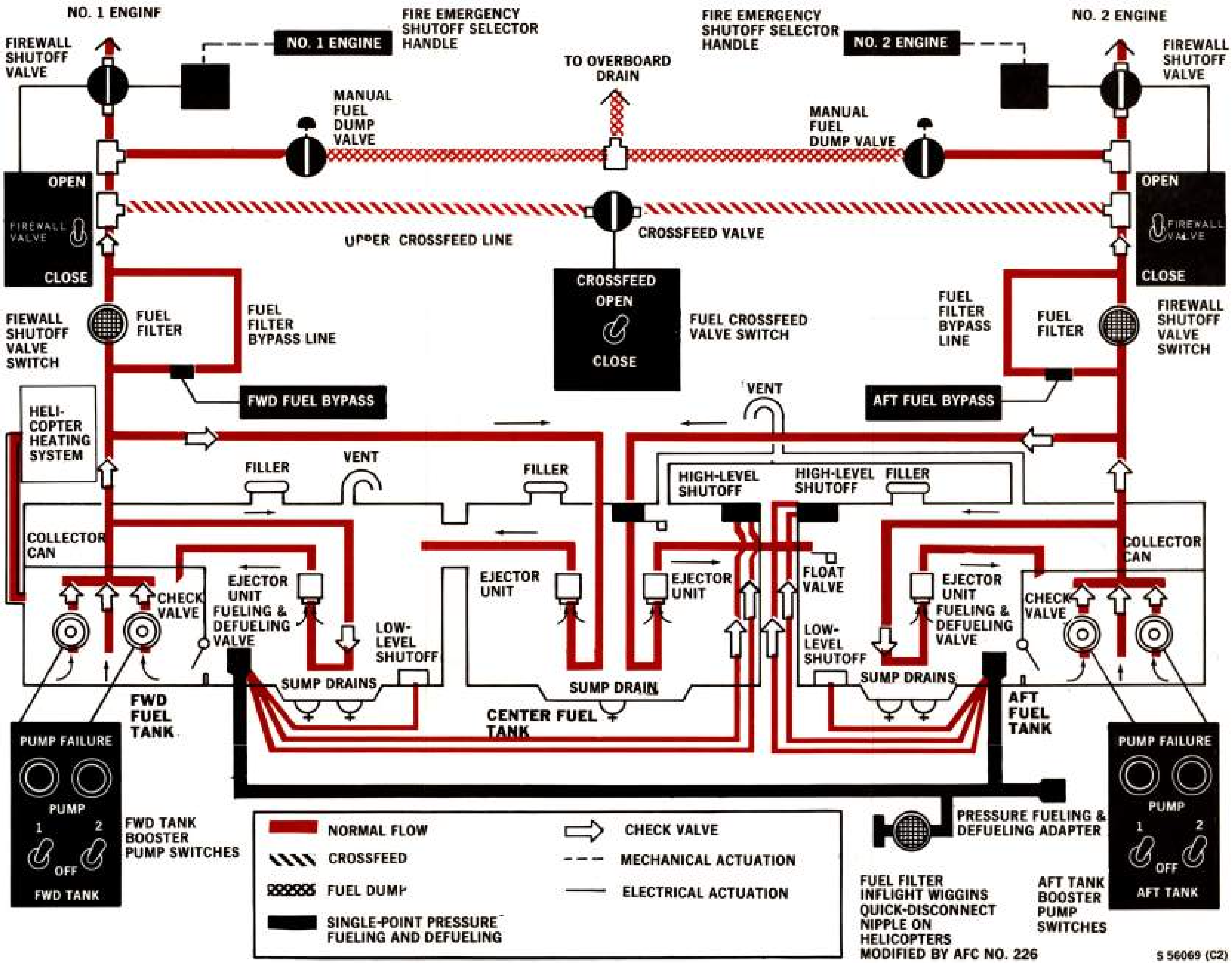
Starting System Diagram



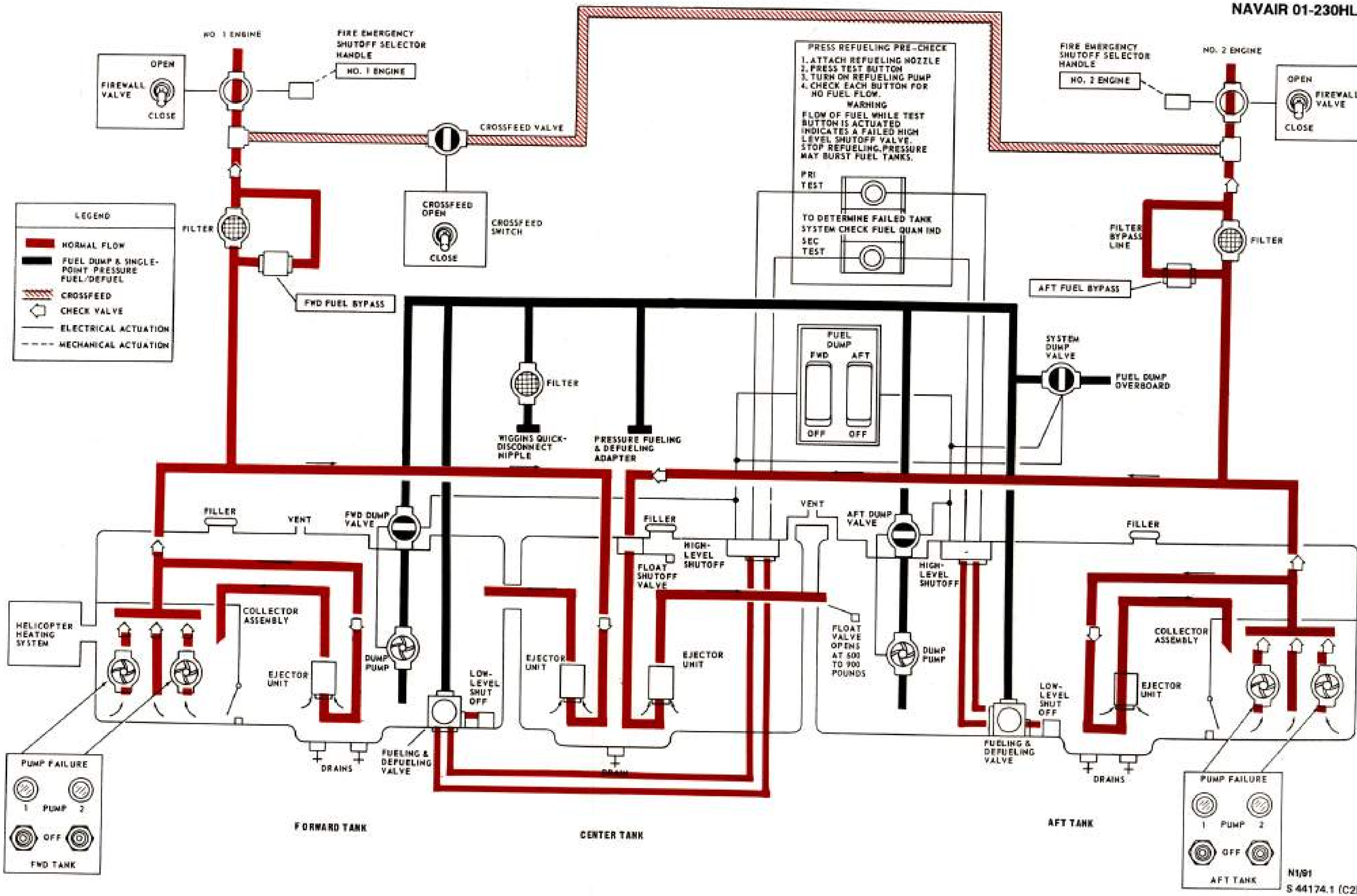
Engine Oil System



Main Gearbox Oil System

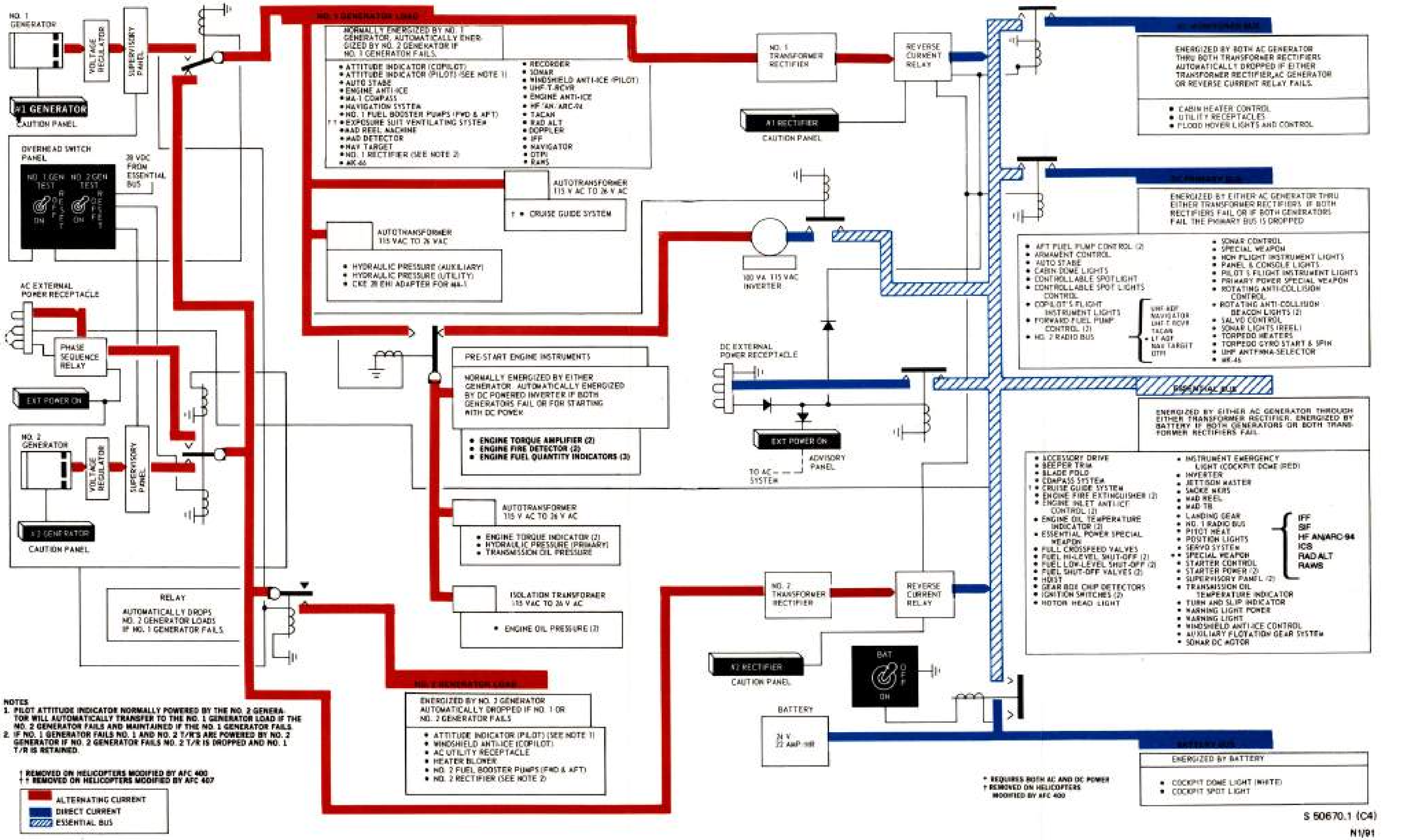


Helicopter Fuel System (SH-3D)

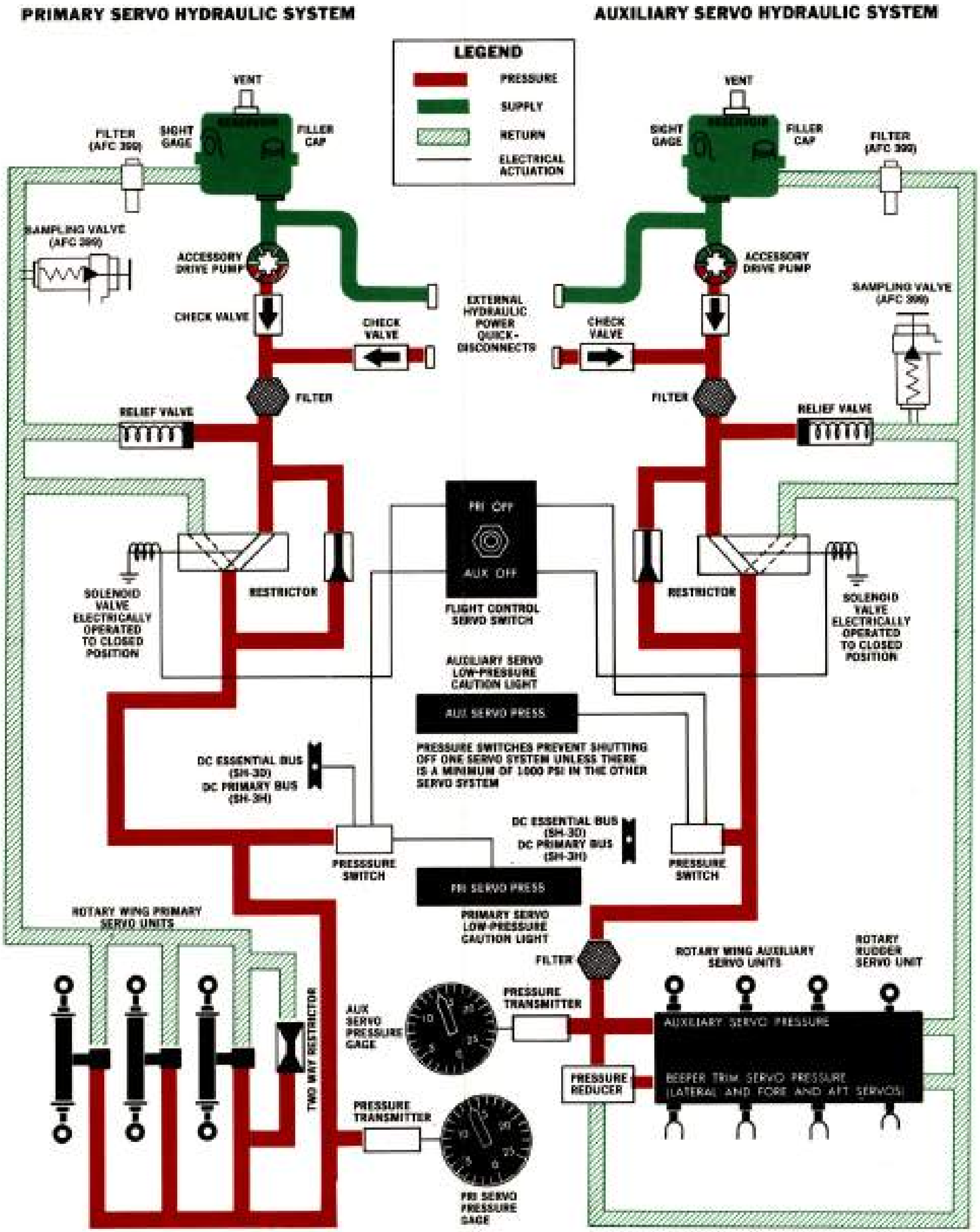


Helicopter Fuel System (SH-3H)

Electrical Power Supply System (SH-3H)

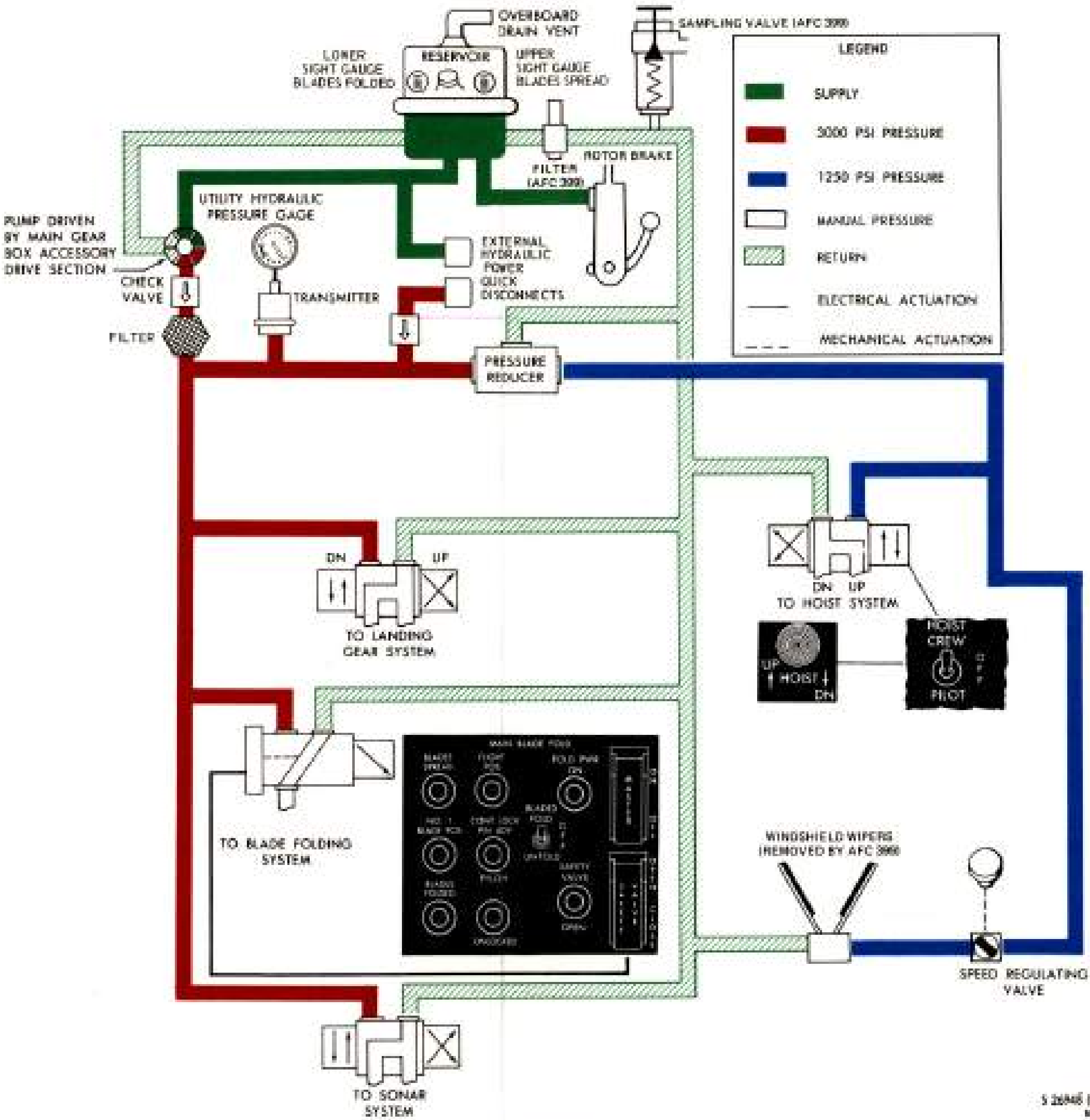


Electrical Power Supply System (SH-3D)



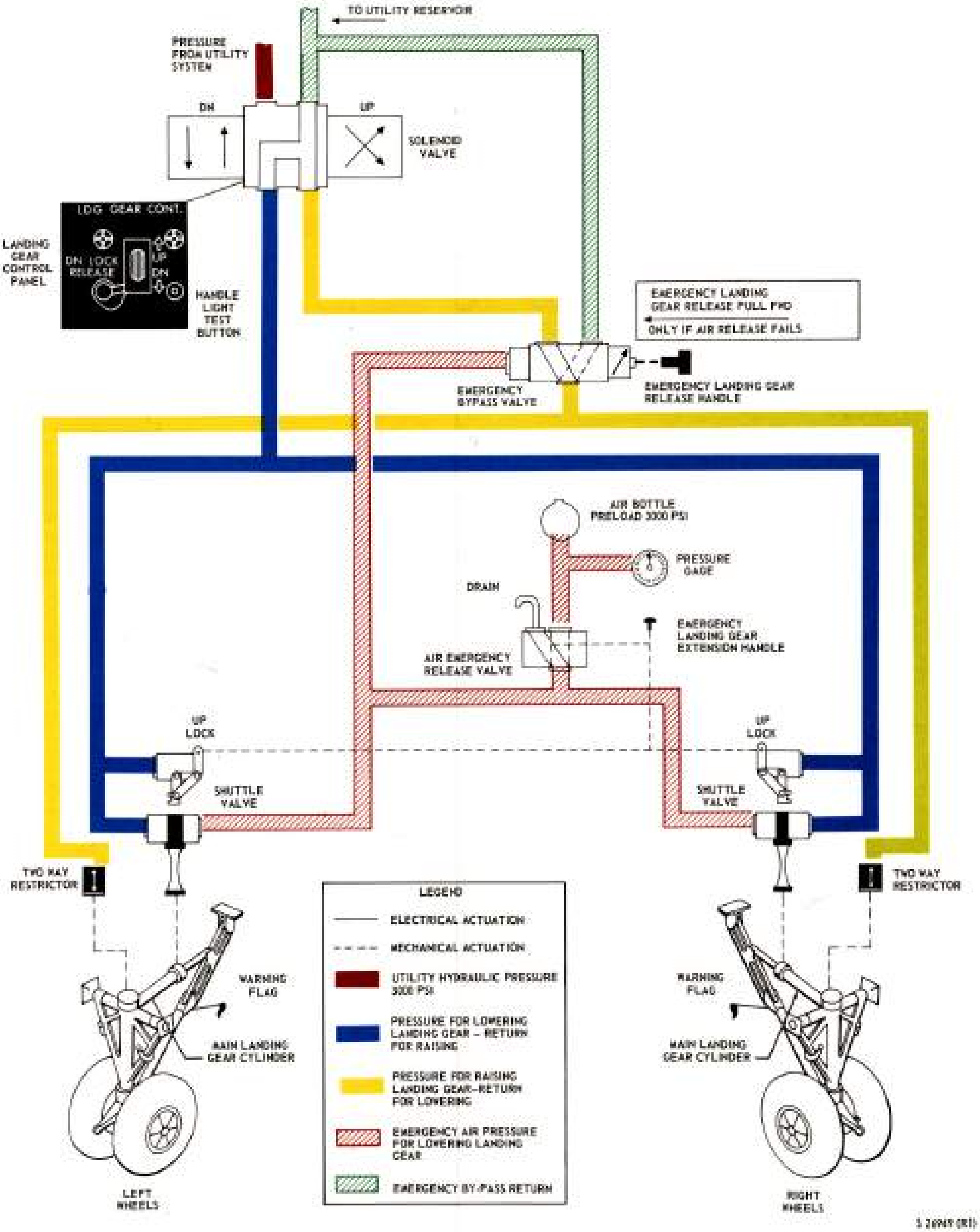
N1/91
S 26939 (R1)

Flight Control Servo Hydraulic System



NAV 01-230HLH-1

Utility Hydraulic System



NAV 01-230HLH-1

Landing Gear Hydraulic System

LIST OF EFFECTIVE PAGES

Effective Pages	Page Numbers
Original	1 (Reverse Blank)
Original	3 (Reverse Blank)
Original	5 thru 33 (Reverse Blank)
Original	35 (Reverse Blank)
Original	37 (Reverse Blank)
Original	39 (Reverse Blank)
Original	41 thru 49 (Reverse Blank)
Original	1-1 thru 1-3 (Reverse Blank)
Original	2-1 thru 2-96
Original	3-1 thru 3-20
Original	4-1 thru 4-12
Original	51 (Reverse Blank)
Original	5-1 thru 5-7 (Reverse Blank)
Original	53 (Reverse Blank)
Original	6-1 thru 6-5 (Reverse Blank)
Original	7-1 thru 7-45 (Reverse Blank)
Original	8-1 thru 8-16
Original	9-1 thru 9-16
Original	10-1 thru 10-56
Original	55 (Reverse Blank)
Original	11-1 thru 11-11 (Reverse Blank)
Original	57 (Reverse Blank)
Original	12-1 thru 12-65 (Reverse Blank)
Original	59 (Reverse Blank)
Original	13-1 thru 13-4
Original	14-1 thru 14-3 (Reverse Blank)
Original	61 (Reverse Blank)
Original	15-1 thru 15-41 (Reverse Blank)
Original	63 (Reverse Blank)

Effective Pages	Page Numbers
Original	16-1 thru 16-20
Original	17-1 thru 17-71 (Reverse Blank)
Original	65 (Reverse Blank)
Original	18-1 thru 18-29 (Reverse Blank)
Original	67 (Reverse Blank)
Original	19-1 thru 19-14
Original	69 (Reverse Blank)
Original	20-1 thru 20-15 (Reverse Blank)
Original	21-1 thru 21-6
Original	22-1 thru 22-6
Original	23-1 thru 23-8
Original	24-1 thru 24-3 (Reverse Blank)
Original	25-1 thru 25-14
Original	26-1 (Reverse Blank)
Original	Index-1 thru Index-13 (Reverse Blank)
Original	FO-1 (Reverse Blank)
Original	FO-2 (Reverse Blank)
Original	FO-3 (Reverse Blank)
Original	FO-4 (Reverse Blank)
Original	FO-5 (Reverse Blank)
Original	FO-6 (Reverse Blank)
Original	FO-7 (Reverse Blank)
Original	FO-8 (Reverse Blank)
Original	FO-9 (Reverse Blank)
Original	FO-10 (Reverse Blank)
Original	FO-11 (Reverse Blank)
Original	FO-12 (Reverse Blank)
Original	LEP-1 (Reverse Blank)