Technical Manual

Aviation Unit and Intermediate Troubleshooting Manual

for

ARMY
AH–64A HELICOPTER
(NSN 1520–01–106–9519) (EIC: RHA)

CHAPTER 1 Introduction

CHAPTER 2 Airframe

CHAPTER 3 Landing Gear System

CHAPTER 4 Power Plants

CHAPTER 5 Rotors

CHAPTER 6 Drive System

SUPERSEDURE NOTICE: This manual supersedes TM 55–1520–238–T–1, dated 15 DECEMBER 1985, including all changes.

HEADQUARTERS, DEPARTMENT OF THE ARMY
30 April 1992

CHANGE NO. 10

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 15 February 2002

TECHNICAL MANUAL
AVIATION UNIT AND INTERMEDIATE
TROUBLESHOOTING MANUAL
FOR
ARMY MODEL AH-64A HELICOPTER
NSN: (1520-01-106-9519) EIC: (RHA)

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

OZONE DEPLETING CHEMICAL INFORMATION

This document has been reviewed for the presence of Class I Ozone depleting chemicals. As of Change 8 dated 19 December 1997, all references to Class I Ozone depleting chemicals have been removed from this document by substitution with chemicals that do not cause atmospheric Ozone depletion.

TM 1-1520-238-T-4, 30 April 1992, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
A and B	A and B
i through iv	i through iv
1-11 and 1-12	1-11 and 1-12
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6-91 and 6-92	6-91 and 6-92
6-155 and 6-156	6-155 and 6-156

2. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

ERIC K. SHINSEKI
General, United States Army
Chief of Staff

Official:

Joel B. Hudson

JOEL B. HUDSON
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CHANGE NO. 9

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TECHNICAL MANUAL
AVIATION UNIT AND INTERMEDIATE
TROUBLESHOOTING MANUAL
FOR
ARMY MODEL
AH-64A HELICOPTER
NSN: (1520-01-106-9519) EIC: (RHA)

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Remove pages	Insert pages
———	A and B
5-1 and 5-2	5-1 and 5-2
5–11 and 5–12	5–11 and 5–12
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———	5-35 through 5-66

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CHANGE
NO. 8

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TECHNICAL MANUAL
AVIATION UNIT AND INTERMEDIATE
TROUBLESHOOTING MANUAL
FOR
ARMY MODEL
AH-64A HELICOPTER
NSN: (1520-01-106-9519) EIC: (RHA)

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Remove pages	Insert pages
a and b	a and b
i and ii	i and ii
ix and x	ix and x
4-57 and 4-58	4-57 and 4-58
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6-82.19 through 6-82.22	6-82.19 through 6-82.22
Electronic 2028	Electronic 2028
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TECHNICAL MANUAL
AVIATION UNIT AND INTERMEDIATE
TROUBLESHOOTING MANUAL
FOR
ARMY MODEL
AH-64A HELICOPTER
NSN: (1520-01-106-9519) EIC: (RHA)

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Remove pages	Insert pages
i and ii	i and ii
ix and x	ix and x
4–25 and 4–26	4–25 and 4–26
4–65 and 4–66	4–65 and 4–66
4–73 and 4–74	4–73 and 4–74
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6–20.1/(6–20.2 blank)	6–20.1/(6–20.2 blank)
6–45 through 6–48	6–45 through 6–48

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AVIATION UNIT AND INTERMEDIATE
TROUBLESHOOTING MANUAL
FOR
ARMY MODEL
AH–64A HELICOPTER
NSN: (1520–01–106–9519) EIC: (RHA)

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Remove pages	Insert pages
1–11 and 1–12	1–11 and 1–12

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AVIATION UNIT AND INTERMEDIATE
TROUBLESHOOTING MANUAL
FOR
ARMY MODEL
AH–64A HELICOPTER
NSN (1520–01–106–9519) EIC: (RHA)

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Remove pages	Insert pages
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6–117 and 6–118	6–117 and 6–118
6–157 through 6–164	6–157 through 6–164

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CHANGE NO. 4

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WASHINGTON, D.C., 30 DECEMBER 1993

AVIATION UNIT AND INTERMEDIATE
TROUBLESHOOTING MANUAL

FOR

ARMY MODEL
AH–64A HELICOPTER
NSN: (1520–01–106–9519) EIC: (RHA)

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Remove pages	Insert pages
i and ii	i and ii
vii through x	vii through x
4–9 and 4–10	4–9 and 4–10
– – – –	4–10.1/(4–10.2 blank)
4–75 and 4–76	4–75 and 4–76
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6–77 and 6–78	6–77 and 6–78
6–161 through 6–164	6–161 through 6–164
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CHANGE
NO. 3

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WASHINGTON, D.C., 7 July 1993

AVIATION UNIT AND INTERMEDIATE
TROUBLESHOOTING MANUAL
FOR
ARMY MODEL
AH–64A HELICOPTER
NSN (1520–01–106–9519) EIC: (RHA)

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Remove pages	Insert pages
ix and x	ix and x
4–57 and 4–58	4–57 and 4–58
4–67 and 4–68	4–67 and 4–68
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————	6–168.1 and 6–168.2
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CHANGE
NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 15 January 1993

Aviation Unit and Intermediate
Maintenance Manual

AH–64A HELICOPTER

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Remove pages	Insert pages
vii and viii	vii and viii
ix and x	ix and x
xi/(xii blank)	xi/(xii blank)
4–49 and 4–50	4–49 and 4–50
4–61 and 4–62	4–61 and 4–62
5–21 and 5–22	5–21 and 5–22
5–25 and 5–26	5–25 and 5–26
5–27 and 5–28	——
6–57 and 6–58	6–57 and 6–58

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CHANGE
NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 30 December 1992

AVIATION UNIT AND INTERMEDIATE TROUBLESHOOTING MANUAL

FOR

ARMY MODEL
AH–64A HELICOPTER
NSN: (1520–01–106–9519) EIC: (RHA)

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1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
vii and viii	vii and viii
4–57 through 4–60	4–57 through 4–60
4–65 through 4–68	4–65 through 4–68
4–79 through 4–82	4–79 through 4–82
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6–151 through 6–154	6–151 through 6–154
6–167 and 6–168	6–167 and 6–168

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The WARNINGS on these pages are to notify you of operating or maintenance procedures, practices or conditions, which, if not strictly observed, could result in long term health hazards, injury or death to personnel. If injury occurs, seek medical aid immediately. These WARNINGS must be obeyed by all personnel using this volume.

WARNING

NOISE

Personnel in the area of jet engine operation will wear approved ear protection to protect their hearing.

WARNING

ELECTRICAL POWER

- Voltages used may cause arcing. Remove rings, watches, and other jewelry which may cause a shock/burn hazard.
- Voltages used may cause severe shock or death on contact. Use caution to avoid contact with energized components.
- Turn off power before detaching or attaching wires and connectors. Failure to do so could result in death or serious injury.
- When opening a circuit breaker during system checks, tag circuit breaker to prevent unforeseen closing, which may cause injury or death to personnel.
- For artificial respiration, refer to FM 21–11.

WARNING

PITOT TUBES

Do not touch Pitot tubes when heating switch is set to on. Heaters in Pitot tubes can cause serious burns.

WARNING

JET ENGINE FUEL

Jet engine fuel is explosive, flammable, and toxic to skin, eyes, and respiratory tract. Work in a well–ventilated area away from open flames. Wear protective clothing. If fuel comes in contact with eyes or skin, flush with water and get medical aid.

WARNING

GRAVITY REFUELING/DEFUELING OPERATIONS

Set REFUEL VALVE switch to OPEN during gravity refueling/defueling operations prior to opening fuel cell filler cap to prevent cap and fuel being forced out of filler neck by nitrogen inerting unit–pressurized air in fuel cell. Failure to do so may result in fuel spillage.

WARNING

CHECKING FUEL CROSSFEED/BOOST SYSTEM

Make sure all personnel are clear of aft deck and engine nacelles 1 and 2 before checking fuel crossfeed/boost system. Failure to do so may result in fire extinguishing agent being sprayed on personnel.

WARNING

FIRE EXTINGUISHING AGENT

- **Fire extinguishing agent can burn eyes and skin or cause oxygen deficiency in a closed environment. Wear safety glasses whenever working around fire bottles. In case of accidental discharge of fire extinguishing agent, wash exposed skin with fresh water and ventilate if discharge occurs in a closed environment. If exposure occurs, seek medical aid immediately.**
- **When using a fire extinguisher in an enclosed area, wear a respirator. If fire extinguisher is discharged, ventilate space as soon as possible. Serious personal injury could occur if vapors are inhaled.**

WARNING

SOLVENTS AND CHEMICALS (INCLUDING HYDRAULIC FLUID)

Solvents and chemicals, including hydraulic fluid, are flammable and toxic to eyes, skin, and respiratory tract. Skin and eye protection is required. Use solvents and chemicals only with adequate ventilation. If solvents or chemicals touch the eyes or skin, flush with water and seek medical aid immediately.

WARNING

HYDRAULIC PRESSURE

Hydraulic system operates at 3000 psi. Do not perform maintenance on system until hydraulic pressure is removed from helicopter. Be certain that trapped hydraulic pressure is released before loosening any connections. Failure to do so could result in death or serious injury.

WARNING

PRESSURIZED AIR

The sudden release of pressurized air can injure personnel. To avoid pressurized lines in the nitrogen inerting system, remove pressurized air before removing electrical power.

WARNING

CONTROL MOVEMENTS

Maintenance personnel must be warned verbally prior to moving the collective or cyclic stick. Any control activated can result in sudden blade movement that can sever or crush fingers or hands.

INSERT LATEST CHANGED PAGES: DESTROY SUPERSEDED PAGES.

LIST OF EFFECTIVE PAGES

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Date of issue for original and change pages are:

Original	0	30 April 1992
Change	1	30 December 1992
Change	2	15 January 1993
Change	3	7 July 1993
Change	4	30 December 1993
Change	5	28 December 1994
Change	6	1 February 1996
Change	7	30 September 1996
Change	8	19 December 1997
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TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 459, CONSISTING OF THE FOLLOWING:

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LIST OF EFFECTIVE PAGES

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***Zero in this column indicates an original page.**

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., 30 April 1992

TECHNICAL MANUAL

AVIATION UNIT AND INTERMEDIATE TROUBLESHOOTING MANUAL

FOR

ARMY MODEL AH–64A HELICOPTER (NSN 1520–01–106–9519) (EIC:RHA)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes, or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898–5230. A reply will be furnished to you.

You may also send in your comments electronically to our e–mail address: 2028@redstone.army.mil or by fax 205–842–6546/DSN 788–6546. Instructions for sending an electronic 2028 may be found at the end of this manual immediately preceding the hard copy 2028.

OZONE DEPLETING CHEMICAL INFORMATION:
This document has been reviewed for the presence of Class I Ozone depleting chemicals. As of Change 8 dated 19 December 1997, all references to Class I Ozone depleting chemicals have been removed from this documentation by substitution with chemicals that do not cause atmospheric Ozone depletion.

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

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*** SUPERSEDURE NOTICE: This manual supersedes TM 55–1520–238–T–4, dated 15 DECEMBER 1985, including all changes.**

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HOW TO USE THIS VOLUME

OVERVIEW

- This is the fourth volume of a ten volume troubleshooting manual (TM 1-1520-238-T-1 through TM 1-1520-238-T-10) for the helicopter.
- TM 1-1520-238-T-4 through TM 1-1520-238-T-8 contains troubleshooting instructions for the helicopter and consists of the following five volumes:

Volume	Contains
TM 1-1520-238-T-4	Airframe Landing Gear System Power Plants Rotors Drive System
TM 1-1520-238-T-5	Hydraulic and Pneumatic System Instruments
TM 1-1520-238-T-6	Electrical System
TM 1-1520-238-T-7	Fuel System Flight Control System
TM 1-1520-238-T-8	Utility System Environmental Control System Hoists and Wenches (not applicable) Auxiliary Power Unit Mission Equipment Appendix Glossary

- TM 1-1520-238-T-4 through TM 1-1520-238-T-8 are used in conjunction with multiple manuals TM 1-1520-238-23 (maintenance information for the helicopter).
- Learn how to use the Integrated Troubleshooting Manual series, which is explained in “How To Use This Manual” in TM 1-1520-238-T-2.
- Chapter 1 of this volume contains general information you will need in order to use TM 1-1520-238-T-4 through TM 1-1520-238-T-8 successfully.

CHAPTERS and SECTIONS

- Chapter 1 contains general troubleshooting information.
- Chapter 2 and subsequent chapters provide troubleshooting information for each system.

HOW TO USE THIS VOLUME (cont)

- Chapters contain sections and paragraphs with troubleshooting procedures.
- Chapter indexes are on the first page of each chapter and provide sections and paragraphs covered.

PARAGRAPHS

Each paragraph in chapter 3 and subsequent chapters contain troubleshooting procedures needed for a specific job.

PARAGRAPH NUMBERING

Paragraph numbers are in two parts. The first is the chapter number. The second is the paragraph number. Each number is separated by a dash as shown in the example.

3 – 19

Paragraph

Chapter

Paragraph numbers are the most important numbers in the volume. Except when using the table of contents always use the paragraph number to find information – NOT the page number.

PAGE NUMBERING

All page numbering is done by chapters, paragraph numbers are not included in the page numbers. The first number represents the chapter, the second number represents the page in that chapter. The numbers are separated by a dash as shown in the example.

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Chapter

INITIAL SETUP

Each maintenance task is headed by an initial setup. This table outlines what is needed as well as certain conditions which must be met before starting the task. DON'T START A TASK UNTIL:

- You understand the task.
- You understand what you are to do.
- You understand what is needed to do the work.
- You have the things you need.

Not all tasks have all the headings shown. The following subparagraphs explain each part of the initial setup.

HOW TO USE THIS VOLUME (cont)

Title: **(a)** The title in the upper border contains the paragraph number and title of the task as listed in the index.

Tools: **(b)** Special tools are listed when needed. Their use is called out in the task.

Personnel Required: **(c)** This heading lists only personnel required to perform the task. Unless otherwise specified, any qualified and certified individual is authorized to perform power up applications on the helicopter.

References: **(d)** This lists other technical manuals (TMs) you will need to complete the task. The steps in the task will tell you when you must refer to another TM.

Equipment Conditions: **(e)** This lists conditions that must be met before starting the task. It may require an installation or removal operation. These operations are described in other tasks or TMs. The TMs that describe how to do these operations are referenced here. The statement "Helicopter safed" refers to TM 55-1520-238-23 where helicopter safety procedures are described. The statement "Helicopter safed" appears in a power up task or a maintenance operational check (MOC) when power up is not required. Be sure to comply with call outs under equipment conditions, then do the task.

EXAMPLE OF INITIAL SETUP

(a) **5–13. MAIN ROTOR BLADE TASB ADJUSTMENT – BLADE GOES OUT OF TRACK MORE THAN 2 INCHES BETWEEN GROUND TRACK (AT 100% N_R) AND HOVER** **5–13**

(b) **Tools:**

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Accessories Kit, Rotor Track and Balance	7-262100008

(c) **Personnel Required:**

67R Attack Helicopter Repairer
Attack Helicopter Repairer Technical/Inspector
152FG Maintenance Test Pilot(2)

(d) **References:**

TM 1-1520-238-23

Equipment Conditions:

(e)

Ref	Condition
TM 1-1520-238-23	Track and balance kit installed

USING THIS VOLUME

Equipment description and theory of operation is provided to aid in troubleshooting the equipment. If performing the MOC does not locate the failure, refer to the appropriate theory of operation for troubleshooting one or more functions of the equipment.

Theory of operation describes how the equipment works by function. Each equipment function has a functional flow diagram with a description of how the equipment performs the function. These troubleshooting aids provide you with additional information for troubleshooting.

Perform the MOC when it has been determined that a failure exists.

The wiring interconnect diagram provides wiring information between related components and may be used with the fault isolation procedures (FIP) as an aid to troubleshooting.

HOW TO USE THIS VOLUME (cont)

USING AH–64A HELICOPTER EFFECTIVITY CODES

Helicopter effectivity codes designate differences between helicopters by helicopter serial numbers. These codes consist of three letters representing various helicopter serial number blocks. They are used throughout this volume as necessary to aid in the helicopter troubleshooting effort.

The codes are used to designate serial number block differences as follows:

- When used within narrative text and FIPs, effectivity codes appear within parenthesis.

  For Example: Narrative text and FIPs (AAA)

- When used inside wiring interconnect diagrams, effectivity codes appear within triangular borders and are placed on the line which represents that particular helicopter's configuration.

  For Example: Wiring interconnect diagrams AAA

This volumes uses these effectivity codes and corresponding helicopter serial numbers for reference.

To use the helicopter effectivity codes, note the helicopter serial number on the left side of the fuselage directly below the CPG window. Use this serial number to determine which procedure or path in a wiring interconnect diagram or FIP to use.

The effectivity codes and helicopter serial number blocks applicable to this volume are as follows:

Effectivity Code	Helicopter Serial No.
AAA	82–23355 thru 82–23365
AAB	82–23355 thru 83–23798
AAC	82–23355 thru 83–23814
AAD	85–25424 and subsequent
AAE	82–23355 thru 84–24231
AAF	84–24216 and subsequent
AAG	82–23355 thru 84–24289
AAH	82–23355 thru 85–25398
AAJ	85–25351 and subsequent
AAK	82–23355 thru 85–25488
AAL	88–0215 and subsequent
AAM	85–25465 and subsequent
AAN	83–23787 thru 85–25415
AAP	82–23355 thru 88–0214
AAQ	82–23355 thru 84–24311

HOW TO USE THIS VOLUME (cont)

Effectivity Code	Helicopter Serial No.
AAR	82–23355 thru 84–24239
AAS	84–24240 and subsequent
AAT	82–23355 thru 83–23804
AAU	83–23787 and subsequent
AAV	83–23805 and subsequent
AAW	83–23799 and subsequent
AAX	83–23799 thru 84–24245
AAY	83–23799 thru 85–25470 (Before MWO 1–1520–238–50–37)
AAZ	83–23815 and subsequent
ABA	84–24200 and subsequent
ABB	84–24246 and subsequent
ABC	84–24290 and subsequent
ABD	82–23355 thru 85–25415
ABE	82–23355 thru 84–24295
ABF	84–24296 and subsequent
ABG	85–25399 and subsequent
ABH	82–23355 thru 84–24245
ABJ	85–25447 and subsequent
ABK	82–23355 thru 85–24446
ABL	82–23355 thru 89–0215
ABM	84–24290 thru 88–0199
ABN	89–0192 and subsequent
ABP	85–25471 and subsequent
ABQ	86–8940 and subsequent
ABR	82–23355 thru 84–24232
ABS	84–24233 and subsequent
ABT	82–23355 thru 83–23816
ABU	83–23817 thru 85–25415
ABV	84–24246 thru 85–25398
ABW	82–23355 thru 83–23795
ABX	83–23796 and subsequent
ABY	With T700–GE 701 engines
ABZ	With T700–GE 701C engines
ACA	82–23355 thru 88–0199

HOW TO USE THIS VOLUME (cont)

Effectivity Code	Helicopter Serial No.
ACB	88–0200 and subsequent
ACC	82–23355 thru 83–23834
ACD	85–25416 and subsequent
ACE	82–23355 thru 86–9011
ACF	82–23355 thru 88–0284
ACG	89–0192 and subsequent
ACH	82–23355 thru 85–25423
ACJ	82–23355 thru 90–0290, 90–0292 thru 90–0301 (Before MWO 1–1520–238–50–07)
ACK	82–23355 thru 90–0290, 90–0292 thru 90–0301 (After MWO 1–1520–238–50–07) 90–0291, 90–0302 and subsequent
ACL	82–23355 thru 83–23814
ACM	83–23815 and subsequent
ACN	85–25471 thru 90–0448 (Before MWO 1–1520–238–50–37)
ACP	85–25471 thru 90–0448 (After MWO 1–1520–238–50–37) 90–0449 and subsequent
ACQ	82–23355 thru 90–0448 (Before MWO 1–1520–238–50–36)
ACR	82–23355 thru 90–0448 (After MWO 1–1520–238–50–36) 90–0449 and subsequent
ACS	82–23355 thru 90–0437
ACT	90–0438 and subsequent
ACU	82–23355 thru 90–0436
ACV	89–0192 thru 90–0434 with T700–GE–701C engines (Before MWO 1–1520–238–50–38)
ACW	89–0192 thru 90–0434 with T700–GE–701C engines (After MWO 1–1520–238–50–38) 90–0435 and subsequent with T700–GE–701C engines
ADC	Before MWO 1–1520–238–50–49
ADD	After MWO 1–1520–238–50–49

HOW TO USE THIS VOLUME (cont)

APPENDIXES

The appendix for this volume is contained in TM 1-1520-238-T-8. It contains a list of other manuals you might need to do your job.

GLOSSARY

The glossary for volumes TM 1-1520-238-T-4 through TM 1-1520-238-T-8 is contained at the end of TM 1-1520-238-T-8. It contains a list of abbreviations and acronyms. An abbreviation is a shortened form of a word, expression, or phase used to conserve space and time. Acronyms are shortened terms for several words and usually use only the first letter of each word. Abbreviations and acronyms are defined the first time they are used within the text of each chapter. The glossary provides a good place to check if there is any doubt. The glossary also contains definitions of unusual terms that appear in this series of volumes. Check the list of definitions if you see a word in a volume that you're not sure of.

ALPHABETICAL INDEX

The alphabetical index for volumes TM 1-1520-238-T-4 through TM 1-1520-238-T-8 is contained at the end of TM 1-1520-238-T-8. It contains a list of all paragraph titles in alphabetical order. After you find the title in the index, it tells the paragraph number. For example, if you need information on how to power–up the drive system, go to the “D” section of the index and look under Drive System.

For Example: Drive System Power Up . . . . Paragraph 6–10

The index informs you that the Drive System Power Up is in chapter 6, paragraph 10.

You can find your paragraph in the index, even if you only know a single word in the title. The example shows how you can also find the paragraph by looking under “Power Up.”

For Example: Power Up, Drive System . . . . Paragraph 6–10

Any paragraph can be located in the way described. If you know the name of the operation, system, assembly, etc., you can use one of the words to find the paragraph number in the index. It makes locating information quick and easy.

DEFINITION OF WARNING, CAUTION, AND NOTE

WARNING

An operation or maintenance procedure, practice, condition, statement, etc., which if not strictly observed could result in long term health hazards, death or injury to personnel. If injury occurs, seek medical aid immediately.

CAUTION

An operating or maintenance procedure, practice, condition, statement, etc., which if not strictly observed could result in damage to or destruction of equipment, cause loss of mission effectiveness.

NOTE

An essential operating or maintenance procedure, condition, or statement which must be highlighted.

HOW TO USE THIS VOLUME (cont)

<u>REFERENCE</u>

For a listing of all TMs applicable to the helicopter, refer to APPENDIX A of TM 1-1520-238-T-8.

<u>USING THE ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX</u>

The ECLC index will help you find electrical components and their connectors on the helicopter during troubleshooting. The ECLC is located at the beginning of the troubleshooting procedures of each chapter (when applicable). This index is a list of connectors and applicable wire harnesses which are illustrated by component location. Component locations are shown from the helicopter's forward sections to its aft sections by horizontal and vertical grid numbers. Connectors are listed numerically in the **FROM COLUMN Connector <u>Ref Des</u>** column of the index. Every connector is referenced to a grid area within the illustrations.

EXAMPLE OF ECLC INDEX

FROM COLUMN		TO COLUMN			
Connector <u>Ref Des</u>	**Component/ <u>Harness</u>**	**Connector <u>Ref Des</u>**	**Component/ <u>Harness</u>**	**Grid <u>Area</u>**	**<u>Access</u>**
P1	A76/W605	J1	A402	8B	PLT STATION
P402	W170	J402	W211	13E	R295 DOOR

Use the index to find connectors on the aircraft by first locating the connector reference designator number in the **FROM COLUMN Connector <u>Ref Des</u>** column of the index. Then, cross–reference the **FROM COLUMN Connector <u>Ref Des</u>** column with the following:

- **FROM COLUMN Component/<u>Harness</u>** column to locate the wiring component or wire harness number.
- **TO COLUMN Connector <u>Ref Des</u>** column to locate the mating connector number.
- **TO COLUMN Component/<u>Harness</u>** column to locate the mating connector or wire harness number.
- **Grid <u>Area</u>** column to find the grid zone (within the illustration) depicting the location of the connector on the aircraft.
- **<u>Access</u>** column to find where access can be obtained to the connector (TM 1-1520-238-23).

For example, to locate connector P1 on the aircraft find connector P1 in the **FROM COLUMN Connector <u>Ref Des</u>** column, then refer to the **FROM COLUMN Component/<u>Harness</u>** column. This column shows that P1 is part of component/harness A76/W605. The **TO COLUMN Connector/<u>Ref Des</u> column** shows that P1 connects to J1 on component A402 (**TO COLUMN Component/<u>Harness</u>** column). The **Grid <u>Area</u>** column indicates that P1 is depicted at illustration grid zone 8B, and that **<u>Access</u>** to the connector is obtained through the PLT STATION.

CHAPTER 1
INTRODUCTION

CHAPTER INDEX

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SECTION I. TROUBLESHOOTING INFORMATION – GENERAL

1–1. SCOPE 1–1

This volume covers equipment description, theory of operation, FIPs, and AVUM and/or AVIM maintenance level instructions for the airframe, landing gear, power plants, rotors and drive system.

1–2. VOLUME CONTENT AND FORMAT 1–2

Equipment description and theory of operation for the helicopter landing gear, power plants, rotors and drive system are presented in Chapters 3, 4, 5, and 6. Before troubleshooting, learn the content and organization of this volume and how it relates to other manuals. For more information on volume content and usage refer to **HOW TO USE THIS VOLUME.**

1–3. REFERENCE MANUALS 1–3

Refer to APPENDIX A for a complete list of manuals you may need when troubleshooting the helicopter.

1–4. ELECTRICAL DATA 1–4

a. **Electrical Units.** Unless otherwise specified, the values indicated for electrical units in this volume are as follows:

- Phase reference symbol (∅) for AC voltage (VAC)
- Resistance (R) in ohms (Ω)
- Capacitance (C) in picofarads (pf)
- Inductance (L) in henrys (H)
- Voltage (E) in volts (V)
- Current (I) in amperes (A)
- Frequency in hertz (Hz)
- Power in watts (W)

b. **Electrical Measurement Tolerances.** Unless otherwise specified, tolerances for resistance, capacitance, inductance, voltage and current are ±10%.

c. **Grounds.** Unless otherwise indicated (such as chassis ground), all grounds shown are common ac, dc and signal grounds.

d. **DC Voltage Polarities.** DC voltages are positive polarity (+28 VDC, etc.) unless otherwise specified.

e. **AC Voltages.** All indicated ac voltages are 400 Hz.

f. **Circuit Breakers.** Circuit breakers are to be at closed (ON) position. Troubleshooting procedures for all circuit breakers and all electrical circuits supplying electrical power to circuit breakers are in TM 1-1520-238-T-6.

g. **Signal Names, States, Conditions, and Values.** Signal values shown exist for the conditions and states indicated by signal names.

h. **Coaxial Cable Resistance Measurements.** When the ends of a coaxial cable are disconnected, resistance measurements from the shield to the center conductor should indicate open.

i. **Coaxial Connectors.** Triaxial connectors and some coaxial connectors are shown in the wiring diagrams with two pins (for example: pin 1 and pin 1S). Pin 1 is shown inside Pin 1S with shield attached to pin 1S. For triaxial connectors, the second shield is attached to the case and is not identified by a pin number or letter.

j. **Electrically Operated Devices.** Relays, solenoids, and other electrically activated devices are shown in the de–energized state in wiring interconnect diagrams.

k. **Wiring Information**.

(1) Wiring interconnect diagrams are used for wiring checks. Reference designators are shown in the lower right corner of the LRU on the wiring interconnect diagrams. Electrical wiring repairs peculiar to the helicopter are in TM 55-1520-238-23. Electrical wiring repairs not peculiar to the helicopter are in TM 55-1500-323-24.

(2) The wiring diagram manual, TM 1-1520-238-T-10, contains the following additional information:

- Wiring diagram directory listing reference designator, component name, wire harness and applicable equipment system.
- End view of all connectors.
- Wiring harness and routing diagram includes wire harness numbers, exact connectors, terminal boards, and ground stud locations, etc., found in the helicopter.

l. **Wiring Checks**. Where **REPAIR OR REPLACE WIRING OR CONNECTIONS** are specified:

(1) A check is to be made for a short or open (as specified) for each wire segment, terminal board, connector pin and connection over the entire length of wiring between pins or terminals indicated.

(2) The wiring interconnect diagram is used to make wiring checks for troubleshooting the equipment.

(3) Instructions to repair wire(s) include repair or replacement of wires, connections at end connector pins, terminals, etc. (all required end–to–end repair and replacement between wiring points specified).

(4) The component location and configuration (ECLC) index is used to locate wiring connectors and components located in the helicopter.

m. **Terminal Board Connections**. Electrical connections at terminal boards are shown as follows (fig. 1–1):

(1) Vertical and horizontal lines indicate electrical separation between terminals and blocks of terminals.

(2) Absence of lines indicate no separations.

(3) Terminal board connections may be illustrated horizontally, vertically, or a combination of both.

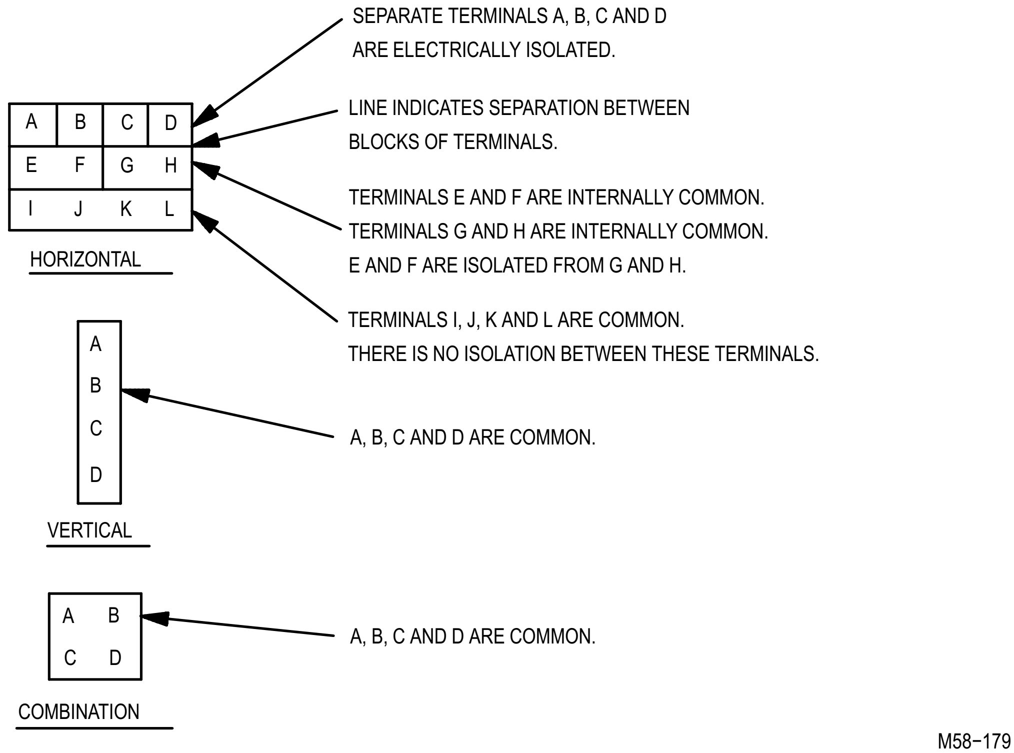


Figure 1–1. Typical Terminal Board Connections

n. **Highway Use (fig. 1–2)**: The alpha character identifies a specific line, and the number in parenthesis identifies the sheet number where the signal terminates.

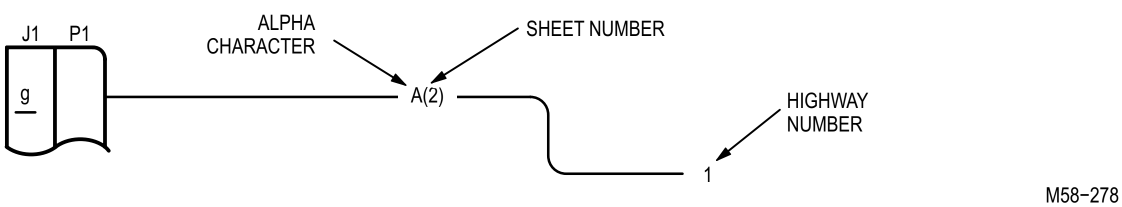


Figure 1–2. Typical Highway Use

o. **Markings**. Markings on equipment and displays are shown in **BOLDFACE** in text.

p. **Lamp Indicators**. When using lamp indicators for troubleshooting, lamp indicators must be known to be working.

q. **Forward and Aft Views.** Forward (fwd) and aft views refer to fwd and aft in the helicopter. Where required for clarity, FWD and AFT arrows are used.

SECTION II. TROUBLESHOOTING METHODS AND CHECKS

1–5. TROUBLESHOOTING THE AH–64A HELICOPTER 1–5

Troubleshooting consists of:

- Using the failure symptom index(es) find the failure symptom to determine the maintenance operational check (MOC) needed.
- Performing a MOC and observing indications on equipment and instruments.
- Performing a FD/LS check, when applicable.
- Manually locating and isolating troubles using TM 1-1520-238-T-3 (when applicable) or FIPs.

1–6. FAILURE SYMPTOMS AND TROUBLESHOOTING 1–6

Troubleshooting begins with failure symptoms. Failure symptoms are organized by system in TM 1-1520-238-T-2. Use this volume to locate what system(s) the failure is in and perform the appropriate FIPs as directed.

1–7. MAINTENANCE OPERATIONAL CHECKS (MOCS) 1–7

A MOC is provided for each system. MOCs test the system by using operator panel switches, controls and indicators. When a desired result is not obtained, a reference is made to a FIP or to the multiplex read codes found in TM 1-1520-238-T-3, based on the failure symptom.

1–8. FAULT DETECTION/LOCATION SYSTEM (FD/LS) CHECK 1–8

FD/LS checks are located in TM 1-1520-238-T-1 along with a description of the FD/LS operating modes and power applications.

1–9. ROADMAP APPROACH 1–9

When doing MOCs and FIPs, use the troubleshooting data like a road map.

a. You must start at the beginning and follow to the end.

- Always start with the MOC.
- Do not skip or miss a step.
- In flow diagrams, always start with the upper left block.
- After repair, always perform the MOC.

b. As shown in the troubleshooting flow diagram (fig. 1–3), if the MOC result is normal, proceed to the next step. If the result is not normal, perform the FIP indicated.

1–9 ROADMAP APPROACH (cont) 1–9

c. Each step of the FIP contains a YES/NO question. The answer determines the route to be followed through the rest of the procedure.

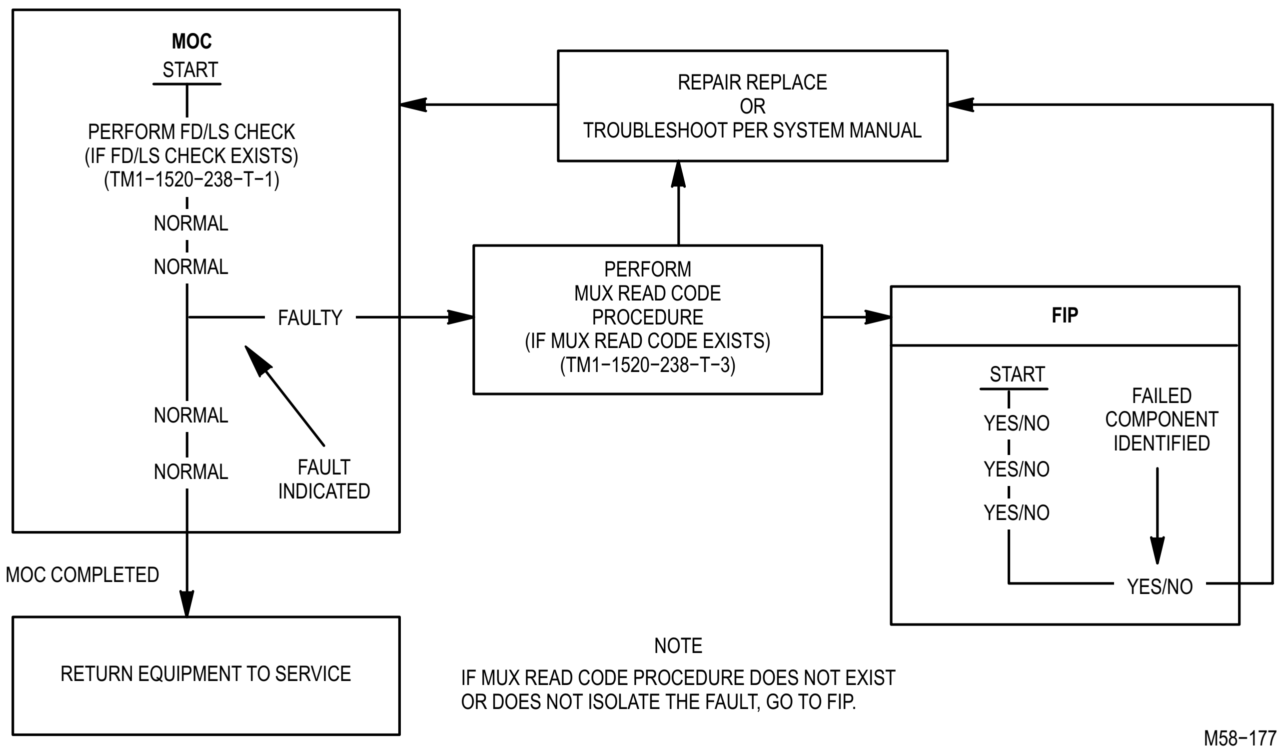


Figure 1–3. Troubleshooting Flow Diagram

1–10. FAULT ISOLATION PROCEDURES (FIPs) 1–10

This procedure is used to manually find and correct the fault. FIPs are referenced from MOC results and depend on the switch control setting of the MOC.

a. Step–by–step checks are done in dichotomous format.

- To find and correct faults, start at the beginning and do all the steps in order.
- To locate electrical components and connectors, use the ECLC index.
- All connectors that have been detached to make checks will be attached prior to continuing to the next step unless connectors, jacks and relays are specifically called out as being detached or removed in a FIP step (example: detach P1 or remove relay). When specifically called out, they will remain detached/removed until the end of the task, unless you are instructed to attach or install in a later FIP step (example: attach P1 or install relay).
- To troubleshoot wiring and circuits, use the wiring interconnect diagrams for that MOC.

b. Checks direct you to the most probable failures.

c. As the procedure is performed, the trouble is found.

d. The checks tell how to correct the trouble.

e. After repair or replacement, the MOC must be repeated.

SECTION III. GENERAL PROCEDURES – SUMMARY

1–11. STARTING TROUBLESHOOTING 1–11

a. Determine the equipment to troubleshoot from the failure symptoms listed in TM 1-1520-238-T-2.

NOTE

If faulty equipment is not known and a failure symptom exists, use failure symptom list in TM 1-1520-238-T-2 to determine system.

b. Select the chapter, section, and paragraph to use. (Refer to information on using this volume in HOW TO USE THIS VOLUME).

c. For use of external power and the ground service utility connectors, refer to TM 1-1520-238-23. If external power is not available, refer to TM 1-1520-238-23 for the application of the auxiliary power unit (APU). Refer to TM 1-1520-238-23 and TM 55-1730-229-12 for application of external electrical and hydraulic power and pressurized air. External power is preferred however, for onboard power the APU may be used.

d. During power up procedures, if circuit breakers do not stay closed refer to TM 1-1520-238-T-2 to identify the location of corrective procedures.

e. During power up procedures, if power is not available to the equipment, refer to TM 1-1520-238-T-6 to troubleshoot the electrical system.

f. Troubleshoot using specific procedures in the selected paragraph.

1–12. DURING TROUBLESHOOTING 1–12

WARNING

- **Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.**
- **To prevent injury, disable the aft avionics bay door fan before performing maintenance or troubleshooting in the aft avionics bay.**

CAUTION

When making resistance, open, short, or other ohmmeter checks on circuits, always de–energize the circuit to avoid damage to the meter.

a. Correct faults and repair any equipment where damage is obvious.

1–12 DURING TROUBLESHOOTING (cont) 1–12

CAUTION

Ensure the environmental control system (ECS) fans are operating while electrical power is applied to the helicopter to prevent equipment damage.

b. ALWAYS maintain required cooling of units while operating equipment.

NOTE

For information on cooling requirements, refer to the ECS in TM 1-1520-238-T-8.

c. If troubleshooting procedures indicate that a LRU is faulty, it is replaced a second time only under one of the following conditions:

(1) When a pre–existing failure in the interconnecting wiring or system caused the newly replaced LRU to fail and the pre–existing failure has been corrected.

(2) The replacement LRU is known to be defective and the interconnecting wiring is known to be good.

d. The LRU is not to be replaced under any of the following conditions:

(1) If the interconnecting wiring is not known to be OK.

(2) If the newly replaced LRU is not known to be defective.

(3) If under any circumstances the LRU has already been replaced a second time.

1–13. COMPLETING TROUBLESHOOTING 1–13

a. Prior to application of power ensure the following:

(1) Attach items detached during troubleshooting.

(2) Reinstall or replace items removed during troubleshooting.

b. To ensure that trouble is corrected, repeat the MOC.

c. Secure all doors, panels, and opened areas.

1–14. GENERAL PROCEDURES – SUMMARY 1–14

a. Use only correct methods and checks (para 1–5).

b. Use the troubleshooting data like a road map (fig. 1–3).

(1) You **MUST** start at the beginning and follow to the end.

(2) Do not skip or miss a step.

(3) In flow diagrams, **ALWAYS** start with the upper left block.

1–14 GENERAL PROCEDURES – SUMMARY (cont) 1–14

c. When completing troubleshooting you **MUST:**

(1) Repeat and complete the MOC.

(2) Secure all doors, panels and opened areas.

1–15. TROUBLESHOOTING LINE REPLACEABLE UNITS (LRUs) OFF THE HELICOPTER 1–15

Troubleshooting beyond the scope of this volume for LRUs with built–in–test equipment is done at the EETF QQ–290(V)2/MSM (TM 11-6625-3085-12).

1–16. ELECTRONIC EQUIPMENT TEST FACILITY (EETF) TESTABLE LRUs 1–16

a. The following is a list of all the helicopter system LRUs which are covered in this volume and on which off helicopter troubleshooting is accomplished using the EETF.

b. The LRUs are listed by chapter, system and name of unit for which on helicopter troubleshooting is performed in this volume.

MANUAL	System	LRU Name
TM 1-1520-238-T-5	Instruments	Signal Data Converter
		Engine Oil Pressure Indicator, Pilot
		Gas Turbine Rpm (N_G RPM%) Indicator, Pilot
		Turbine Gas Temperature (TGT) Indicator, Pilot
		Engine TORQUE Indicator, Pilot and CPG
		Engine Rotor (ENG–RTR RPM%) Rpm Indicator, Pilot and CPG
		Fuel Quantity Indicator, Pilot
		Selectable Digital Display, CPG
TM 1-1520-238-T-6	Electrical	Generator Control Unit 1
		Generator Control Unit 2
		Transformer/Rectifier 1
		Transformer/Rectifier 2
		Battery Charger
		Engine Out/Rotor Rpm/Stabilator Warning Box
		Caution/Warning Panel, Pilot
		Caution/Warning Panel, CPG
		Master Caution/Warning Panel, Pilot
		Master Caution/Warning Panel, CPG
		Multi–Channel Dimming Controller
		Anti–Collision Light Power Supply
		External Power Monitor

1–16 ELECTRONIC EQUIPMENT TEST FACILITY (EETF) TESTABLE LRUs (cont) 1–16

MANUAL	System	LRU Name
TM 1-1520-238-T-7	Flight Control System	Digital Automatic Stabilization Equipment Computer (DASEC)
		Stabilator Control Unit 1
		Stabilator Control Unit 2
		Pitch Linear Variable Differential Transducer (LVDT), Pilot
		Pitch LVDT, CPG
		Roll LVDT, Pilot
		Roll LVDT, CPG
		Yaw LVDT, Pilot
		Yaw LVDT, CPG
		Collective LVDT, Pilot
		Collective LVDT, CPG
TM 1-1520-238-T-8	Utility	Rotor Blade De–Ice Control
		Ice Detector Signal Processor
		Control, Windshield Anti–Ice (Heater Control)
		Pilot ANTI ICE Panel
	Mission Equipment	External Stores Control Box
		Pylon Actuator Controller 1, 2, 3, 4

1–17. MAINTENANCE HEADSET CONNECTION PROCEDURE 1–17

Tools:

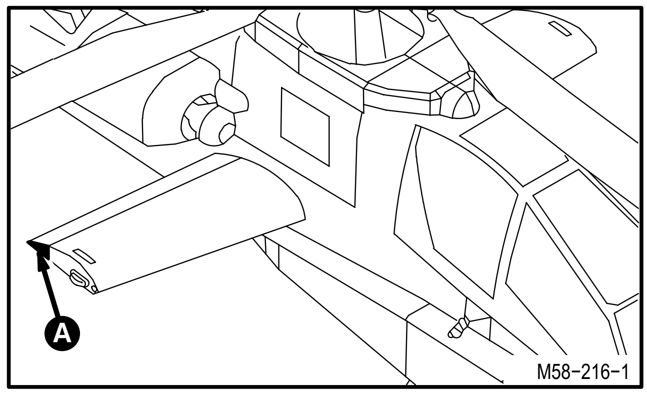
Nomenclature	Part Number
Headset, Microphone (2)	H157AIC
Adapter Harness, Intercommunication System (2)	7-311B22060-81601
Cord Assembly, Electrical (make item)	7-262100009-601 TM 1-1520-238-23

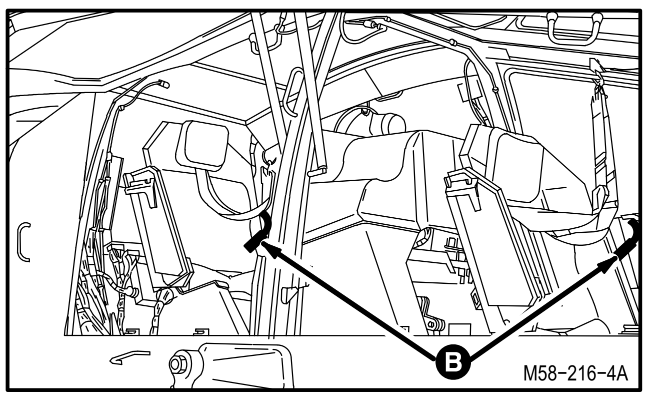
References:

TM 1-1520-238-23

NOTE

This task is typical for right and left wings or pilot and CPG cockpits.





1–17. MAINTENANCE HEADSET CONNECTION PROCEDURE (cont) 1–17

1. **Attach maintenance headset to ground service panel.**

   a. Attach cord assembly receptacle (1) to maintenance headset connector (2).

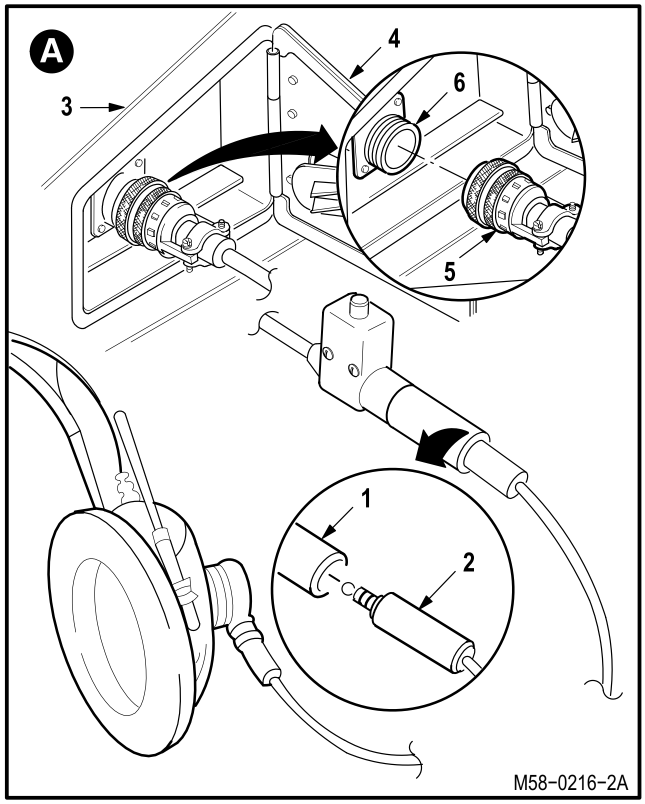
   b. At ICS ground service panel (3), open door RW12 (4).

   c. Attach cord assembly plug (5) to ground service panel receptacle (6).

2. **Attach headset in flight station.**

   a. Attach adapter harness receptacle (7) to headset connector (2).

   b. Attach intercommunication system adapter harness (8) to in-flight station receptacle (9).

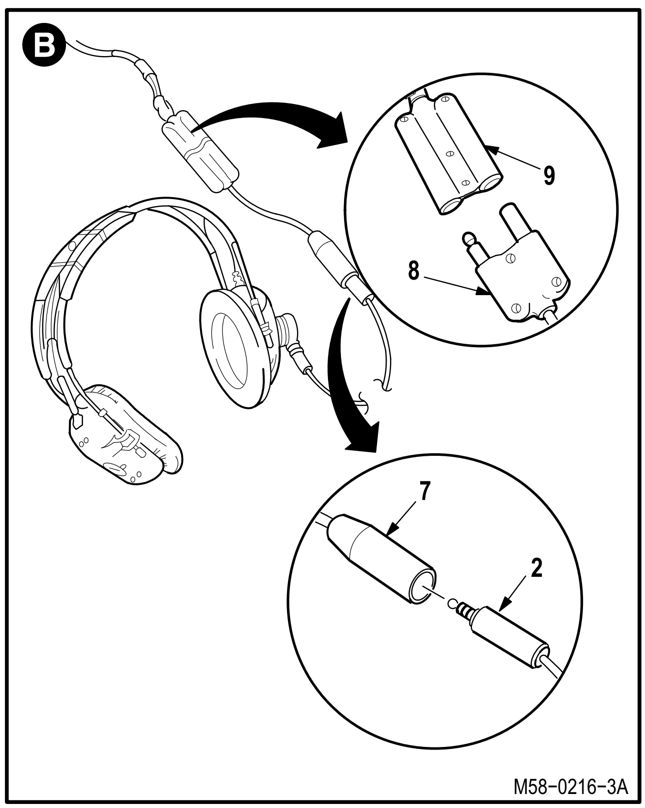


3. **Detach headset from ground service panel.**

   a. Detach cord assembly plug (5) from ground service panel receptacle (6).

   b. Close door RW12 (4).

4. **Detach headset in flight station.** Detach intercommunication system adapter harness (8) from in-flight station receptacle (9).



END OF TASK

CHAPTER 2
AIRFRAME

NOTE

Airframe system troubleshooting is performed during inspections.

- **SPECIAL INSTRUCTIONS – TM 1-1520-238-23.**
- **10 HOUR/14 DAY INSPECTIONS CHECKLIST – TM 1-1520-238-PMS.**
- **PHASED MAINTENANCE INSPECTIONS CHECKLIST – TM 1-1520-238-PM.**

CHAPTER 3
LANDING GEAR SYSTEM

CHAPTER INDEX

Para Title	Para No.
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Location and Description of Major Components	3–2
Equipment Data	3–3
Equipment Configuration	3–4
Safety, Care and Handling of Equipment	3–5
Controls and Indicators	3–6
SECTION II. THEORY OF OPERATION	
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Multiplex Read Codes	3–8
SECTION III. TROUBLESHOOTING PROCEDURES	
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Main Landing Gear (MLG) – Maintenance Operational Check	3–10
Tail Landing Gear (TLG) – Maintenance Operational Check	3–11

SECTION I. EQUIPMENT DESCRIPTION AND DATA

3–1. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES 3–1

a. **Characteristics.** The landing gear system is fixed (non–retractable).

b. **Capabilities and Features.**

(1) The landing gear system supports the aircraft and allows it mobility for ground operations.

(2) The MLG brake system stops the aircraft and give it stability during servicing and maintenance.

(3) The TLG tail wheel can be locked electrically from the pilot station or manually with a lever on the tail wheel lock actuator.

(4) The MLG can be kneeled to transport the helicopter.

3–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS 3–2

Landing Gear System. The landing gear system (fig. 3–1) consists of the MLG assembly, the TLG assembly, and the MLG brake system.

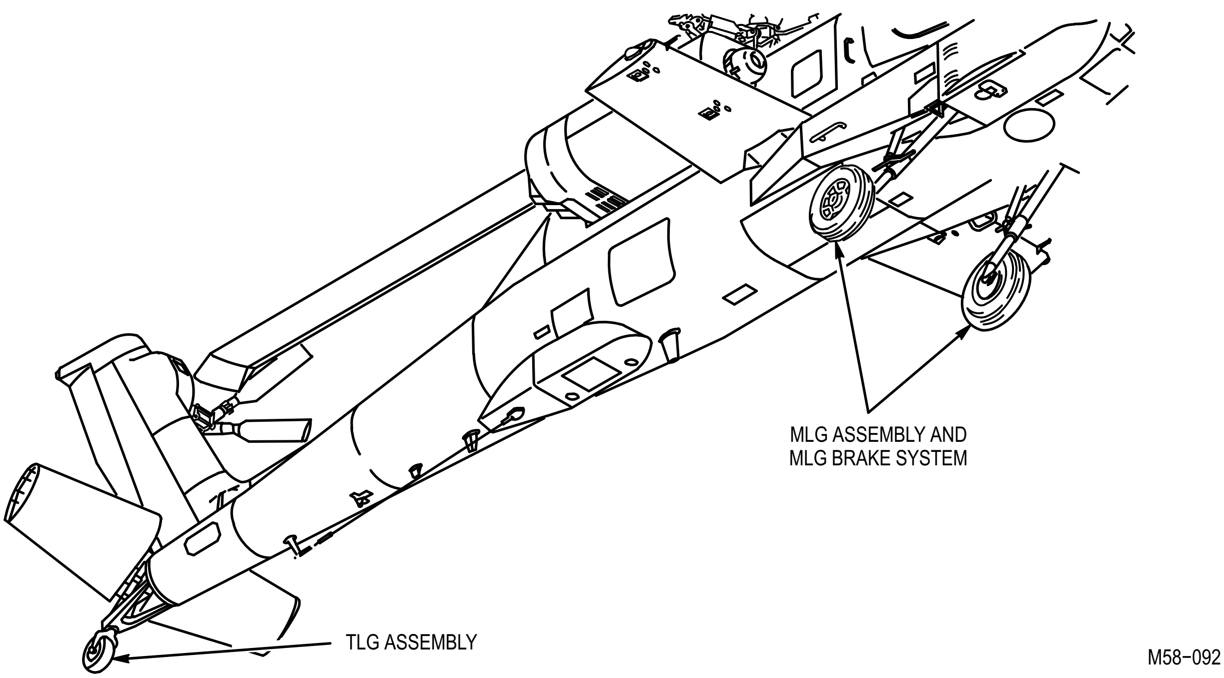


Figure 3–1. Landing Gear System

a. **MLG Assembly.** The MLG assembly (fig. 3–2) is mounted on both sides of the lower fuselage forward of the wings. The MLG assembly consists of a cross tube assembly, two trailing arm assemblies, two shock strut assemblies, and two wheel and tire assemblies.

3–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 3–2

(1) **Cross Tube Assembly.** The cross tube assembly is located and mounted through the lower portion of the center fuselage and extends from both sides of the fuselage. Each end is threaded for the installation of a trailing arm retainer and two in–line holes exist for installation of the end cap studs. Each end of the cross tube has a band of polished chrome for wear resistance where the tube mates with the trailing arms and support bearings. The support bearings are self–lubricating ball bearings pressed into each pivot attachment assembly which are mounted on each side of the fuselage. The pivot attachment assembly is the major support structure for the helicopter (left and right) and is fastened to the fuselage.

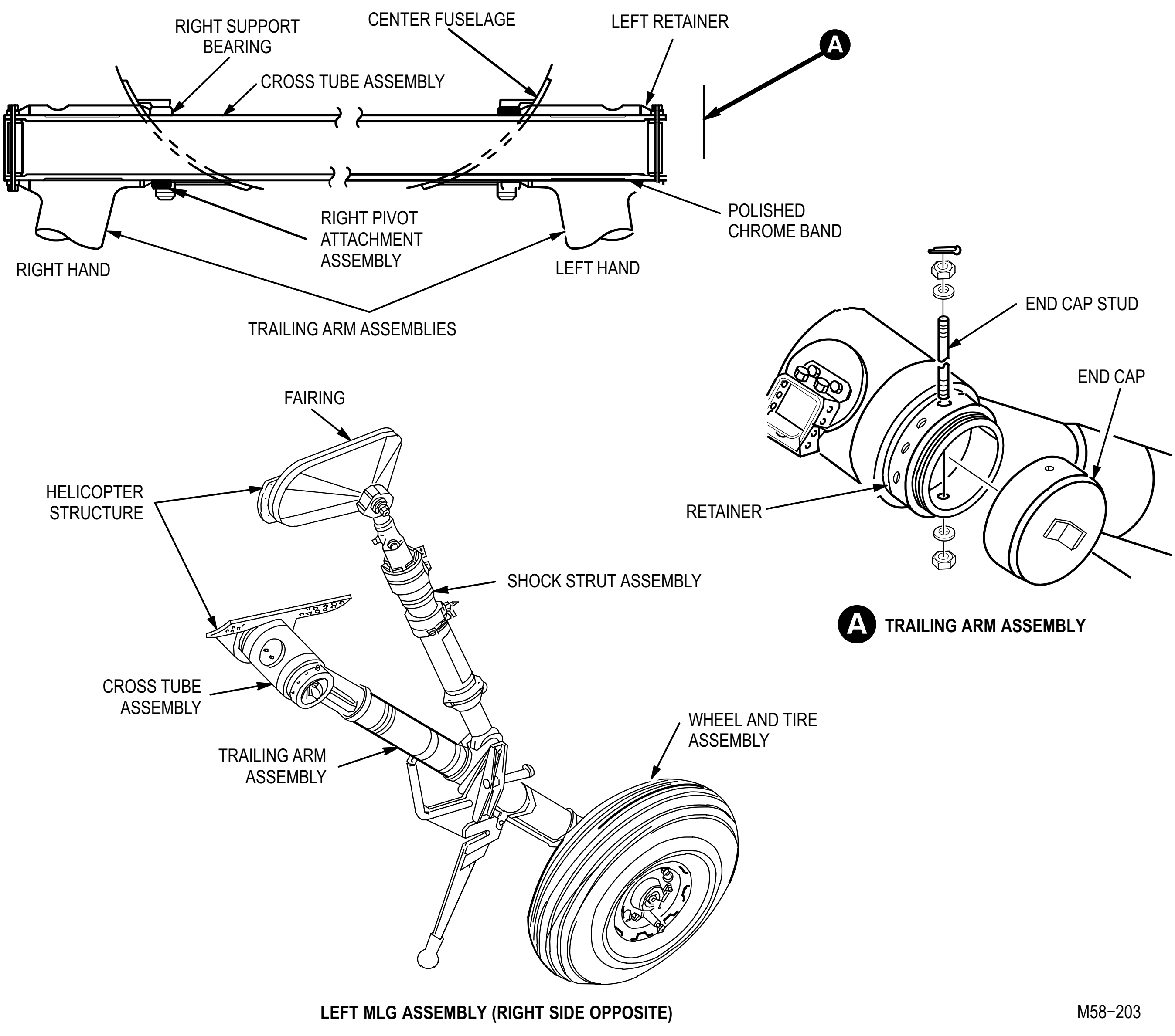


Figure 3–2. MLG and Cross Tube Assembly

3–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 3–2

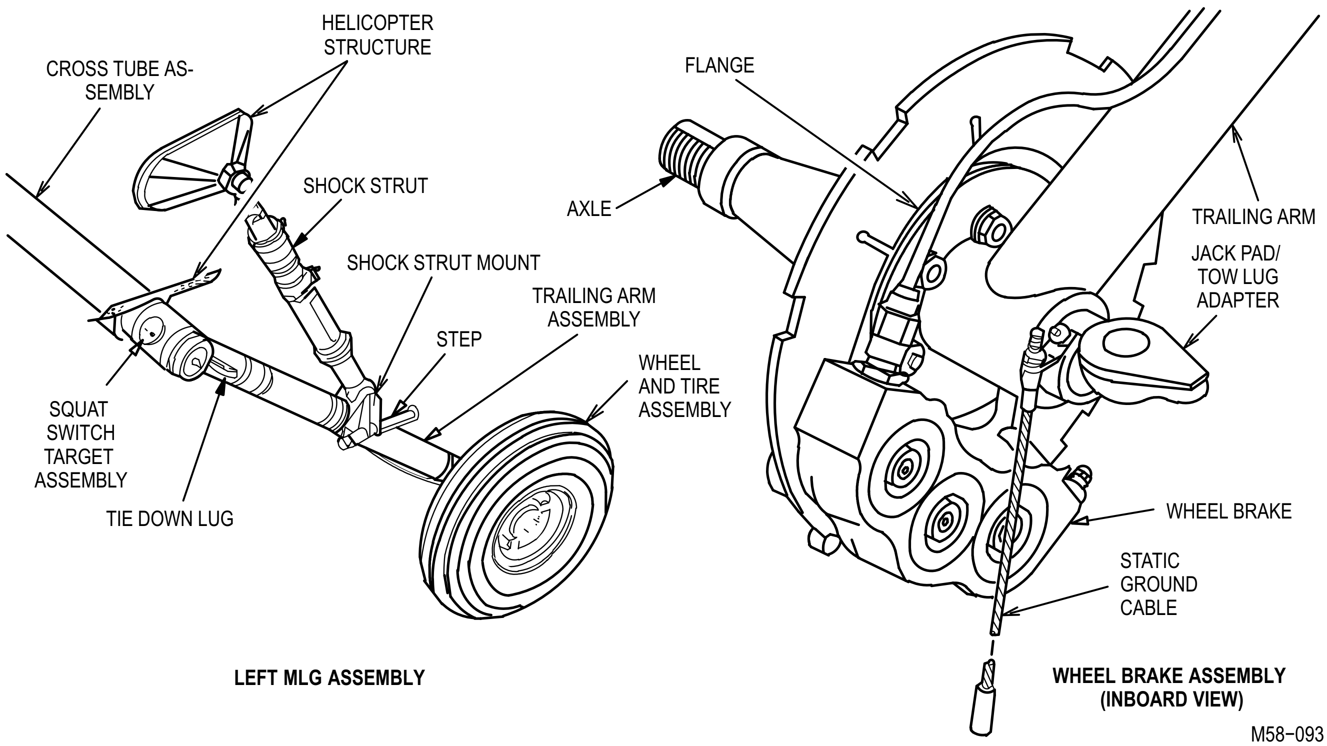


Figure 3–3. Trailing Arm Assembly

(2) **Trailing Arm Assembly.** The trailing arm assembly (2 each) (fig. 3–3) attaches to the cross tube assembly and consists of a trailing arm and a wheel brake assembly. The trailing arm assembly transmits vertical loads to the shock strut assembly and absorbs longitudinal and lateral loads during landing. A tie down lug is located at the top outboard end of the assembly. The trailing arm attachment fitting contains Teflon/fiberglass bushings. A threaded cap is installed at the top of the left hand trailing arm attachment fitting for the installation of the squat switch target assembly. A step is installed on each trailing arm, secured by hardware that attaches the shock strut to the trailing arm tie down lugs, which provides access to the crew stations and the upper fuselage. An axle and flange is provided at the lower end of the trailing arm for mounting of the brake assembly. A removable jack pad/tow lug adapter is installed inboard of the wheel and brake assembly on the lower end of each trailing arm. A static ground cable is attached to the base of the left MLG trailing arm at the jack pad/tow lug attachment.

(3) **Shock Strut Assembly.** The shock strut assembly (fig. 3–4), one each for the left and right side, is an air–oil shock absorber that consists of a cylinder, and an upper and lower pistons. The shock strut assembly absorbs or dampens the vertical forces induced by landing and provides lowering (kneeling) and raising (erecting) capability for transporting the helicopter. It is also capable of a high–impact energy absorption landing. The upper shock strut fitting is attached to the fuselage pivot mount. The lower shock strut fitting is attached to the center mount of the trailing arm. The cylinder contains the upper and lower pistons. For servicing the upper cylinder a hydraulic fill port and bleed port are located on the external side of the cylinder. The upper piston has a nitrogen fill port for servicing. A spherical bearing is installed in the upper end of the strut that serves as an attachment point for the pivot mount. The lower piston has a drain plug for servicing. A spherical bearing is located at the lower end of the strut and serves as a pivot attachment point and a kneeling coupling for maintenance or shipping of the helicopter.

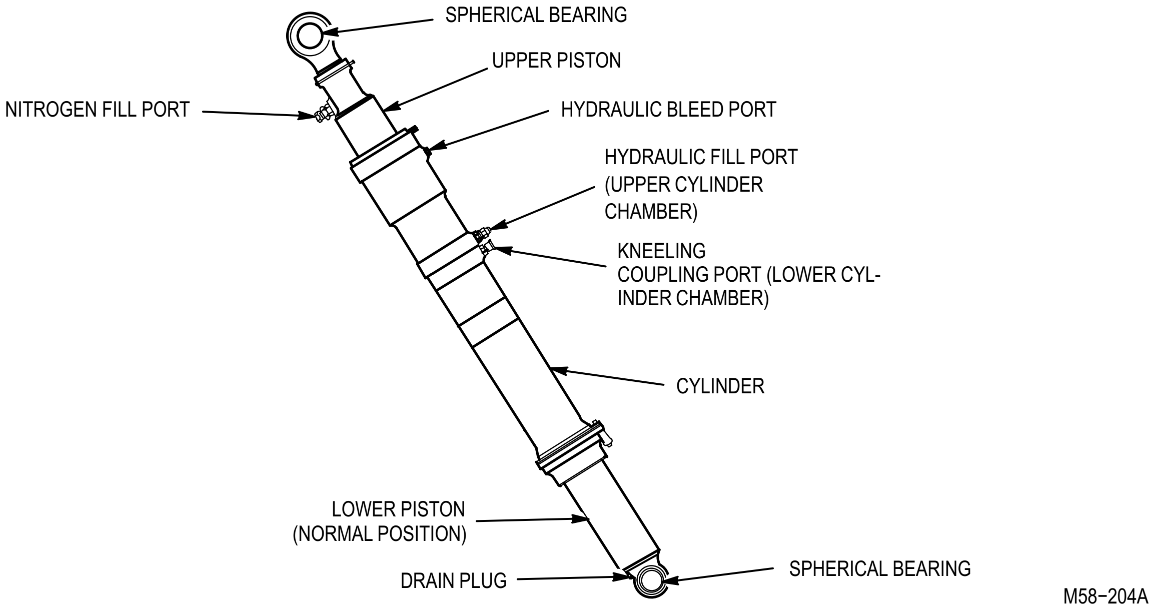


Figure 3–4. Shock Strut Assembly

(4) **Wheel and Tire Assembly.** The wheel and tire assembly (2 each) (fig. 3–5) consists of a wheel and a tire attached to an axle. The wheel is attached to the axle by a lock–ring and axle nut which screws the end of the axle against the outside wheel bearings. The wheel is a split–rim type with an O–ring that provides a seal between the two halves which are bolted together. The outboard rim is equipped with a nitrogen valve for inflating or deflating the tire. The tire is tubeless with a rib thread design. The inboard rim is equipped with a brake disc (rotor).

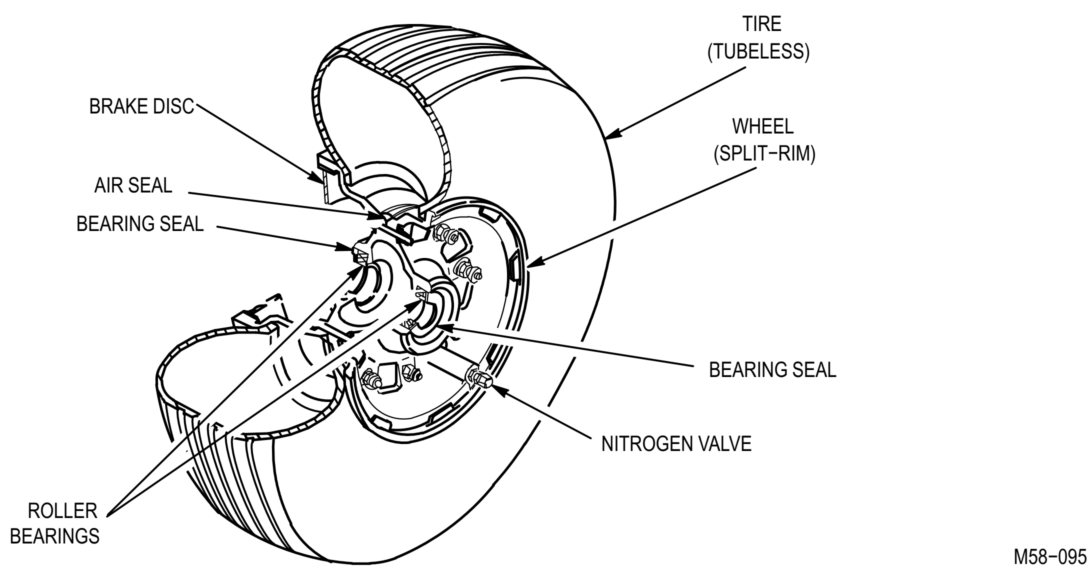


Figure 3–5. Wheel and Tire Assembly

b. **TLG Assembly.** The TLG assembly (fig. 3–6) is attached to the aft end of the fuselage tailboom section. The TLG assembly consists of the shock strut assembly, trailing arm assembly, fork and axle assembly, wheel centering mechanism, wheel and tire assembly, and the tail wheel lock actuator system.

3–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 3–2

(1) **Shock Strut Assembly.** The shock strut assembly is a steel cylinder that is fitted with an upper and lower piston assembly with pivot points which attach to the tailboom mount at one end and the trailing arm mount on the other end. A hydraulic service valve is provided at the center of the upper piston of the cylinder. A nitrogen charge valve is provided for servicing of the upper piston.

(2) **Trailing Arm Assembly.** The trailing arm assembly provides support for the TLG and provides mounting for the TLG components. Two trailing arm attachments are provided for mounting of the trailing arm assembly. The aft end of the trailing arm forms an integral housing and socket which provides mounting for the fork assembly. A jack pad is mounted on the lower surface of the trailing arm housing forward of the tail wheel.

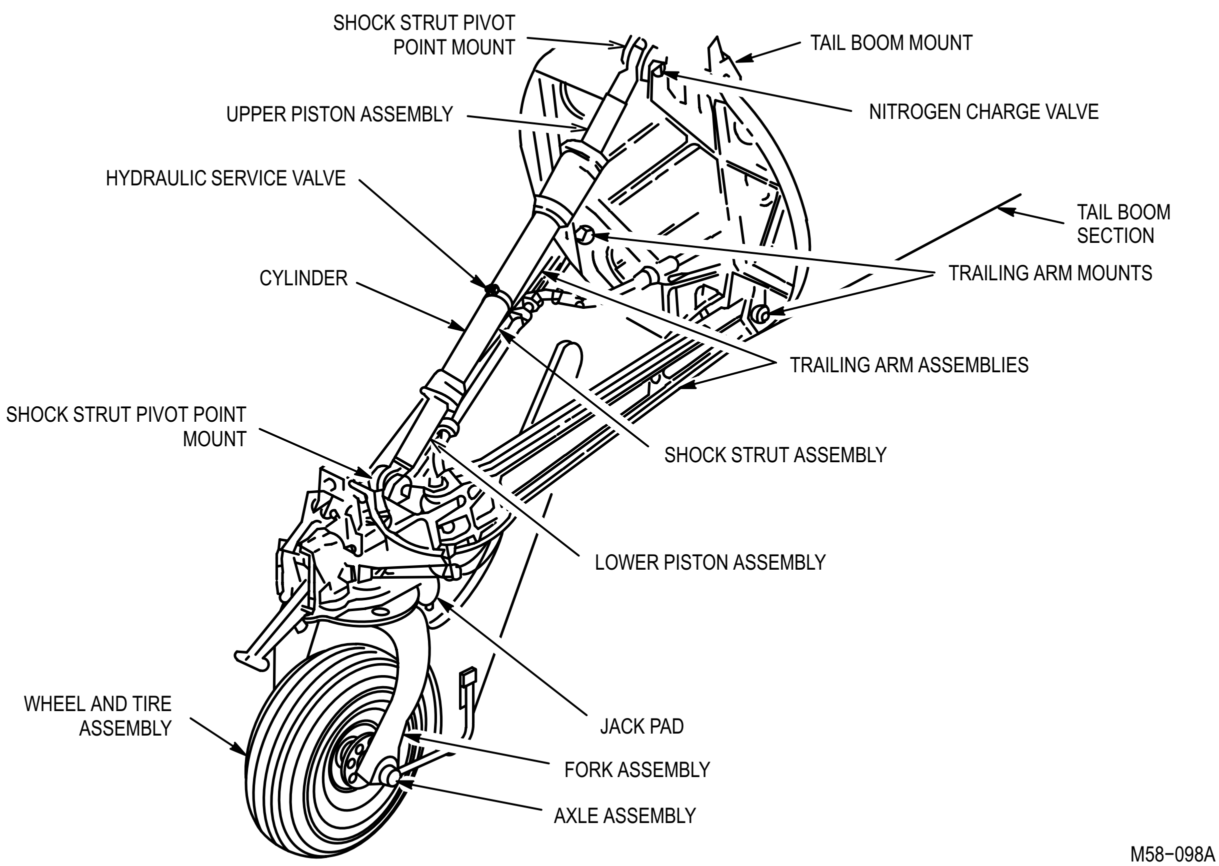


Figure 3–6. TLG Assembly

(3) **Fork and Axle Assembly.** The fork and axle assembly (fig. 3–7) consists of a fork and axle which is mounted by inserting the lower cam of the fork in the trailing arm socket. The center pivot shaft of the fork is hollow and provides mounting for the wheel centering mechanism. A wear plate is mounted on the fork assembly and is drilled with a single locking hole for the actuator lock pin to contact until fork centering is accomplished. A dust seal is installed between the trailing arm housing and the fork assembly to prevent foreign object damage (FOD) from the centering and locking the mechanisms. A static ground cable is attached to the bottom on the left hand side of the fork. The axle is attached to the open ends of the fork assembly and has bushings installed in both ends. A hole is drilled through each end of the axle which provides a way to secure the axle to the fork assembly. The hollow end of the axle is used to attach a steering bar during ground handling or a tow bar for towing from the rear of the helicopter.

3–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 3–2

(4) **Wheel Centering Mechanism.** The wheel centering mechanism is mounted into the trailing arm socket and fork assembly and consists of a center pivot shaft, a lower cam, and an upper cam. The center pivot shaft of the fork contains two internal springs, a spring guide, and a lower cam. The lower cam is retained in the fork assembly by a headless pin through a slot in the cam which allows it to move up and down on the fork liner during activation. The upper cam is retained in the upper cam housing assembly by a headless pin. The stationary cam mates with the lower cam. When the fork rotates it forces the lower cam down. Internal spring tension at the the lower cam causes the the fork assembly to center when weight is removed from the TLG.

(5) **Wheel and Tire Assembly.** The wheel and tire assembly mounts on the fork axle and consists of a wheel, a tire and a tube. The tire is a 14–ply tubeless rib tread design with an inner tube installed to provide added impact protection. The TLG tire is inflated to 95 ±5 psi using dry nitrogen. Tire burst pressure is 340 psi. The wheel is a split–rim type with the halves bolted together. Left and right taper roller anti–friction, internally mounted bearings are used to ride the axle. Two spacers are installed internally on the axle, one non–adjustable, the other adjustable. Spacers center the wheel on the axle and a locknut provides bearing adjustment and wheel free play.

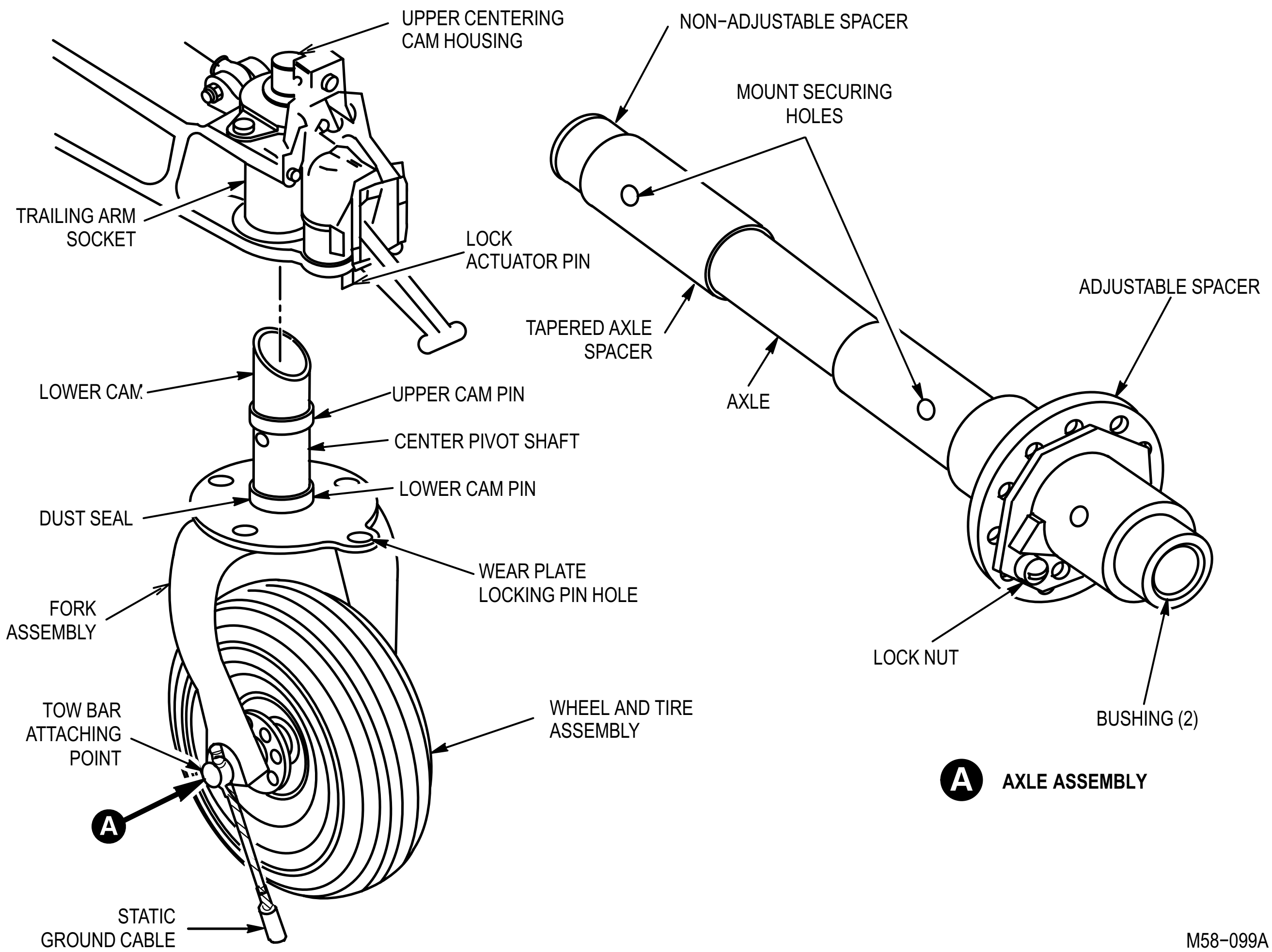


Figure 3–7. Fork and Axle Assembly, Wheel Centering Mechanism, and Wheel and Tire Assembly

3–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 3–2

(6) **Tail Wheel Lock Actuator System.** The tail wheel lock actuator system (fig. 3–8) consists of an actuator, a lock/unlock handle, a proximity switch and a tail wheel lock control valve. The tail wheel lock actuator is mounted to the trailing arm housing and is spring loaded to the locked position and controlled by the tail wheel **UNLOCK/LOCK** switch on the pilot's **TAIL WHEEL** panel. A handle on the lock actuator allows the ground crew to manually operate the actuator. The lock/unlock handle is held in the locked and unlocked position by two springs attached on each side of the handle and the tail wheel lock actuator. The underside of the lock handle contains an adjustable bolt to set the handle mechanism to prevent it from automatically returning to the full up position. The proximity switch, an electrically controlled and magnetically operated sensor, informs the pilot of current actuator position. The proximity switch mounts to the upper portion of the lock actuator and works in conjunction with the lock target installed in the upper end of the lock actuator. The tail wheel lock control valve is energized when the pilot's **TAIL WHEEL** switch is placed in the **UNLOCK** position and allows hydraulic fluid to be sent to the actuator.

c. **MLG Brake System.** The MLG brake system (fig. 3–9) consists of two pilot master cylinders, two CPG master cylinders, two transfer valves, a parking brake valve, two wheel brake assemblies and two brake discs. The MLG brake system is mounted on the inboard side of each wheel and tire assembly.

(1) **Master Cylinder.** A master cylinder (fig. 3–10) is attached to each of the four directional control pedals (rod end bearing) and the directional control pedal mounting bracket (end cap bearing). The master cylinders transfer force applied by a crewmember's foot, into fliud pressure. The master cylinders apply hydraulic fliud pressure to other brake system components and also serve as hydraulic fliud reservoirs.

(2) **Transfer Valves.** Two transfer valves (fig. 3–9) are mounted on a bracket between the pilot's directional control pedals and the pilot's forward, lower console structure. Each valve has a bleed valve, an output pressure port (to attach a brake line from the valve to the each park brake valve), an input port (to attach a brake line from the valve to the pilot master cylinders), and an input port (to attach a brake line from the valve to the CPG master cylinders). The major internal components of the transfer valves are a piston valve, a poppet valve and 2 springs.

(3) **Parking Brake Valve.** The parking brake valve, secured to a bracket assembly forward and below the transfer valves, consists of a control lever and cam, a handle, two compensators and two bleed valves. The parking brake valve body has two inlet pressure ports which receive pressure from the transfer valves. Two outlet pressure ports provide fluid pressure to the wheel brake assemblies. A cam shaft assembly positions four internal valves. The control lever is installed at one end of the cam shaft to rotate the shaft and set the park brake. A return spring is attached to one end of the lever and the transfer valve mounting bracket. The parking brake handle assembly is in the pilot station and is connected via a flexible steel wire cable to an adjustable clevis in the brake lever. Two compensators and two bleed valves are installed at the pilot center console panels. The bleed valves are connected via tubing to the bleed ports at the parking brake valve.

(4) **Wheel Brake Assembly and Brake Disc.** The wheel brake assembly (fig. 3–11) is bolted to each MLG flange at the inboard portion of the trailing arm axle. Brake discs are attached to the wheel and tire assemblies. The wheel brake assembly (2 each) consists of a brake housing, a pressure inlet port and a bleed port. Each brake disc has eight key slots which mount over eight corresponding keys on the wheel rim. The brake housing mounts to a flange on the axle. The brake disc rotates between the friction linings in the brake housing.

3–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 3–2

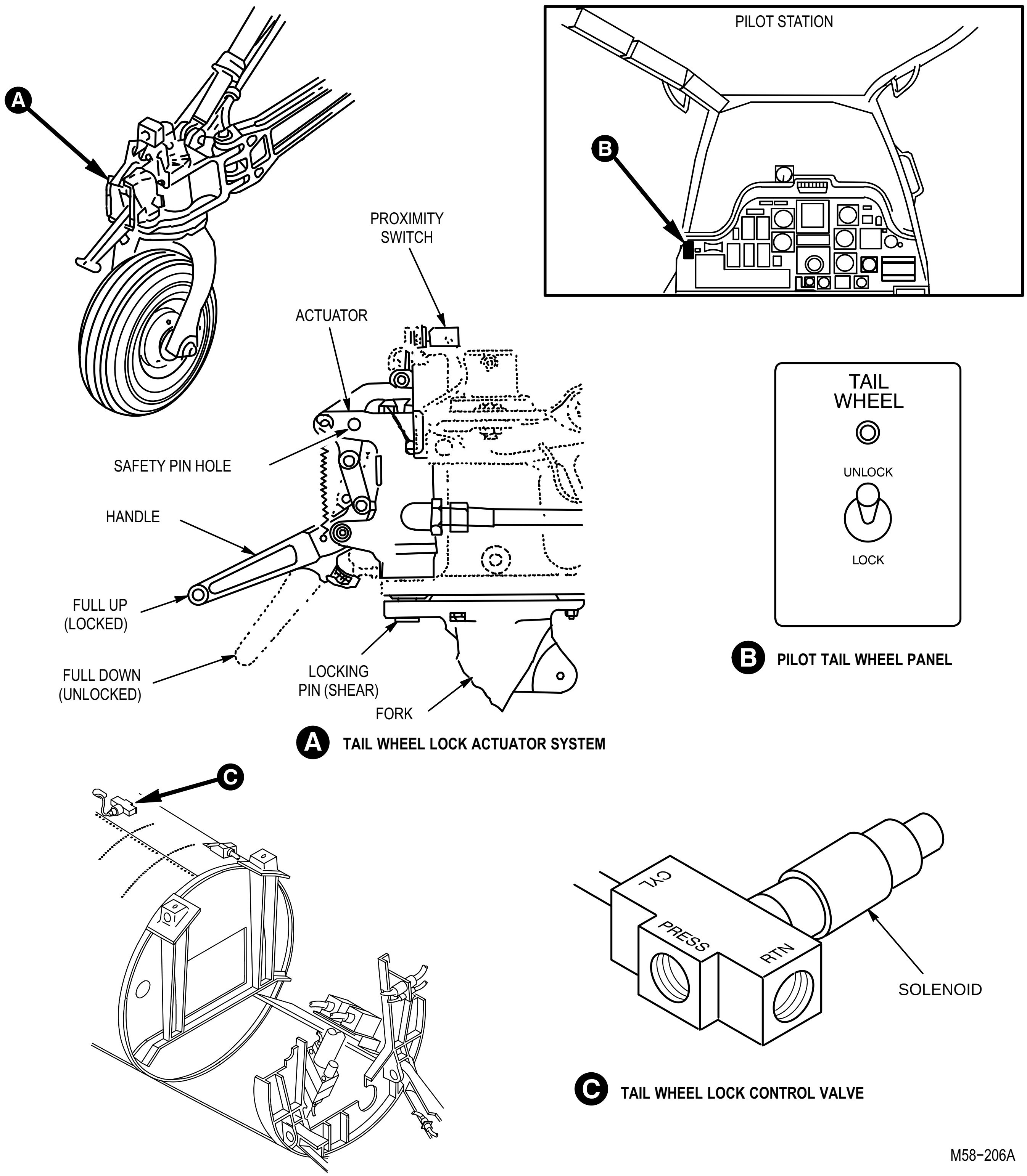


Figure 3–8. Tail Wheel Lock Actuator System

3–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 3–2

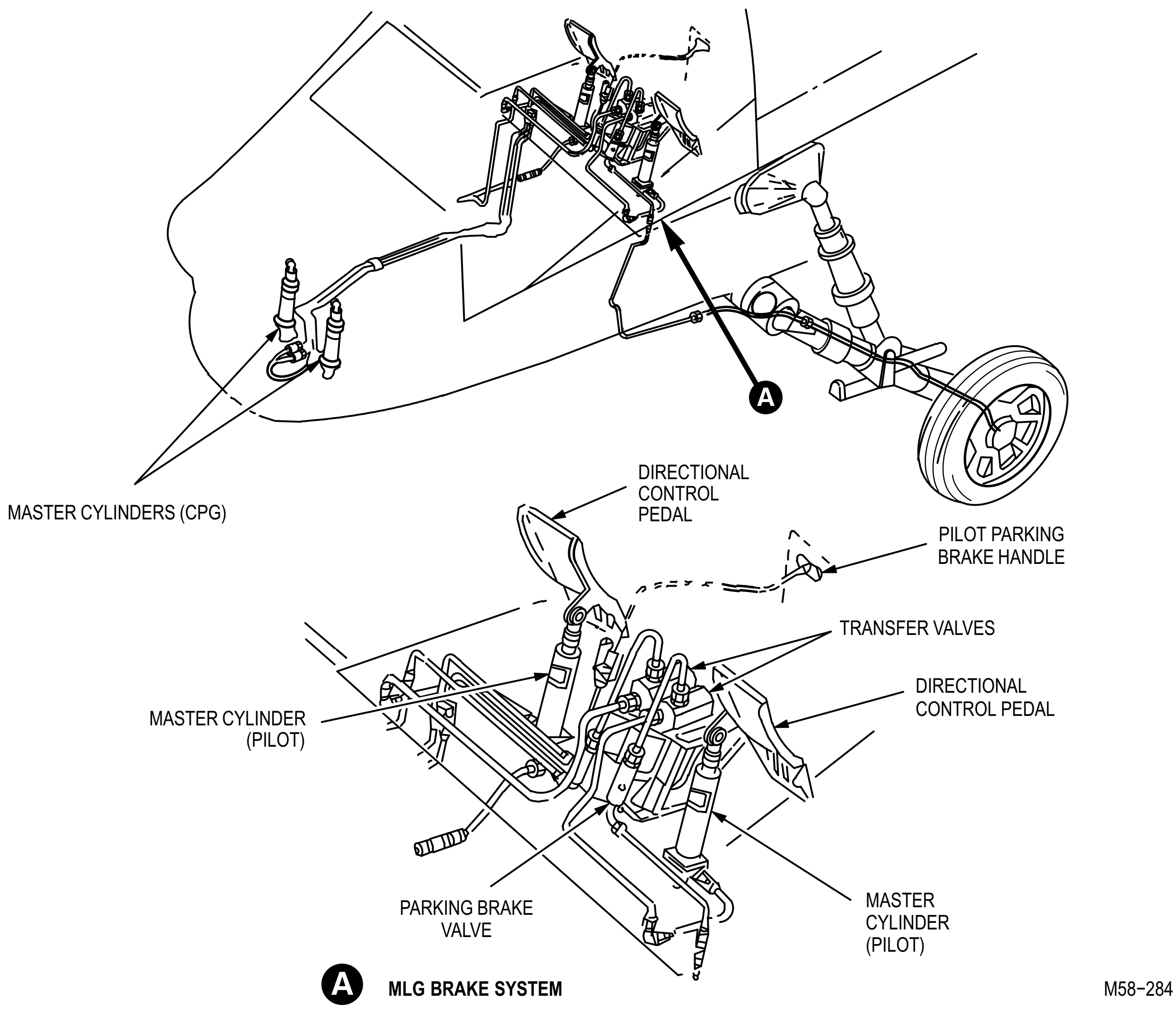


Figure 3–9. MLG Brake System

3–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 3–2

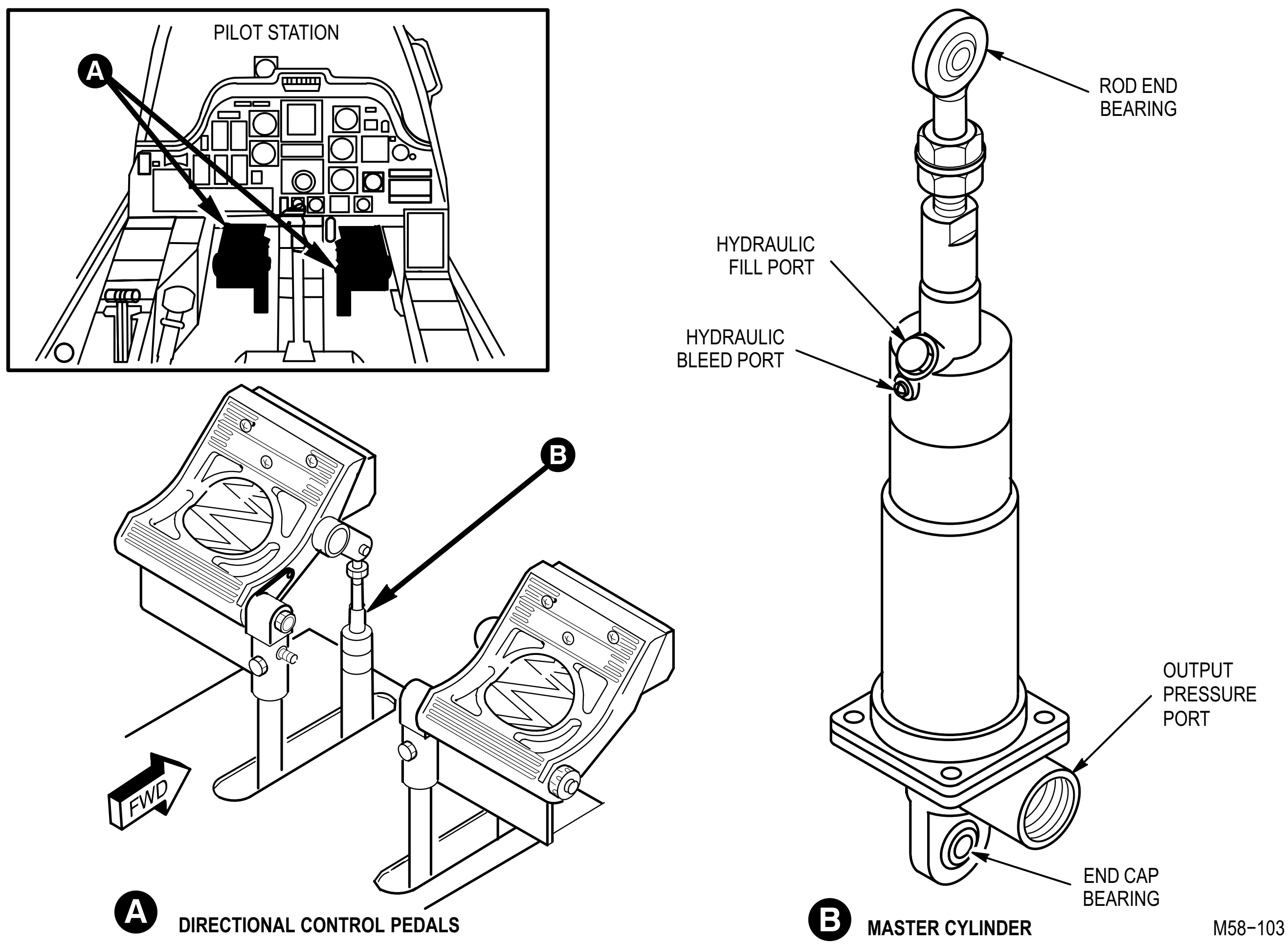


Figure 3–10. Directional Control Pedals and Master Cylinder

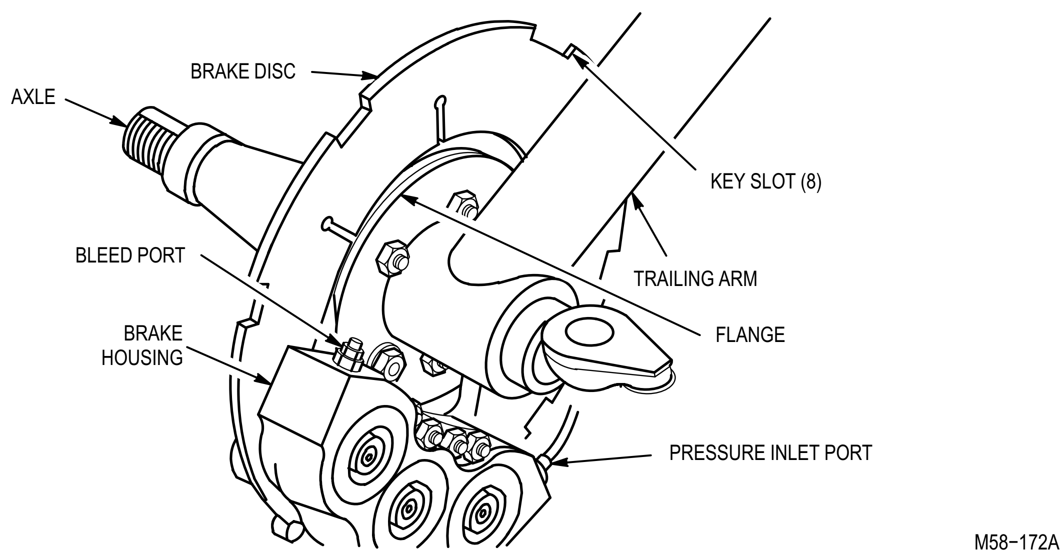


Figure 3–11. Wheel Brake Assembly and Brake Disc

3–3. EQUIPMENT DATA 3–3

MLG

Helicopter turning radius	37 ft. 6 inches
MLG shock strut hydraulic fluid capacity	3.8 U.S. qts.
MLG shock strut weight	42.9 lbs.
Tire (MLG) type	10 ply tubeless
Tire (MLG) size	8.5x10 inches

TLG

Tail wheel lock relay (electrical requirements)	28 VDC
Wheel width	4.75 inches
Wheel diameter	5.50 inches
Tire (TLG) type	14 ply tubeless

MLG Brake System

Gross weight capability	17,650 lbs.
Master cylinder weight	1 lb.

3–4. EQUIPMENT CONFIGURATION 3–4

Not applicable.

3–5. SAFETY, CARE AND HANDLING OF EQUIPMENT 3–5

a. Tires must be deflated before wheel removal. Pressure on loosened nuts can result in separation of wheel halves.

b. Wheels must be chocked before system maintenance.

c. Shock strut system contains high pressure nitrogen. Strut must be bled off prior to system servicing.

3–6. CONTROLS AND INDICATORS 3–6

The landing gear system receives mode selects and remote switch inputs from various controls located in the pilot station (fig. 3–12). Table 3–1 provides a listing of the controls, switches and associated indicators pertaining to the landing gear system along with a description of their function.

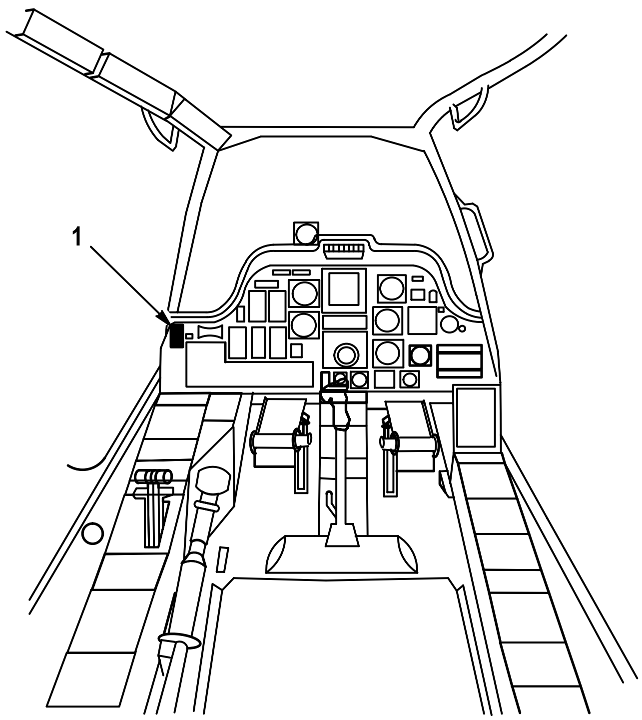


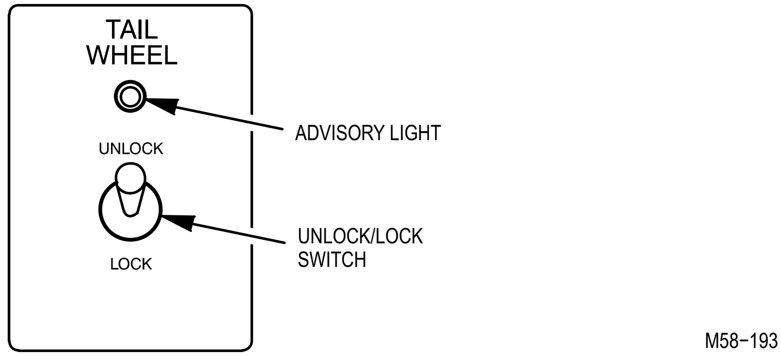
Figure 3–12. Pilot Station

Table 3–1. Landing Gear System Controls and Indicators

Pilot TAIL WHEEL Panel		
SWITCH/INDICATOR	POSITION	FUNCTION
TAIL WHEEL UNLOCK/ LOCK 2–position switch	**UNLOCK**	Energizes electrical circuit to control tail wheel lock solenoid.
	UNLOCK	De–energizes solenoid in tail wheel lock circuit.
Advisory Light	GREEN	Lights when **TAIL WHEEL** switch is set to **UNLOCK**.

3–6. CONTROLS AND INDICATORS (CONT) 3–6

Table 3–1. Landing Gear System Controls and Indicators



Pilot TAIL WHEEL Panel

SECTION II. THEORY OF OPERATION

3–7. SYSTEM DESCRIPTION 3–7

a. **Landing Gear System.** The purpose of the landing gear system is to support the helicopter for all ground operations and absorb landing shocks. The system consists of two MLGs and one TLG.

(1) The MLG incorporates a trailing arm assembly which is connected at the top of the cross tube assembly and has a wheel and tire mounted to the bottom. The cross tube assembly provides the major support structure for the helicopter. A shock strut is mounted on the angled trailing arm assembly to provide normal/high–impact energy absorption and to provide kneel/erect capability for the helicopter for transportation. The MLG has a separate brake system for each wheel and is operated by the toe portion of the directional control pedals in the pilot and CPG crew stations. The parking brake can only be locked from the pilot station but can be released from the either crew station.

(2) The TLG trailing arm assembly is connected to the tail boom and has a fork and axle assembly with the wheel and tire mounted at the bottom. The fork provides 360° swiveling capability of the tail wheel. The TLG fork can be locked at center position manually or hydraulically. The TLG wheel and tire assembly also centers itself as weight is removed from the wheel.

b. **Purpose.** The landing gear system provides support and ground stability for the helicopter fuselage during taxiing, takeoff, landing, towing and parking. The system dampens and absorbs landing shocks before they are transmitted to the airframe structure. The TLG swivels, with a wheel centering mechanism, for steering the helicopter on the ground, or can be locked when desired. The MLG provides mounting for the helicopter wheel brake assembly.

c. **System Operation.**

(1) **MLG Assembly**. The MLG assembly (fig. 3–13) consists of the cross tube assembly, trailing arm assembly, shock strut assembly, and the wheel and tire assembly.

(a) **Cross Tube Assembly.** The cross tube assembly is a major support structure and provides an interconnecting pivot for the left and right MLG trailing arms, while transmitting loads from the trailing arm to the fuselage.

(b) **Trailing Arm Assembly.** When the wheels contact the ground during landing, the trailing arms pivot (rotate) down, transferring the vertical load inputs to the shock struts. As the weight of the fuselage is supported by the MLG, the squat switch target on the left MLG moves out of proximity with the squat switch (proximity switch). The proximity switch de–energizes a set of relays which in turn: (When the helicopter becomes airborne, the shock struts extend causing the trailing arms to rotate up and move the squat switch target back into proximity of the squat switch. This causes the relays to become energized and returns to its previous condition.)

- Enables the wing–mounted intercommunication system (ICS) receptacles.
- Activates the generator under–frequency protection circuit.
- Commands the pylon ejector racks to the ground stow position.
- Enables the fault detection/location system (FD/LS) ground test.
- Disables the laser, gun, rockets, and missiles.
- Disables the yaw function of the digital automatic stabilization equipment (DASE).
- Removes electrical power from the TADS/PNVS anti–ice circuit.
- Erases the code in the TSEC/Kit–1A if IFF mode 4 has been selected.

(c) **Shock Strut Assembly.** The lower chamber of the cylinder and the lower piston are filled with hydraulic fluid. The upper strut assembly is filled with dry nitrogen. During operation, the internal floating diaphragm rides on top of this hydraulic fluid and compresses the nitrogen for a dampening effect of shocks received to the fuselage. When the helicopter is in flight (or on jacks), nitrogen pressure forces the floating diaphragm toward the lower end of the piston driving the piston to the extended position. The rate of extension is controlled by an internal poppet valve and orifices at the lower end of the piston. Servicing of the strut is accomplished through the hydraulic fill/bleed port, and a nitrogen fill/bleed port. Two vent ports at the lower chamber, either side of the kneeling coupling, are used during servicing. Several markings are stenciled on the strut to indicate location of valves, plugs, ports, and locking positions. A data plate gives shock strut inflation, instructions, and servicing procedures. During takeoff, as the upper piston extends the controlled rate of fluid flow prevents the MLG from dropping too fast. An elastomer spring assembly, installed internally in the top portion of the upper cylinder, provides damping during extension. During landing, the weight of the helicopter causes the shock struts to compress. The upper piston is forced toward the bottom of the cylinder. The poppet valve and orifice, in the upper chamber valve assembly, controls the rate of fluid flow between the piston and cylinder as the upper piston moves in and out. The floating diaphragm is forced upward by fluid pressure increasing the nitrogen pressure against the upper side of the diaphragm. The compression of the nitrogen acts as a spring to cushion the landing. A fuse collar mates with the machined flanges on the exterior surface of the lower piston. A quick release pin is used to secure the fuse collar in the lock position. Three retaining pins (screws) prevent the fuse collar from pulling away from the cylinder when the collar is disengaged from the internal flanges. The external operating surface of the piston is chrome plated, with a red band around the upper portion of the lower piston housing which provides visual indication of proper piston extension for fuse collar to flange engagement. The lower end of the piston attaches to the trailing arm through a spherical self–lubricating bearing installed in the lower piston.

(d) **Kneeling/Erecting.** The kneeling/erecting operation of the helicopter can be started by connecting external hydraulic pressure to the kneeling couplings on both struts (TM 1-1520-238-23). When the fluid in the cylinder is externally pressurized, the shear collars are unlocked. Fluid pressure is then slowly reduced to allow the lower pistons to move into the lower cylinder chambers. This controlled method of lowering the helicopter avoids damage to the aircraft. To raise the helicopter, external pressure is applied to the cylinders until the pistons are fully extended. The shear collars are then locked.

(e) **Normal/High–Impact Landing.** During normal operation, the fuse collar holds the lower piston in an extended position. The lower cylinder is filled with hydraulic fluid which provides a solid column of fluid against the lower piston chamber. In the event of a high impact landing, the force shears the retaining flanges on the piston and rupture a burst–disc. The lower piston then moves into the cylinder and hydraulic fluid flows into the upper piston chamber at a restricted rate through an orifice. This action aids the upper piston in absorbing excessive shock loads by providing a controlled rate of collapse.

(f) **Wheel and Tire Assembly.** The wheel and tire assembly rotates on the trailing arm axle bearings. The wheel and tire assembly provides the helicopter with ground movement capability for taxiing, run–on landings, towing, aids in cushioning landing shocks, and provides parking support.

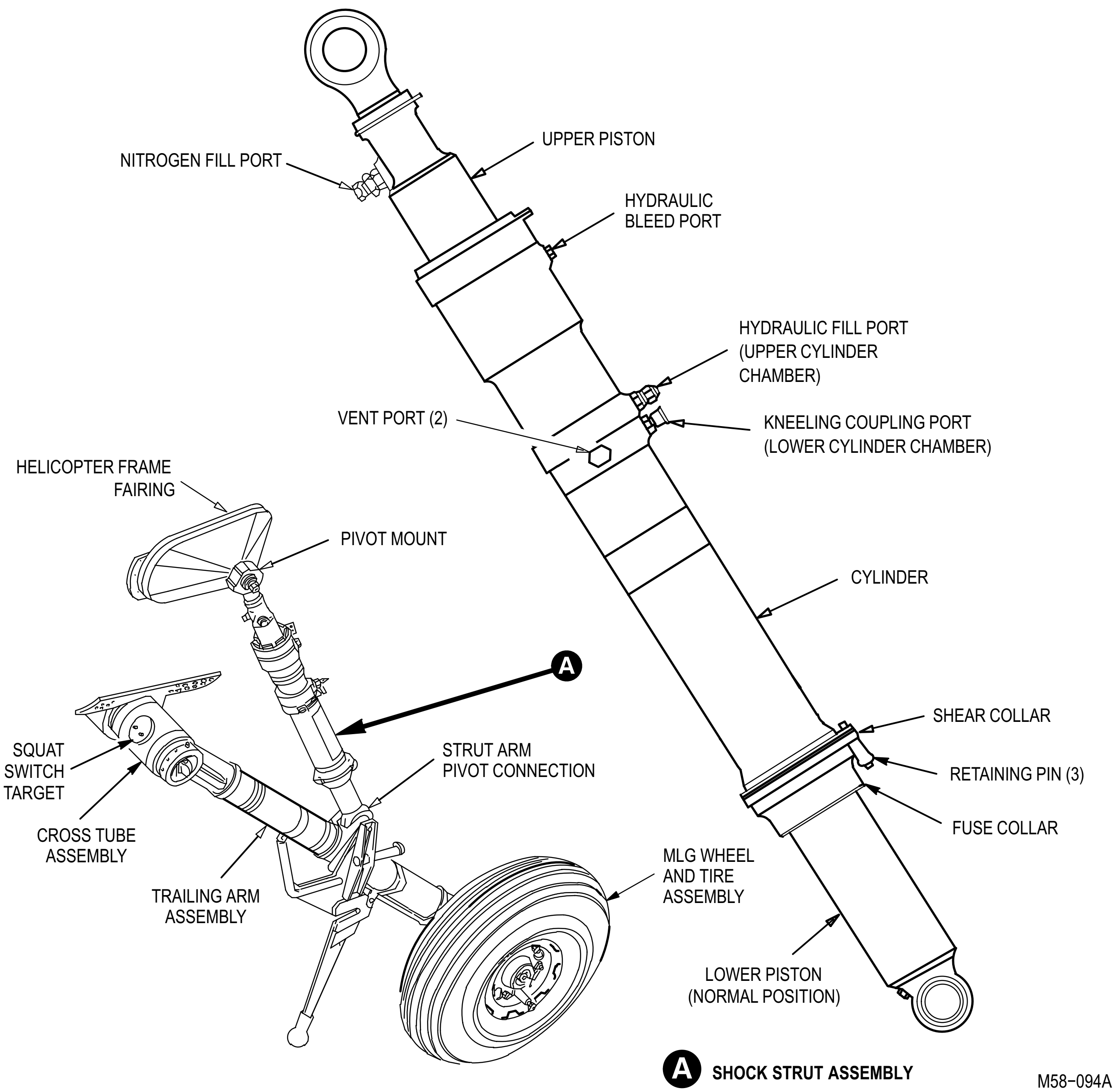


Figure 3–13. MLG Assembly

(2) **TLG Assembly**. The TLG assembly (fig. 3–14) supports the helicopter during all modes of ground operations. The TLG extends and compresses which reduces pitching velocities and the possibility of blade–to–boom contact during tail–low landing impacts. The tail wheel proximity switch provides the pilot the capability of verifying that the tail fork and wheel assembly are in a locked position.

(a) **Trailing Arm Assembly.** The trailing arm assembly provides support to the TLG by absorbing loads during landing and taxiing and transfers the loads to the shock strut and tail boom structure.

(b) **Wheel Centering Mechanism.** The TLG fork and axle assembly provides a housing and socket for operation of the tail wheel centering mechanism and allows the tail wheel to swivel 360°. At takeoff, the wheel centering mechanism causes the fork assembly to center as helicopter weight is removed from the wheel.

(c) **Shock Strut Assembly.** The shock strut assembly absorbs and cushions vertical impact loads resulting from normal and high–impact landings. The TLG shock strut assembly functions basically the same as the MLG shock strut. An internal floating diaphragm separates the hydraulic fluid from the nitrogen gas and moves on–top of the fluid as the shock strut's upper piston extends and retracts. The hydraulic fluid flows between the upper piston and cylinder through a poppet valve and orifices which restrict flow. This, in conjunction with the nitrogen gas compression, dampens helicopter landing shock.

(d) **Wheel and Tire Assembly.** The wheel and tire assembly provides the helicopter with the capability of ground movement during taxi, towing and run–on landing operations.

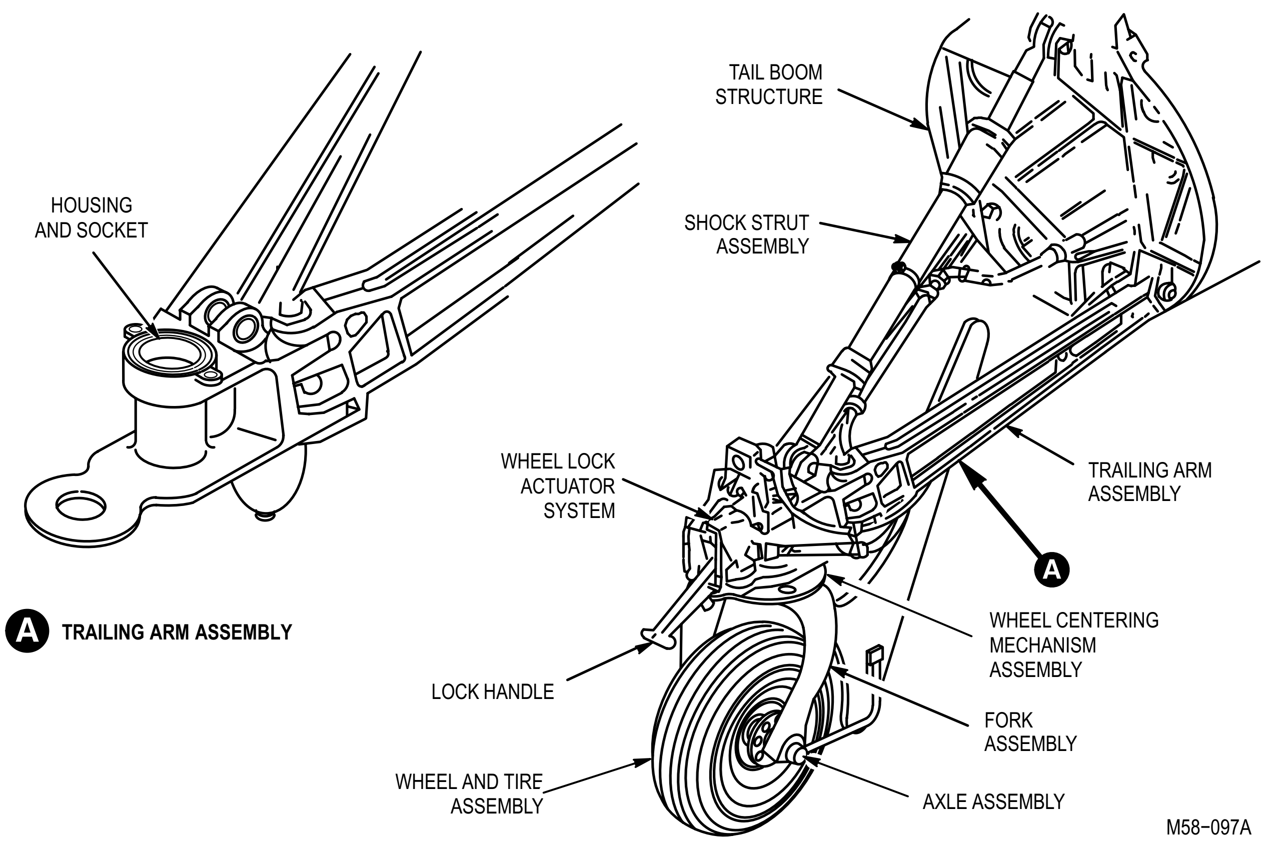


Figure 3–14. TLG Assembly

(e) **Tail Wheel Lock Actuator System** (fig. 3–15). When the actuator is in the locked position, fuselage reaction is minimized to rotor torque and crosswind effects. The lock actuator also prevents the tail wheel from swerving during normal landings, or when landing on a sloped terrain, and inhibits shimmy of the tail wheel during takeoff or landing. The locking pin shears under high side load conditions to prevent damage to the fork, trailing arm assembly or tailboom. The tail wheel lock actuator system can also be manually controlled**.** The handle attached to the lock actuator is used to manually unlock and lock the tail wheel. A quick–release safety pin, with an attached warning flag, is used to hold the lock actuator in the unlocked position during ground handling which prevents accidental locking of the tail wheel. When the handle is placed in the full up position, it seats the lock pin which secures the wheel in the center position. Placing the handle in the full down position unseats the lock pin, allowing the fork assembly freedom of movement.

(f) **Tail Wheel Proximity Switch.** The working circuit of the tail wheel lock/unlock actuator electrical operation consists of a **TWHL LOCK** circuit breaker (CB59) that applies 28 VDC to the pilot **TAIL WHEEL UNLOCK/LOCK** switch, to the open contacts of the tail wheel lock relay (K34) and the tail wheel lock proximity switch. The tail wheel lock relay is controlled by the tail wheel lock proximity switch. When the tail wheel is unlocked, the proximity switch supplies an electrical ground to the tail wheel lock relay. Placing the **TAIL WHEEL** switch in the **UNLOCK** position applies 28 VDC to the tail wheel lock control valve solenoid allowing hydraulic pressure to unlock the tail wheel. When the tail wheel lock/unlock actuator is in the the unlock position, the tail wheel lock proximity switch is actuated and supplies an electrical ground to the tail wheel lock relay. When the tail wheel lock relay is energized, 28 VDC control voltage is applied to the multi–channel dimming controller which supplies voltage to illuminate the **TAIL WHEEL UNLOCK** advisory light.

(3) **MLG Brake System.** The MLG brake system **(**fig. 3–16) provides braking and directional control for taxiing the aircraft. The brake system holds a maximum alternate gross weight of 17,650 lbs. on a 12° slope. A separate system is provided for the left and right wheels. The MLG brake system can be operated from the pilot or CPG station by depressing the top of the pilot or CPG directional control pedals. The parking brake is locked from the pilot station only, but can be released from either crew station.

(a) **Transfer Valves.** The transfer valves allow the pilot or CPG master cylinder pressure to operate the brakes without mixing fluids. The two transfer valves provide pressure which interconnects between the pilot and CPG master brake cylinders. The bleed screws on the transfer valve are used to bleed air from the CPG master cylinders. When the brakes are operated from the pilot station, the transfer valve does not function mechanically. Fluid pressure passes from the pilot’s master brake cylinder through the transfer valves to the wheel brakes. The tranfer valve functions only when the CPG’s brakes are operated. Fluid pressure from the CPG master cylinder moves the piston, opening the CPG inlet port and poppet, thus closing the pilot’s inlet port which prevents fluid from flowing back into the pilot’s reservoir. The CPG piston transmits pressure to the hydraulic fluid forcing it through the outlet port into the transfer valve. This action operates the MLG wheel brakes. Pressure from the pilot’s master cylinder overrides the poppet valve. Unseating the poppet opens the pilot’s inlet and seals the CPG’s inlet to allow the pilot’s pressure to operate the wheel brakes.

(b) **Wheel Brake Assembly.** The wheel brake assembly converts hydraulic pressure into a retarding mechanical force that stops wheel rotation. Hydraulic pressure activates three pistons in each brake assembly to press friction linings against a floating brake disc, thus slowing or stopping wheel rotation.

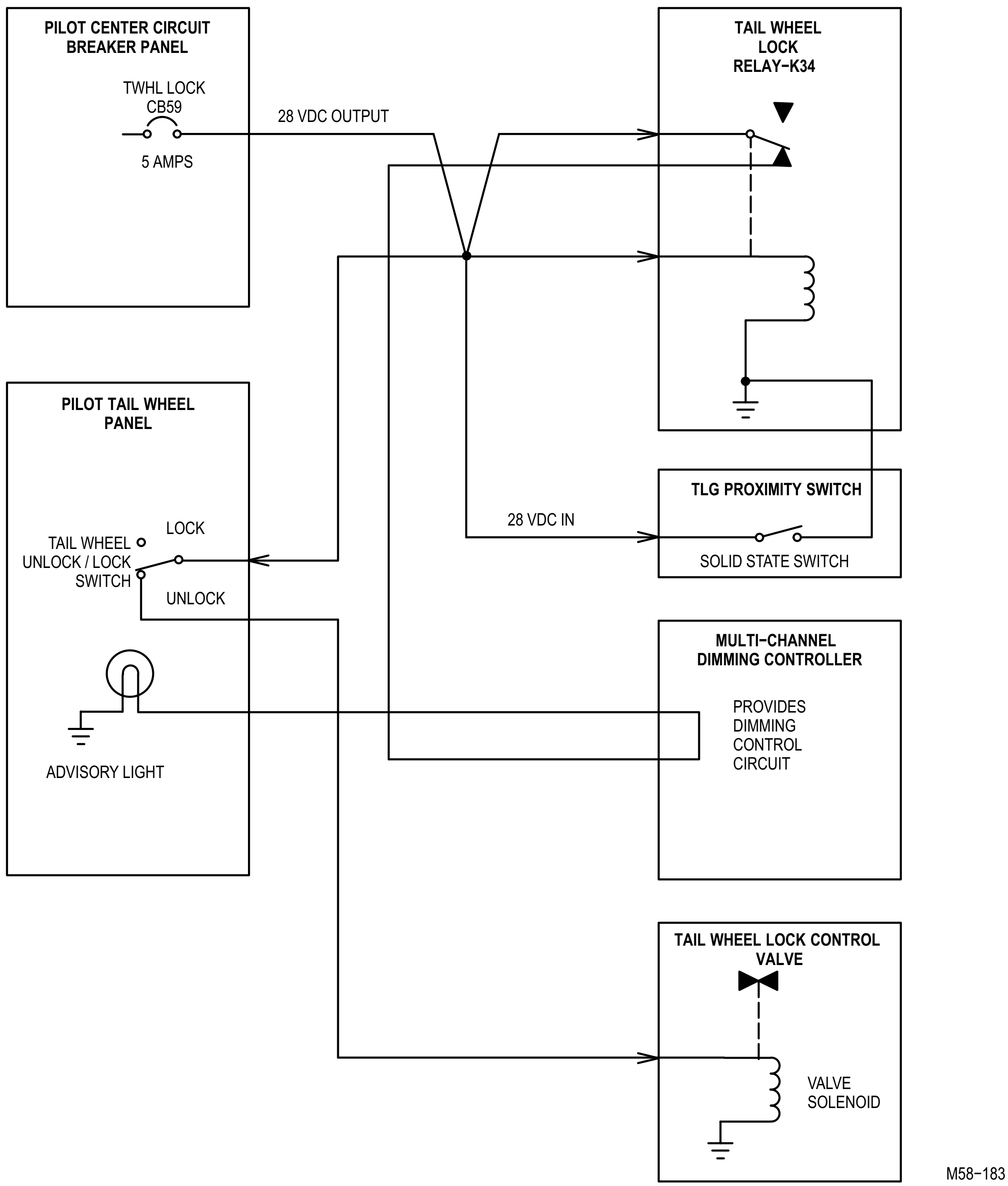


Figure 3–15. Tail Wheel Lock/Unlock Actuator Electrical Operation

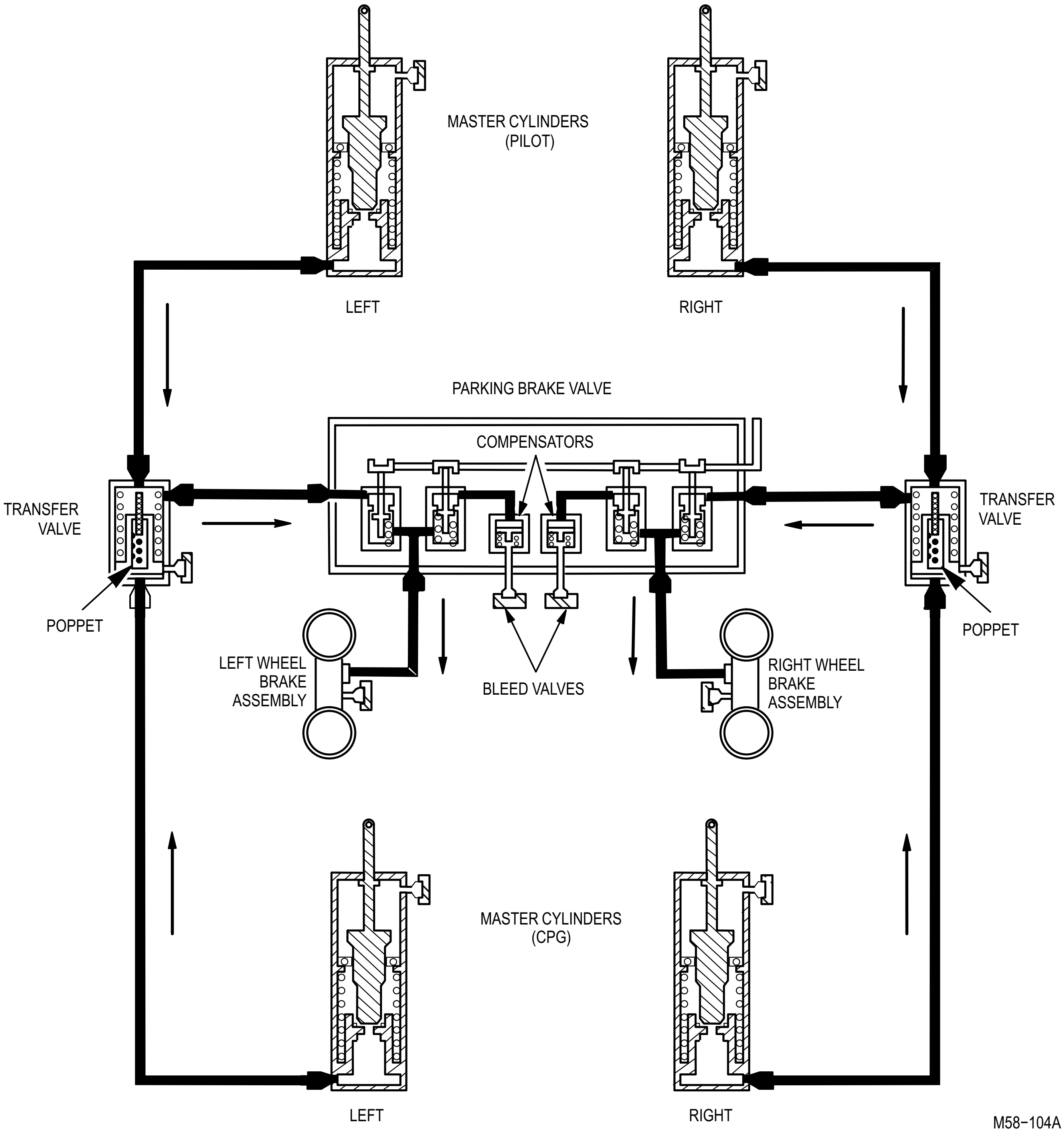


Figure 3–16. MLG Brake System

3–7. SYSTEM DESCRIPTION 3–7

(c) **Master Brake Cylinders.** When the cylinder is static, an internal spring maintains the extension of the piston rod and pressure is not present. When the top (toe pressure) of a directional control pedal is pushed, hydraulic fluid is pressurized. As the upper piston head moves downward, the cap seats against the upper piston head, stopping the flow of fluid to the reservoir. When the reservoir closes, pressure builds in the upper chamber. This pressure buildup causes hydraulic fluid to flow through screens in the piston assembly. It also partially unseats an internal poppet valve. As pressure continues to build in the upper chamber, the piston assembly seats, trapping fluid in the lower chamber. Increased pressure causes the piston to fully open the poppet, allowing unused fluid to flow from the upper chamber back to the reservoir. Hydraulic braking pressure is supplied to the wheel brakes from the lower chamber through an outlet port. When the directional control pedals are released, a spring inside the upper chamber extends the cylinder to its original length, relieving fluid pressure and de–pressurizing the system.

(d) **Parking Brake System.** The parking brake system (fig. 3–17) sets the wheel brakes for stability. During normal braking operation, with the brake pedal actuated, the lever of the parking brake valve is held in the off position by a spring assembly. The lever is attached to a camshaft which holds the two outer valves open. Fluid pressure is applied to the MLG wheel brakes by applying pressure to the toe portion of the pilot or CPG directional control pedals. The master brake cylinders force fluid through the transfer valves, parking brake valve, and connecting brake lines to the wheel brakes. With the parking lever in the unlock position, the inner valves are seated (closed) and the compensators are inoperative.

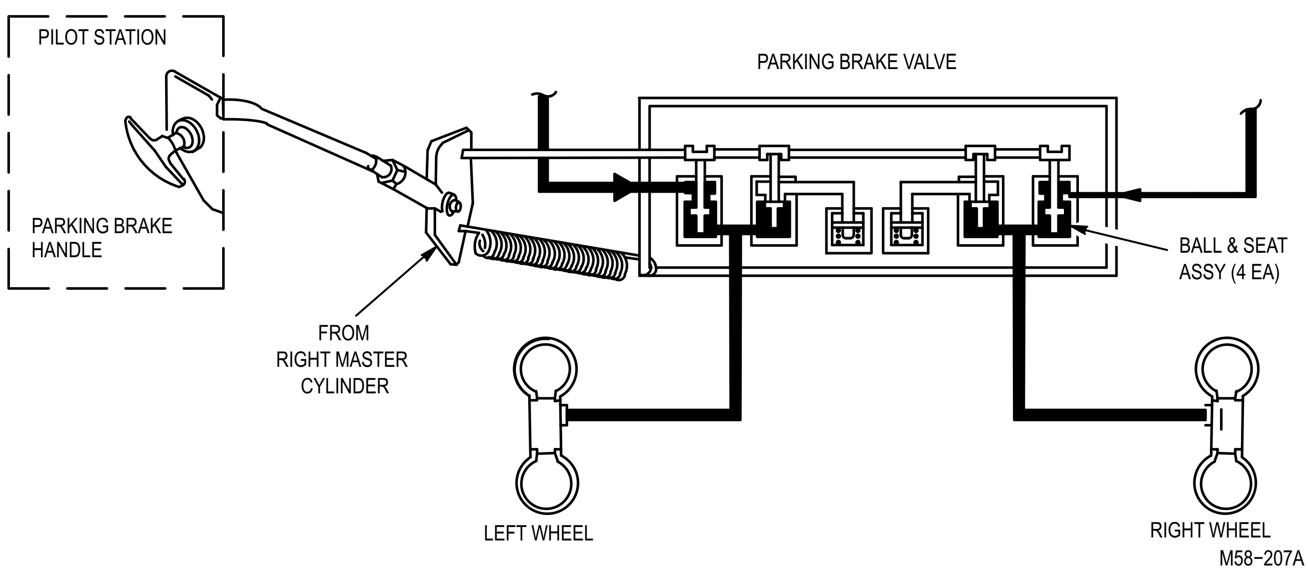


Figure 3–17. Parking Brake System Operational Schematic

3–8. MULTIPLEX READ CODES 3–8

Not applicable.

SECTION III. TROUBLESHOOTING PROCEDURES

3–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX 3–9

Not applicable.

3–10. MAIN LANDING GEAR – MAINTENANCE OPERATIONAL CHECK 3–10

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Jack, Hydraulic Axle, 5-Ton (2)	MIL-J-26013

Personnel Required:

67R Attack Helicopter Repairer
One person to assist

References:

TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Helicopter safed

NOTE

- **Refer to pilot station (fig. 3–18) for cockpit configuration and equipment.**
- **If referenced out of one paragraph or volume and into another for additional troubleshooting, upon completion of the task, return to the maintenance operational check for the original paragraph or volume.**

1. Perform inspection of MLG (TM 1-1520-238-23).
2. Check MLG tires for proper pressure (MLG tire servicing TM 1-1520-238-23).
3. At pilot station, release parking brakes by applying and then releasing toe pressure on the top portion of the directional control pedals.
4. Jack left and right MLG at trailing arm jack pads (fig. 3–19) (TM 1-1520-238-23).

3–10. MAIN LANDING GEAR – MAINTENANCE OPERATIONAL CHECK (cont) 3–10

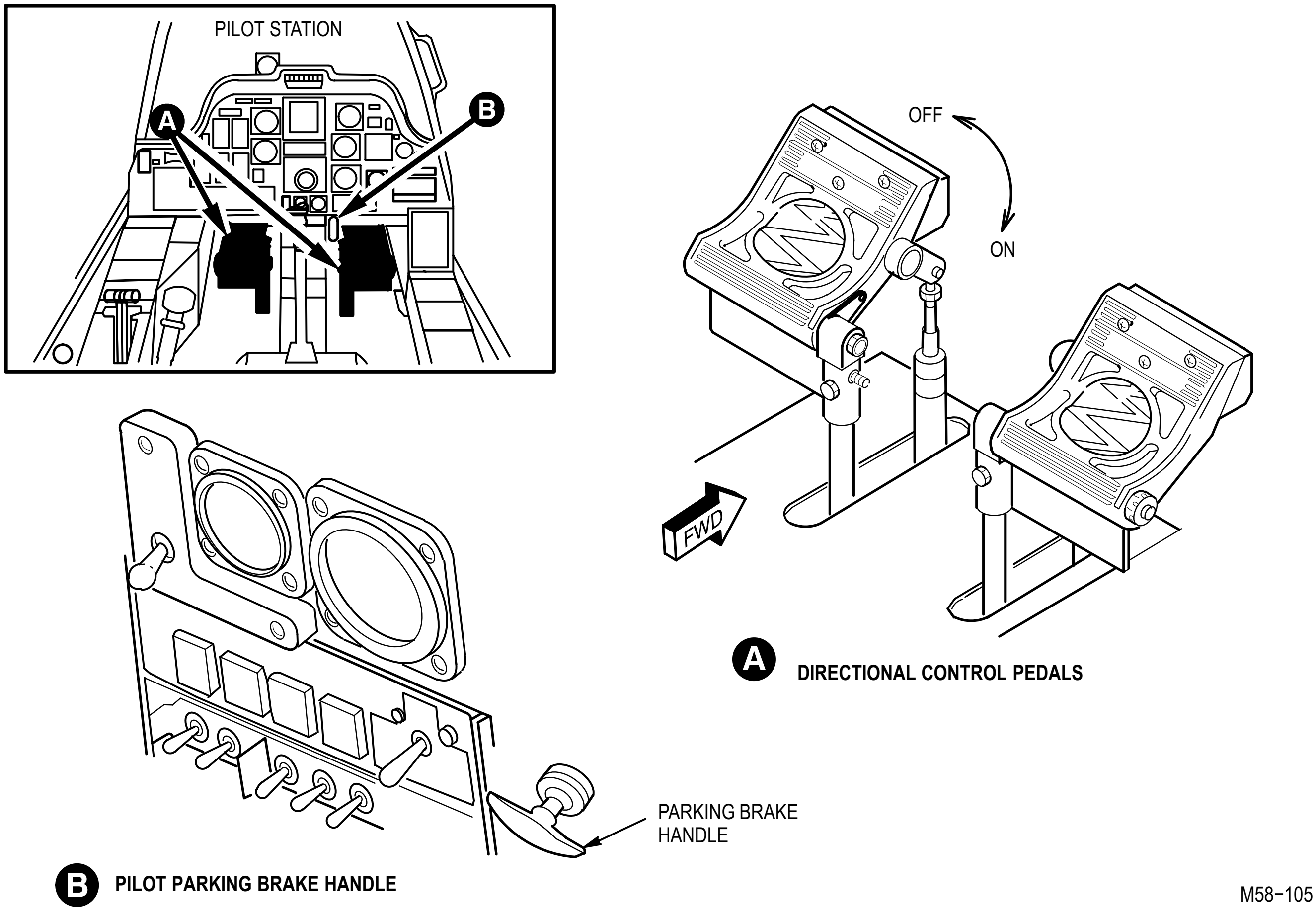


Figure 3–18. Directional Control Pedals and Pilot Parking Brake Handle

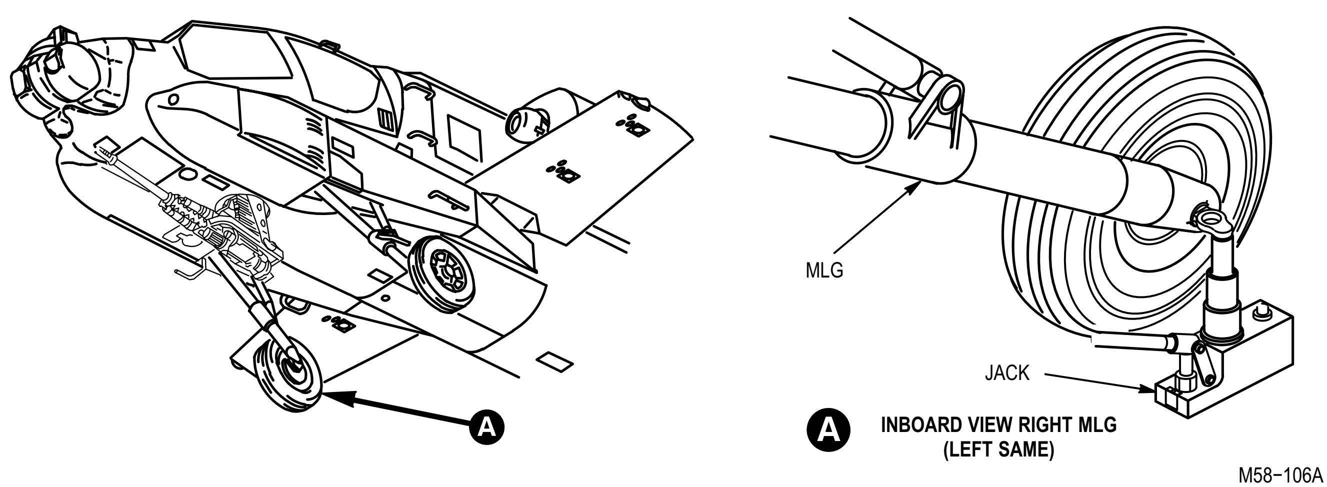


Figure 3–19. Right MLG

3–10. MAIN LANDING GEAR – MAINTENANCE OPERATIONAL CHECK (cont) 3–10

5. Complete the maintenance operational check as follows:

Task	Result
a. Rotate left main wheel.	If left main wheel does not rotate freely, go to paragraph 3–12.
b. Check left main wheel for looseness.	If left main wheel is loose, check for loose axle nut or worn bearings (TM 1-1520-238-23).
c. Rotate right main wheel.	If right main wheel does not rotate freely, go to paragraph 3–12.
d. Check right main wheel for looseness.	If right main wheel is loose, check for loose axle nut or worn bearing (TM 1-1520-238-23).
e. Apply and maintain pressure on pilot left directional control pedal.	If pilot's left brake is not firm, go to paragraph 3–13.
f. Check left main wheel for rotation.	If left main wheel rotates, go to paragraph 3–13.
g. Release pilots left directional control pedal. Apply and maintain pressure on pilot right directional pedal.	If pilot's right brake is not firm, go to paragraph 3–13.
h. Check right main wheel for rotation.	If right main wheel rotates, go to paragraph 3–13.
i. Release pilots right directional control pedal.	
j. Set parking brake by pressing pilot toe portion of directional control pedals, pulling parking brake handle and releasing pedals. Check that parking brake handle does not automatically retract.	If parking brake handle retracts, go to paragraph 3–14.
k. Release parking brake by pressing toe portion of pilots or CPG directional control pedals. Check that parking brake handle retracts.	If parking brake handle does not retract, go to paragraph 3–15.
l. Apply and maintain pressure on CPG right directional control pedal.	If CPG right brake is not firm, go to paragraph 3–16.
m. Check right main wheel for rotation.	If right main wheel rotates, go to paragraph 3–16.
n. Release CPG right directional control pedal.	If right wheel does not rotate freely, go to paragraph 3–16.
o. Apply and maintain pressure on CPG left directional control pedal.	If CPG left brake is not firm, go to paragraph 3–16.

3–10. MAIN LANDING GEAR – MAINTENANCE OPERATIONAL CHECK (cont) 3–10

Task	Result
p. Check left main wheel for rotation.	If left main wheel rotates, go to paragraph 3–16.
q. Release CPG left directional control pedal.	If left wheel does not rotate freely, go to paragraph 3–16.
r. Set parking brake using CPG directional control pedals, and parking brake handle (at pilot station). Observe that parking brake handle does not retract.	If parking brake handle retracts, go to paragraph 3–14.
s. At CPG station, release parking brake by pressing CPG directional control pedals. Observe that parking brake handle (at pilot station) retracts.	If parking brake handle does not retract, go to paragraph 3–15.
t. Check left main wheel for freedom of rotation.	If left main wheel does not rotate freely, go to paragraph 3–12.
u. Check main wheel tires for uneven wear.	If uneven tire wear exists, go to paragraph 3–17.

6. Remove jacks (TM 1-1520-238-23).
7. Set parking brake by applying toe pressure on top portion of directional control pedals and then pull pilot parking brake handle. Release toe pressure on directional control pedals before releasing pilot parking brake handle.

END OF TASK

3–11. TAIL LANDING GEAR – MAINTENANCE OPERATIONAL CHECK 3–11

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Jack, Hydraulic Axle, 5-Ton	MIL-J-26013

Personnel Required:

67R Attack Helicopter Repairer

References:

TM 1-1520-238-T-5
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Helicopter safed
Paragraph 1–17	Maintenance headset connected

NOTE

- **Refer to pilot station (fig. 3–20) for cockpit configuration and equipment.**
- **If referenced out of one paragraph or volume and into another for additional troubleshooting, upon completion of the task, return to the maintenance operational check for the original paragraph or volume.**

1. Perform inspection of TLG (TM 1-1520-238-23).
2. Raise TLG at jack pad (TM 1-1520-238-23).
3. Remove safety pin from tail wheel lock actuator (TM 1-1520-238-23).
4. Complete the maintenance operational check as follows:

Task	Result
a. Use handle (fig. 3–20) to unlock tail wheel locking pin.	If tail wheel locking pin is binding or does not disengage from locking plate, go to paragraph 3–18.
b. Move tail wheel to either side of helicopter centerline and release.	If tail wheel does not return to centerline, go to paragraph 3–19.
c. Perform external power application electrical and utility hydraulic (TM 1-1520-238-23).	
d. On pilot **TAIL WHEEL** panel (fig. 3–20), set **UNLOCK/LOCK** switch to **LOCK.** Check that tail wheel is locked.	If tail wheel does not lock, refer to TM 1-1520-238-T-5 to troubleshoot utility hydraulic system.

3–11. TAIL LANDING GEAR – MAINTENANCE OPERATIONAL CHECK (cont) 3–11

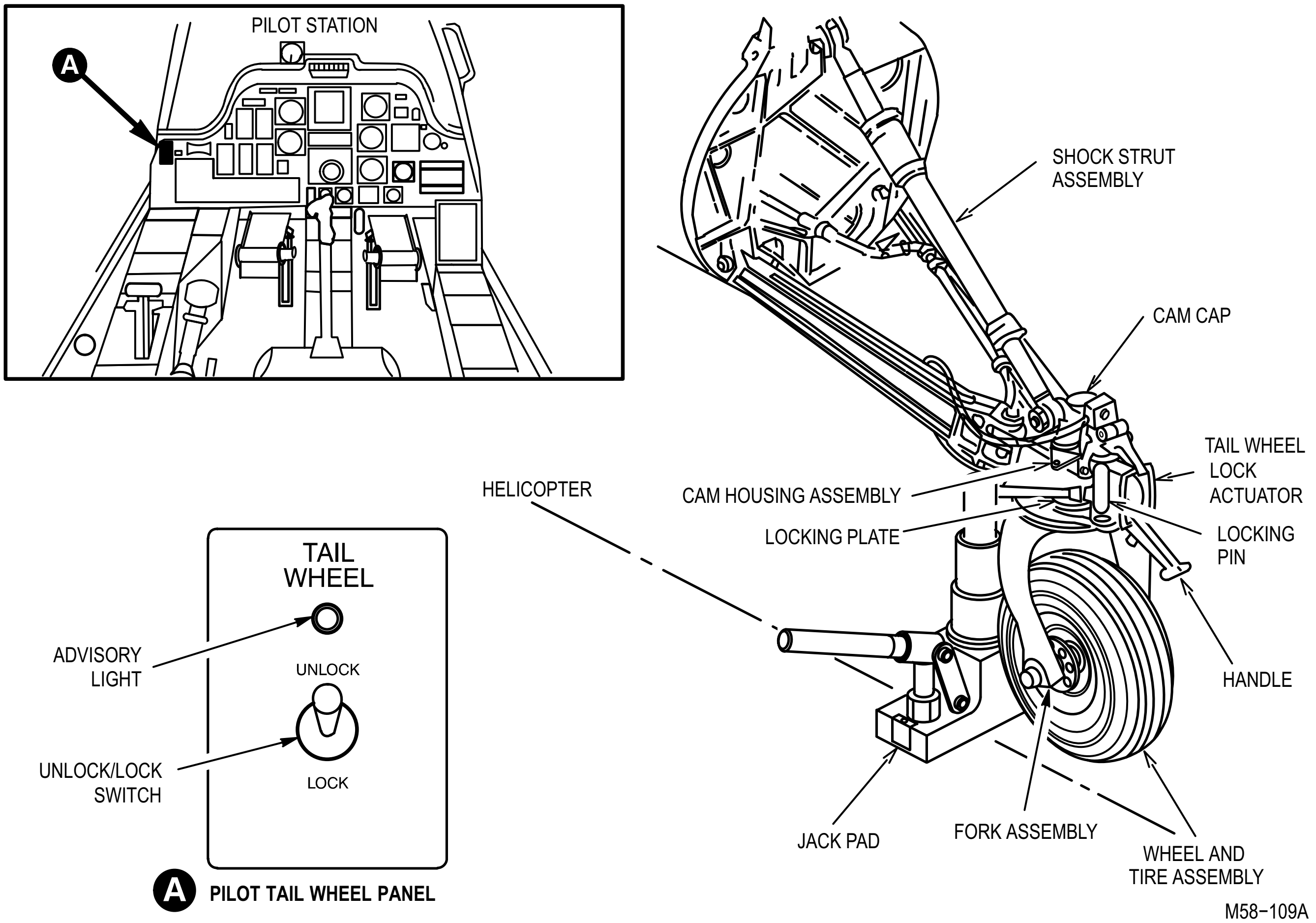


Figure 3–20. Pilot TAIL WHEEL Panel and Tail Wheel Assembly

Task	Result
e. Use handle (fig. 3–20) to unlock tail wheel locking pin.	If tail wheel locking pin is binding or does not disengage from locking plate, go to paragraph 3–18.
f. On pilot **TAIL WHEEL** panel (fig. 3–20), set **UNLOCK/LOCK** switch to **UNLOCK.** Check that tail wheel is unlocked.	If tail wheel is not unlocked, refer to TM 1-1520-238-T-5 to troubleshoot the utility hydraulic system.
g. Check that advisory light on the pilot **TAIL WHEEL** panel is lighted when the tail wheel is unlocked.	If advisory light is not lighted, replace lamp (TM 1-1520-238-23). If lamp still does not light, refer to TM 1-1520-238-T-5 to troubleshoot utility hydraulic system.

3–11. TAIL LANDING GEAR – MAINTENANCE OPERATIONAL CHECK (cont) 3–11

5. Perform external power – power down electrical and utility hydraulic (TM 1-1520-238-23).
6. Remove jack (TM 1-1520-238-23).
7. Install safety pin in tail wheel lock actuator ((TM 1-1520-238-23).
8. Disconnect maintenance headset (para 1–17).

END OF TASK

3–12. LEFT OR RIGHT MAIN WHEEL ASSEMBLY – DOES NOT ROTATE FREELY 3–12

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Jack, Hydraulic Axle, 5-Ton (2)	MIL-J-26013

Personnel Required:

67R Attack Helicopter Repairer
One person to assist

References:

TM 1-1520-238-23

WARNING

Brake fluid may be pressurized. To avoid possible eye injury, wear face shield.

NOTE

- **Veering to the left may be caused by grabbing of the left brake or by complete free wheeling of the right wheel.**
- **Veering to the right may be caused by grabbing of the right brake or by complete free wheeling of the left wheel.**

1. Release brake pressure and rotate binding wheel assembly.
Does wheel rotate freely?

   YES Go to paragraph 3–10.

   NO Go to step 2.

2. Inspect binding wheel brake assembly.
Is brake disc binding in brake assembly?

   YES Go to step 3.

   NO Go to step 4.

3. Check parking brake.
Is parking brake released?

   YES Go to step 6.

   NO Go to step 5.

4. Check binding wheel assembly for looseness.
Is wheel assembly loose?

   YES Inspect binding wheel assembly axle nut, axle and bearings (TM 1-1520-238-23).

   NO Remove wheel assembly and inspect bearings. Replace as necessary (TM 1-1520-238-23).

5. Release parking brake and rotate binding wheel assembly.
Does wheel rotate freely?

   YES Go to paragraph 3–10.

   NO Go to step 6.

6. Check brake disc assembly.
Is brake disc binding in brake assembly?

   YES Inspect brake assembly and replace as necessary (TM 1-1520-238-23).

   NO Remove wheel assembly and inspect bearings. Replace as necessary (TM 1-1520-238-23).

END OF TASK

3–13. PILOT BRAKE – IS NOT FIRM OR WHEEL ASSEMBLY ROTATES (WITH PRESSURE APPLIED) 3–13

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Jack, Hydraulic Axle, 5-Ton (2)	MIL-J-26013

Personnel Required:

67R Attack Helicopter Repairer
One person to assist

References:

TM 1-1520-238-23

WARNING

Brake fluid may be pressurized. To avoid possible eye injury, wear face shield.

NOTE

Ensure that parking brake is released prior to proceeding.

1. Service and bleed brake system (TM 1-1520-238-23).
   Are pilot brakes firm?

   YES Go to paragraph 3–10.

   NO Go to step 2.

2. Check CPG brakes.
   Are CPG brakes firm?

   YES Go to step 3.

   NO Go to step 4.

3. Inspect brake lines between pilot's master cylinder and transfer valves.
   Are brake lines leaking?

   YES Repair leaking brake lines and service and bleed brake system (TM 1-1520-238-23).

   NO Go to step 6.

4. Detach left or right upper trailing arm hose at fuselage quick disconnect.
   Are pilot brakes firm?

   YES Go to step 5.

   NO Go to step 7.

5. Attach hose assembly and apply pilot's brakes.
   Is leakage present at trailing arm lines or wheel brake assembly?

   YES Repair and/or replace as necessary to correct leakage. Service and bleed brake system TM 55-1520-238-23).

   NO Inspect wheel brake system for wear and replace as necessary3 (TM 1-1520-238-23).

6. Apply and maintain pressure on CPG left or right brake.
   Are pilot brakes firm?

   YES Go to step 8.

   NO Replace pilot master cylinder (TM 1-1520-238-23).

7. Remove fluid level screw on CPG master cylinder and apply brakes.
   Does fluid flow from CPG master cylinder?

   YES Replace transfer valve (TM 1-1520-238-23).

   NO Repair or replace as necessary to correct leakage. Service and bleed brake system (TM 1-1520-238-23).

8. Inspect brake lines between transfer valves and parking valves.
   Are brake lines leaking?

   YES Repair leaking brake lines. Service and bleed brake system TM 55-1520-238-23).

   NO Replace parking brake valve (TM 1-1520-238-23).

END OF TASK

3–14. PARKING BRAKE HANDLE – RETRACTS WHEN BRAKES ARE SET TO PARK (BRAKES DO NOT SET) 3–14

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Jack, Hydraulic Axle, 5-Ton (2)	MIL-J-26013

Personnel Required:

67R Attack Helicopter Repairer
One person to assist

References:

TM 1-1520-238-23

NOTE

Ensure that parking brake is released prior to proceeding.

1. Visually inspect parking brake cable assembly and spring.
Is cable assembly or spring bent or broken?

YES Replace cable assembly and/or spring (TM 1-1520-238-23).

NO Go to step 2.

2. Pull parking brake handle to full travel and observe parking brake valve lever.
Does parking brake valve lever fully travel from stop to stop?

YES Go to step 3.

NO Adjust brake cable clevis at parking brake valve to obtain full travel of parking brake lever (TM 1-1520-238-23).

3. Apply and maintain pressure on pilot left directional control pedal.
Can left wheel assembly be rotated?

YES Service and bleed brake system (TM 1-1520-238-23).

NO Go to step 4.

4. Apply and maintain pressure on pilot right directional control pedal.
Can right wheel assembly be rotated?

YES Service and bleed brake assembly (TM 1-1520-238-23).

NO Go to step 5.

5. Apply and maintain pressure on both left and right pilot directional control pedals. Pull parking brake handle and observe parking brake valve lever.
Does parking brake release pin protrude out to parking brake lock lever?

YES Go to step 6.

NO Replace parking brake valve (TM 1-1520-238-23).

6. Release directional control pedal and brake handle.
Does parking brake valve lever lock to park position?

YES Go to paragraph 3–10.

NO Go to step 7.

7. Check release pin.
Is release pin sheared or broken?

YES Replace parking brake valve (TM 1-1520-238-23).

NO Go to step 8.

8. Check parking brake valve lever.
Is lever loose on parking brake valve shaft?

YES Tighten screw of parking brake lever (TM 1-1520-238-23).

NO Go to paragraph 3–10.

END OF TASK

3–15. PARKING BRAKE HANDLE – DOES NOT RETRACT 3–15

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Jack, Hydraulic Axle, 5-Ton (2)	MIL-J-26013

Personnel Required:

67R Attack Helicopter Repairer
One person to assist

References:

TM 1-1520-238-23

1. Visually inspect parking brake valve.
   Is valve lever or spring broken or loose?

   YES Replace spring and/or lever (TM 1-1520-238-23).

   NO Go to step 2.

2. Check pilot brakes.
   Are pilot brakes firm?

   YES Go to step 3.

   NO Go to paragraph 3–10.

3. Check parking brake release pin.
   Is parking brake release pin protruding from locking lever?

   YES Go to step 5.

   NO Go to step 4.

4. Inspect cable assembly for binding or bends.
   Is cable assembly binding or bent?

   YES Replace cable assembly (TM 1-1520-238-23).

   NO Go to step 6.

5. Depress pin and release lever.
   Can lever move up and down?

   YES Go to step 7.

   NO Go to step 6.

6. Detach cable assembly at valve lever.
   Can cable assembly move in and out freely?

   YES Go to step 7.

   NO Replace cable assembly (TM 1-1520-238-23).

7. Service and bleed brake system (TM 1-1520-238-23).
   Are pilot brakes firm?

   YES Go to step 8.

   NO Go to paragraph 3–13.

8. Check parking brakes.
   Can parking brakes be set?

   YES Go to step 9.

   NO Replace parking brake valve (TM 1-1520-238-23).

9. Check parking brakes.
   Can parking brake be retracted to release brakes?

   YES Go to paragraph 3–10.

   NO Replace parking brake valve (TM 1-1520-238-23).

END OF TASK

3–16. CPG BRAKE – IS NOT FIRM OR WHEEL ASSEMBLY ROTATES (WITH PRESSURE APPLIED) 3–16

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic’s	SC518099CLA01
Jack, Hydraulic Axle, 5-Ton (2)	MIL-J-26013

Personnel Required:

67R Attack Helicopter Repairer
One person to assist

References:

TM 1-1520-238-23

1. Service and bleed brake system (TM 1-1520-238-23).
   Are CPG brakes firm?

   YES Go to paragraph 3–10.

   NO Go to step 2.

2. Check pilot brakes.
   Are pilot brakes firm?

   YES Go to step 4.

   NO Go to step 3.

3. Inspect brake system for leakage.
   Is leakage present?

   YES Repair leakage as necessary. Service and bleed brake system (TM 1-1520-238-23).

   NO Go to paragraph 3–13.

4. Inspect brake lines between CPG master cylinder and transfer valve for leaks.
   Are brake lines leaking?

   YES Replace leaking brake lines. Service and bleed brake system (TM 1-1520-238-23).

   NO Replace CPG master cylinder (TM 1-1520-238-23).

END OF TASK

3–17. UNEVEN TIRE WEAR – EXISTS 3–17

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Jack, Hydraulic Axle, 5-Ton (2)	MIL-J-26013

Personnel Required:

67R Attack Helicopter Repairer
One person to assist

References:

TM 1-1520-238-23

1. With wheel jacked, check wheel for looseness.
   Is wheel loose?

   YES Go to step 3.

   NO Go to step 2.

2. Rotate wheel and check that wheel and tire rotation is true.
   Is wheel and tire rotation true?

   YES Go to step 4.

   NO Replace wheel and tire (TM 1-1520-238-23).

3. Remove wheel and inspect wheel, bearings and axle for damage (TM 1-1520-238-23).
   Are bearings, wheel or axle worn or damaged?

   YES Replace worn or damage parts (TM 1-1520-238-23).

   NO Install wheel ().
   Go to step 1

4. Check strut for damage TM 55-1520-238-23).
   Is strut damaged?

   YES Replace worn or damaged parts (TM 1-1520-238-23).

   NO Replace tire (TM 1-1520-238-23).

END OF TASK

3–18. TAIL WHEEL LOCK ACTUATOR LOCKING PIN – DOES NOT ENGAGE LOCKING PLATE OR DOES NOT DISENGAGE FROM LOCKING PLATE 3–18

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Jack, Hydraulic Axle, 5-Ton	MIL-J-26013

Personnel Required:

67R Attack Helicopter Repairer
One person to assist

References:

TM 1-1520-238-23
TM 1-1520-238-T-5

1. Visually inspect tail wheel lock actuator.
Is lock actuator locking pin visible?

   YES Go to step 2.

   NO Go to step 3.

2. Engage lock actuator locking pin.
Using handle, does lock actuator pin engage locking plate hole when tail wheel is centered?

   YES Go to step 4.

   NO Go to step 5.

3. Move actuator handle up and center tail wheel.
Is lock actuator locking pin visible?

   YES Go to paragraph 3–11.

   NO Replace tail wheel lock actuator locking pin TM 55-1520-238-23.

4. Start APU TM 55-1520-238-23). On pilot **TAIL WHEEL** panel, set **UNLOCK/LOCK** switch to **UNLOCK.**
Does lock actuator locking pin disengage when using hydraulic power?

   YES Go to step 6

   NO Refer to TM 1-1520-238-T-5 to troubleshoot utility hydraulic system.

5. Set **UNLOCK/LOCK** switch to **LOCK.**
Does lock actuator locking pin engage when using hydraulic power?

   YES Go to paragraph 3–11.

   NO Replace tail wheel lock actuator TM 55-1520-238-23).

6. Visually inspect tail wheel lock actuator locking pin.
Is lock actuator locking pin sheared or bent?

   YES Replace tail wheel lock actuator locking pin TM 55-1520-238-23).

   NO Go to step 7.

7. Check stop adjustment of tail wheel lock release handle TM 55-1520-238-23).
Is handle stop adjusted properly?

   YES Remove tail wheel lock actuator and inspect. Repair as necessary TM 55-1520-238-23).

   NO Go to step 8.

8. Adjust stop TM 55-1520-238-23).
Does lock actuator locking pin completely disengage?

   YES Go to step 9.

   NO Remove and repair tail wheel lock actuator TM 55-1520-238-23).

3–18. TAIL WHEEL LOCK ACTUATOR LOCKING PIN – DOES NOT ENGAGE LOCKING PLATE OR DOES NOT DISENGAGE FROM LOCKING PLATE (cont) 3–18

9. Lock actuator locking pin.
   Does lock actuator locking pin fully engage?

   YES Go to paragraph 3–11

   NO Replace tail wheel lock actuator
   TM 55-1520-238-23).

END OF TASK

3–19. TAIL WHEEL – DOES NOT RETURN TO CENTERLINE 3–19

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic’s	SC518099CLA01
Jack, Hydraulic Axle, 5-Ton	MIL-J-26013

Personnel Required:

67R Attack Helicopter Repairer
One person to assist

References:

TM 55-1520-238-23

1. Turn tail wheel to side and release.
   Does tail wheel return to centerline?

   YES Go to step 10.

   NO Go to step 2.

2. Turn tail wheel to side.
   Does tail wheel turn easily?

   YES Go to step 4.

   NO Go to step 3.

3. Turn tail wheel to side.
   Does tail wheel bind or stick when turned?

   YES Remove fork assembly and inspect. Repair as necessary TM 55-1520-238-23).

   NO Go to step 5.

4. Check for lock pin in upper cam housing.
   Is pin present in upper cam housing?

   YES Remove fork assembly and inspect. Repair as necessary TM 55-1520-238-23).

   NO Repair upper cam housing as necessary TM 55-1520-238-23).

5. Check for lock pin in upper cam housing.
   Is pin present in upper cam housing?

   YES Go to step 6.

   NO Repair upper cam housing as necessary TM 55-1520-238-23).

6. Visually inspect lock pin.
   Is actuator lock pin completely disengaged from wear plate?

   YES Go to step 8.

   NO Go to step 7.

7. Using handle, completely disengage lock pin of actuator.
   Does lock pin completely disengage?

   YES Remove fork assembly and inspect for broken spring. Replace as necessary TM 55-1520-238-23).

   NO Go to step 9.

8. Visually inspect lock pin.
   Is lock pin bent?

   YES Repair tail wheel lock actuator TM 55-1520-238-23).

   NO Go to step 9.

9. Check stop adjustment of tail wheel lock release handle TM 55-1520-238-23).
   Is handle stop adjusted properly?

   YES Remove tail wheel lock actuator and inspect. Repair as necessary TM 55-1520-238-23).

   NO Go to step 10.

10. Move fork assembly forward and aft in socket.
    Is fork assembly loose in socket?

    YES Remove fork assembly and inspect socket bushings for wear. Repair as necessary TM 55-1520-238-23).

    NO Go to step 11.

3–19. TAIL WHEEL – DOES NOT RETURN TO CENTERLINE (cont) 3–19

11. Adjust stop (TM 1-1520-238-23).
Does lock pin completely disengage?

YES	Go to step 12.
NO	Repair tail wheel lock actuator TM 55-1520-238-23).

12. Turn tail wheel to side and release.
Does tail wheel return to center line when turned and released?

YES	Go to paragraph 3–11.
NO	Remove and inspect fork assembly for broken spring and presence of grease. Repair as necessary TM 55-1520-238-23).

END OF TASK

CHAPTER 4
POWER PLANTS

CHAPTER INDEX

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SECTION I. EQUIPMENT DESCRIPTION AND DATA

4–1. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES 4–1

a. **Characteristics.** The T700–GE–701 and T700–GE–701C engines consist of an accessory section module, a cold section module, a hot section module and a power turbine module.

b. **Capabilities and Features.** The T700–GE–701 and T700–GE–701C engines provides power to the drive system. Helicopters with T700–GE–701C engines are equipped with a digital electronic control (DEC) which performs the same functions as the elctronic control unit (ECU) on the T700–GE–701.

4–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS 4–2

a. **Power Plants.** The major components of the power plants (fig. 4–1) consist of two T700–GE–701 or T700–GE–701C front drive turboshaft engines and related subsystems. Engine 1 is on the left side of the helicopter and engine 2 is on the right.

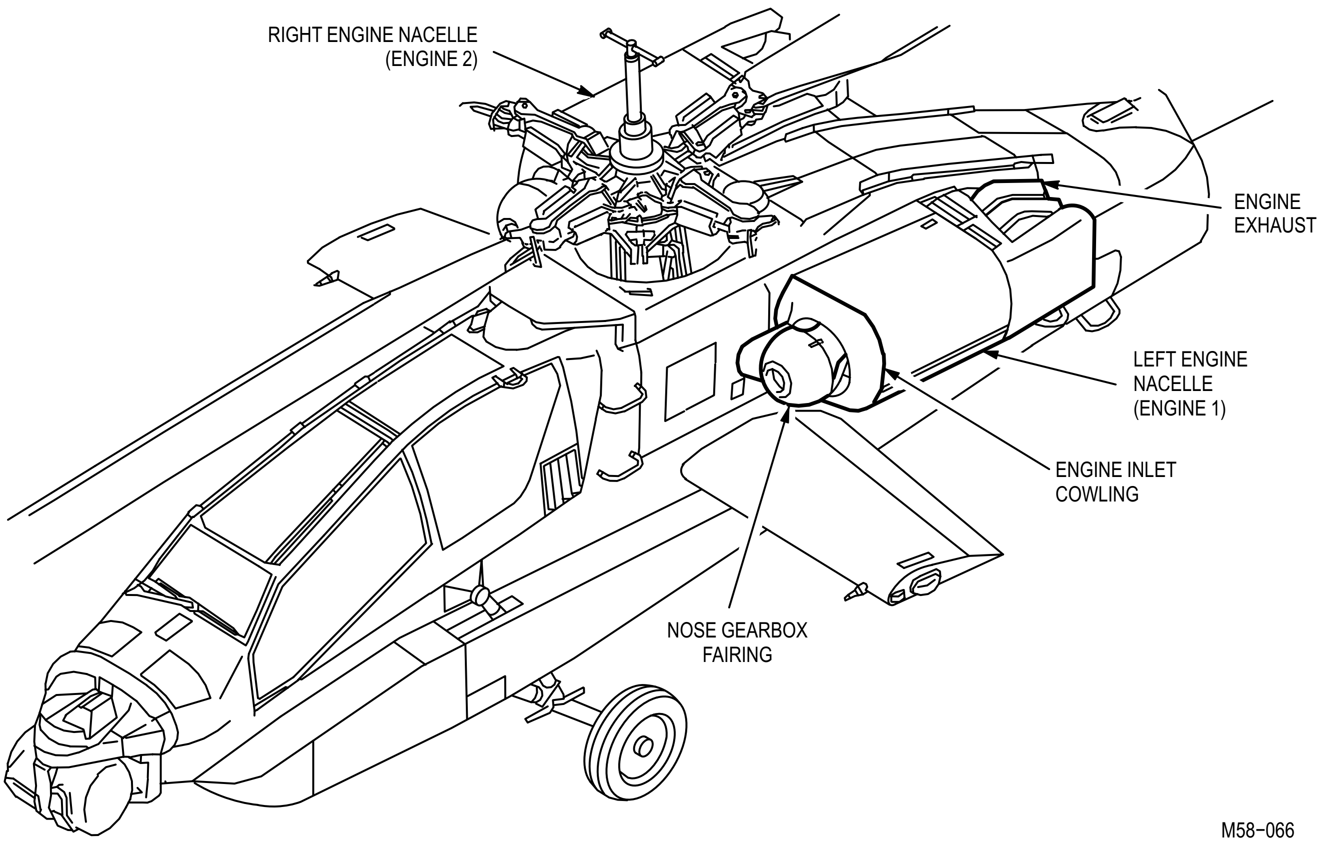


Figure 4–1. Power Plants Major Component Locations

b. **Related Subsystems.** Related subsystems control the engines and provide cooling and engine exhaust. The subsystems include the following:

- **Engine Cooling Subsystem.** Provides cool air for the engines.
- **Engine Anti–Ice Subsystem.** Prevents icing of the engine air inlets and the nose gearboxes (NGB).

4–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 4–2

- **Engine Exhaust Subsystem.** Directs and cools engine exhaust gases and removes foreign particles from the engine.
- **Engine Ignition Subsystem**. Described in TM 1-1520-238-23.
- **Engine Start Subsystem.** Provides initial engine rotation to start the engines.
- **Engine Power Controls**. Allows crew to regulate power output.
- **Engine Instruments.** Informs crew of engine operating conditions (TM 1-1520-238-T-5).

(1) **Engine Cooling Subsystem.** The major components of the engine cooling subsystem (fig. 4–2) for each engine include the louver assembly, the louver actuator, the directional control valve, the cooling doors, the cooling door actuator and the fixed louvers.

(a) **Louver Assembly**. The louver assembly, a rectangular box frame with movable vanes, opens to allow airflow from main transmission area to the engine nacelles.

(b) **Louver Actuator**. The louver actuator, a pneumatic actuator, is mounted on the rear of the left louver assembly and on the front of the right louver assembly. It opens the louver assembly for cooling airflow or closes the louver assembly to shut off airflow.

(c) **Directional Control Valve**. The directional control valve is an electrically actuated, 3–way pneumatically controlled valve and is mounted alongside the louver actuators. The directional control valve controls pressurized air to the louver actuators.

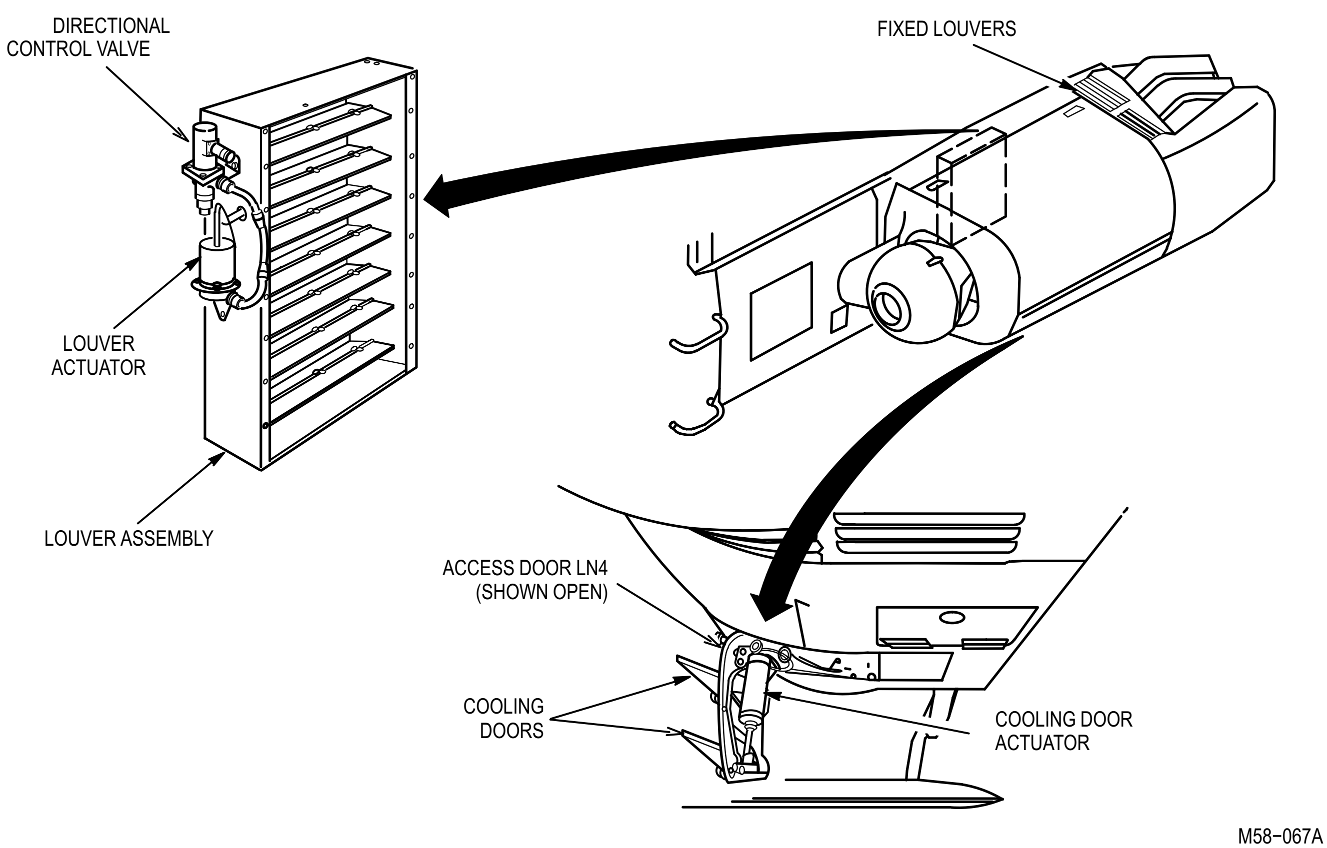


Figure 4–2. Engine Cooling System

4–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 4–2

(d) **Cooling Doors**. The cooling doors are movable vane type doors that open when the engines are shutdown. They are located at the bottom on both the right and left hand nacelles.

(e) **Cooling Door Actuator**. The cooling door actuator, a pneumatic piston with an internal spring, opens and closes the cooling door.

(f) **Fixed Louvers**. The fixed louvers are fixed air scoops that are angled forward with a honeycomb filter in the vents.

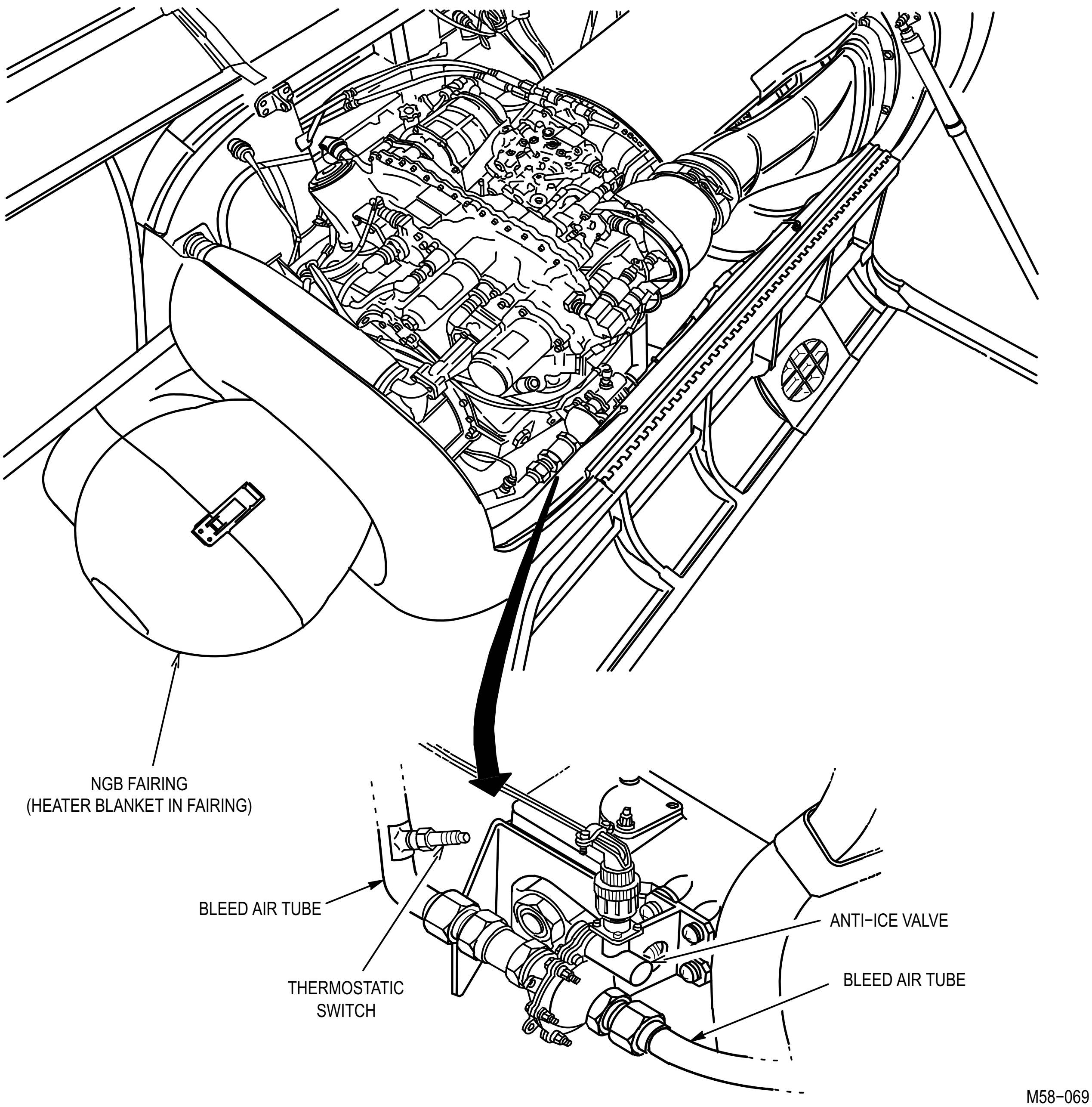


Figure 4–3. Engine Anti–Ice Subsystem

(2) **Engine Anti–Ice Subsystem.** Major components of the engine anti–ice subsystem (fig. 4–3) are the thermostatic switch, the anti–ice valve, the NGB heater blanket and the bleed air tubes.

(a) **Thermostatic Switch**. The thermostatic switch, mounted in the bleed air tube between the inlet anti–ice valve and the engine inlet fairing, senses a change in the temperature of the air in 40 seconds or less.

(b) **Anti–Ice Valve**. The anti–ice valve, an electrically controlled pneumatic valve, spring–loaded to the open position and closed by a solenoid, controls anti–icing airflow to the engine inlet fairings.

(c) **NGB Heater Blanket.** The NGB heater blanket includes a control unit and heater elements. The control unit consists of a control sensor and a safety sensor. The control unit is a non–repairable unit. The heater elements are 115/200 VAC, 400 Hz heaters.

(d) **Bleed Air Tube**. A bleed air tube connects the thermostatic switch and anti–ice valve to the engine and a second tube connects them to the engine inlet cowling.

(3) **Engine Exhaust Subsystem.** Major components of the engine exhaust subsystem (fig. 4–4) are the primary exhaust nozzle, the rim clenching clamp, the secondary exhaust nozzle and an air duct assembly.

(a) **Primary Exhaust Nozzle**. The primary exhaust nozzle, attached to the engine exhaust frame by a rim clenching clamp, provides a path for engine exhaust gas airflow.

(b) **Rim Clenching Clamp**. The rim clenching clamp is an adjustable tension v–band coupling clamp.

(c) **Secondary Exhaust Nozzle**. The secondary exhaust nozzle has three curved finned nozzles and is attached to the rear of the nacelle structure. It mixes gases from the engine with ambient air for exhaust gas cooling.

(d) **Air Duct Assembly**. The air duct assembly, attached to an adaptor on the primary nozzle and the secondary nozzle support assembly, provides an exit for foreign objects from the inlet particle separator and additional cooled air for engine exhaust gas temperature.

(4) **Engine Ignition Subsystem.** The engine ignition subsystem is described in TM 1-1520-238-23.

(5) **Engine Start Subsystem.** The major components of the engine start subsystem (fig. 4–5) are the starter speed cutout switch, the regulating valve, and an engine air starter.

(a) **Air Turbine Speed Cutout Switch**. The air turbine speed cutout switch is a sealed electronic unit installed on the the aft section of the electrical power distribution box behind the pilot station. It holds and maintains the engine start circuit energized until the engine has started and reached a self–sustaining speed.

(b) **Regulating Valve**. The regulating valve, coupled to the engine air starter, is an air–actuated, solenoid–controlled valve. It provides required air from the pressurized air system (PAS) to the engine air starter.

(c) **Engine Air Starter**. The engine air starter is mounted on the right side, rear of the accessory gearbox and consists of a turbine wheel, reduction gears, clutch and an output shaft. Lubrication oil is supplied from the oil sump in the starter case. The engine air starter rotates the compressor through the accessory gearbox until the engine reaches a speed that permits it to be self–sustaining.

4–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 4–2

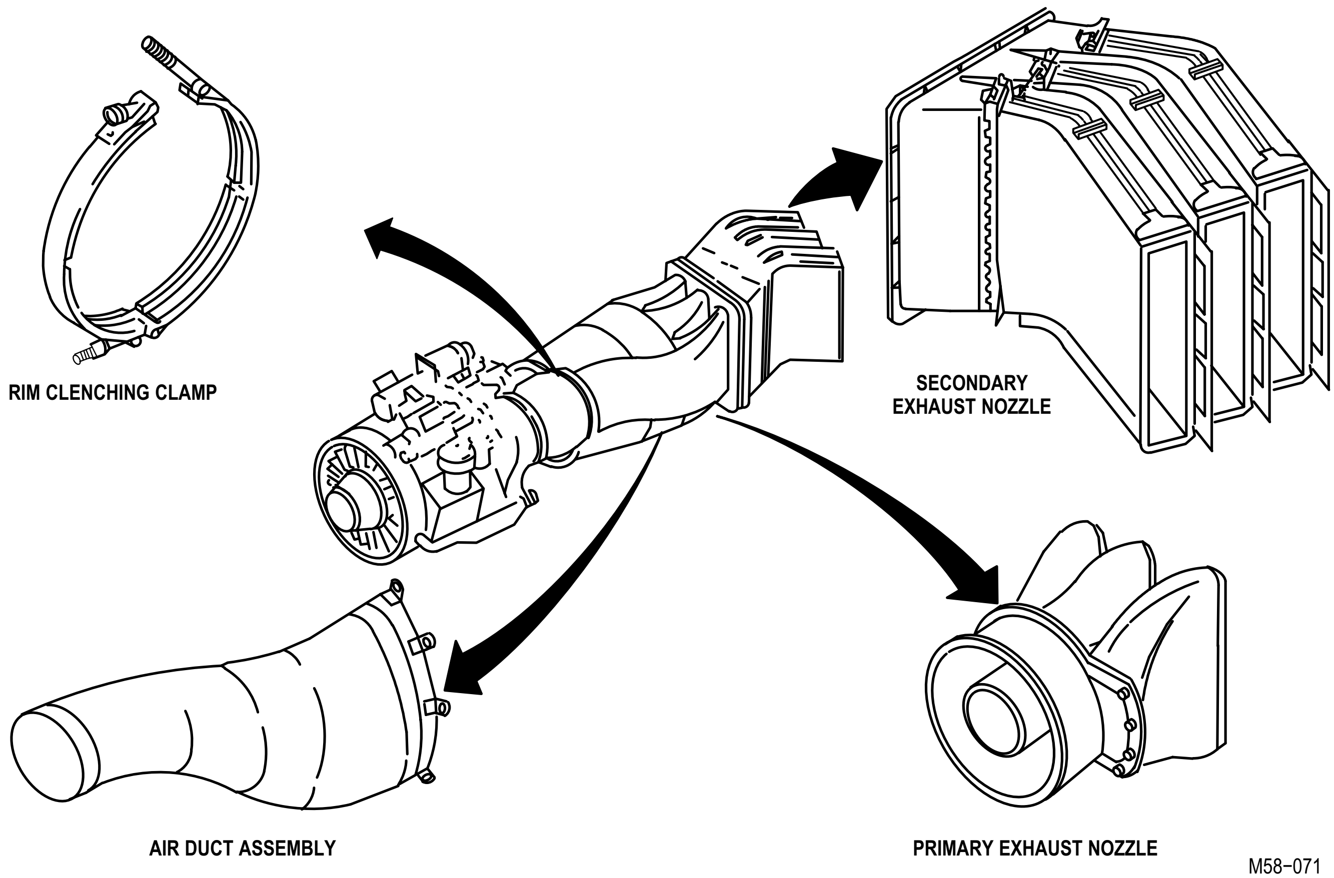


Figure 4–4. Engine Exhaust Subsystem

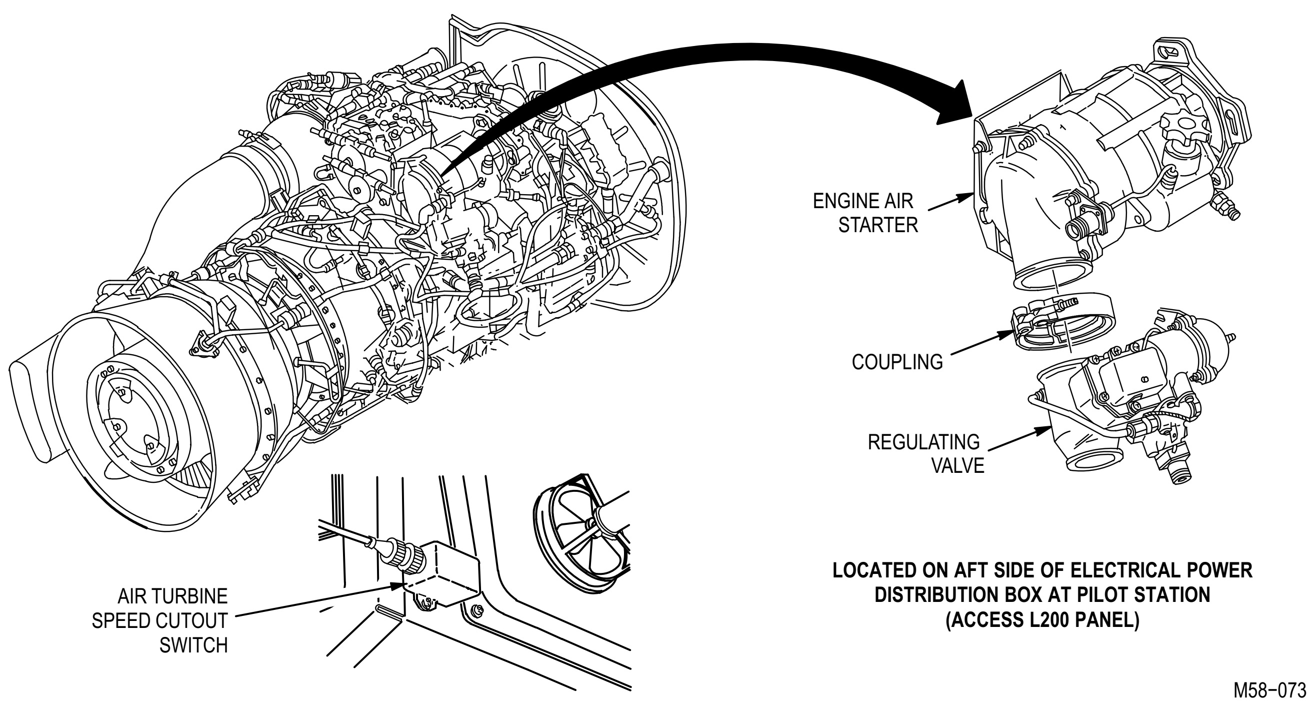


Figure 4–5. Engine Start Subsystem

4–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 4–2

(6) **Engine Power Controls.** The major components of the engine power controls are the pilot power quadrant, CPG power quadrant (fig. 4–6), control cables, the power available spindle gearbox, the load demand spindle (LDS) gearbox, the grip control collar switch, the hydro–mechanical unit (HMU) and the turbine speed control box (fig. 4–7).

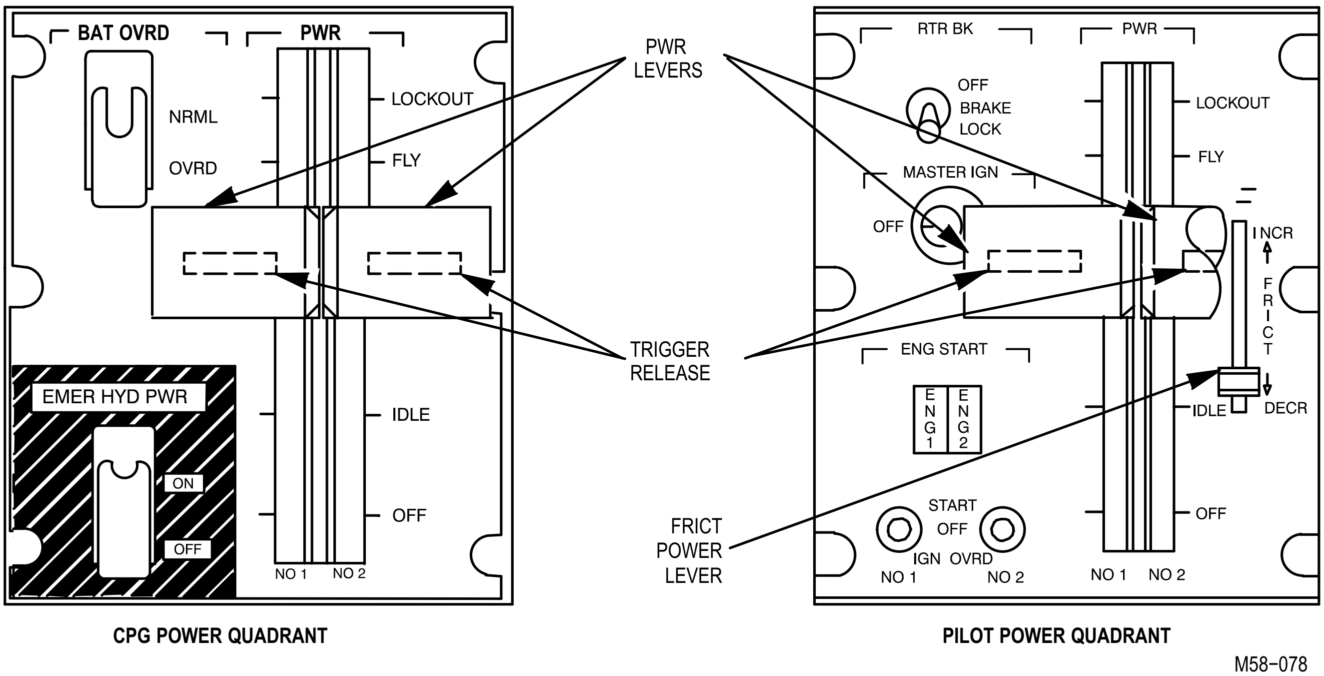


Figure 4–6. Power Quadrants

(a) **Power Quadrants.** The pilot and CPG power quadrants contain two power levers. The left **PWR** lever operates engine **NO 1**. The right **PWR** lever operates engine **NO 2**. The **PWR** levers have four positions: **OFF**, **IDLE**, **FLY**, and **LOCKOUT**. A trigger release on each of the power levers release the stops. The pilot's power quadrant has a **FRICT** (friction) power lever, a **MASTER IGN** (master ignition) switch, and a **RTR BK** (rotor brake) switch. The pilot power quadrant has mechanical stops that lock the position of the levers. The CPG's quadrant has a **EMER HYD PWR** (emergency hydraulic power) switch and **BAT OVRD** (battery override) switch. The stop release levers on the CPG quadrant are connected to a solenoid.

(b) **Control Cables**. The control cables (fig. 4–7) link the power levers and collective control sticks to the HMU. There are six sections of control cables located between the power levers and the power available spindle gearboxes. There are four sections of control cables located between the collective bellcrank and the LDS gearboxes. The cables are composed of balls, ball guides and outer and inner races inside of a flexible stainless steel tubing covered by plastic. The center element of the race is the action element that travels on the balls to reduce friction.

(c) **Power Available Spindle and LDS Gearboxes**. The power available spindle and LDS gearboxes are on the HMU for each engine. They are linked to the pilot and CPG power levers, collective pitch servocylinder, and the turbine speed control unit. The power available spindle and LDS gearboxes are simple rack and pinion and are interchangeable with their respective gearboxes on the opposite engine.

4–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 4–2

(d) **Grip Control Collar**. A grip control (**CHOP**) collar switch is installed inside the chop collars on the pilot and CPG collective sticks. The **CHOP** collar is spring–loaded in the aft position.

(e) **Turbine Speed Control Unit**. The turbine speed control unit is located at the forward outboard side of the aft avionics bay. This unit has a rpm adjustment screw, an electrical connector, and two internal potentiometers (one for each engine).

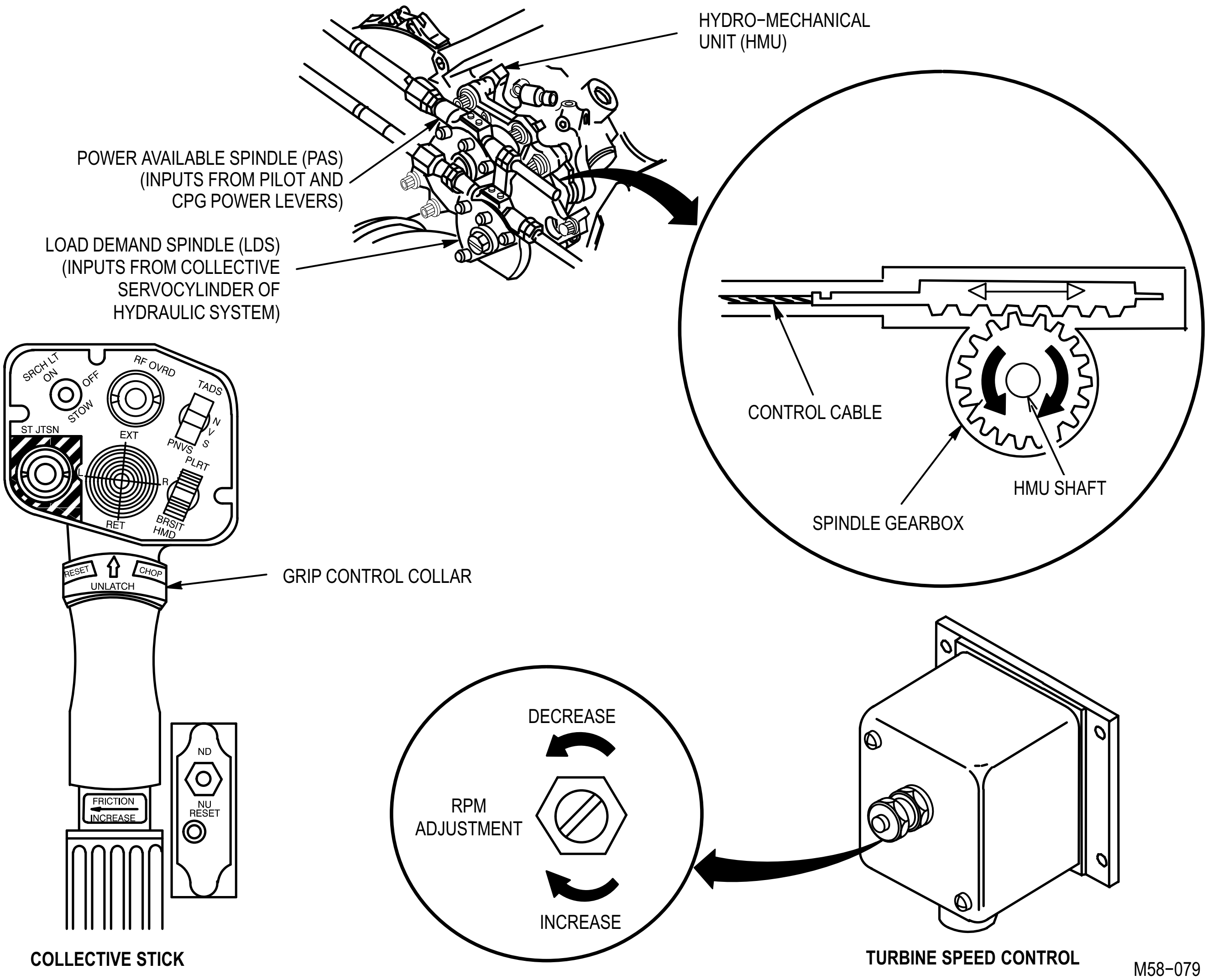


Figure 4–7. Engine Power Controls

(7) **Engine Indicator Controllers.** The major components of the engine indicator controllers (fig. 4–8) are the fuel pressure switch and the oil pressure transmitter.

(a) **Fuel Pressure Switch**. Fuel pressure switch is an electro–mechanical device that monitors low engine fuel pressure.

(b) **Oil Pressure Transmitter**. The oil pressure transmitter is an electro–mechanical device.

4–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 4–2

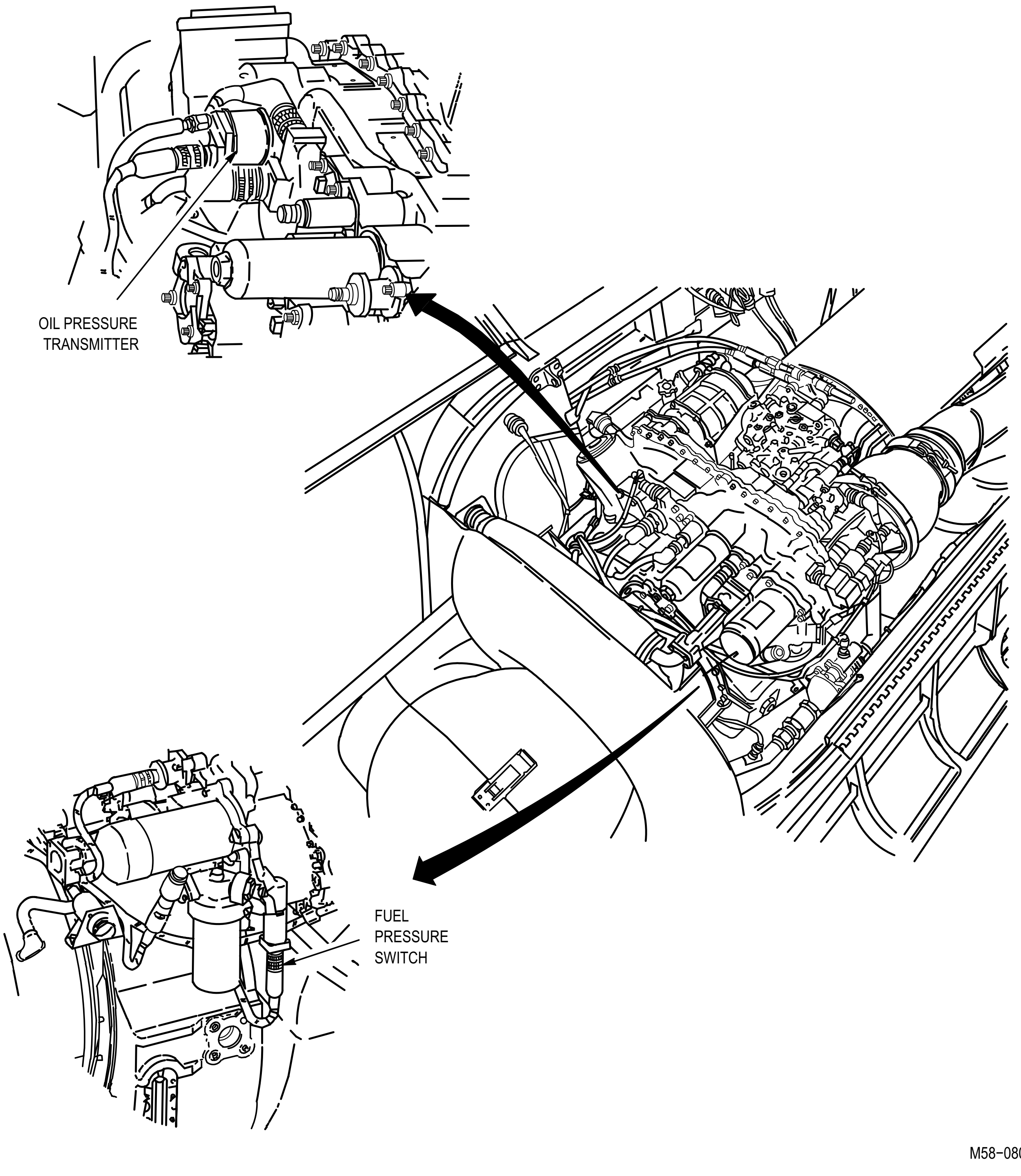


Figure 4–8. Engine Indicator Controllers

4–3. EQUIPMENT DATA 4–3

Item	Engine Characteristics/Data
Models	T700–GE–701 T700–GE–701C
Type of engine	Turboshaft
Output power (T700–GE–701)	1698 shaft horsepower (SHP), intermediate rated power (IRP), at sea level, 15 degrees Celsius standard day conditions at 20,900 rpm Np
Output power (T701–GE–701C)	1800 shaft horsepower (SHP) at sea level, 15 degrees Celsius standard day conditions at 20,900 rpm Np
Type of compressor	Combined axial/centrifugal
Number of compressor stages	6 stages (5 axial, and 1 centrifugal)
Variable geometry	Inlet guide vanes, stage 1 and 2 stator vanes
Type of combustion chamber	Single annular chamber with axial flow
Gas generator turbine stages	2
Power turbine stages	2
Direction of engine rotation (gas generator and power turbine rotors)	Clockwise (aft looking fwd)
Engine weight (dry) T701 Engine weight (dry) T701C	438.5 lbs. maximum 456 lbs. maximum
Engine length	47 inches
Max engine diameter	25 inches
Fuel:	
Primary	JP–4 (MIL–T–5624), NATO Code F–40, or JET B
Alternate	JP–5 (MIL–T–5624), or JP–8 (MIL–T–83133), NATO Code F–44, or NATO Code F–34, JET A, or JET A–1

4–4. EQUIPMENT CONFIGURATION 4–4

Aircraft Engine:

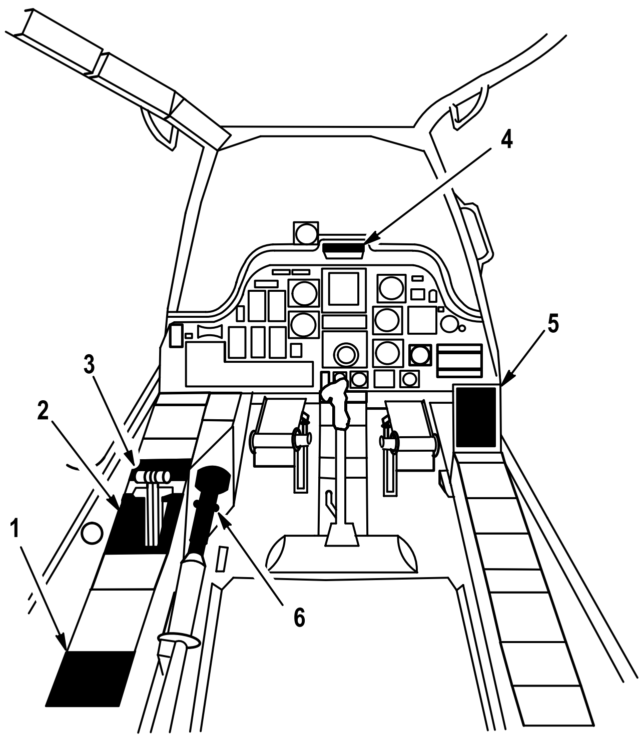
Model	T700–GE–701, Turboshaft
Alternate	T700–GE–701C, Turboshaft

4–5. SAFETY, CARE AND HANDLING OF EQUIPMENT 4–5

Refer toTM 55-2840-248-23 for safety, care and handling of T700 –GE–701 and T700–GE–701C engines.

4–6. CONTROLS AND INDICATORS 4–6

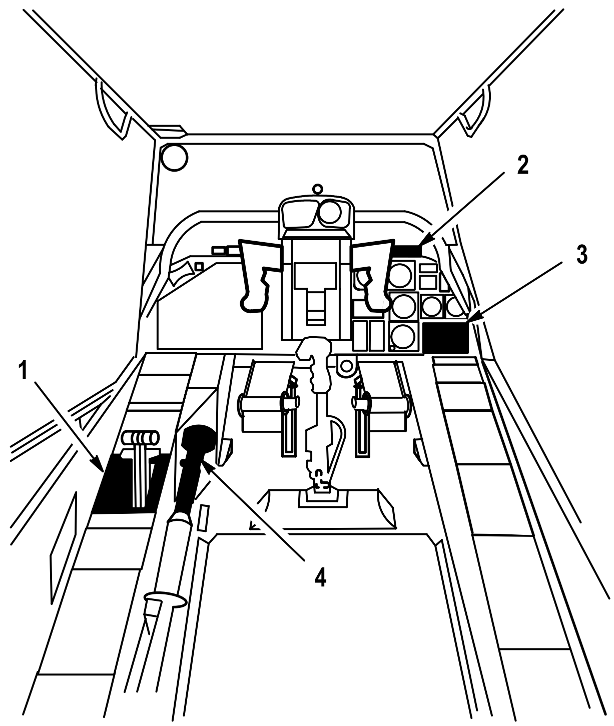
Power plants receive mode select and remote switch inputs from various controls located in the pilot station (fig. 4–9) and CPG station (fig. 4–10). Table 4–1 listing of the controls, switches and associated indicators pertaining to power plants along with a descriptions of their function.



1. PILOT ANTI ICE CONTROL PANEL
2. PILOT POWER QUADRANT
3. PILOT EMERG PWR CHK OVSP TEST PANEL
4. PILOT MASTER CAUTION/WARNING PANEL
5. PILOT CAUTION/WARNING PANEL
6. PILOT COLLECTIVE STICK

M58−199

Figure 4–9. Pilot Station



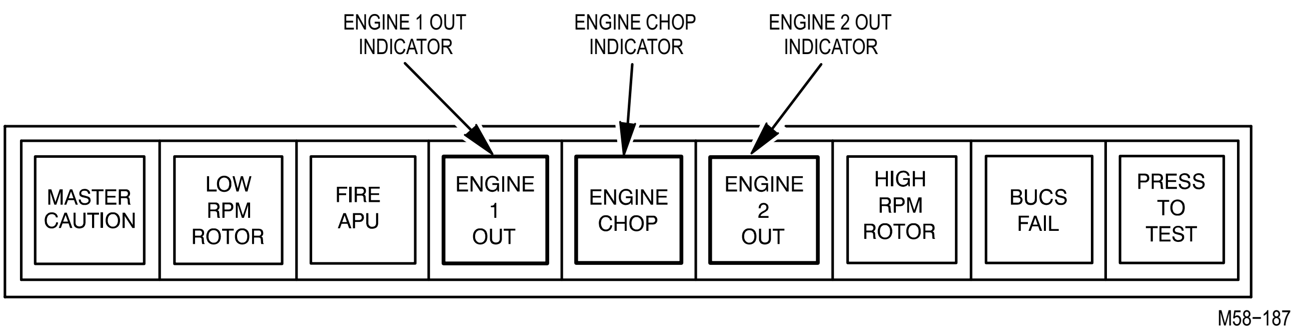
1. CPG POWER QUADRANT
2. CPG MASTER CAUTION/WARNING PANEL
3. CPG CAUTION/WARNING PANEL
4. CPG COLLECTIVE STICK

M58−202

Figure 4–10. CPG Station

Table 4–1. Power Plants Controls and Indicators

Master Caution/Warning Panel		
SWITCH/INDICATOR	POSITION	FUNCTION
ENGINE 1 OUT indicator	RED	Lights when N_P is below 94% or turbine speed (N_G) is below 63% for engine 1.
ENGINE CHOP indicator	RED	Lights when reduced engine rpm for both engines via **CHOP** collar on collective stick.
ENGINE 2 OUT indicator	RED	Lights when N_P is below 94% or turbine speed (N_G) is below 63% for engine 2.

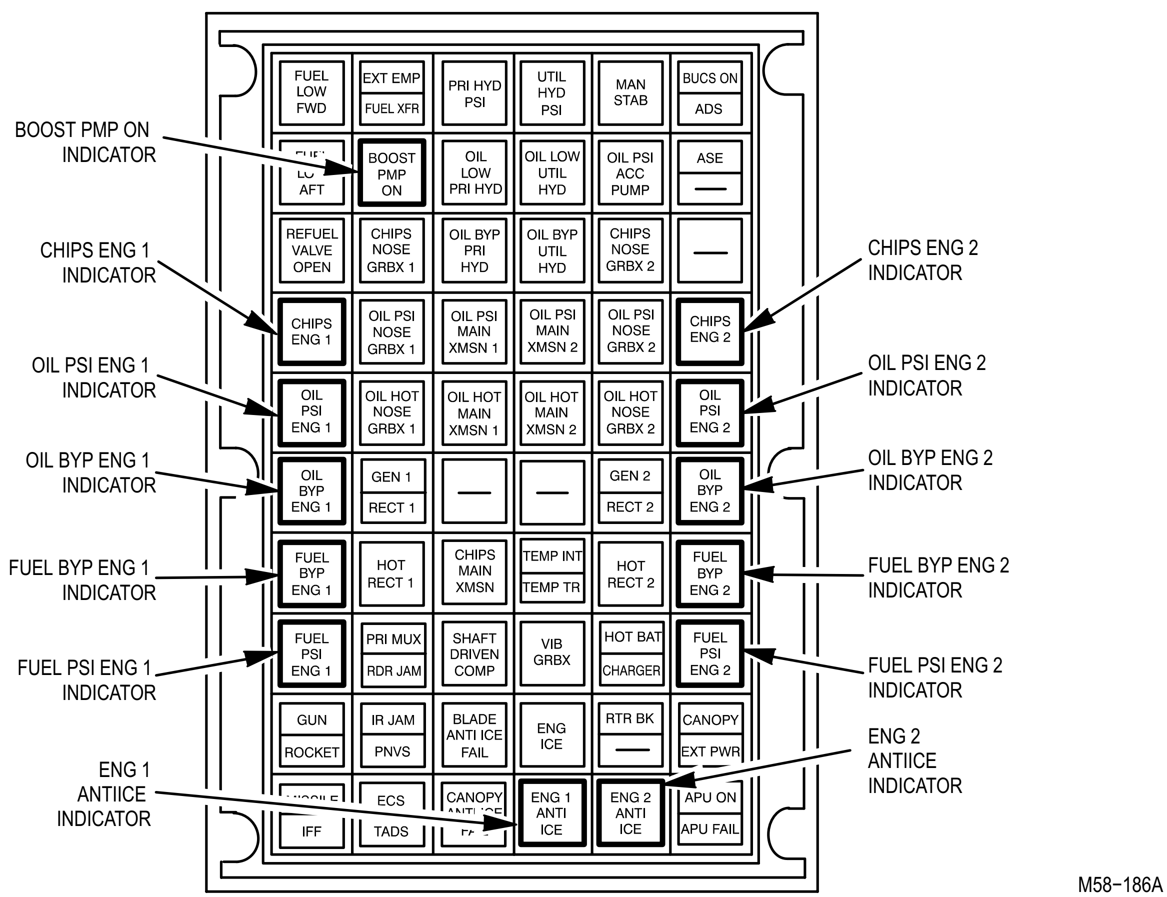


Master Caution/Warning Panel

Pilot Caution/Warning Panel		
SWITCH/INDICATOR	POSITION	FUNCTION
CHIPS ENG 2 indicator	AMBER	Lights when engine 2 has chip fragments in scavenge oil.
OIL PSI ENG 2 indicator	AMBER	Lights when engine 2 oil pressure is below 25 psi.
OIL BYP ENG 2 indicator	AMBER	Lights when engine 2 oil filter is clogged and bypass has begun.
FUEL BYP ENG 2 indicator	AMBER	Lights when engine 2 fuel filter is clogged and bypass has begun.
FUEL PSI ENG 2 indicator	RED	Lights when engine 2 fuel pressure is less than 9 psi.
ENG 2 ANTI–ICE indicator	AMBER	Lights when engine 2 anti–ice subsystem has failed.
ENG 1 ANTI–ICE indicator	AMBER	Lights when engine 1 anti–ice subsystem has failed.
FUEL PSI ENG 1 indicator	RED	Lights when engine 1 fuel pressure is less than 9 psi.
FUEL BYP ENG 1 indicator	AMBER	Lights when engine 1 fuel filter is clogged and bypass has begun.

Table 4–1. Power Plants Controls And Indicators (cont)

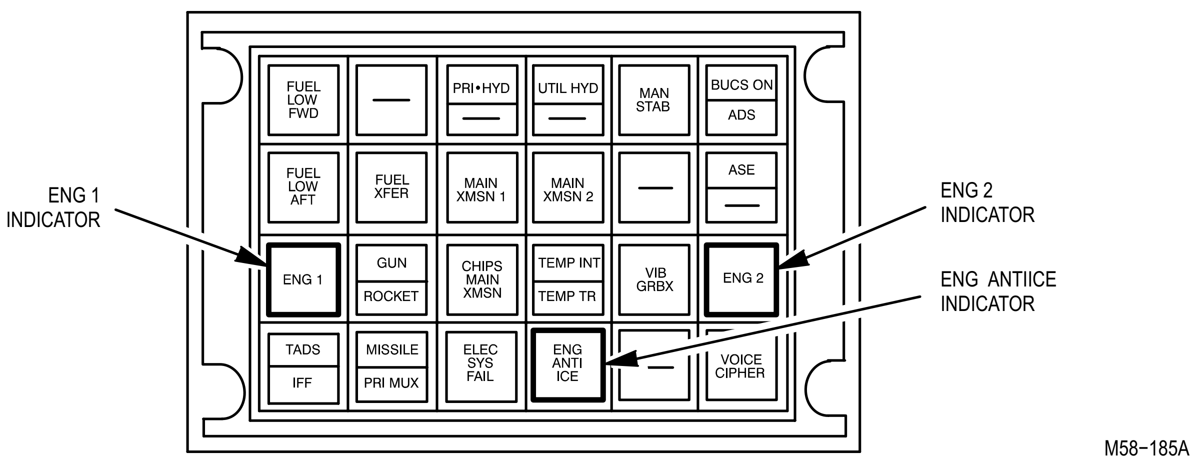
Pilot Caution/Warning Panel (cont)		
SWITCH/INDICATOR	POSITION	FUNCTION
OIL BYP ENG 1 indicator	AMBER	Lights when engine 1 oil filter is clogged and bypass has begun.
OIL PSI ENG 1 indicator	AMBER	Lights when engine 1 oil pressure is below 25 psi.
CHIPS ENG 1 indicator	AMBER	Lights when engine 1 has chip fragments in scavenge oil.
BOOST PMP ON indicator	AMBER	Lights when boost pump is providing 8 to 10 psi to engine fuel filter through fuel line.



Pilot Caution/Warning Panel

Table 4–1. Power Plants Controls And Indicators (cont)

CPG Caution/Warning Panel		
SWITCH/INDICATOR	POSITION	FUNCTION
ENG 2 indicator	AMBER	Lights when one or more of the following occur for engine 2: low engine fuel pressure, low engine oil pressure, oil filter bypassed, engine chips, engine fuel filter bypassed, NGB chips, NGB oil pressure low, or NGB oil temperature high.
ENG ANTI ICE indicator	AMBER	Lights when engine cowling thermostatic switches are less than 155° F (68.3° C).
ENG 1 indicator	AMBER	Lights when one or more of the following occur for engine 1: low engine fuel pressure, low engine oil pressure, oil filter bypassed, engine chips, engine fuel filter bypassed, NGB chips, NGB oil pressure low, or NGB oil temperature high.

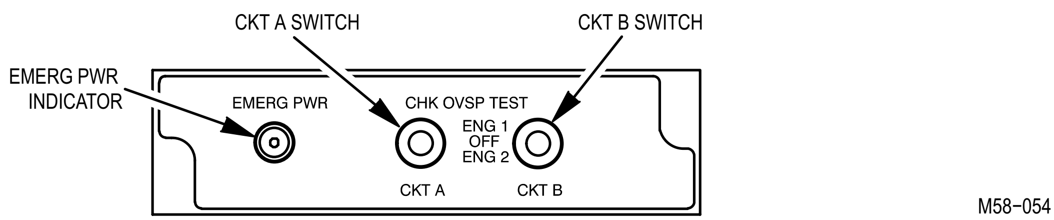


CPG Caution/Warning Panel

Pilot EMERG PWR CHK OVSP TEST Panel		
SWITCH/INDICATOR	POSITION	FUNCTION
CKT A switch	**ENG 1**	Simulates an overspeed condition of 119–120% to test protection system.
	OFF	Disables **CKT A** switch.
	ENG 2	Simulates an overspeed condition of 119–120% to test protection system.

Table 4–1. Power Plants Controls And Indicators (cont)

Pilot EMERG PWR CHK OVSP TEST Panel (cont)		
SWITCH/INDICATOR	POSITION	FUNCTION
CKT B switch	**ENG 1**	Simulates an overspeed condition of 119–120% to test protection system.
	OFF	Disables **CKT B** switch.
	ENG 2	Simulates an overspeed condition of 119–120% to test protection system.
EMERG PWR indicator	GREEN	Lights when availability of emergency electrical power from the **ENG START** circuit breaker.

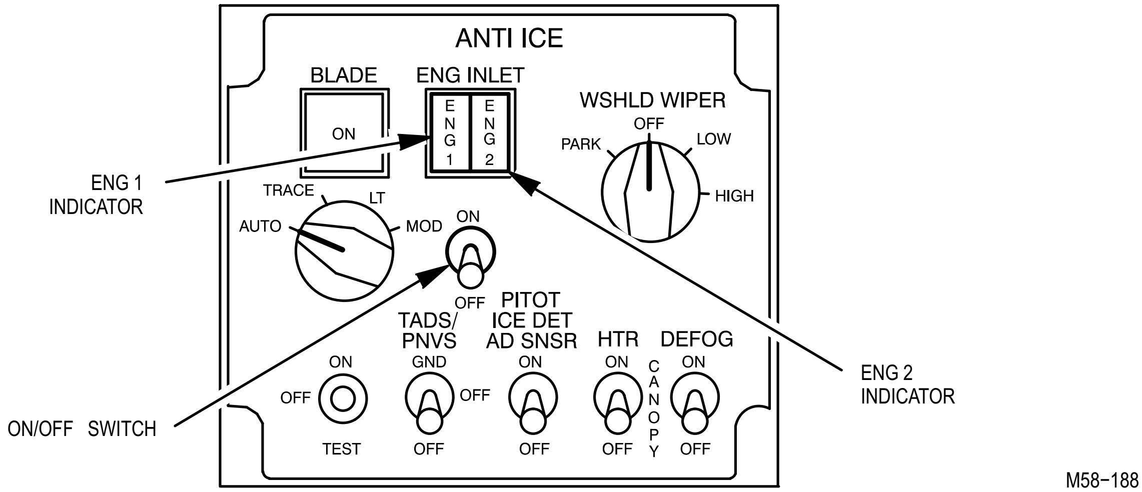


Pilot EMERG PWR CHK OVSP TEST Panel

Pilot ANTI ICE Panel		
SWITCH/INDICATOR	POSITION	FUNCTION
ENG 1 indicator	GREEN	Lights when engine 1 anti–ice subsystem is operating properly.
ENG 2 indicator	GREEN	Lights when engine 2 anti–ice subsystem is operating properly.
ON/OFF switch	**ON**	Energizes NGB heaters and anti–ice valves.
	OFF	De–energizes anti–ice solenoids. Bleed air is ported to cowling via spring–loaded valves.

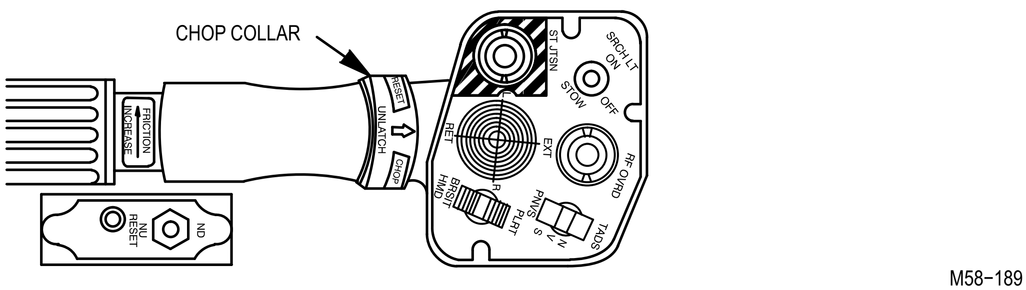
4–6 CONTROLS AND INDICATORS (cont) 4–6

Table 4–1. Power Plants Controls And Indicators (cont)



Pilot ANTI ICE Panel

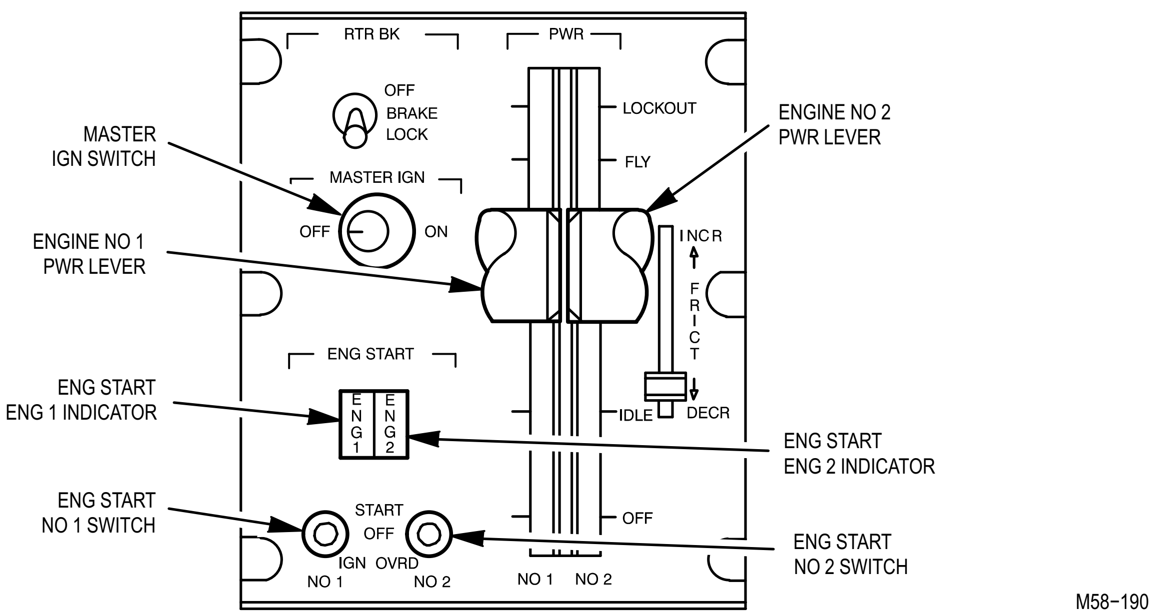
Collective Stick		
SWITCH/INDICATOR	POSITION	FUNCTION
CHOP collar	Clockwise	Reduces engine power to idle.
	Counter-clockwise	Returns engines to previous power setting.



Collective Stick

Table 4–1. Power Plants Controls And Indicators (cont)

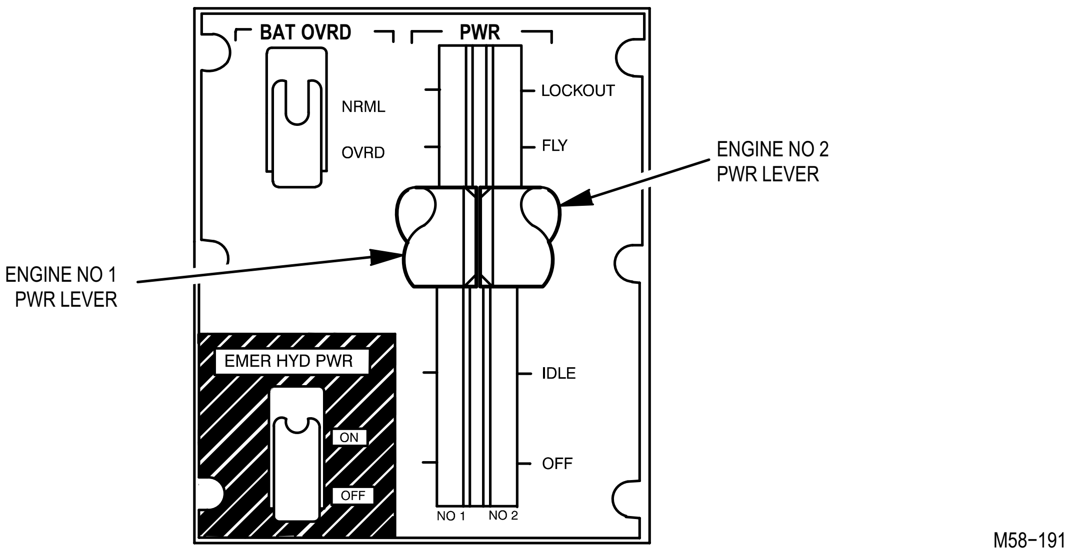
Pilot Power Quadrant		
SWITCH/INDICATOR	POSITION	FUNCTION
PWR levers (engines **NO 1** and **NO 2**)	**LOCKOUT**	Disengages automatic control, allows manual control with **PWR** levers.
	FLY	Allows normal engine operation, controlled by the ECU/DECU.
	IDLE	Allows engines to operate at ground idle speed.
	OFF	Stops fuel flow to engine.
ENG START ENG 2 indicator	GREEN	Lights when engine 2 air starter regulating valve is open.
ENG START switch (engines **NO 1** and **NO 2**)	**START**	Initiates automatic start sequence.
	OFF	Terminates start sequence.
	IGN OVRD	Aborts automatic start sequence.
ENG START ENG 1 indicator	GREEN	Lights when engine 1 air starter regulating valve is open.
MASTER IGN switch	**ON**	Energizes **ENG START** switches.
	OFF	De–energizes **ENG START** switch.



Pilot Power Quadrant

Table 4–1. Power Plants Controls And Indicators (cont)

CPG Power Quadrant		
SWITCH/INDICATOR	POSITION	FUNCTION
PWR levers (engines **NO 1** and **NO 2**)	**LOCKOUT**	Disengages automatic control, allows manual control with **PWR** levers.
	FLY	Allows normal engine operation, controlled by the ECU/DECU.
	IDLE	Allows engines to operate at ground idle speed.
	OFF	Stops fuel flow to engine.



CPG Power Quadrant

SECTION II. THEORY OF OPERATION

4–7. SYSTEM DESCRIPTION 4–7

a. **Power Plants.** Power plants (fig. 4–11) provides power to drive the rotor system. The engines are mounted in nacelles on the left and right side of the helicopter and drive the rotors through the NGBs. Access to the engines is through a work platform that is a part of each nacelle. The engines are easily configured for installation on either side of the helicopter. Engine cooling air is drawn from the main transmission deck into the nacelle by the jet–pumping action of the primary nozzle and the exhaust system while cooling doors in each nacelle open and close automatically. A history recorder records and displays the engine operating hours, time/temperature index, and low cycle fatigue (LCF) events. The engine bleed air subsystem provides fifth stage compressor bleed air for the anti–ice system and PAS. Provisions for water wash of the engines are also provided.

(1) The pilot and CPG power quadrants are connected together with flexible control cables which transmit power selections from the power levers to the HMU torque motor on the engine. Control inputs to the HMU are also received from the collective sticks. The pilot power quadrant provides engine start controls and indicators and a rotor brake switch. The CPG power quadrant provides an emergency hydraulic power switch and a battery override switch.

(2) The engine starter is pneumatically operated and rotates the compressor through the accessory gearbox until the engine reaches a speed that permits it to be self–sustaining. The engine exciter and igniter plugs supply high voltage sparks to ignite the fuel during engine starting.

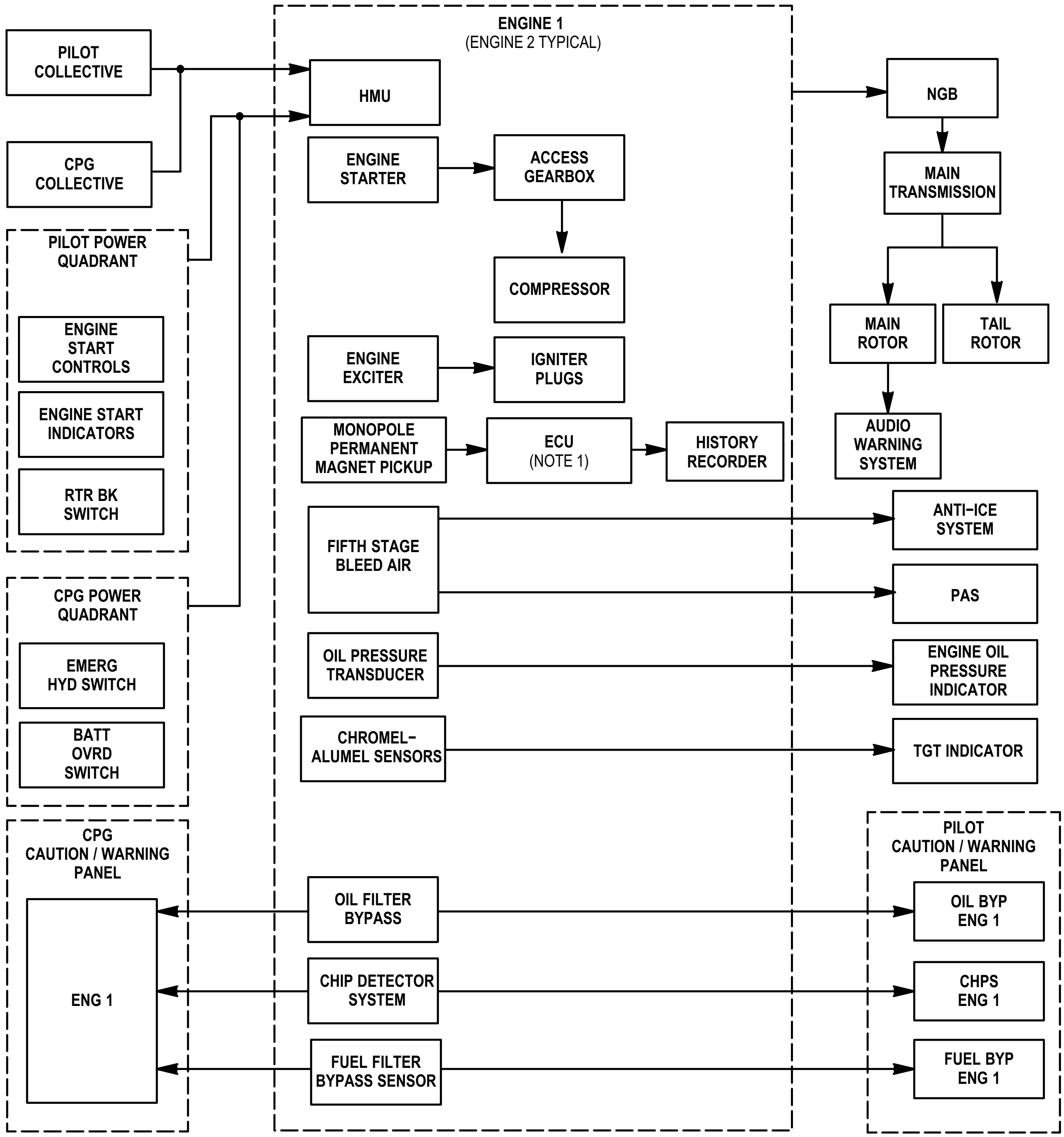
(3) An oil pressure transducer is installed on each engine to drive the engine oil pressure indicator. An oil filter bypass sensor measures differential pressure across the oil filter and lights the **OIL BYP ENG 1** or **OIL BYP ENG 2** indicator on the pilot caution/warning panel and the **ENG 1** or **ENG 2** indicator on the CPG caution/warning panel. Each engine is equipped with a chip detector system to detect metal particles in the oil system and lights the **CHPS ENG 1** or **CHPS ENG 2** indicator on the pilot caution/warning panel and the **ENG 1** or **ENG 2** indicator on the CPG caution/warning panel. A monopole permanent magnet pickup monitors engine rpm and sends the signal to the ECU or DECU. Turbine gas temperature (TGT) is sensed by chromel–alumel sensors on the TGT harness and displayed on the TGT indicator. A fuel filter bypass sensor measures differential pressure across the fuel filter and lights the **FUEL BYP ENG 1** or **FUEL BYP ENG 2** indicator on the pilot caution/warning panel and the **ENG 1** or **ENG 2** indicator on the CPG caution/warning panel. The engine out warning unit provides visual and audible warning when main rotor or engine rpm is low.

b. **Purpose.** Power plants provides power to operate the drive systems on the helicopter.

c. **System Operation.** Refer to TM 55-2840-248-23 for operation of power plant, fuel, oil, air and electrical systems. Related subsystems (described here) control the engines and provide engine cooling and exhaust. The subsystems include the engine cooling, engine exhaust, engine anti–ice, engine ignition (starting), engine power, and control and indicators.

(1) **Engine Cooling Subsystem.** The engine cooling subsystem provides cooling air for the engines during and after operation. The cooling and exhaust systems work together. The exhaust system helps the cooling airflow, the engine cooling air cools the exhaust gases and components.

4–7 SYSTEM DESCRIPTION (cont) 4–7



NOTE:

1. HELICOPTERS WITH T700–GE–701C ENGINES INSTALLED ARE EQUIPPED WITH A DECU.

M58–274

Figure 4–11. Power Plants Functional Block Diagram

4–7 SYSTEM DESCRIPTION (cont) 4–7

(a) Each firewall louver assembly (fig. 4–12) is operated by a louver actuator and a directional control valve. During operation, the directional control valve closes off pressurized airflow to the louver actuator. The louver actuator extends by spring tension, pushing the louver vanes open which allows air flow between the main transmission area and the engine nacelles. If a fire occurs during engine operation, the pilot or CPG **FIRE PULL** handle is pulled and the louver vanes close. The louver vanes are closed by pressurized air through the directional control valve to the louver actuator. Closing the louver vanes keeps air from entering the nacelle and also keeps the fire fighting agent from entering the main transmission deck.

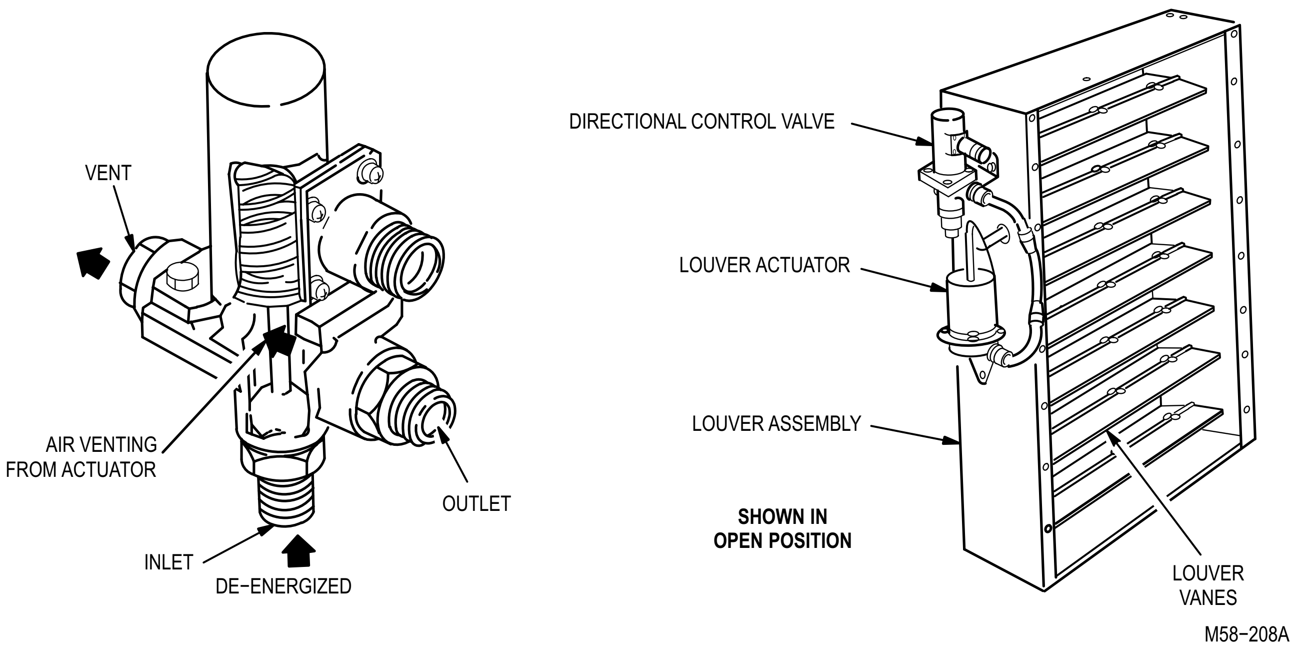


Figure 4–12. Firewall Louver Assembly

(b) The cooling louvers are moveable louver type vanes which are located on the cooling louver access door. When the engine is operating, fifth stage bleed air is directed to the cooling louver actuator (fig. 4–13). Air pressure against the actuator piston overcomes the spring and extends the piston rod to close the louvers. The louvers remain closed as long as the engine is operating. When the engine is shutdown, the cooling louvers on the lower side of the nacelle are opened by the spring–loaded actuator, providing cooling airflow. The fixed louvers, on the top and bottom aft section of the nacelle, are fixed air scoops that are angled forward, honey comb filters that prevent foreign objects from entering the nacelle.

(c) The engines are cooled by engine exhaust gases flowing through the primary nozzle (fig. 4–14) which create a pumping action that draws the surrounding cooling air along with the exhaust gases, this creates a low–pressure area inside the nacelle that causes cool outside air to flow into the nacelle. Outside air enters the nacelle through the normally open louver assembly and flows around the engine. Cooling air also enters the nacelle through the upper and lower fixed louvers and the inlet particle separator transition duct. The pumping action in the secondary nozzles draws cooling air into the secondary nozzles, where it mixes with and cools the hot exhaust gases. The cooled exhaust gases exit the secondary nozzles and are immediately dispersed by the main rotor downwash. Cooling fins on the secondary nozzles help cool the secondary nozzles.

(2) **Engine Exhaust Subsystem.** The engine exhaust subsystem directs and cools engine exhaust gases and removes foreign particles from the engine. During engine operation, exhaust gas from the engine is forced through the primary nozzle into the secondary nozzle. The flow of exhaust gas from the primary to the secondary nozzle draws ambient (outside) air into the nacelle which creates an ejector pumping action. The ambient air in the nacelle is drawn into the secondary nozzle which causes the air to mix with the exhaust gas as it leaves the primary nozzle. The air mixing reduces the temperature of the exhaust gas and the remaining heat is absorbed by the secondary exhaust nozzle. The fins on the secondary exhaust nozzle emits the remaining heat which lowers the temperature of the exhaust gas leaving the nozzle. The air duct receives air and foreign particles (if any) from the inlet particle separator (IPS) blower. The duct routes particles to the primary nozzle where it mixes with the exhaust gas.

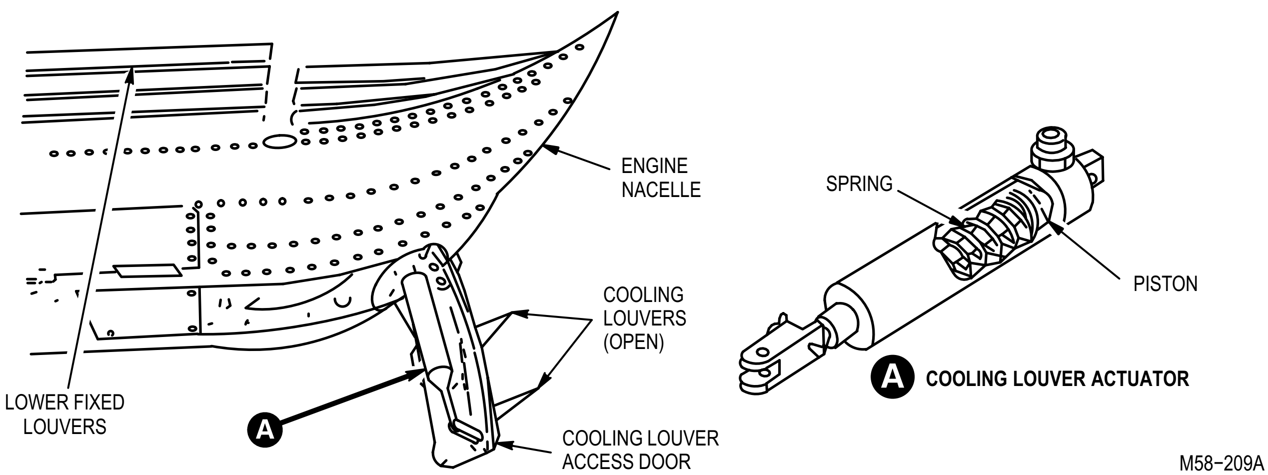


Figure 4–13. Right Engine Cooling Louver Operation

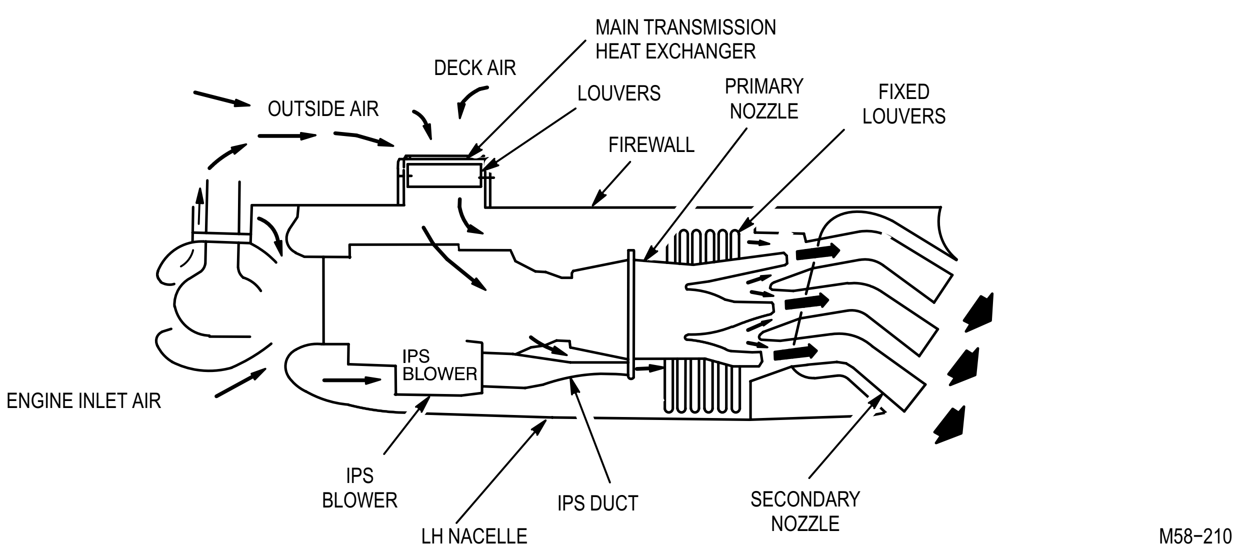


Figure 4–14. Engine Cooling and Exhaust Operation

(3) **Engine Anti–Ice**. The engine anti ice system prevents icing of the engine air inlets and the NGB.

(a) Heater blankets in each NGB fairing (fig. 4–15) prevent ice from forming on the gearbox coupling fan and air duct to the main transmission deck. The heater blankets operate as follows (fig. 4–15): **ECS ENG ANTI–ICE** circuit breaker (CB67) supplies 28 VDC through the electrical power distribution box to the pilot **ANTI ICE** panel. Setting the anti ice **ON/OFF** switch to **ON** sends a signal through the electrical power distribution box to a heater controller in each engine NGB fairing. **ECS R NOSE GRBX HTR** circuit breaker (CB211) and **ECS L NOSE GRBX HTR** circuit breaker (CB212) supply 115 VAC power to the heater controllers. When the heater controllers receive the signal from the pilot **ANTI ICE** panel, they send 115 VAC to the engine NGB fairing heater blankets. The heater blankets provide heat to warm the NGBs to approximately 225° to 235° F (107° to 112° C). The heater blankets return sensor signals to the heater controllers. If a heater overheats or fails, the controller sends an **NGB HEATER FAIL** signal to the caution/warning panels in both crew stations which lights the pilot **ENG 1 ANTI ICE** or **ENG 2 ANTI ICE** indicators, and the CPG **ENG ANTI ICE** indicator.

(b) Each engine has an anti–ice and start bleed valve which is spring–loaded open. It can be closed either mechanically by the HMU or electrically by the pilot **ANTI ICE** control panel controlled solenoid. The start bleed valve controls anti–icing airflow to the engine and bleeds air from the compressor during engine starting and low engine speeds. During starting and at low engine rpm, the HMU actuator positions the cam plate to open the valve. The valve closes at 91% N_G rpm or 60% torque, whichever occurs first (fig. 4–16). When energized, the solenoid opens to allow fifth stage air to enter the servo and close the metering valve against spring pressure in the servo. De–energizing the solenoid closes off the fifth stage air and vents the servo, allowing the servo spring to open the metering valve. If power to the solenoid is lost, the valve opens. If the metering valve fails to open when the solenoid is de–energized, the metering valve shaft closes a sensing switch. This lights the **ENG 1 ANTI ICE** or **ENG 2 ANTI ICE** indicator on the pilot caution/warning panel and the **ENG ANTI ICE** indicator on the CPG caution/warning panel.

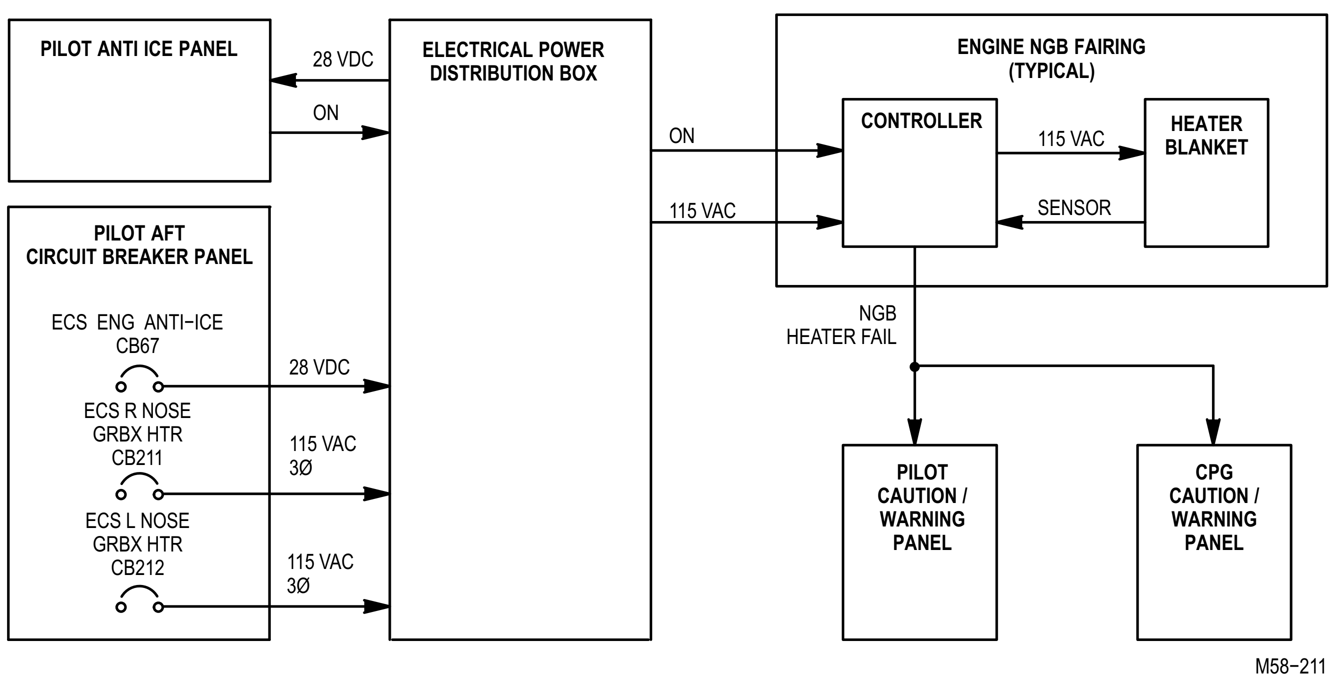


Figure 4–15. NGB Fairing Heater Block Diagram

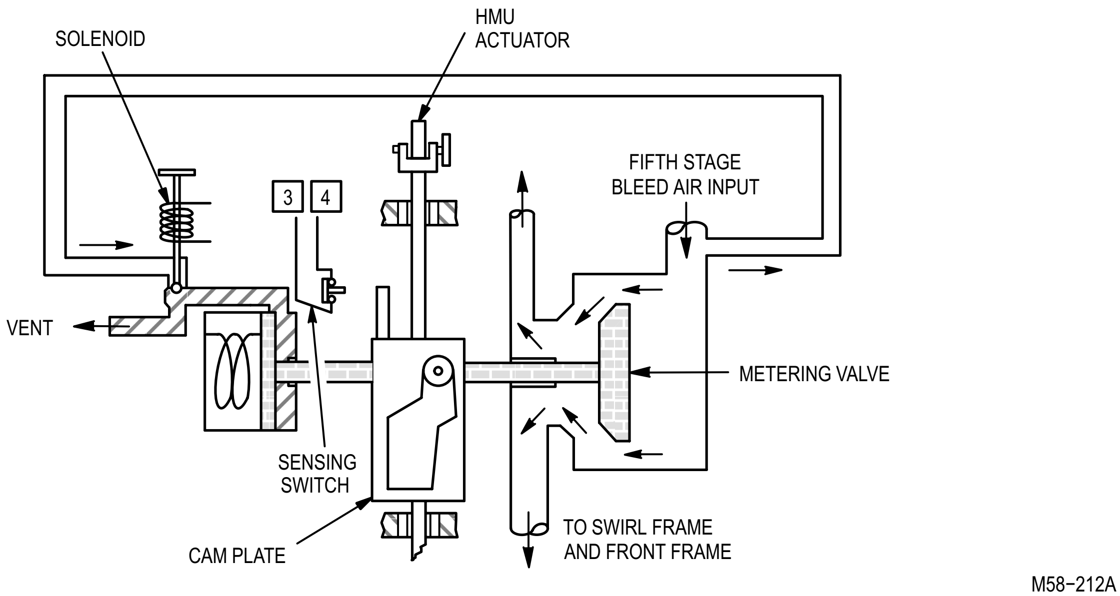


Figure 4–16. Anti–Ice and Start Bleed Valve Operation

(4) **Engine Start Subsystem.** The starting system (fig. 4–17) uses air from the PAS and provides means for starting each engine. When the pilot power quadrant **MASTER IGN** switch is set to **ON**, 28 VDC is supplied to the **ENG START** switch. Setting the **ENG START** switch momentarily to **START** initiates an automatic start sequence which sends a 28 VDC signal to the start relay in the engine start mode relay panel. The start relay sends the following signals:

- Regulator energize to the engine. The engine air pressure regulator opens, supplying PAS air to the air turbine starter. The ECU/DECU sends a signal to the pilot power quadrant which lights the **ENG 1** or **ENG 2 START** indicators.
- Interlock valve to the ENCU shutoff valve. The valve closes to ensure all PAS air is available to drive the air turbine starter.
- Ignition enable to the engine ignition system. The ignition system supplies electrical ignition to the engine.
- Speed control switch to the engine speed cutout switch in the electrical power distribution box. This maintains the start sequence after the **ENG START** switch is released.
- When the engine starts it sends speed sensor to the engine speed cutout switch. The switch opens, ending the start sequence.

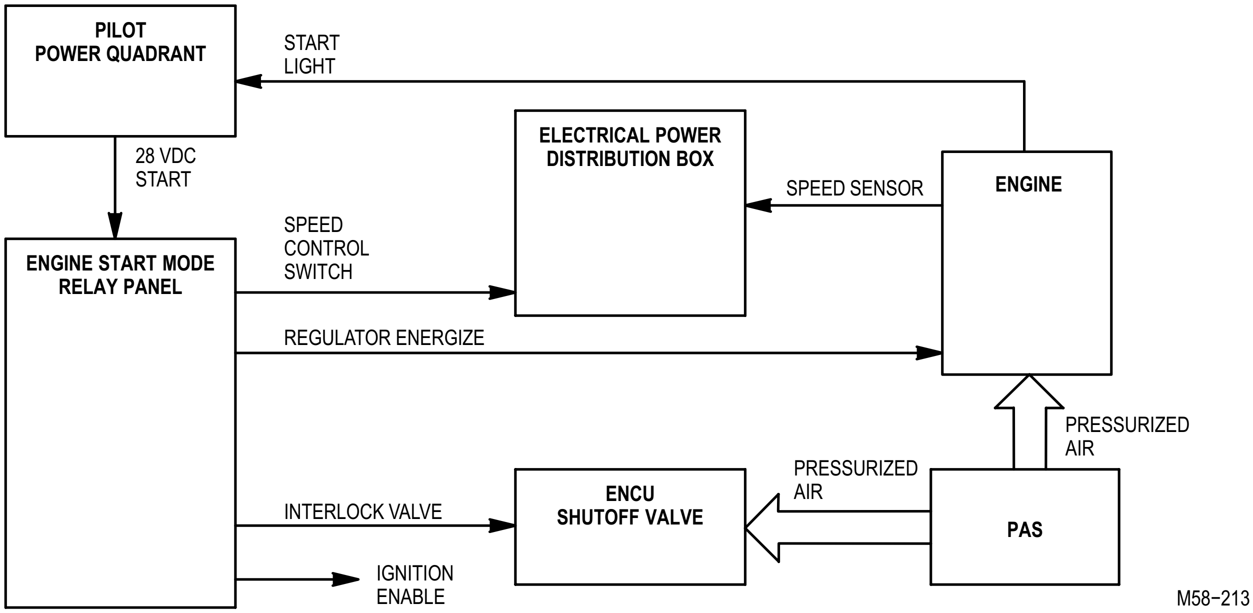


Figure 4–17. Engine Start System Block Diagram

(5) **Power Quadrants.** The power quadrants (fig. 4–6) provide command inputs to the HMU on each engine. The HMU controls the amount of fuel supplied to the engines.

(a) The pilot and CPG power quadrants transmit power selections from the crew stations to the engines. The engines are controlled by two power levers. The left lever operates engine 1. The right lever operates the engine 2. The power levers must be placed in **IDLE** to return to automatic control which are then advanced to the **FLY** position. The pilot power quadrant has mechanical stops to prevent the pilot and CPG power levers from being moved from **FLY** to **LOCKOUT** or from **IDLE** to **OFF**. The CPG power quadrant does not have mechanical stops. The stops are released by a trigger release on the power levers. The stop release levers on the CPG power levers operate a solenoid. The solenoid frees the mechanical stops on the power quadrants. A friction power lever on the pilot power quadrant applies friction to both power levers to hold the levers in place.

(6) **Engine Power Controls.** The engine power controls provide inputs to the HMU on each engine. The HMU controls the amount of fuel supplied to the engine. Inputs are provided by the pilot and CPG power quadrant power levers, collective stick, and turbine speed control unit.

(a) The power levers (fig. 4–18) are connected by control cables to the power available spindle on the respective engine HMU. Moving a power lever causes the control cable to move the respective power available spindle on the HMU. Normally, the power levers are used to set the engine speed to **OFF, IDLE** or **FLY** when the collective is at flat pitch.

(b) A **CHOP** collar is installed on the pilot and CPG collective sticks. The collar provides for rapid reduction of engine power. Pushing forward and twisting clockwise reduces engine power to idle. Pushing forward and twisting counter–clockwise causes both engines to return to the previous power setting. Pushing the collective stick down reduces the fuel flow to the engine to compensate for a power demand decrease. When the collective is moved, the LVDT develops a signal that is proportional to the rate and amount of movement. This signal is applied to both engine ECUs or DECUs to help the engines maintain 100% N_P/N_R under high power requirements. The collective stick actuator is connected by control cables to the load demand spindles on both engines. Pulling the collective stick up causes the load demand spindle to move, supplying more fuel to the engine to compensate for the increased power demand on the engines.

4–7 SYSTEM DESCRIPTION (cont) 4–7

(c) Engine turbine speed is controlled by the turbine speed control unit. The speed control unit limits the maximum turbine rpm of the engine. The speed control unit sends a signal to the ECU which signals the ECU to control the flow of fuel to the engine.

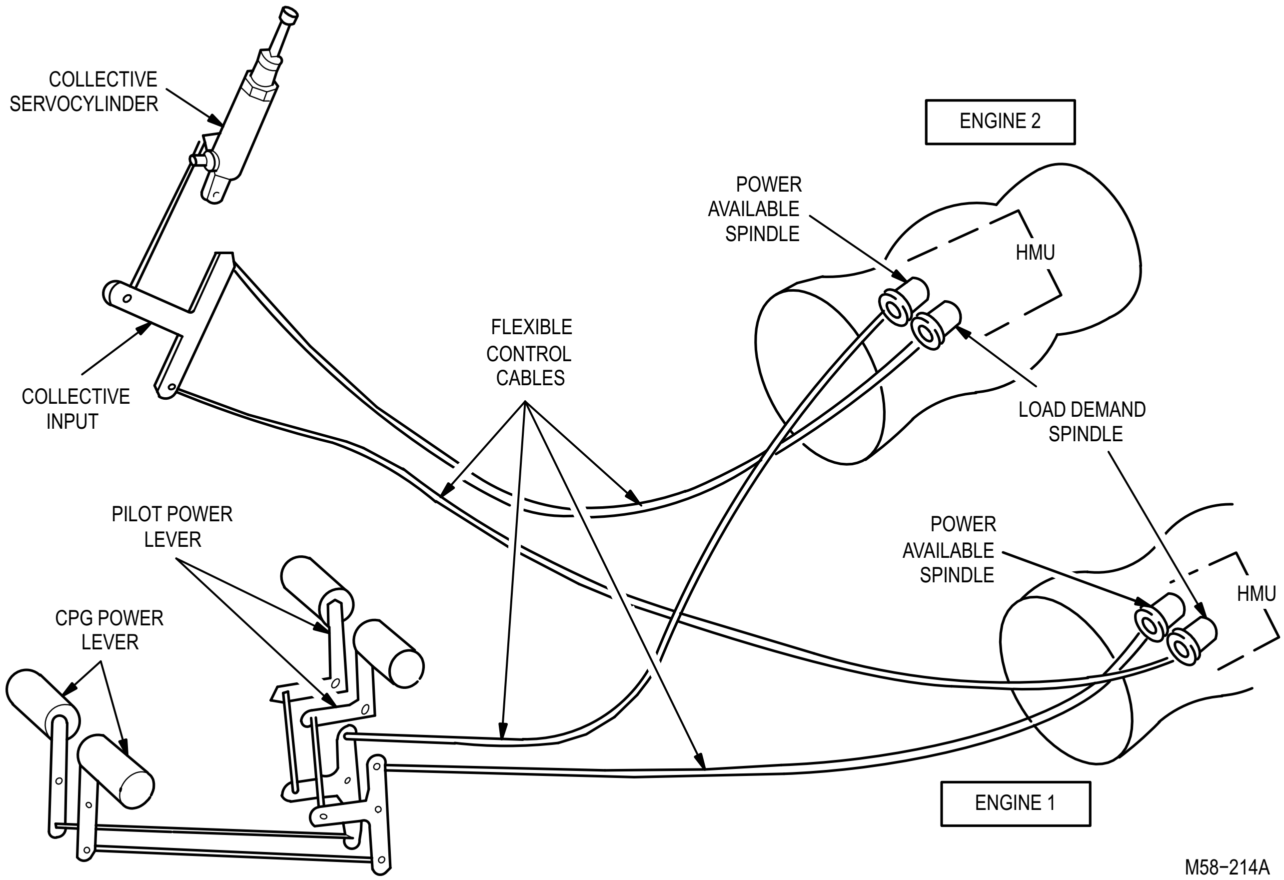


Figure 4–18. Engine Control System

4–8. MULTIPLEX READ CODES 4–8

a. Power plants transmit engine 1 and engine 2 torque status to the fire control computer (FCC) via the multiplex data bus (MUX) system.

b. Integrated in the MUX bus system is the fault detection/location system (FD/LS). FD/LS utilizes the CPG data entry keyboard (DEK) (ADC) or control display unit (CDU) (ADD) for FD/LS command initialization and/or FCC memory read code accessing.

SECTION III. TROUBLESHOOTING PROCEDURES

4–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX 4–9

Use the information in Table 4–2 to find the electrical components and their connectors to perform the troubleshooting tasks in this chapter. Table 4–2 includes locater illustrations which supplement the ECLC listing. The listing entry in the grid area column in the listing tells you where to locate the component in the illustrations.

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing

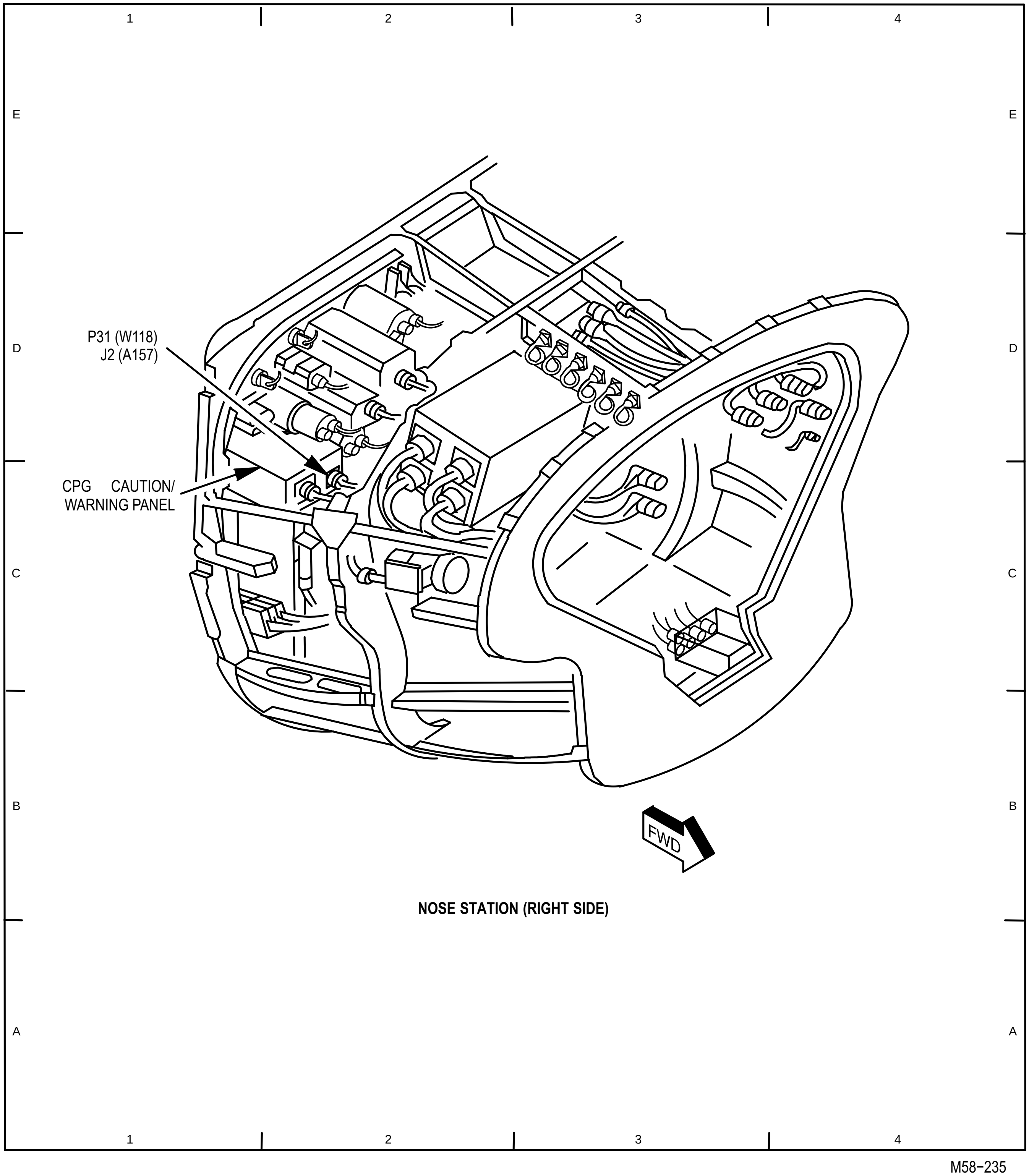
FROM COLUMN		TO COLUMN			
Connector Ref Des	Component/ Harness	Connector Ref Des	Component/ Harness	Grid Area	Access
P1	W605/A76	J1	A402	40B	PLT STATION
P107	A81	J107	W119	26B	PLT STATION
P108	A80	J108	W119	10B	CPG STATION
P1121	W119	J1	A656	25B	PLT STATION
P18	W118	J1	A106	17C	PLT STATION
P173	W119	J1	A24	30C	PLT STATION
P175	W175	J1	A78	30D	PLT STATION
P190	W119	J1	A29	14D	CPG STATION
P20	W118	J2	A106	17B	PLT STATION
P21	W165	J21	W119	55E	LN1 ENG 1
P22	W166	J22	W118	58E	RN1 ENG 2
P23	W165	J23	W261	55E	LN1 ENG 1
P24	W166	J24	W264	58E	RN1 ENG 2
P31	W118	J2	A157	1D	L40 COVER
P35	W165	J1	A3	54E	LN1 ENG 1
P36	W166	J1	A4	59E	RN1 ENG 2
P39	W165	J1	L3	55B	LN1 ENG 1
P40	W166	J1	L4	58D	RN1 ENG 2
P405	W261	J3	A326	23C	CPG STATION
P409	W261	J4	A326	23C	CPG STATION

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)

FROM COLUMN		TO COLUMN			
Connector Ref Des	Component/ Harness	Connector Ref Des	Component/ Harness	Grid Area	Access
P41	W165	J1	E1	55D	LN1 ENG 1
P42	W166	J1	E1	60A	RN1 ENG 2
P431	W211	J27	A402	39D	L200 PANEL
P433	W119	J20	A402	39E	L200 PANEL
P435	W261	J7	A326	24B	CPG STATION
P438	W118	J15	A402	38C	L200 PANEL
P439	W119	J21	A402	39E	L200 PANEL
P448	W118	J448	W119	25C	PLT STATION
P449	W221	J449	W119	47E	T205L FAIRING
P45	W165	J1	E3	53E	LN1 ENG 1
P452	W264	J452	W261	25D	PLT STATION
P456	W118	J456	W211	25C	PLT STATION
P46	W166	J1	E3	57B	RN1 ENG 2
P463	W119	J1	A76	28D	PLT STATION
P464	W211	J1	A5	47C	L200 PANEL
P469	W119	J2	A326	23C	CPG STATION
P470	W264	J19	A326	21B	CPG STATION
P482	W118	J18	A326	21C	CPG STATION
P49	W261	J1	A9	43B	L140 FAIRING
P54	W211	J1	A166	50B	R295 DOOR
P70	W261	J1	M6	34C	PLT STATION
P748	W119	J2	A403	6D	L90 DOOR
P977	W119	J1	A330	48E	L200 PANEL
P978	W119	J2	A330	48E	L200 PANEL

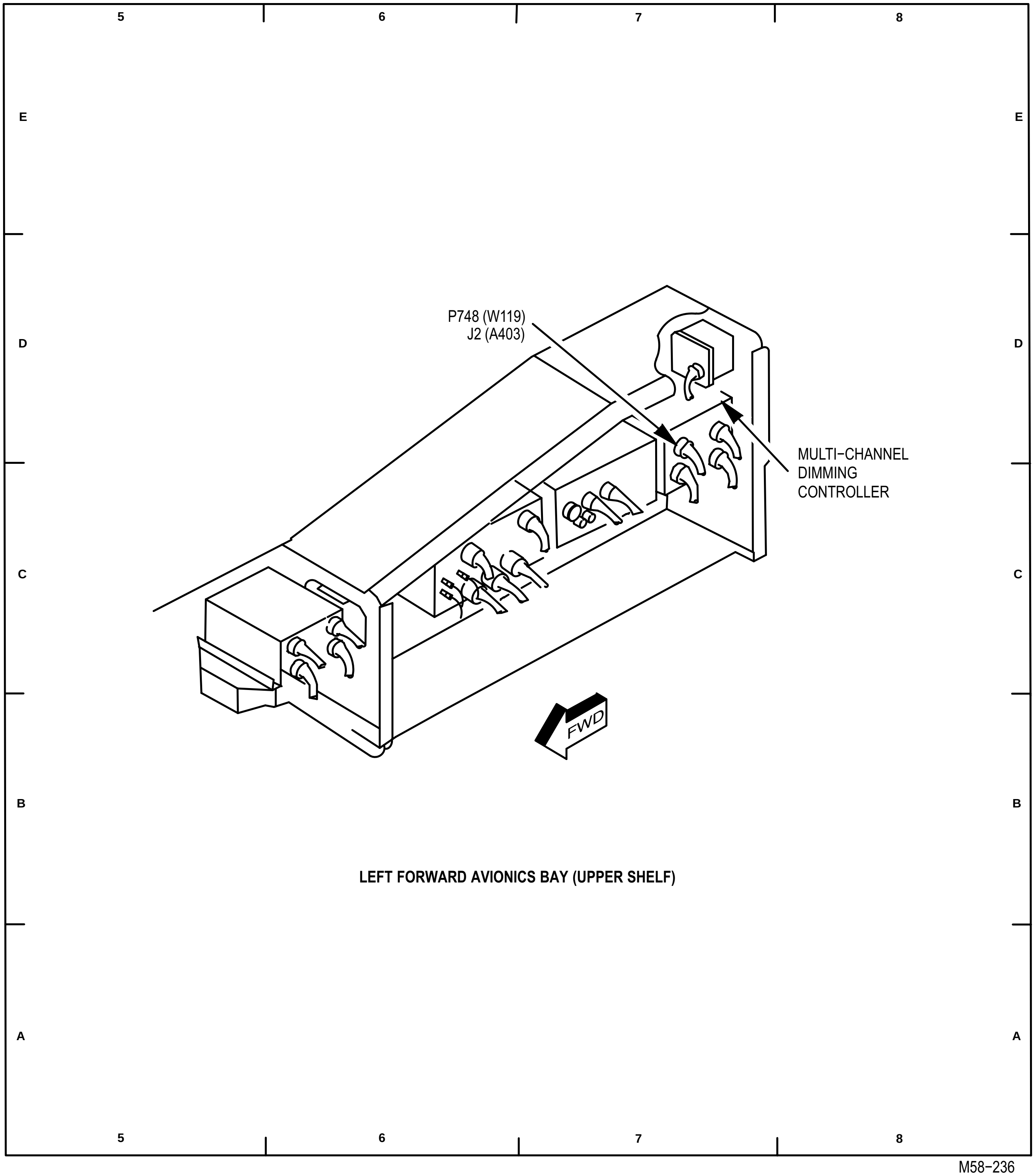
4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



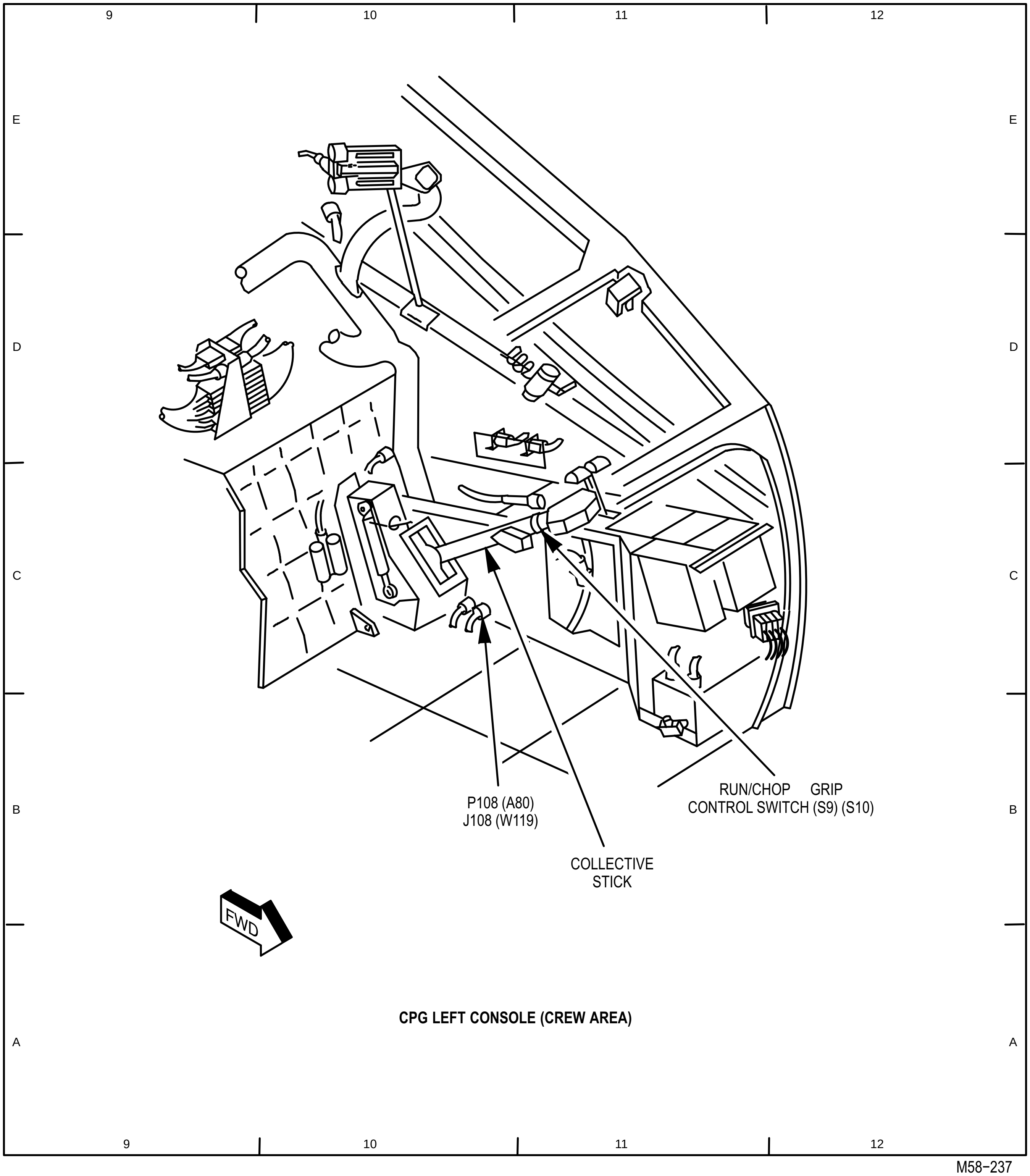
4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



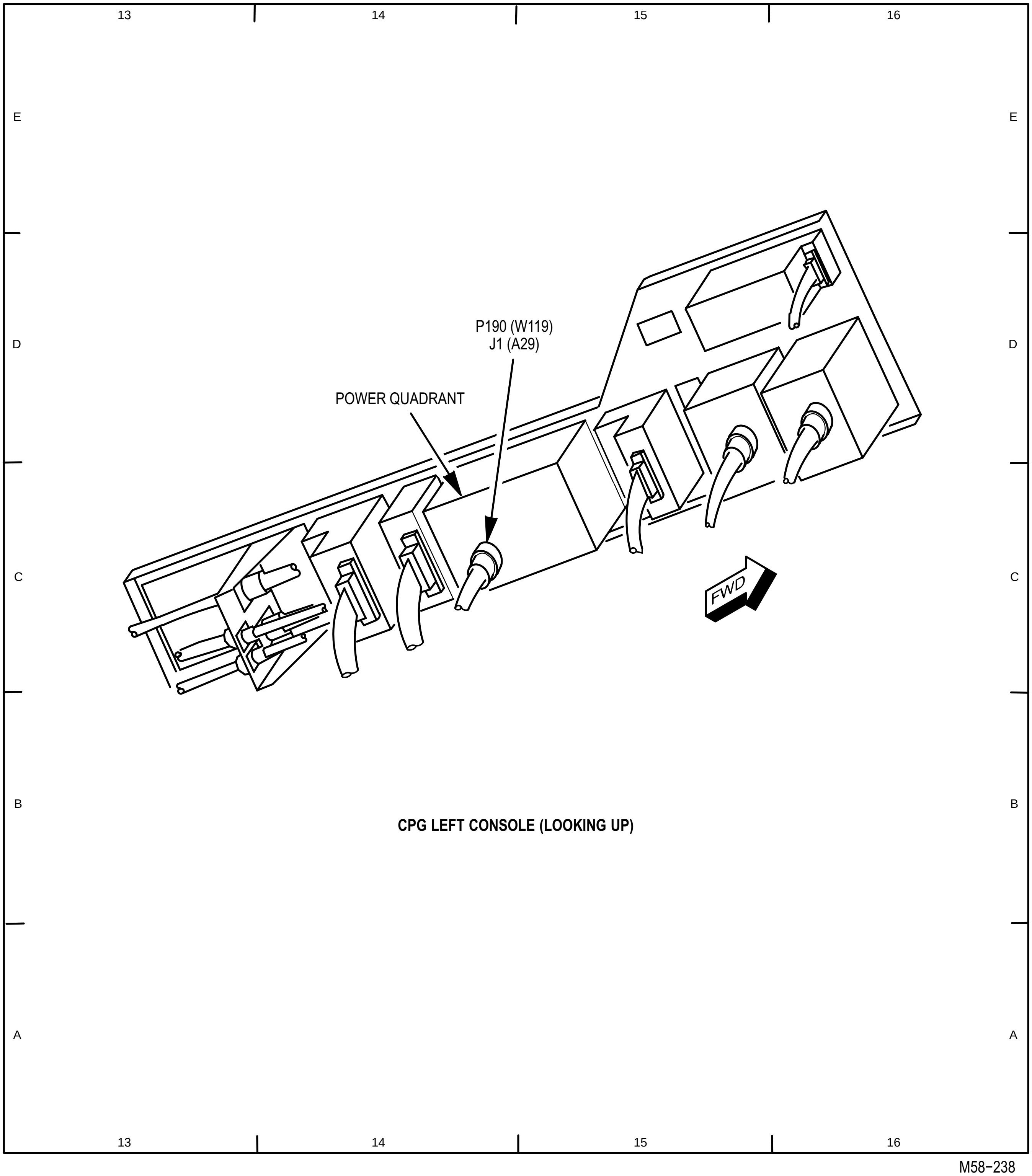
4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



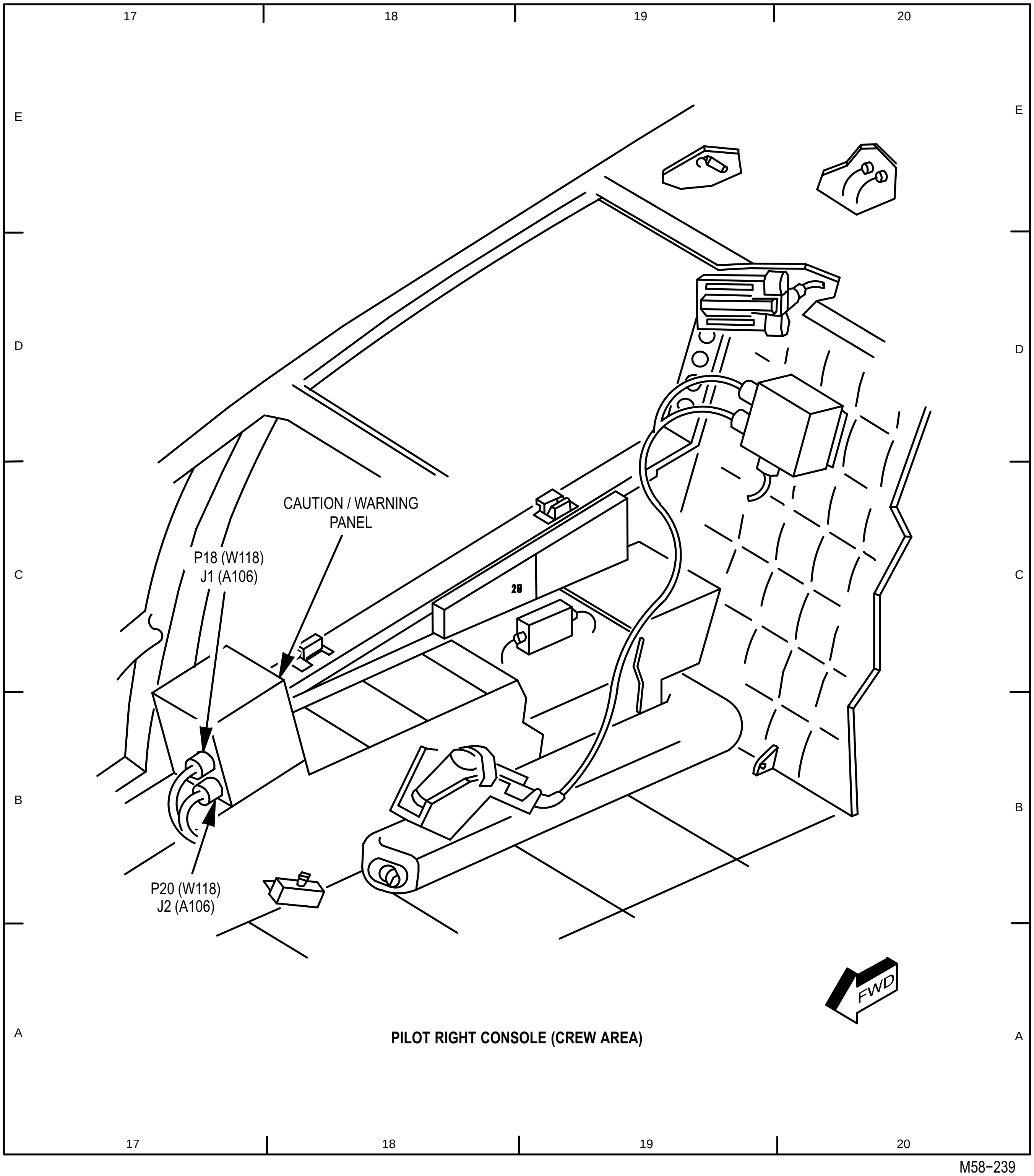
4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



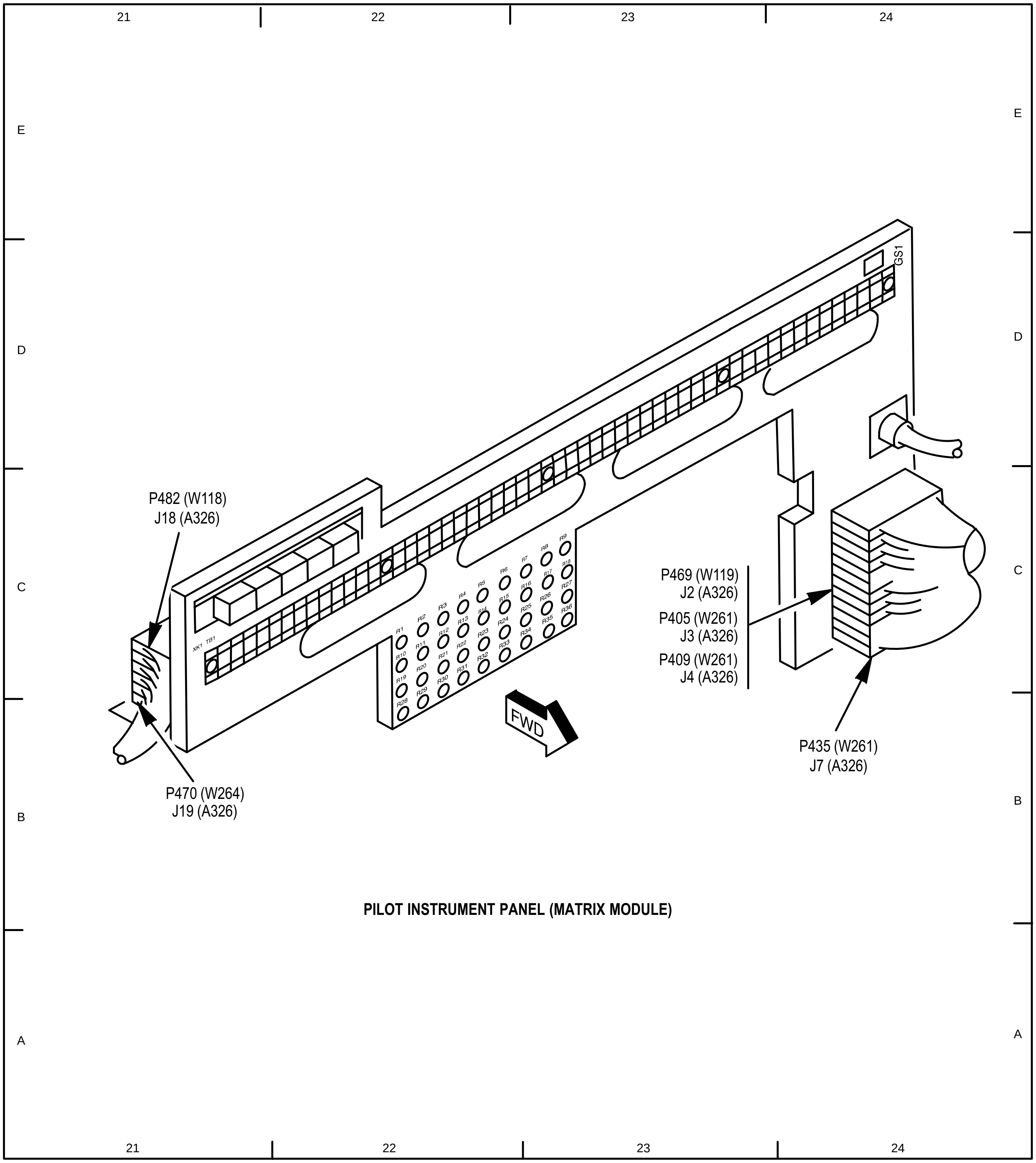
4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)

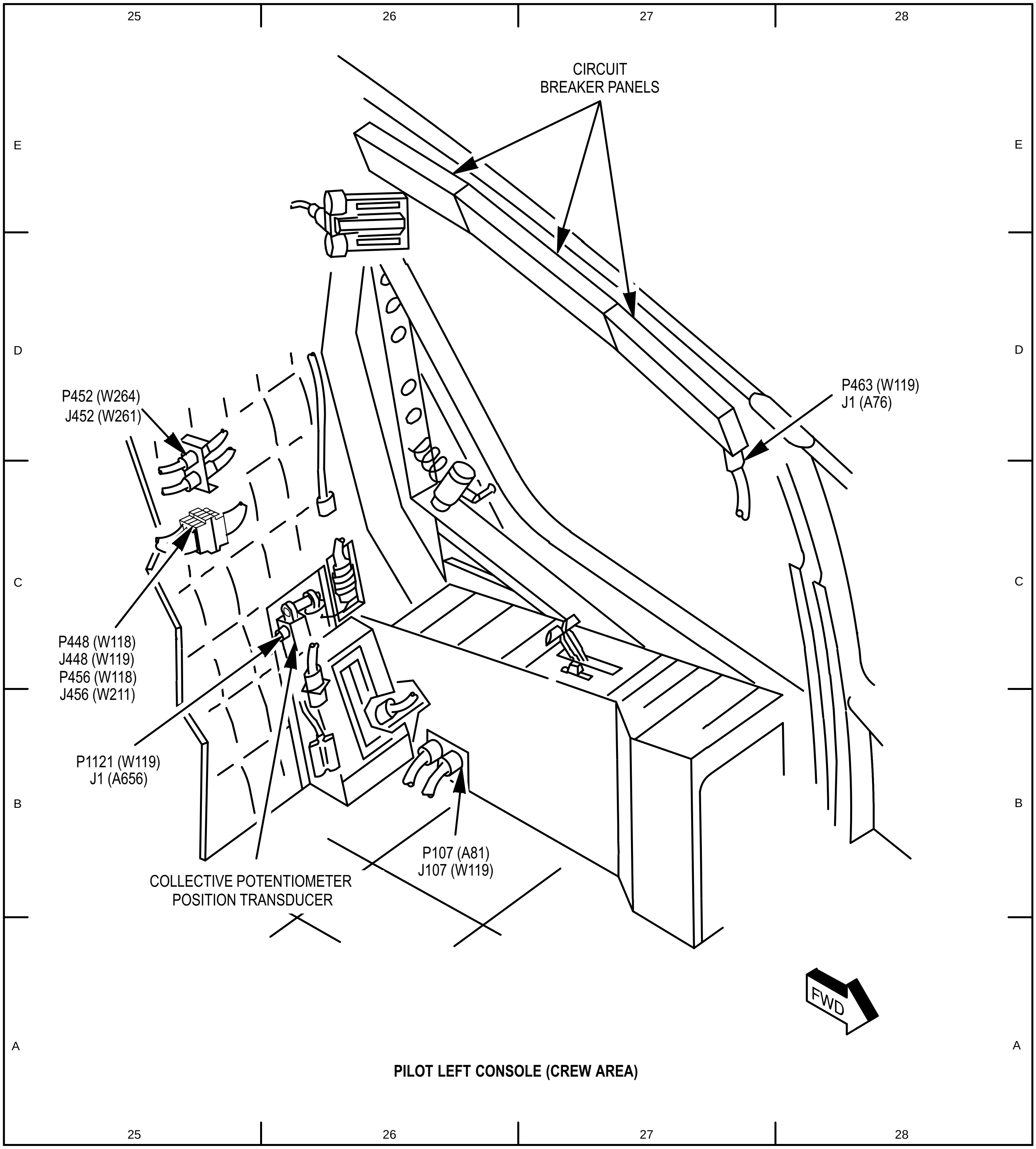


PILOT INSTRUMENT PANEL (MATRIX MODULE)

M58−240

4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



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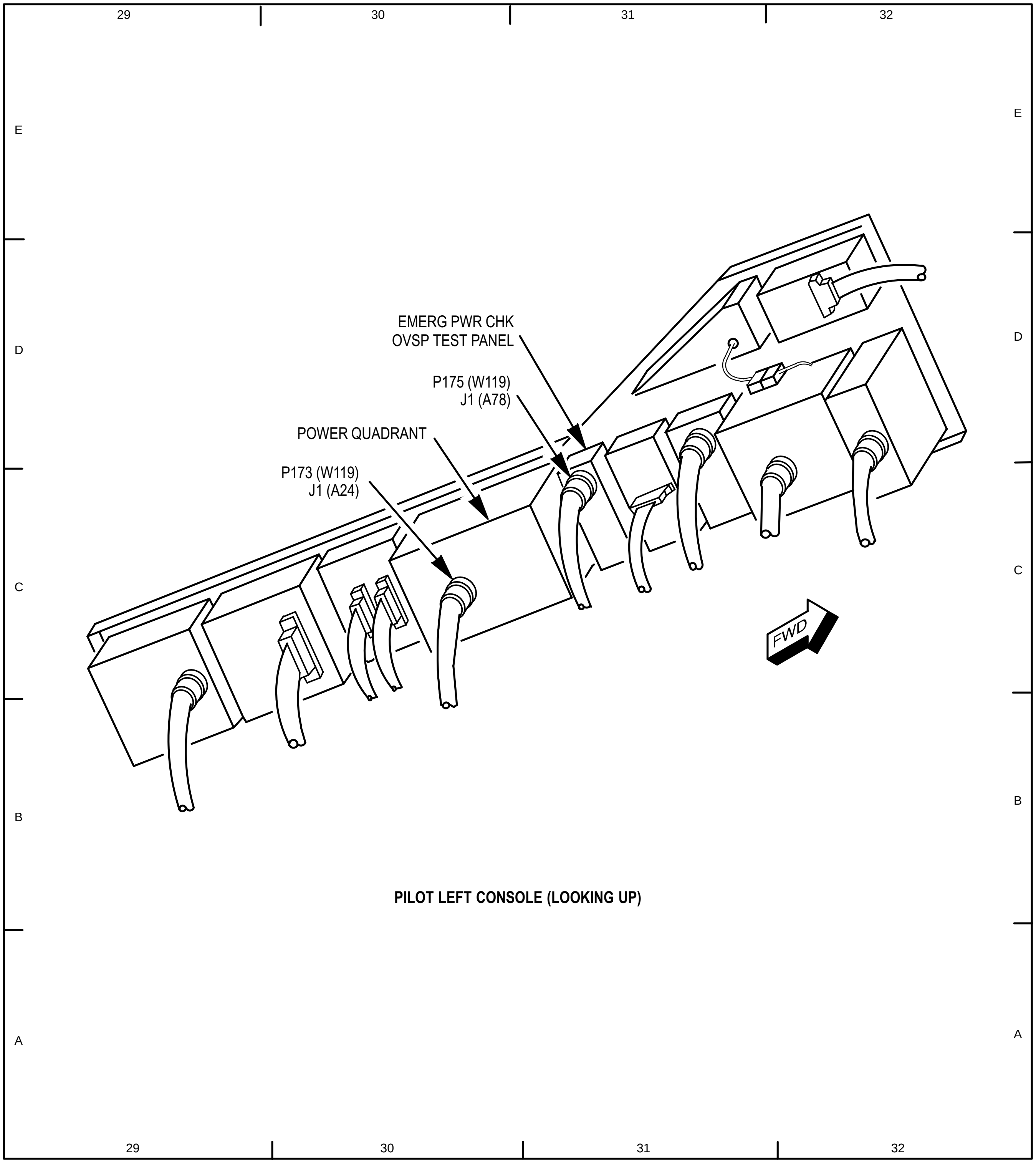
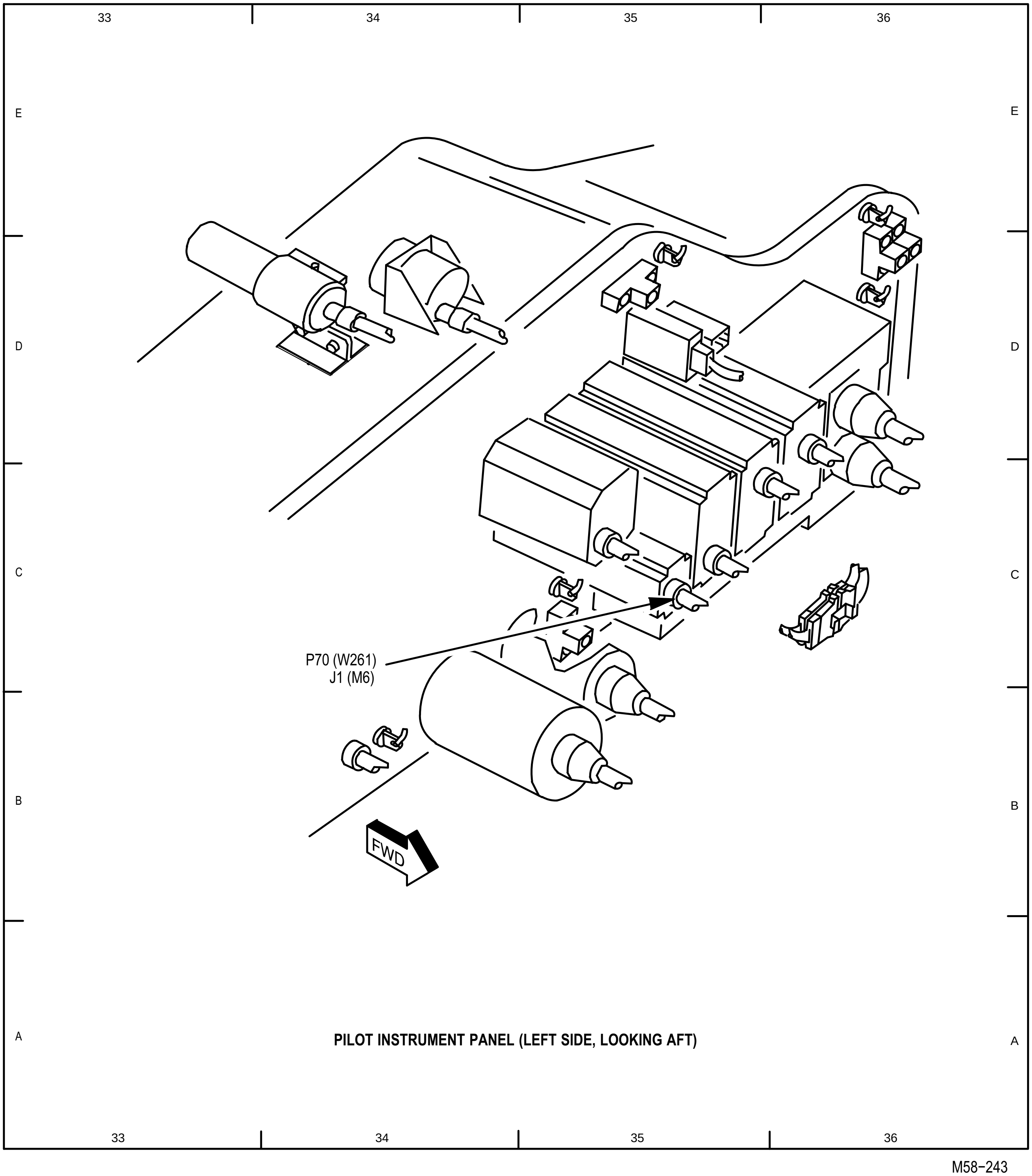
4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

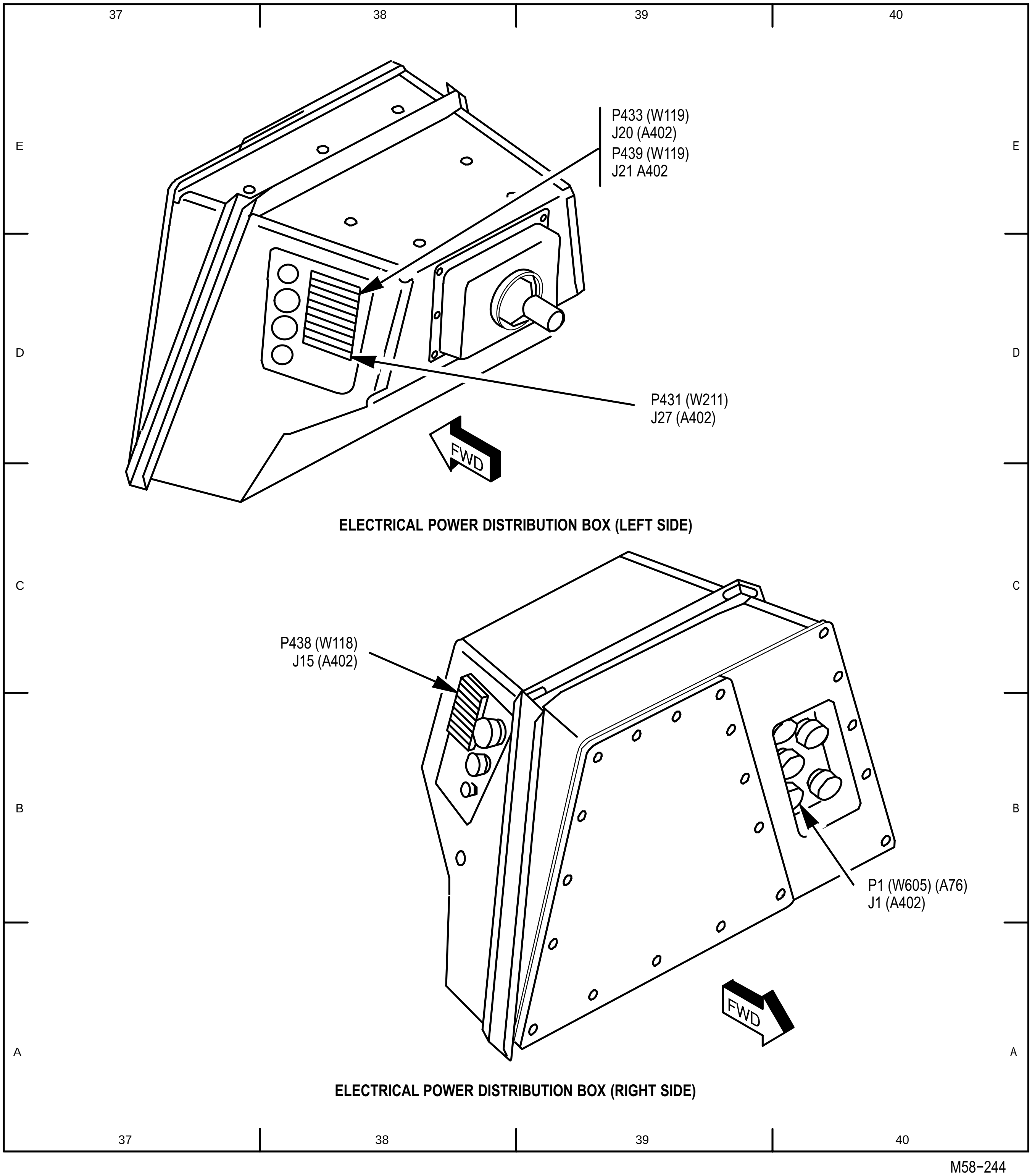
Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



PILOT INSTRUMENT PANEL (LEFT SIDE, LOOKING AFT)

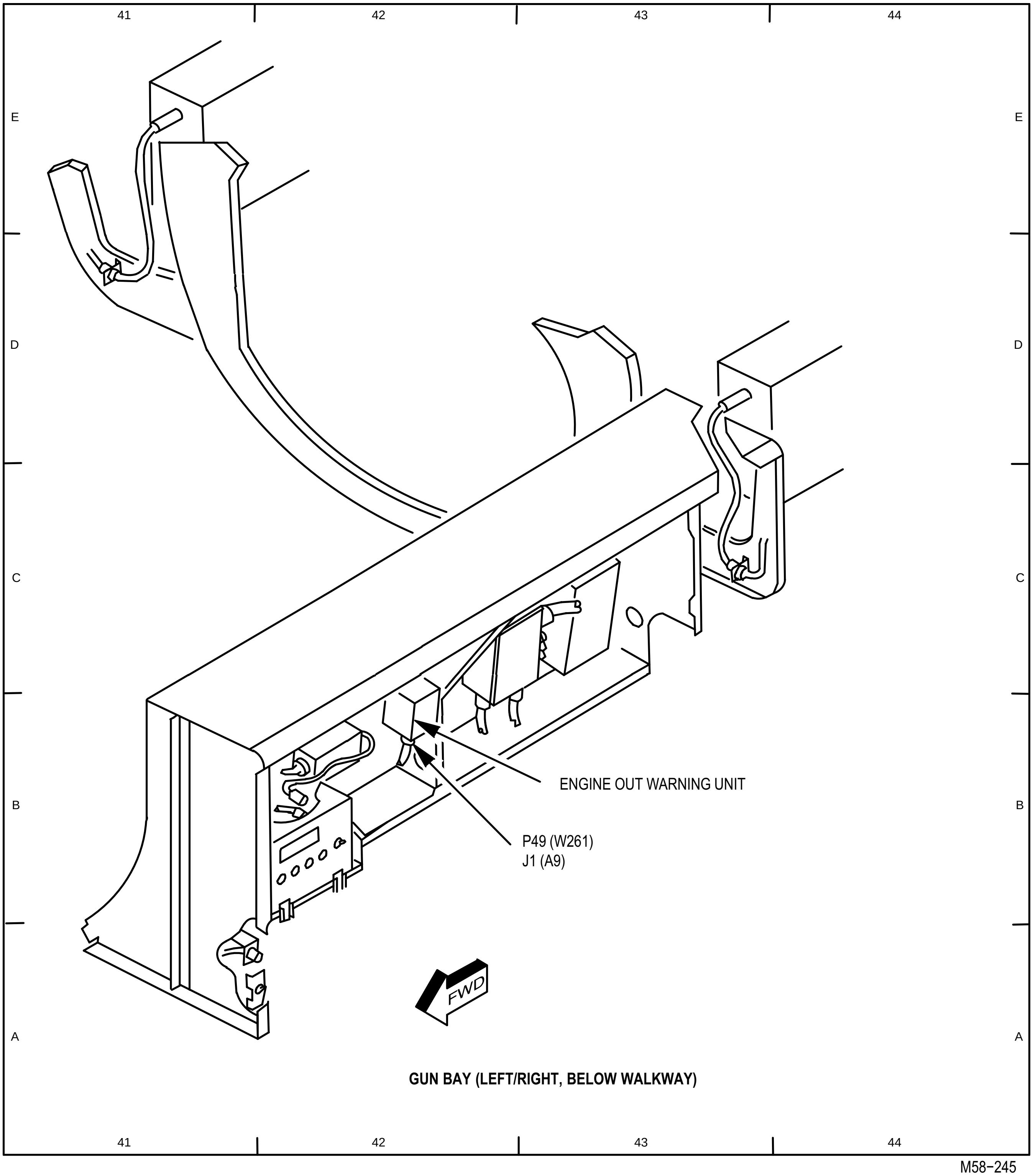
4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



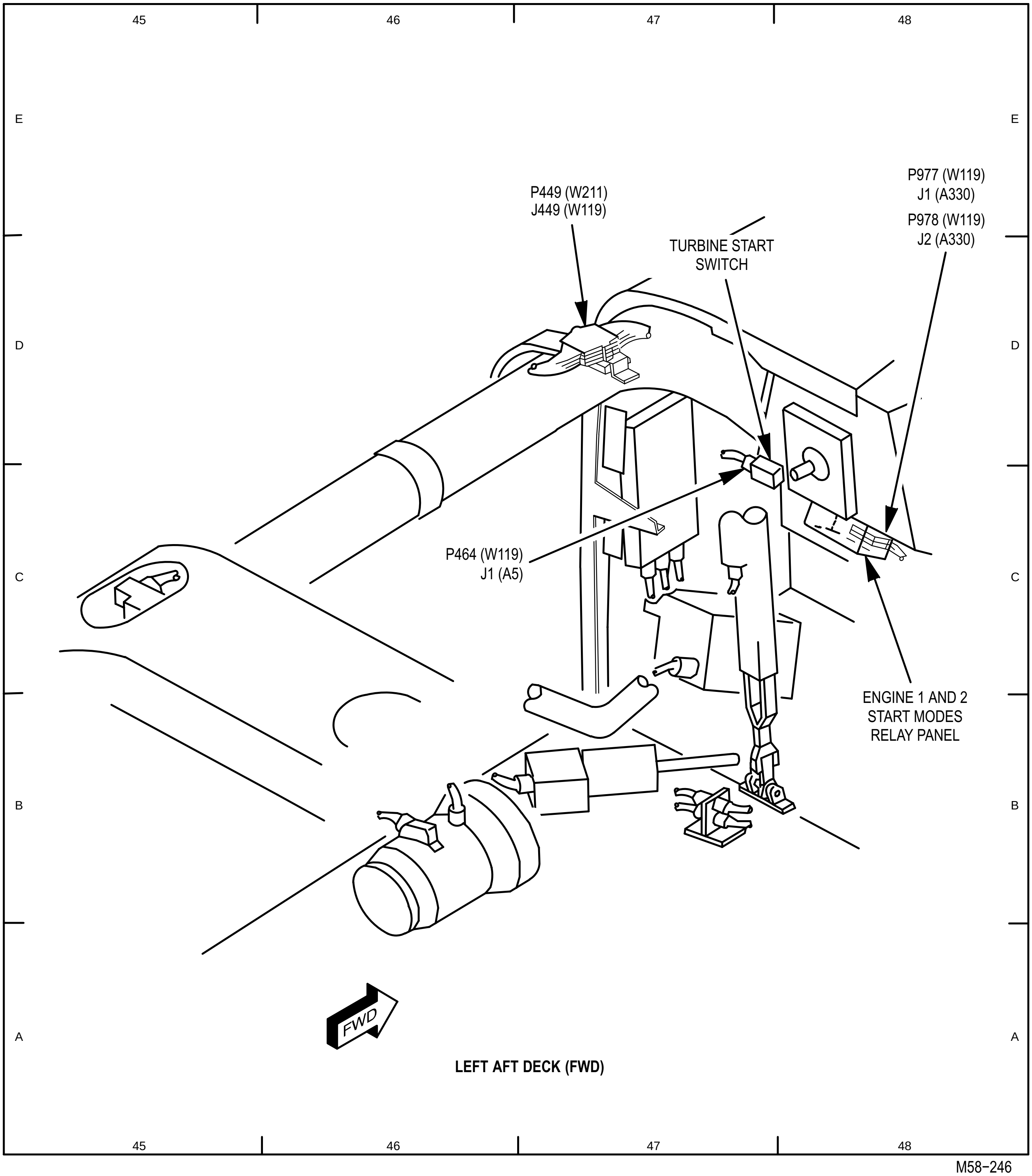
4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



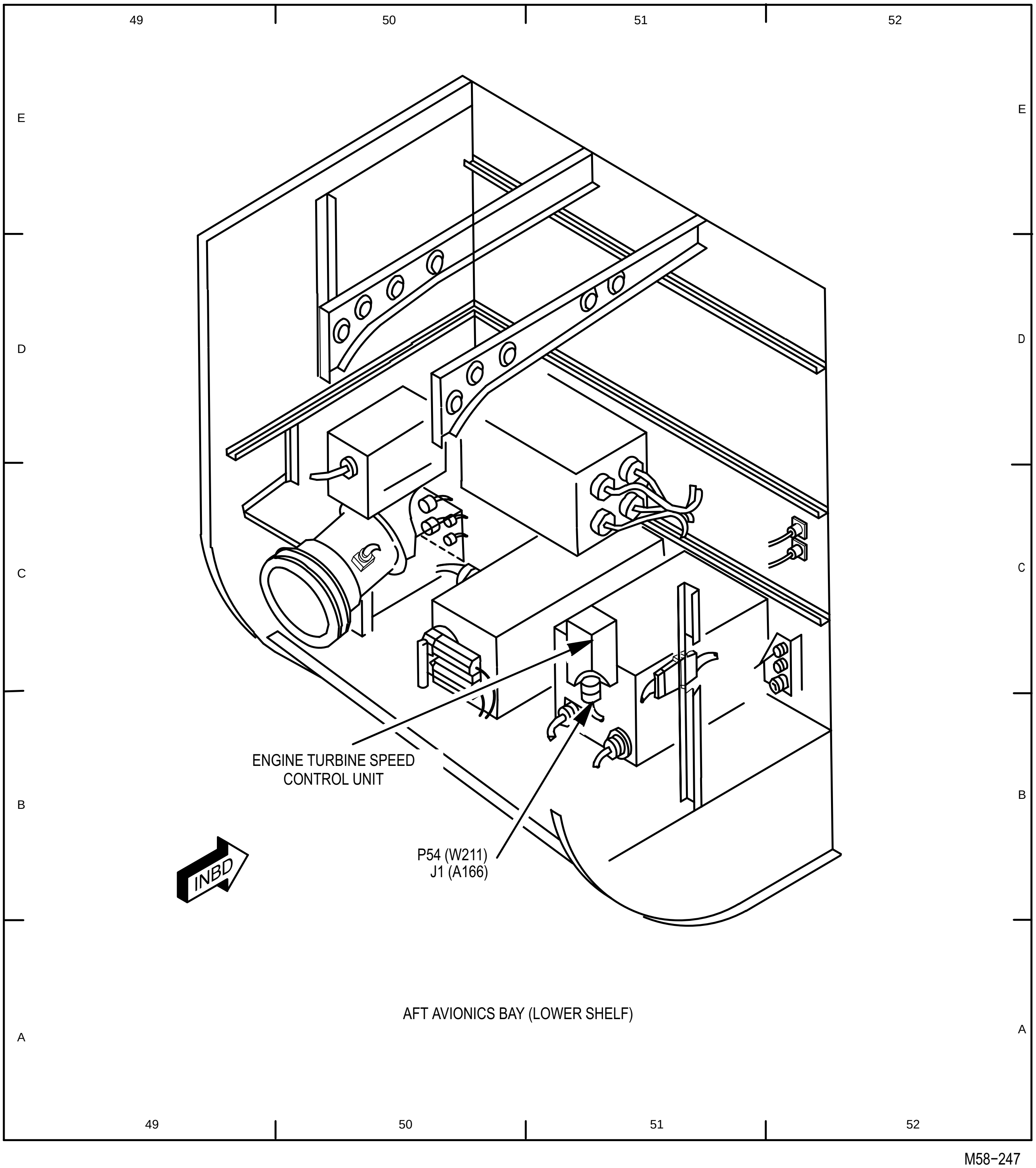
4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



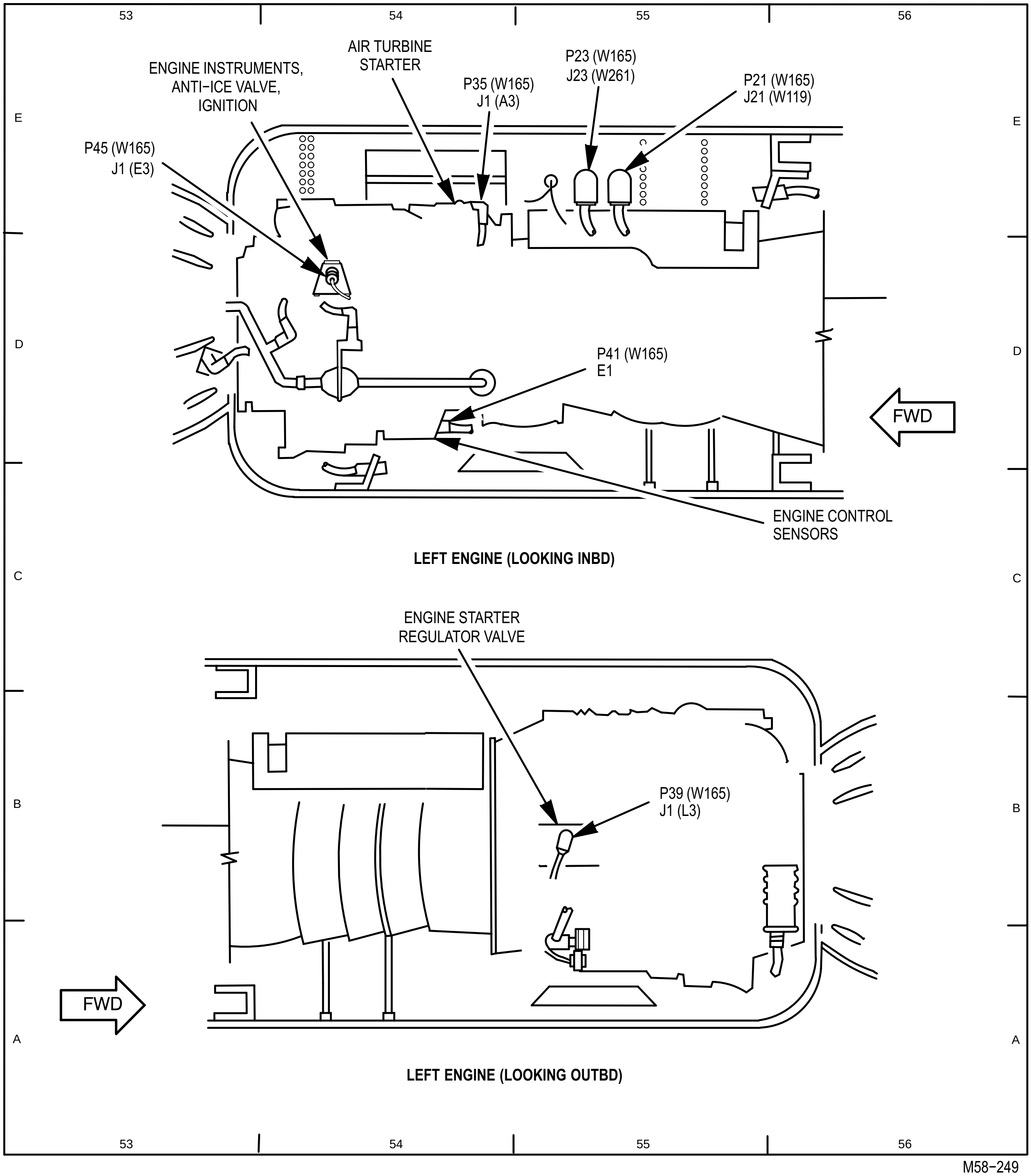
4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



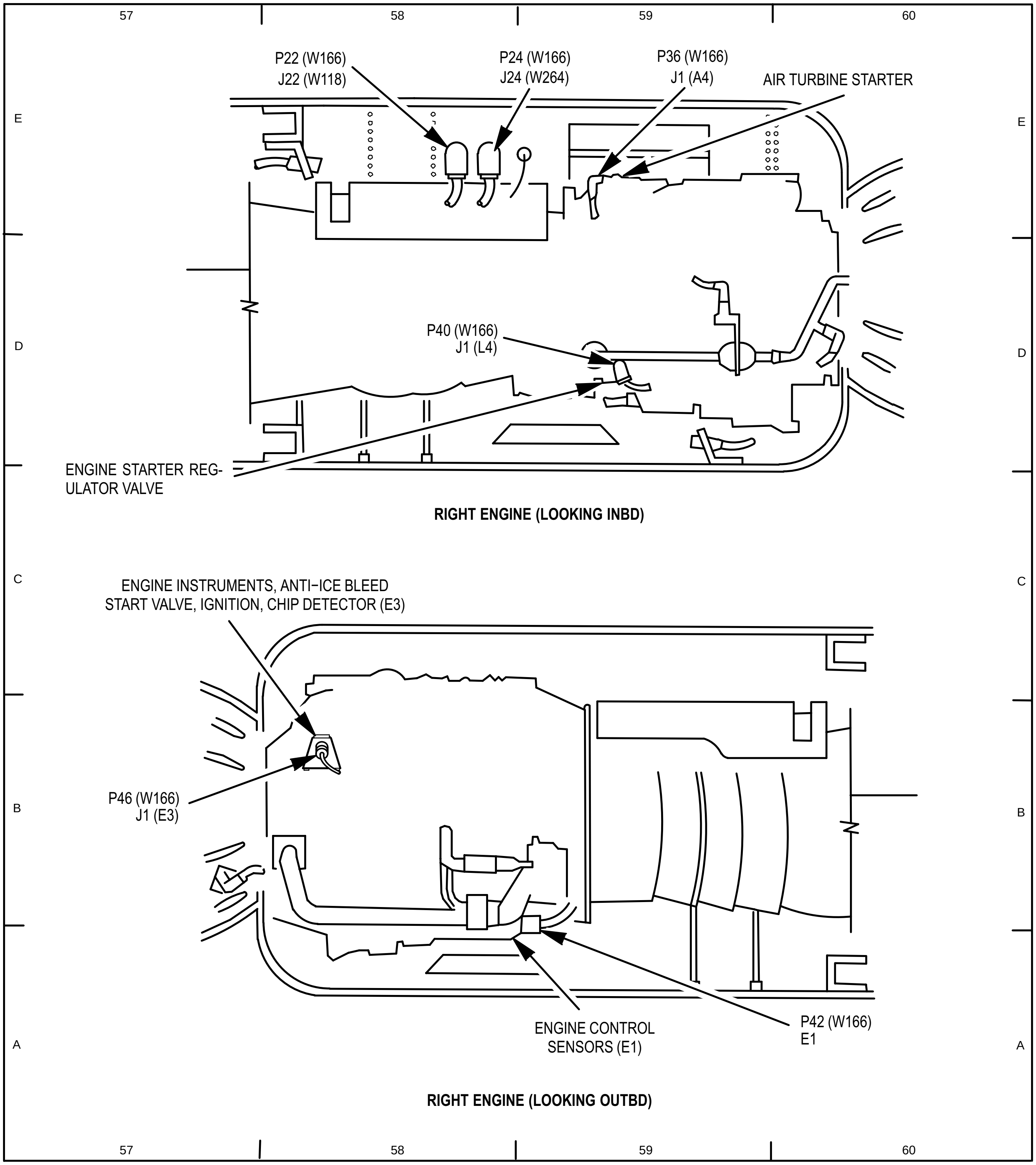
4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



4–9 ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 4–9

Table 4–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



4–10. POWER PLANTS – POWER UP 4–10

4

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01

Personnel Required:

67R Attack Helicopter Repairer

References:

TM 1-1520-238-T-7
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Helicopter safed
TM 1-1520-238-T-7	FUEL SYSTEM – POWER UP completed

NOTE

Refer to pilot station (fig.4–19) and CPG station (fig. 4–20) for cockpit configuration and equipment.

4–10. POWER PLANTS – POWER UP (cont) 4–10

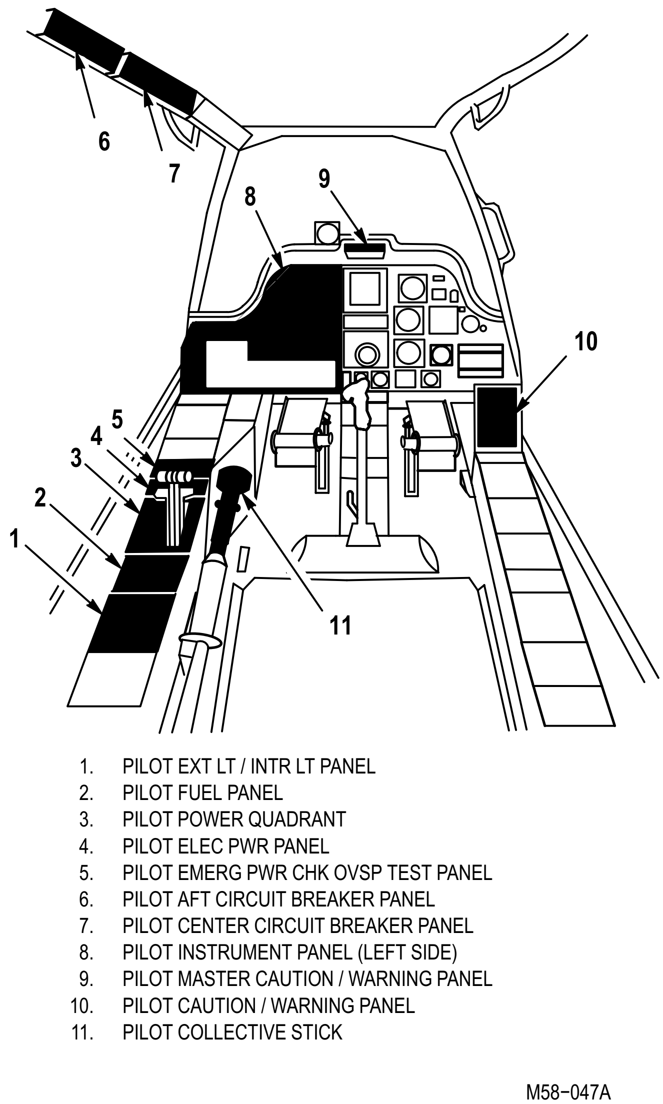


Figure 4–19. Pilot Station

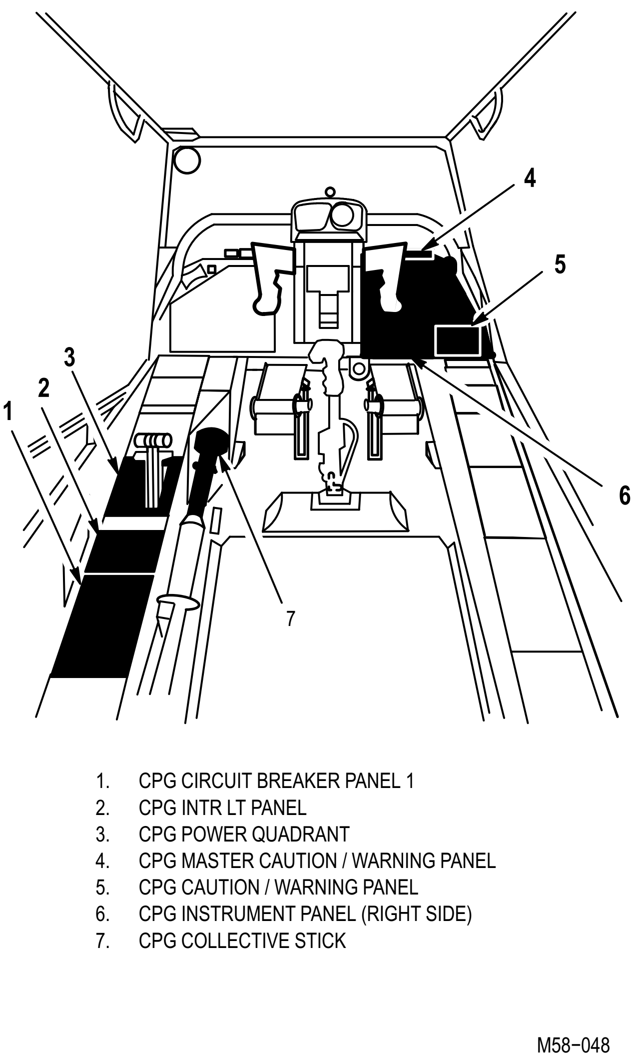


Figure 4–20. CPG Station

1. On pilot **ELEC PWR** panel (fig. 4–21), set **BATT/EXT PWR** switch to **EXT PWR.**

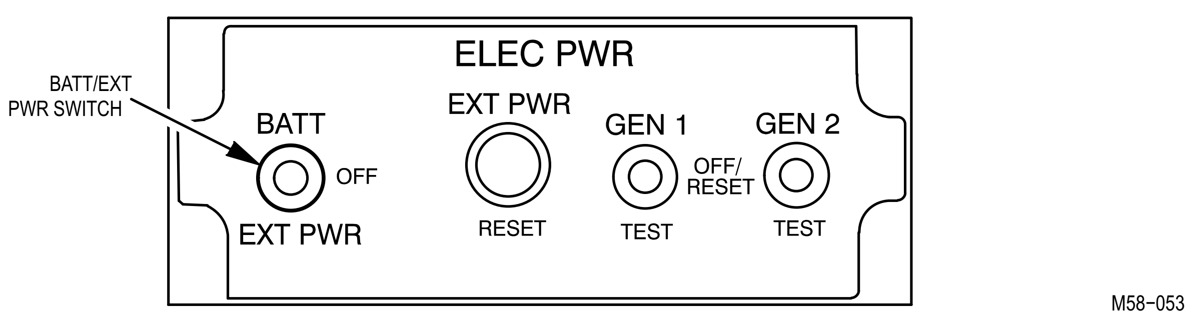


Figure 4–21. Pilot ELEC PWR Panel

2. On pilot center circuit breaker panel (fig. 4–22), check that the following circuit breakers are closed.

Circuit Breaker Name	Circuit Breaker Name
LT PRI	**ENG WARN**
ENG INST	**ENG START**
FIRE DETR ENG 1	**ENG LVR**
FIRE DETR ENG 2	**ENG CUT**
FIRE EXTGH PLT	**THROT**
FIRE EXTGH CPG	**LT CAUT**

3. On pilot aft circuit breaker panel, check that **POWER ENG 1** and **POWER ENG 2** circuit breakers are closed.

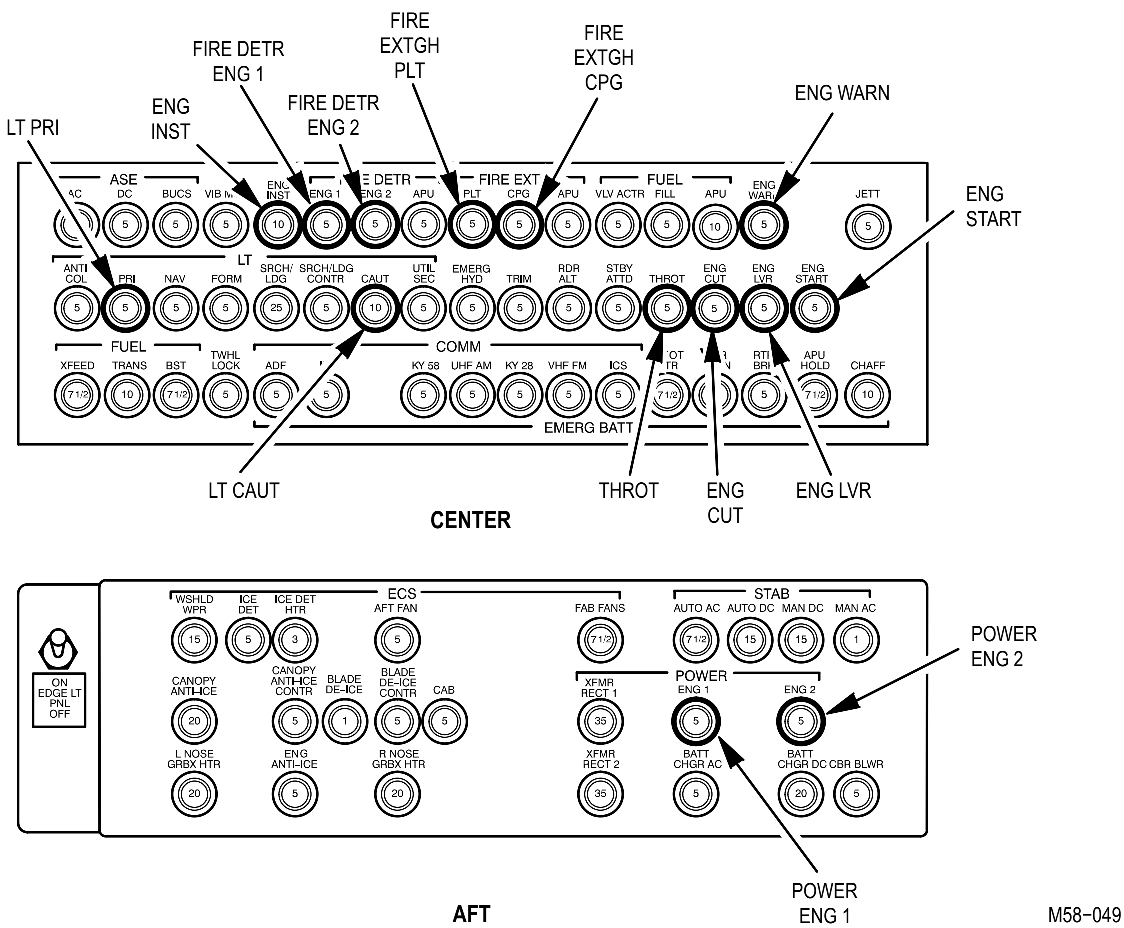


Figure 4–22. Pilot Center and Aft Circuit Breaker Panels

4. On pilot **EXT LT/INTR LT** panel (fig. 4–23), set **L CSL** and **INST** controls to **BRT**.

4–10. POWER PLANTS – POWER UP (cont) 4–10

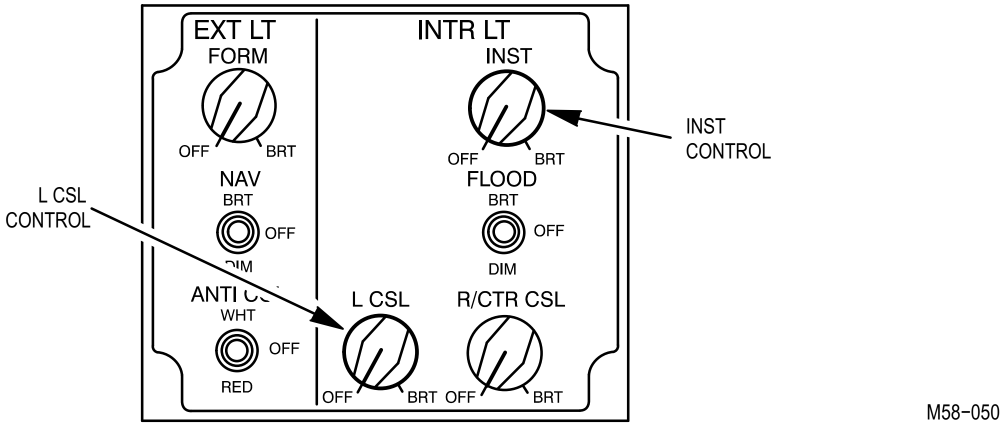


Figure 4–23. Pilot EXT LT/INTR LT Panel

5. On CPG circuit breaker panel 1 (fig. 4–24), check that the following circuit breakers are closed:

Circuit Breaker Name	Circuit Breaker Name
EMERG BATT ENG INST	**PRI LT**
EMERG BATT CAUT	

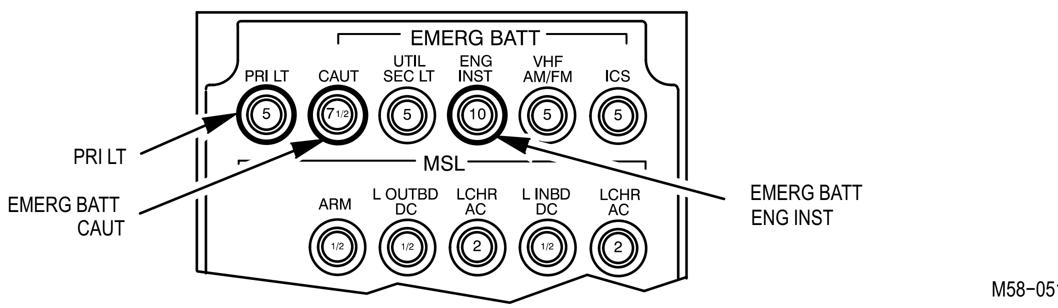


Figure 4–24. CPG Circuit Breaker Panel 1

6. On **CPG INTR LT** panel (fig. 4–25), set **L CSL,** and **INST** controls to **BRT**.

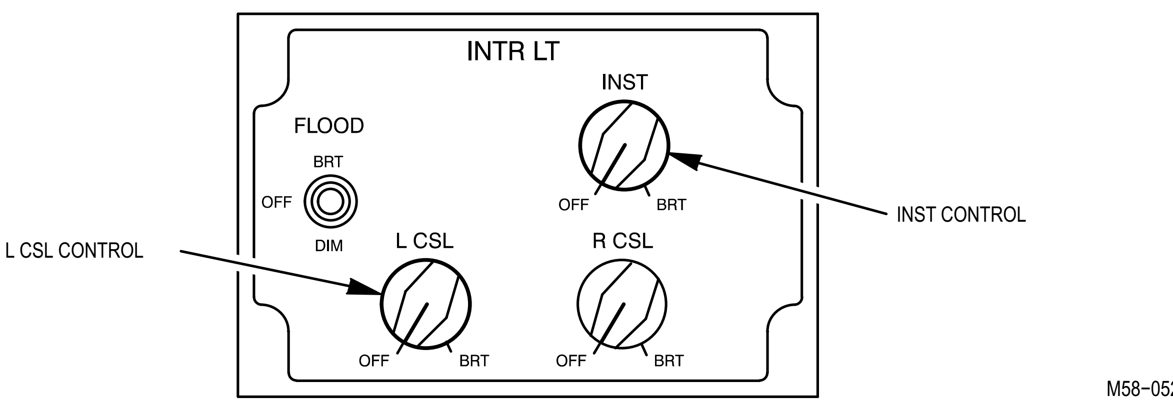


Figure 4–25. CPG INTR LT Panel

END OF TASK

4–11. POWER PLANTS – POWER DOWN 4–11

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01

Personnel Required:

67R Attack Helicopter Repairer

References:

TM 1-1520-238-T-7

Equipment Conditions:

Ref	Condition
Paragraph 4–10	POWER PLANTS – POWER UP completed

NOTE

Refer to pilot station (fig. 4–19) and CPG station (fig. 4–20) for cockpit configuration and equipment.

1. On pilots **EXT LT/INTR LT** panel (fig. 4–23), set **L CSL** and **INST** controls to **OFF**.
2. On **CPG INTR LT** panel (fig. 4–25), set **L CSL** and **INST** controls to **OFF**.
3. On **ELEC PWR** panel (fig. 4–21), set **BATT/EXT PWR** switch to **OFF**.
4. Perform FUEL SYSTEM – POWER DOWN (TM 1-1520-238-T-7).

END OF TASK

4–12. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 1) 4–12

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01

Personnel Required:

67R Attack Helicopter Repairer
One person to assist
152FG Pilot

References:

TM 1-1520-238-T-5
TM 1-1520-238-T-6
TM 1-1520-238-T-7
TM 1-1520-238-T-8
TM 1-1520-238-23
TM 1-1520-238-CL
TM 55-2840-248-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Power Plants inspection performed Engine 1 power available spindle rigging procedure completed No. 1 and No. 2 Engine load demand spindle (LDS) rigging check completed
TM 1-1520-238-T-7	FUEL SYSTEM VISUAL CHECK completed
TM 1-1520-238-T-8	ENVIRONMENTAL CONTROL SYSTEM – POWER UP completed
Paragraph 1–17	Maintenance headset connected
Paragraph 4–10	POWER PLANTS – POWER UP completed

NOTE

- **Refer to pilot station (fig. 4–19) and CPG station (fig. 4–20) for cockpit configuration and equipment.**
- **If referenced out of one paragraph or volume and into another for additional troubleshooting, upon completion of the task, return to the maintenance operational check for the original paragraph or volume.**
- **If problem involves excessive torsional vibration and N_R droop during flight maneuvers (engine 1 Np lags engine 2 Np during recovery maneuvers), go to paragraph 4–57.**
- **The vapor vent procedure is to be performed anytime a connection is broken on any of the fuel delivery components to insure purging of air in lines. If vapor procedure is not required, go to step h.**

4–12. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 1) (cont) 4–12

WARNING

- **Make sure helicopter safed procedures are accomplished. Observe all safety precautions during troubleshooting or maintenance tasks. Failure to comply could result in death or serious injury.**
- **Jet engine fuel is explosive, flammable, and toxic to skin, eyes, and respiratory track. Work in well ventilated area away from open flames. Wear protective clothing. If fuel comes in contact with the eyes or skin, flush with water and seek medical aid immediately.**
- **Do not allow spark or flame near helicopter when servicing or performing maintenance on fuel system.**
- **Make certain helicopter is grounded.**

CAUTION

Ensure proper container is placed under engine 1 overboard fuel drain to prevent fuel spillage.

1. Complete the maintenance operational check as follows:

Task	Result
a. On pilot power quadrant (fig. 4–26), check that edge–light panel is lighted.	If pilot power quadrant edge–light panel does not light, refer to paragraph 4–61.

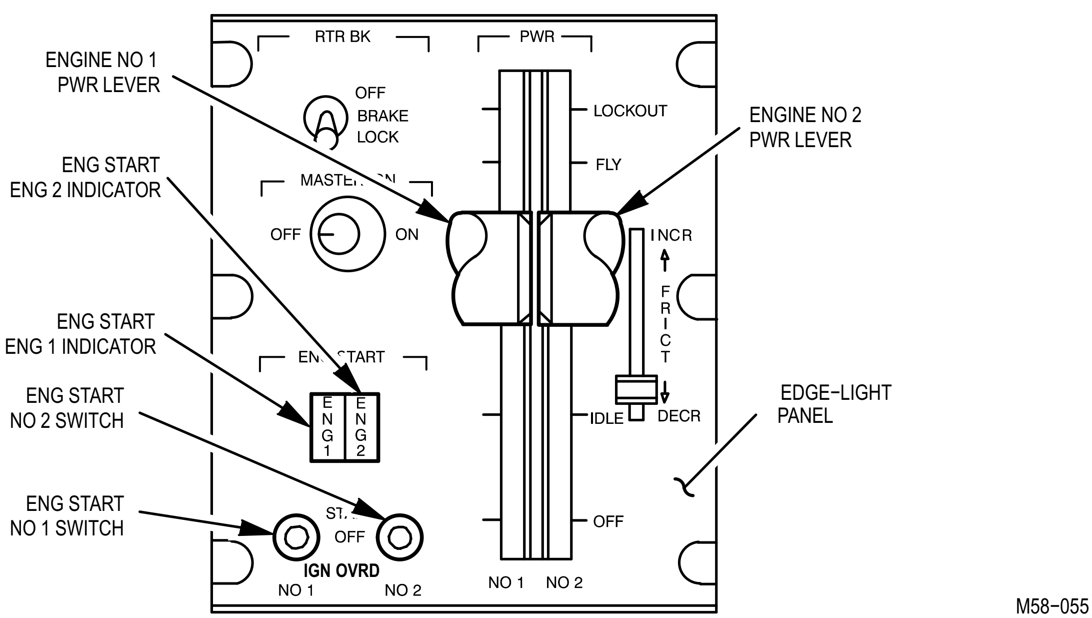


Figure 4–26. Pilot Power Quadrant

4–12. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 1) (cont) 4–12

Task	Result
b. On CPG power quadrant (fig. 4–27), check that edge–light panel is lighted.	If CPG power quadrant edge–light panel does not light, refer to paragraph 4–62.

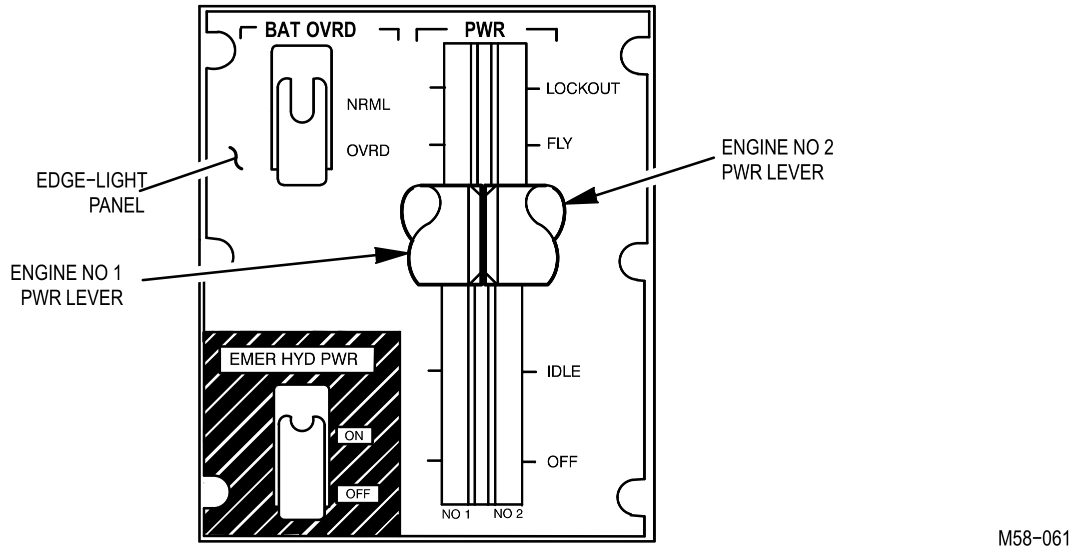


Figure 4–27. CPG Power Quadrant

c. On pilot power quadrant (fig. 4–26), set **PWR NO 1** lever to **LOCKOUT**.

NOTE

Fuel boost pump does not operate through pilot FUEL panel BOOST switch unless CROSSFEED switch is set to AFT TK.

d. On pilot **FUEL** panel (fig. 4–28), set **CROSSFEED** switch to **AFT TK, ENG 1 FUEL** switch to **ON**, and **BOOST** switch to **ON**.

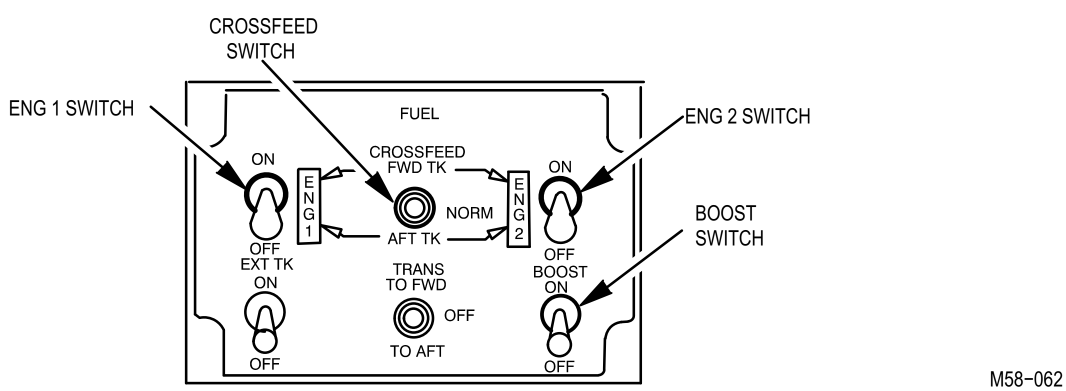


Figure 4–28. Pilot FUEL Panel

4–12. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 1) (cont) 4–12

Task	Result
e. On pilot caution/warning panel (fig. 4–29), check that **BOOST PMP ON** indicator is lighted.	If **BOOST PMP ON** indicator is not lighted, refer to TM 1-1520-238-T-7 to troubleshoot fuel crossfeed/boost system.

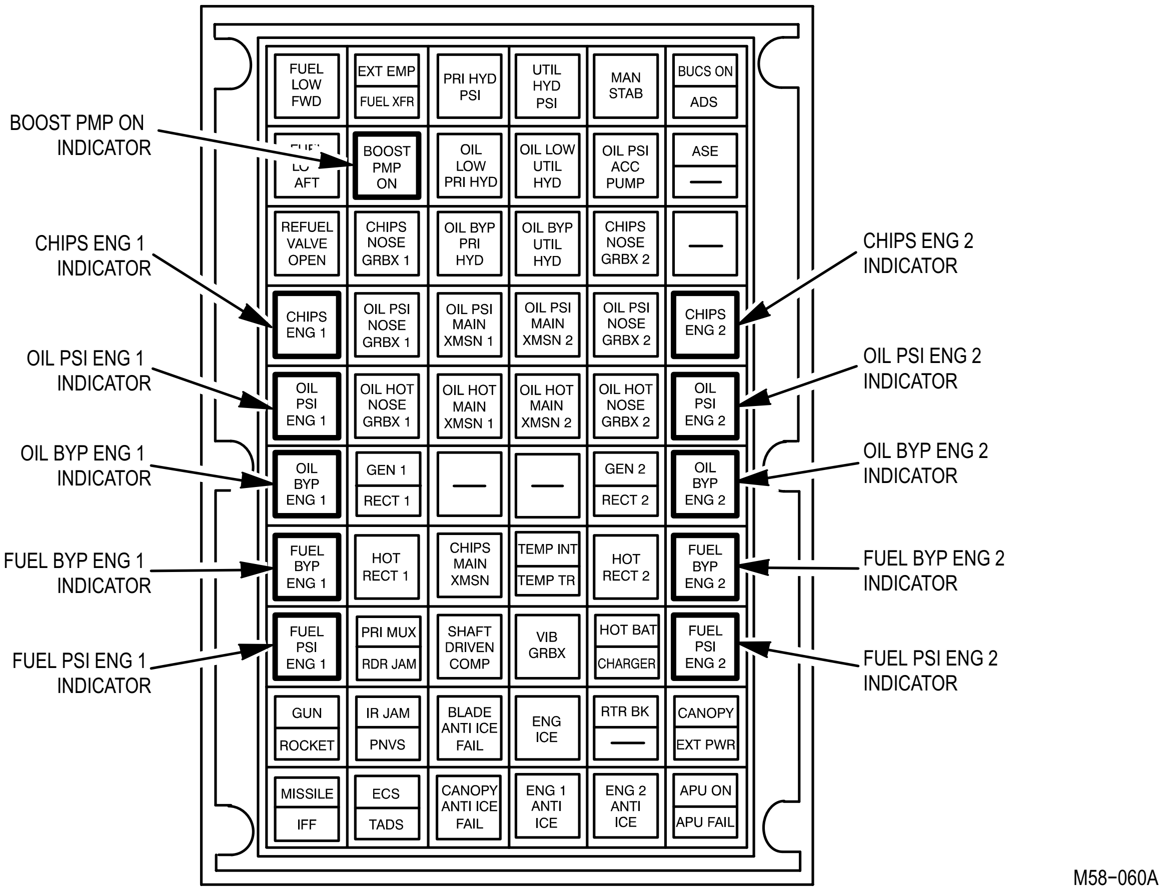


Figure 4–29. Pilot Caution/Warning Panel

Task	Result
f. Have assistant check for steady flow of fuel from engine 1 overboard fuel drain (fig. 4–30).	If fuel flow is not present, refer to TM 1-1520-238-T-7 to troubleshoot fuel crossfeed/boost system.
g. On pilot **FUEL** panel (fig. 4–28), set **CROSSFEED** switch to **NORM**, **BOOST** switch moves to **OFF** and set **ENG 1** switch to **OFF**. Check that the **BOOST PMP ON** indicator is not lighted.	If **BOOST** switch is not released to **OFF**, refer to TM 1-1520-238-T-7 to troubleshoot fuel crossfeed/boost system. If **BOOST PMP ON** indicator is lighted, refer to TM 1-1520-238-T-7 to troubleshoot fuel crossfeed/boost system.

4–12. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 1) (cont) 4–12

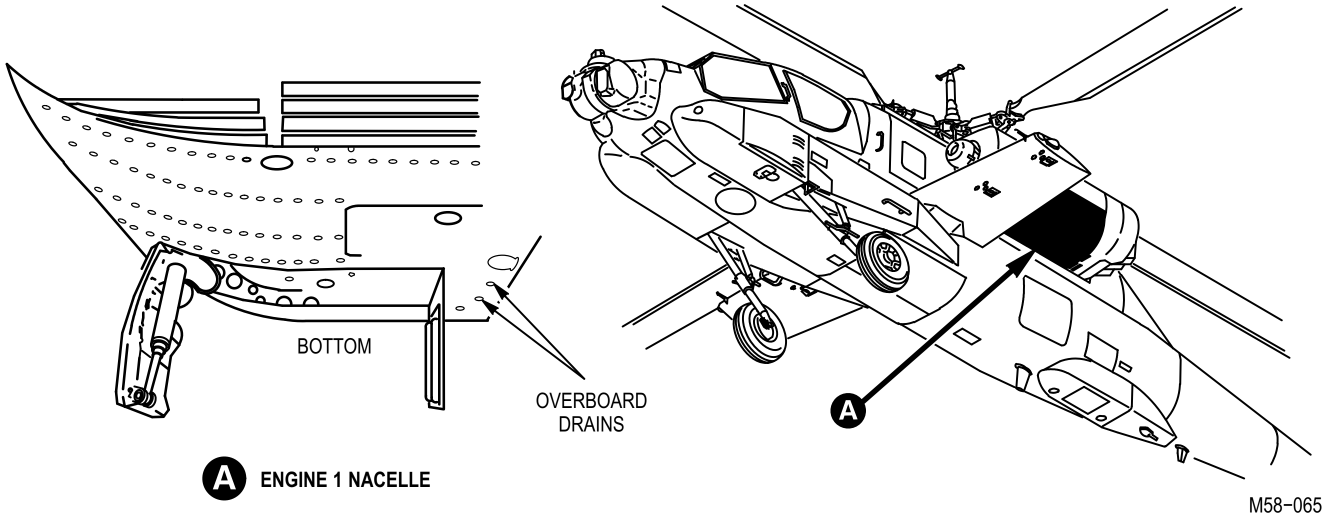


Figure 4–30. Engine 1 Overboard Fuel Drain Locations

Task	Result
h. On pilot master caution/warning panel (fig. 4–31), press and hold **MASTER CAUTION** indicator. Check that the following indicators are lighted but not flashing:	If indicators continue to flash after pressing pilot **MASTER CAUTION** indicator, refer to TM 1-1520-238-T-6 to troubleshoot pilot caution/warning system.
	If indicators are not lighted, replace lamp (TM 1-1520-238-23). If lamp still does not light, refer to TM 1-1520-238-T-6 to troubleshoot pilot caution/warning system.

Location	Indicator
Master caution/warning panel	**ENGINE 1 OUT**
Pilot caution/warning panel (fig. 4–29)	**OIL PSI ENG 1**
	FUEL PSI ENG 1

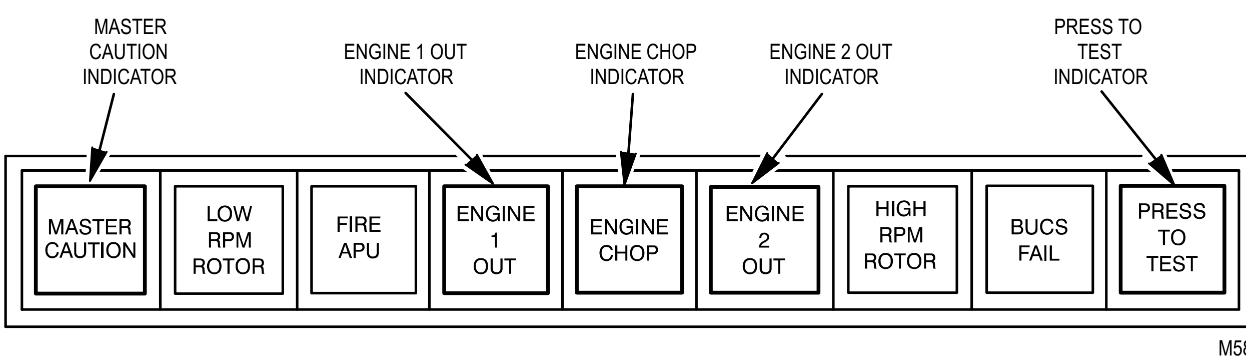


Figure 4–31. Master Caution/Warning Panel

4–12. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 1) (cont) 4–12

Task	Result
i. On CPG master caution/warning panel (fig. 4–31), press and hold **MASTER CAUTION** indicator. Check that the following indicators are lighted but not flashing:	If indicators continue to flash after depressing CPG **MASTER CAUTION** indicator, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system.
<u>Location</u> / <u>Indicator</u> Master caution/warning panel — **ENGINE 1 OUT** CPG caution/warning panel (fig. 4–32) — **ENG 1**	If indicators are not lighted, replace lamp (TM 1-1520-238-23). If lamp still does not light, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system.
j. On pilot master caution/warning panel (fig. 4–31), press and hold **PRESS TO TEST** indicator. Check that the following indicators are lighted:	If indicators are not lighted, replace lamp (TM 1-1520-238-23). If lamp still does not light, refer to TM 1-1520-238-T-6 to troubleshoot pilot caution/warning system.
<u>Location</u> / <u>Indicator</u> Master caution/warning panel — **ENGINE CHOP** Pilot caution/warning panel (fig. 4–29) — **CHIPS ENG 1**, **OIL BYP ENG 1**, **FUEL BYP ENG 1** Pilot **EMERG PWR CHK OVSP TEST** panel (fig. 4–33) — EMERG **PWR** Pilot dim/test panel (fig. 4–34) — **AUX PWR**	

4–12. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 1) (cont) 4–12

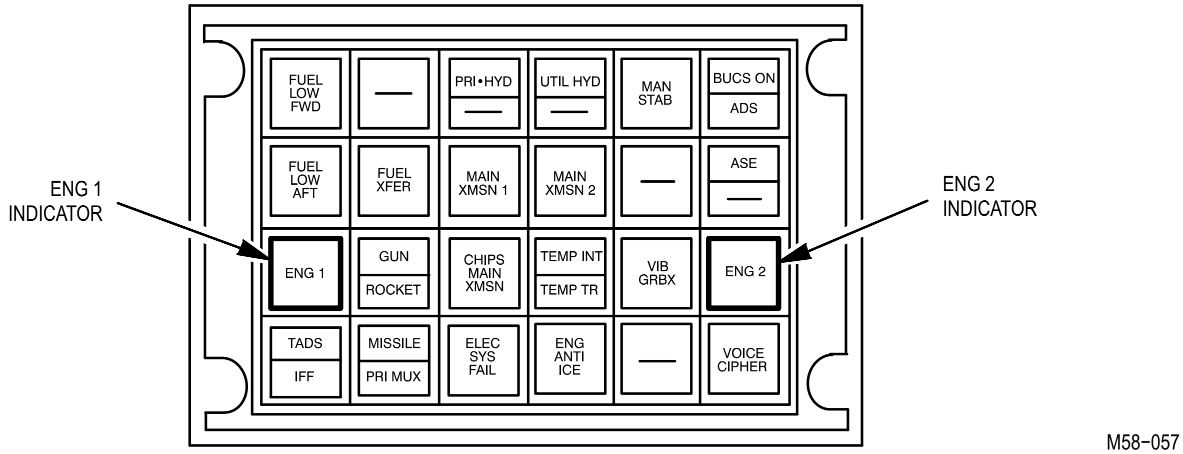


Figure 4–32. CPG Caution/Warning Panel

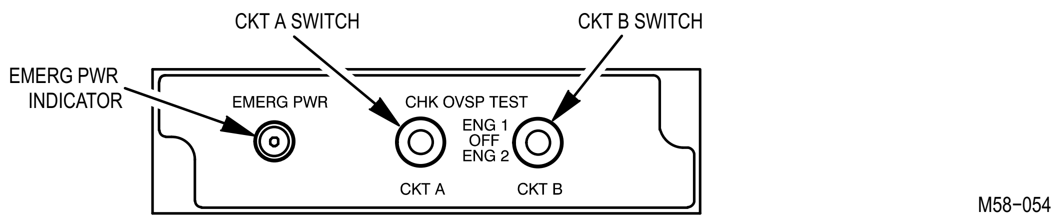


Figure 4–33. Pilot EMERG PWR CHK OVSP TEST Panel

Task	Result
k. On CPG master caution/warning panel (fig. 4–31), press and hold **PRESS TO TEST** indicator. Check that **ENGINE CHOP** indicator is lighted.	If **ENGINE CHOP** indicator is not lighted, replace lamp (TM 1-1520-238-23). If lamp still does not light, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system.
l. On pilot instrument panel (fig. 4–34) dim test panel, place **DGT OFF/NORM/TST** switch to **TST**. Check that **N**$_G$, **TGT**, **ENG–RTR, TORQUE** and **ENG OIL** indicators show full scale readings for 3 seconds. Check that digital displays show **888**.	If **N**$_G$, **TGT**, **ENG–RTR, TORQUE** and **ENG OIL** indicators do not go to full scale for 3 seconds or do not show **888**, refer to TM 1-1520-238-T-5 to troubleshoot engine instruments.
m. On CPG instrument panel (fig. 4–35) dim test panel, place **DGT OFF/NORM/TST** switch to **TST**. Check that **N**$_G$, **TGT**, **ENG–RTR, TORQUE** and **ENG OIL** indicators light and/or that **LEFT/FWD** and **RIGHT/AFT** digital displays show **888** on CPG selectable digital display (SDD) panel.	If **N**$_G$, **TGT**, **ENG–RTR, TORQUE** and **ENG OIL** indicators do not light or CPG SDD panel do not show **888**, refer to TM 1-1520-238-T-5 to troubleshoot engine instruments.

4–12. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 1) (cont) 4–12

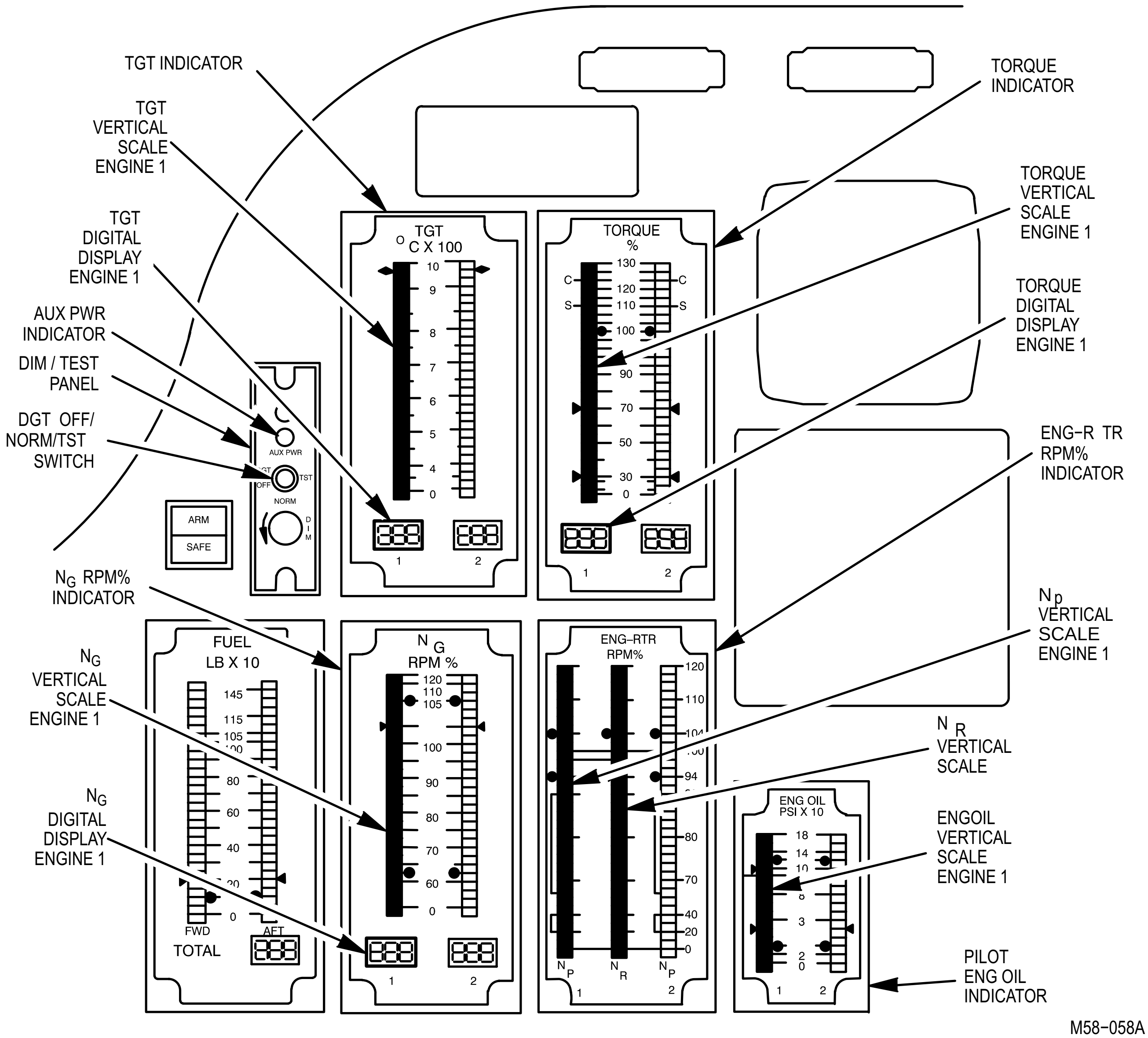


Figure 4–34. Pilot Instrument Panel (Left side)

Task	Result
n. Move engine **NO 1 PWR** lever on pilot power quadrant (fig. 4–26) to **OFF**. Place engine **NO 1** start switch to **IGN OVRD**. Check cockpit ECS outlets for loss of air flow and the $\mathbf{N_G}$ indicator (fig. 4–34) shows engine 1 accelerate to and remains between **23%** and **25%** $\mathbf{N_G}$. After 30 seconds place engine **NO 1** start switch to **OFF**.	If engine 1 does not accelerate to or remain between **23%** and **25%** $\mathbf{N_G}$, go to paragraph 4–19. If air flow from ECS outlets does not stop, go to paragraph 4–55.

4–12. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 1) (cont) 4–12

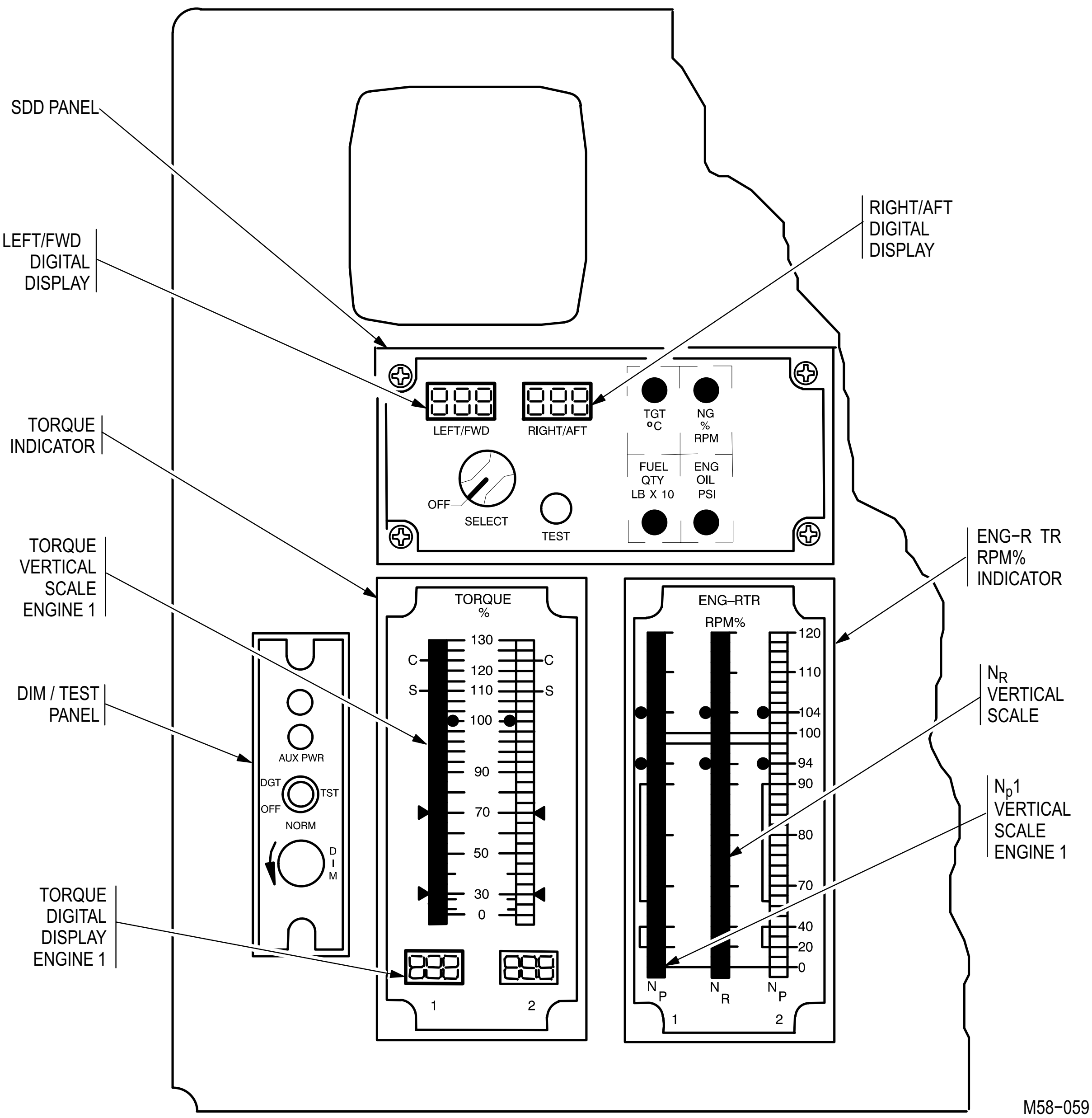


Figure 4–35. CPG Instrument Panel (Right Side)

NOTE

- **If step n. was successfully performed using external power – pressurized air, go to step o.**
- **If step n. was successfully performed using the on–board PAS, go to step r.**

4–12. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 1) (cont) 4–12

Task	Result
o. Start and operate APU (TM 1-1520-238-CL).	
p. Remove external power–pressurized air, only (TM 1-1520-238-23).	

CAUTION

If engine over temperature or hang start occurs or ENG 1 START indicator on pilot power quadrant (fig. 4–26) remains lighted above 52% N_G, shut down engine 1. If positive oil pressure does not occur within 30 seconds after N_G begins to increase, shut down engine 1. Failure to comply could result in damage to equipment.

Task	Result
q. Repeat step n.	If engine 1 does not accelerate to or remain between **23%** and **25% N_G**, refer to TM 1-1520-238-T-5 to troubleshoot PAS.
r. Start engine 1 (TM 1-1520-238-CL).	If engine 1 does not start, go to paragraph 4–49. If engine 1 starts then flames out, and fuel crossfeed/shutoff valve indicator is positioned at **NORMAL**, refer to TM 1-1520-238-T-7 to troubleshoot fuel crossfeed/boost system. If hang start occurs (**TGT** increases, but **N_G** does not reach idle speed), refer to TM 55-2840-248-23 to troubleshoot engine 1. If pilot **ENG OIL** indicator does not indicate positive oil pressure within 30 seconds of **N_G** increase, refer to TM 1-1520-238-T-5 to troubleshoot engine instruments. If **TGT** indicator exceeds **852**°C (1560°F) during start, refer to TM 55-2840-248-23 to troubleshoot engine. If CPG SDD panel, **N_G**, **TGT**, **ENG–RTR**, **TORQUE** or **ENG OIL** indicators do not indicate, refer to TM 1-1520-238-T-5 to troubleshoot engine instruments.
s. Check that **ENG START NO 1** indicator on pilot power quadrant (fig. 4–26), is not lighted when **N_G** is greater than **52%**.	If **ENG START NO 1** indicator does not light, go to paragraph 4–21. If **ENG START NO 1** indicator remains lighted above **52% N_G**, go to paragraph 4–22.
t. Check that **ENGINE 1 OUT** indicators on pilot and CPG master caution/warning panels are not lighted.	If **ENGINE 1 OUT** indicators are lighted, go to paragraph 4–23.

4–12. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 1) (cont) 4–12

Task	Result
u. Check that **ENG START** circuit breaker on pilot center circuit breaker panel (fig. 4–22) stays closed.	If engine start circuit breaker does not stay closed, go to paragraph 4–20.
v. On pilot power quadrant (fig. 4–26), move engine **NO 1 PWR** lever to **FLY**. On **EMERG CHK OVSP TEST** panel (fig. 4–33), set and hold **CKT A** switch to **ENG 1**. Check that engine **1** $\mathbf{N_G}$ remains stable and release **CKT A** switch.	If $\mathbf{N_G}$ does not remain stable with **CKT A** switch closed, go to paragraph 4–24.
w. Set and hold **CKT B** switch to **ENG 1**. Check that engine **1** $\mathbf{N_G}$ remains stable and **EMERG PWR** indicator is lighted. Release **CKT B** switch. Set and hold **CKT A** and **CKT B** switches to **ENG 1** and check for drop in engine 1 $\mathbf{N_G}$. Release switches.	If $\mathbf{N_G}$ does not remain stable with **CKT A** switch closed, go to paragraph 4–25. If **EMERG PWR** indicator is not lighted with **CKT B** switch closed, go to paragraph 4–53. If $\mathbf{N_G}$ does not decrease with **CKT A** and **CKT B** switches closed, go to paragraph 4–26. If engine 1 does not restart with **CKT A** and **CKT B** switches released, go to paragraph 4–59.
x. Check that the following indicators on pilot caution/warning panel (fig. 4–29) are not lighted:	
CHIPS ENG 1 indicator	If **CHIPS ENG 1** indicator is lighted, check for metal chips on chip detector (TM 1-1520-238-23). If chips are not present, go to paragraph 4–27.
OIL BYP ENG 1 indicator	If **OIL BYP ENG 1** indicator is lighted, check for clogged oil filter (TM 1-1520-238-23). If filter is not clogged, go to paragraph 4–28.
OIL PSI ENG 1 indicator	If **OIL PSI ENG 1** indicator is lighted, go to paragraph 4–51.
FUEL BYP ENG 1 indicator	If **FUEL BYP ENG 1** indicator is lighted, check for clogged fuel filter (TM 1-1520-238-23). If filter is not clogged, go to paragraph 4–29.
FUEL PSI ENG 1 indicator	If **FUEL PSI ENG 1** indicator is lighted, go to paragraph 4–30.
y. On CPG caution/warning panel (fig. 4–32), check that **ENG 1** indicator is not lighted.	If **ENG 1** indicator on CPG caution/warning panel is lighted, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system.

4–12. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 1) (cont) 4–12

Task	Result
z. On pilot power quadrant (fig. 4–26), move pilot engine **NO 1 PWR** lever to **LOCKOUT**, and at first indication of N_G, N_R or N_P increase immediately move engine **NO 1 PWR** lever back to a position midway between **FLY** and **IDLE**. Check that N_G, N_R, and N_P decrease and stabilize. Move engine **NO 1 PWR** lever to **IDLE**, then to **FLY**.	If N_G, N_R or N_P does not increase, refer to TM 55-2840-248-23 to troubleshoot engines. If N_P fluctuates refer to TM 1-1520-238-23 to adjust engine 1 turbine speed control unit.
aa. Repeat step z. above using CPG engine **NO 1 PWR** lever on CPG power quadrant (fig. 4–27).	If CPG **NO 1 PWR** lever cannot be advanced to **LOCKOUT**, go to paragraph 4–31.
ab. Push pilot collective stick (fig. 4–36) forward and turn **CHOP** collar clockwise until **ENGINE CHOP** indicator lights on pilot caution/warning panel (fig. 4–29). Release **CHOP** collar. Check that engine **1** N_G stabilizes at **IDLE**. Move engine **NO 1 PWR** lever to **IDLE**. Push forward and turn pilot **CHOP** collar counter–clockwise until **ENGINE CHOP** indicator goes out. Release **CHOP** collar. Check that N_G, **TGT**, and N_P are stabilized. Move engine **NO 1 PWR** lever to **FLY**.	If pilot **ENGINE CHOP** indicator does not light, go to paragraph 4–32. If engine N_G does not decrease to and stabilize at idle, go to paragraph 4–33. If **NO 1 PWR** lever is advanced to **FLY** and engine 1 does not accelerate, go to paragraph 4–33. If pilot **ENGINE CHOP** indicator does not go out, refer to TM 1-1520-238-T-6 and troubleshoot pilot caution/warning system.
ac. Repeat step ab. using CPG collective stick **CHOP** collar and engine **NO 1 PWR** lever.	If CPG **ENGINE CHOP** indicator does not light, go to paragraph 4–34. If engine N_G does not decrease to and stabilizes at idle, replace engine 1 chop relay (TM 1-1520-238-23). If CPG **ENGINE CHOP** indicator does not go out, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system. If N_P decreases and stabilizes between 100% N_P and idle N_P refer to TM 55-2840-248-23 to troubleshoot engines. If **NO 1 PWR** lever is advance to **FLY** and engine 1 does not accelerate, go to paragraph 4–35.

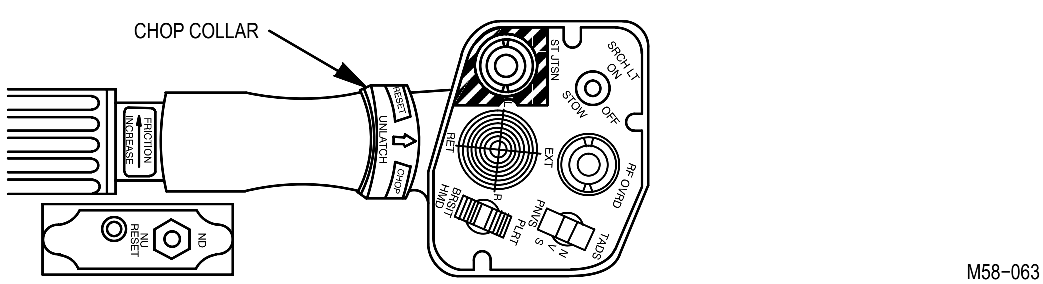


Figure 4–36. Collective Stick

4–12. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 1) (cont) 4–12

2. Perform POWER PLANTS – POWER DOWN (para 4–11).
3. Disconnect maintenance headset (para 1–17).

END OF TASK

4–13. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 2) 4–13

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01

Personnel Required:

67R Attack Helicopter Repairer
One person to assist
152FG Pilot

References:

TM 1-1520-238-T-5
TM 1-1520-238-T-6
TM 1-1520-238-T-7
TM 1-1520-238-T-8
TM 1-1520-238-23
TM 1-1520-238-CL
TM 55-2840-248-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Power plants inspection performed
TM 1-1520-238-23	Engine 2 power available spindle rigging procedure completed
	No. 1 and No. 2 Engine load demand spindle (LDS) rigging check completed
TM 1-1520-238-T-7	FUEL SYSTEM VISUAL CHECK completed
TM 1-1520-238-T-8	ENVIRONMENTAL CONTROL SYSTEM – POWER UP completed
Paragraph 1–17	Maintenance headset connected
Paragraph 4–10	POWER PLANTS – POWER UP completed

NOTE

- **Refer to pilot station (fig. 4–19) and CPG station (fig. 4–20) for cockpit configuration and equipment.**
- **If referenced out of one paragraph or volume and into another for additional troubleshooting, upon completion of the task, return to the maintenance operational check for the original paragraph or volume.**
- **If problem involves excessive torsional vibration and N_R droop during flight maneuvers (engine 1 Np lags engine 2 Np during recovery maneuvers), go to paragraph 4–58.**
- **The vapor vent procedure is to be performed anytime a connection is broken on any of the fuel delivery components, to insure purging of air in lines. If vapor procedure is not required, go to step h.**

4–13. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 2) (cont) 4–13

WARNING

- **Make sure helicopter safed procedures are accomplished. Observe all safety precautions during troubleshooting or maintenance tasks. Failure to comply could result in death or serious injury.**
- **Jet engine fuel is explosive, flammable, and toxic to skin, eyes, and respiratory track. Work in well ventilated area away from open flames. Wear protective clothing. If fuel comes in contact with the eyes or skin, flush with water and seek medical aid immediately.**
- **Do not allow spark or flame near helicopter when servicing or performing maintenance on fuel system.**
- **Make certain helicopter is grounded.**

CAUTION

Ensure proper container is placed under engine 2 overboard fuel drain to prevent fuel spillage. Failure to comply could result in hazardous material spill.

1. Complete the maintenance operational check as follows:

Task	Result
a. On pilot power quadrant (fig. 4–26), check that edge–light panel is lighted.	If pilot power quadrant edge–light panel does not light, refer to paragraph 4–61.
b. On CPG power quadrant (fig. 4–27), check that edge–light panel is lighted.	If CPG power quadrant edge–light panel does not light, refer to paragraph 4–62.
c. On pilot power quadrant, set **PWR NO 2** lever to **LOCKOUT**.	

NOTE

Fuel boost pump does not operate through pilot FUEL panel BOOST switch unless CROSSFEED switch is set to AFT TK.

Task	Result
d. On pilot **FUEL** panel (fig. 4–28), set **CROSSFEED** switch to **AFT TK, ENG 2 FUEL** switch to **ON**, and **BOOST** switch to **ON**.	
e. On pilot caution/warning panel (fig. 4–29), check that **BOOST PMP ON** indicator is lighted.	If **BOOST PMP ON** indicator is not lighted, refer to TM 1-1520-238-T-7 to troubleshoot fuel crossfeed/boost system.

4–13. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 2) (cont) 4–13

Task	Result
f. Have assistant check for steady flow of fuel from engine 2 overboard fuel drain (fig. 4–37).	If fuel flow is not present, refer to TM 1-1520-238-T-7 to troubleshoot fuel crossfeed/boost system.

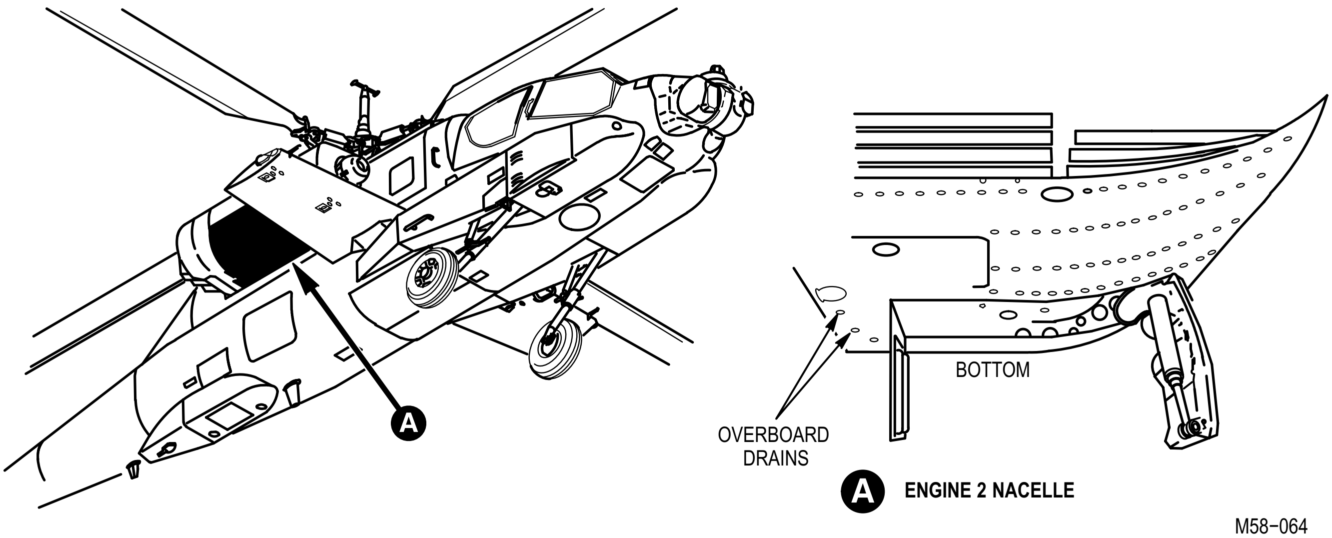


Figure 4–37. Overboard Fuel Drain Locations

Task	Result
g. On pilot **FUEL** panel (fig. 4–28), set **CROSSFEED** switch to **NORM**, **BOOST** switch will move to **OFF** and set **ENG 2** switch to **OFF**. Check that the **BOOST PMP ON** indicator is not lighted.	If **BOOST PMP ON** indicator is lighted, refer to TM 1-1520-238-T-7 to troubleshoot fuel crossfeed/boost system. If **BOOST** switch is not released to **OFF**, refer to TM 1-1520-238-T-7 to troubleshoot fuel crossfeed/boost system.
h. On pilot master caution/warning panel (fig. 4–31), press and hold **MASTER CAUTION** indicator. Check that the following indicators are lighted but not flashing:	If indicator continue to flash after pressing pilot **MASTER CAUTION** indicator, refer to TM 1-1520-238-T-6 to troubleshoot pilot caution/warning system. If indicators are not lighted, replace lamps (TM 1-1520-238-23). If lamp still does not light, refer to TM 1-1520-238-T-6 to troubleshoot pilot caution/warning system.

Location	Indicator
Master caution/warning panel	**ENGINE 2 OUT**
Pilot caution/warning panel (fig. 4–29)	**OIL PSI ENG 2**
	FUEL PSI ENG 2

4–13. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 2) (cont) 4–13

Task	Result
i. On CPG master caution/warning panel (fig. 4–32), press and hold **MASTER CAUTION** indicator. Check that the following indicators are lighted but not flashing:	If indicators continue to flash after pressing CPG **MASTER CAUTION** indicator, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system.
Location / Indicator Master caution/warning panel — **ENGINE 2 OUT** CPG caution/warning panel (fig. 4–32) — **ENG 2**	If indicators are not lighted, replace lamps (TM 1-1520-238-23). If lamps still do not light, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system.
j. On pilot master caution/warning panel (fig. 4–31), press and hold **PRESS TO TEST** indicator. Check that the following indicators are lighted:	If indicators are not lighted, replace lamps (TM 1-1520-238-23). If lamps still do not light, refer to TM 1-1520-238-T-6 to troubleshoot pilot caution/warning system.
Location / Indicator Master caution/warning panel — **ENGINE CHOP** Pilot caution/warning panel (fig. 4–29) — **CHIPS ENG 2**; **OIL BYP ENG 2**; **FUEL BYP ENG 2** **EMERG PWR CHK OVSP TEST** panel (fig. 4–33) — **EMERG PWR** Pilot dim/test panel (fig. 4–34) — **AUX PWR**	
j1. On pilot dim/test panel (fig 4–34), place **DGT OFF/NORM/TEST** switch to **TEST**. Check that **AUX PWR** indicator lights.	If indicator is not lighted, replace lamp (TM 1-1520-238-23). If lamp still does not light, refer to TM 1-1520-238-T-6 to troubleshoot pilot caution/warning system.

4–13. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 2) (cont) 4–13

Task	Result
k. On CPG master caution/warning panel, press and hold **PRESS TO TEST** indicator. Check that **ENGINE CHOP** indicator is lighted.	If **ENGINE CHOP** indicator is not lighted, replace lamp ((TM 1-1520-238-23). If lamp still does not light, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system.
l. On pilot instrument panel (fig. 4–34) dim test panel, place **DGT OFF/NORM/TST** switch to **TST**. Check that $\mathbf{N_G}$, **TGT**, **ENG–RTR, TORQUE** and **ENG OIL** indicators show full scale readings for 3 seconds. Check that digital displays show **888**.	If $\mathbf{N_G}$, **TGT**, **ENG–RTR, TORQUE** and **ENG OIL** indicators do not go to full scale for 3 seconds or do not show **888**, refer to TM 1-1520-238-T-5 to troubleshoot engine instruments.
m. On CPG instrument panel (fig. 4–35) dim test panel, place **DGT OFF/NORM/TST** switch to **TST**. Check that $\mathbf{N_G}$, **TGT**, **ENG–RTR, TORQUE** and **ENG OIL** indicators light and/or that **LEFT/FWD** and **RIGHT/AFT** digital displays show **888** on CPG SDD panel.	If $\mathbf{N_G}$, **TGT**, **ENG–RTR, TORQUE** and **ENG OIL** indicators do not light or CPG SDD panel does not show all **888**, refer to TM 1-1520-238-T-5 to troubleshoot engine instruments.
n. On pilot power quadrant (fig. 4–26), move engine **NO 2 PWR** lever to **OFF**. Place engine **NO 2** start switch to **IGN OVRD**. Check cockpit ECS outlets for loss of air flow and the engine 2 accelerates to and remains between **23%** and **25%** $\mathbf{N_G}$ on the pilot instrument panel. After 30 seconds place engine **NO 2** start switch to **OFF**.	If engine 2 does not accelerate to or remain between **23%** and **25%** $\mathbf{N_G}$, go to paragraph 4–36. If air flow from ECS does not stop, go to paragraph 4–56.

NOTE

- **If step n. was successfully performed using external power – pressurized air, go to step o.**
- **If step n. was successfully performed using the on–board PAS, go to step r.**

o. Start and operate APU (TM 1-1520-238-CL).

p. Remove external power – pressurized air, only (TM 1-1520-238-23).

4–13. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 2) (cont) 4–13

Task	Result

CAUTION

If engine over temperature or hang start occurs or ENG 2 START indicator on pilot power quadrant (fig. 4–26) remains lighted above 52% N_G, shut down engine 2. If positive oil pressure does not occur within 30 seconds after N_G begins to increase, shut down engine 2. Failure to comply could result in damage to equipment.

Task	Result
q. Repeat step n.	If engine 2 does not accelerate to or remain between **23%** and **25%** N_G, go to paragraph 4–36.
r. Start engine 2 (TM 1-1520-238-CL).	If engine 2 does not start, go to paragraph 4–50. If engine 2 starts then flames out and fuel crossfeed/shutoff valve indicator is positioned at **NORMAL**, refer to TM 1-1520-238-T-7 to troubleshoot fuel crossfeed/boost system. If hang start occurs (**TGT** increases, but N_G does not reach idle speed), refer to TM 55-2840-248-23 to troubleshoot engine. If pilot **ENG OIL** indicator does not indicate positive oil pressure within 30 seconds of N_G increase, refer to TM 1-1520-238-T-5 to troubleshoot engine instruments. If **TGT** indicator exceeds **852**°C (1560°F) during start, refer to TM 55-2840-248-23 to troubleshoot engine. If CPG SDD panel, N_G, **TGT**. **ENG–RTR**, **TORQUE** or **ENG OIL** indicators do not indicate, refer to TM 1-1520-238-T-5 to troubleshoot engine instruments.
s. Check that **ENG START NO 2** indicator on pilot power quadrant (fig. 4–26) is not lighted when N_G is greater than **52%**.	If **ENG START NO 2** indicator does not light, go to paragraph 4–38. If **ENG START NO 2** indicator remains lighted above **52%** N_G, go to paragraph 4–39.
t. Check that **ENGINE 2 OUT** indicators on the master caution/warning panels (fig. 4–31) are not lighted.	If **ENGINE 2 OUT** indicators are lighted, go to paragraph 4–40.

4–13. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 2) (cont) 4–13

Task	Result
u. On pilot center circuit breaker panel (fig 4–22), check that **ENG START** circuit breaker stays closed.	If **ENG START** circuit breaker does not stay closed, go to paragraph 4–37.
v. On pilot power quadrant (fig. 4–26), move engine **NO 2 PWR** lever to **FLY**. On **EMERG CHK OVSP TEST** panel (fig. 4–33), set and hold **CKT A** switch to **ENG 2**. Check that engine **2** $\mathbf{N_G}$ remains stable and release **CKT A** switch.	If $\mathbf{N_G}$ does not remain stable with **CKT A** switch closed, go to paragraph 4–41.
w. Set and hold **CKT B** switch to **ENG 2**. Check that engine **2** $\mathbf{N_G}$ remains stable and **EMERG PWR** indicator is lighted. Release **CKT B** switch. Set and hold **CKT A** and **CKT B** switches to **ENG 2** and check for drop in engine 2 $\mathbf{N_G}$. Release switches.	If $\mathbf{N_G}$ does not remain stable with **CKT B** switch closed, go to paragraph 4–42. If **EMERG PWR** indicator is not lighted with **CKT B** switch closed, go to paragraph 4–54. If $\mathbf{N_G}$ does not decrease with **CKT A** and **CKT B** switches closed, go to paragraph 4–43. If engine 2 does not restart with **CKT A** and **CKT B** switches released, go to paragraph 4–60.
x. Check that the following indicators on pilot caution/warning panel (fig. 4–29) are not lighted:	
CHIPS ENG 2 indicator	If **CHIPS ENG 2** indicator is lighted, check for metal chips on chip detector (TM 1-1520-238-23). If chips are not present, go to paragraph 4–44.
OIL BYP ENG 2 indicator	If **OIL BYP ENG 2** indicator is lighted, check for clogged oil filter (TM 1-1520-238-23). If filter is not clogged, go to paragraph 4–45.
OIL PSI ENG 2 indicator	If **OIL PSI ENG 2** indicator is lighted, go to paragraph 4–51.
FUEL BYP ENG 2 indicator	If **FUEL BYP ENG 2** indicator is lighted, check for clogged fuel filter (TM 1-1520-238-23). If filter is not clogged, go to paragraph 4–46.
FUEL PSI ENG 2 indicator	If **FUEL PSI ENG 2** indicator is lighted, go to paragraph 4–47.

4–13. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 2) (cont) 4–13

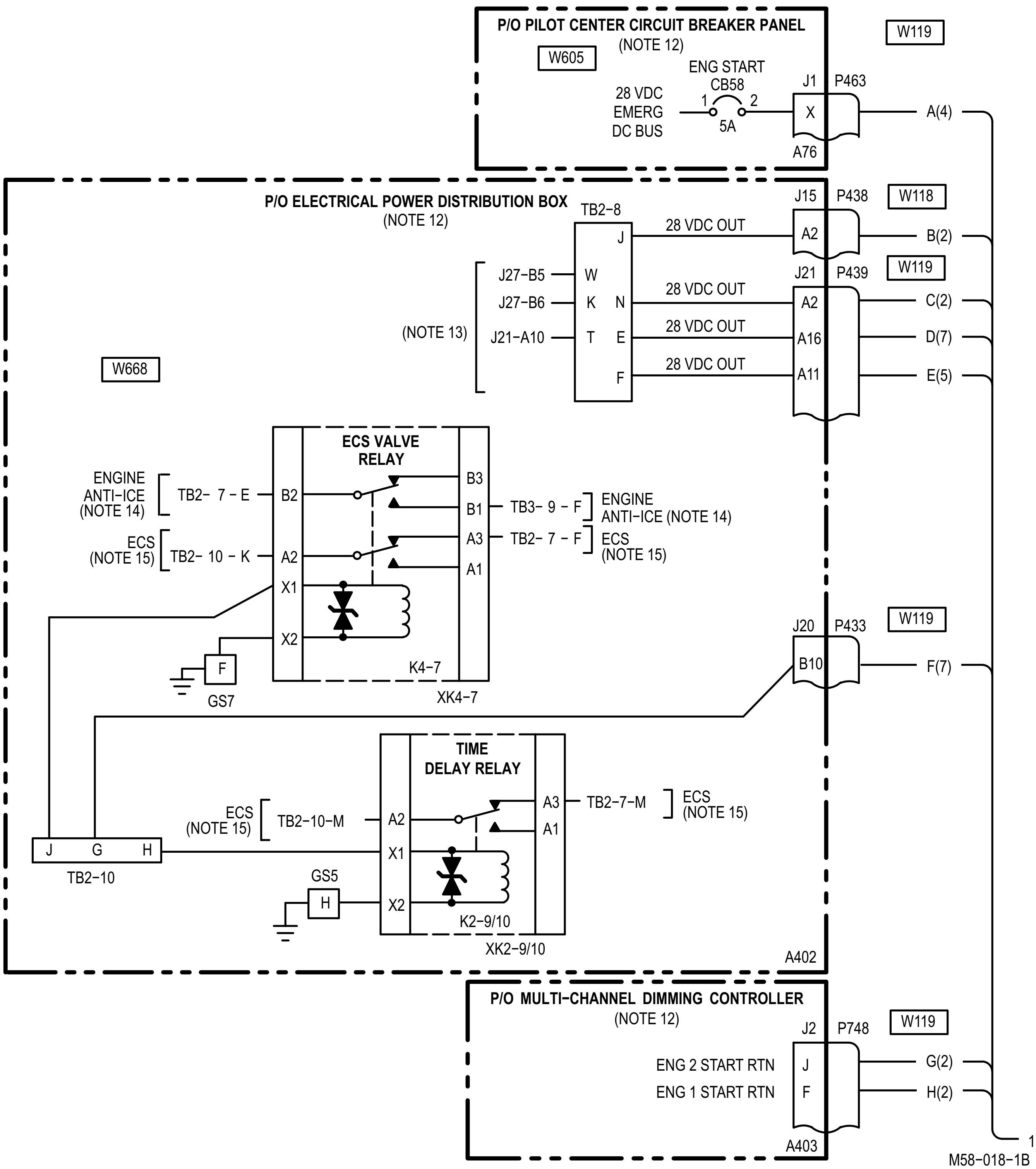
Task	Result
y. On CPG caution/warning panel (fig. 4–32), check that **ENG 2** indicator is not lighted.	If **ENG 2** indicator on CPG caution/warning panel is lighted, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system.
z. On pilot power quadrant (fig. 4–26), move pilot engine **NO 2 PWR** lever to **LOCKOUT**, and at first indication of N_G, N_R or N_P increase immediately move engine **NO 2 PWR** lever back to a position midway between **FLY** and **IDLE**. Check that N_G, N_R, and N_P decrease and stabilize. Move engine **NO 1 PWR** lever to **IDLE**, then to **FLY**.	If N_G, N_R or N_P does not increase, refer to TM 55-2840-248-23 to troubleshoot engines. If N_P fluctuates refer to TM 55-2840-248-23 to adjust engine 2 turbine speed control unit.
aa. Repeat step z. above using CPG engine **NO 2 PWR** lever on CPG power quadrant (fig. 4–27).	If CPG **NO 2 PWR** lever cannot be advanced to **LOCKOUT**, go to paragraph 4–48.
ab. On pilot collective stick (fig. 4–36), push forward and turn **CHOP** collar clockwise until **ENGINE CHOP** indicator lights on pilot caution/warning panel (fig. 4–29). Release **CHOP** collar. Check that engine **2** N_G stabilizes at **IDLE**. Move engine **NO 2 PWR** lever to **IDLE**. Push forward and turn pilot **CHOP** collar counter–clockwise until **ENGINE CHOP** indicator goes out. Release **CHOP** collar. Check that N_G, **TGT**, and N_P are stabilized. Move engine **NO 2 PWR** lever to **FLY**.	If pilot **ENGINE CHOP** indicator does not light, go to paragraph 4–33. If engine N_G does not decrease to and stabilize at **IDLE**, replace engine 2 chop relay (TM 1-1520-238-23). If **NO 2 PWR** lever is advanced to **FLY** and engine 2 does not accelerate, go to paragraph 4–33. If pilot **ENGINE CHOP** indicator does not go out, refer to TM 1-1520-238-T-6 and troubleshoot pilot caution/warning system.
ac. Repeat step ab. using CPG collective stick **CHOP** collar and engine **NO 2 PWR** lever.	If CPG **ENGINE CHOP** indicator does not light, go to paragraph 4–34. If engine N_G does not decrease to and stabilizes at idle, replace engine 2 chop relay (TM 1-1520-238-23). If CPG **ENGINE CHOP** indicator does not go out, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system. If N_P decreases and stabilizes between 100% N_P and idle N_P refer to TM 55-2840-248-23 to troubleshoot engines. If **NO 2 PWR** lever is advance to **FLY** and engine 2 does not accelerate, refer to paragraph 4–35.

4–13. POWER PLANTS – MAINTENANCE OPERATIONAL CHECK (ENGINE 2) (cont) 4–13

2. Perform POWER PLANTS – POWER DOWN (para 4–11).
3. Disconnect maintenances headset (para 1–17).

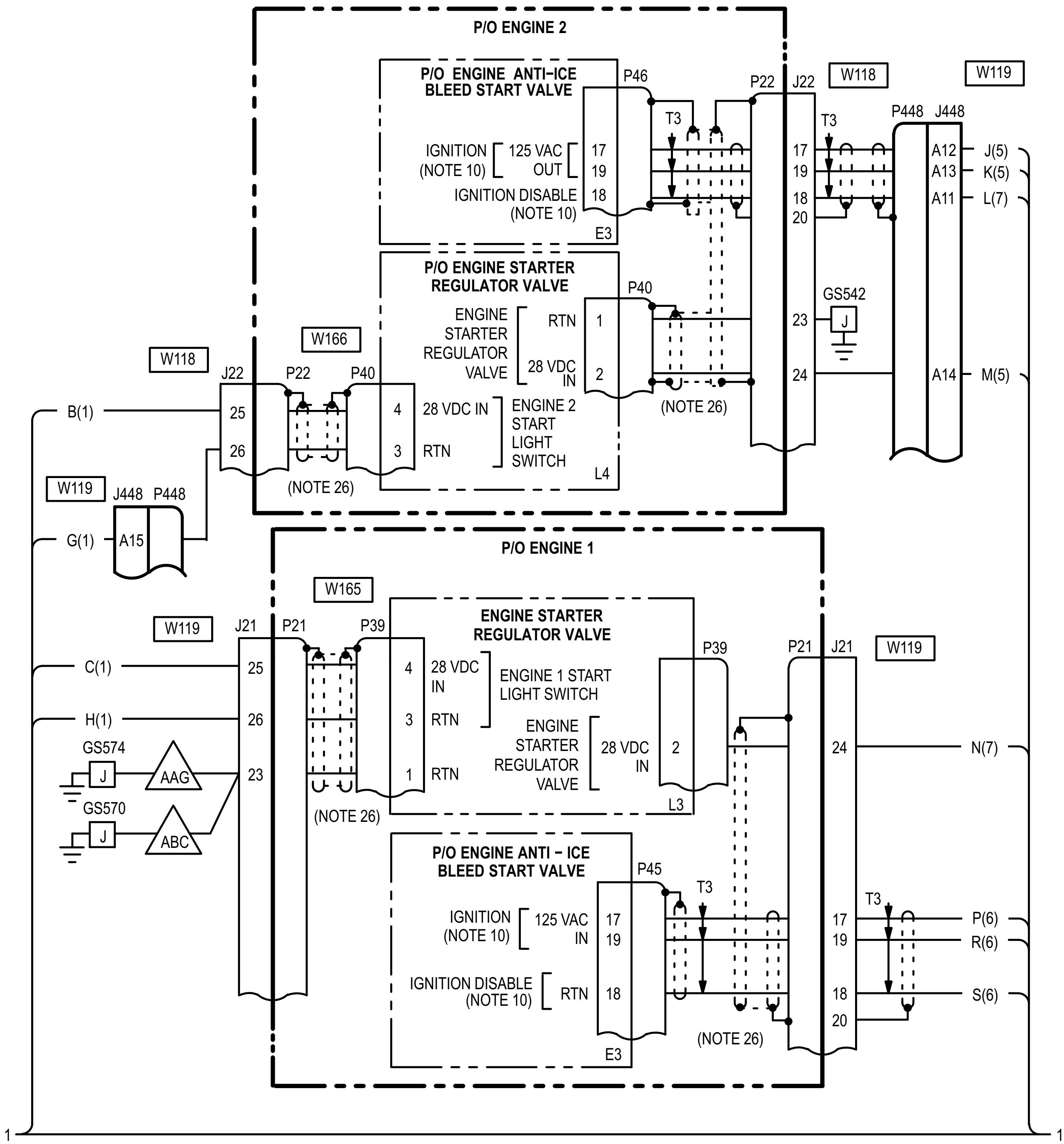
END OF TASK

4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM 4–14



M58−018−1B
SHEET 1 OF 21

4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



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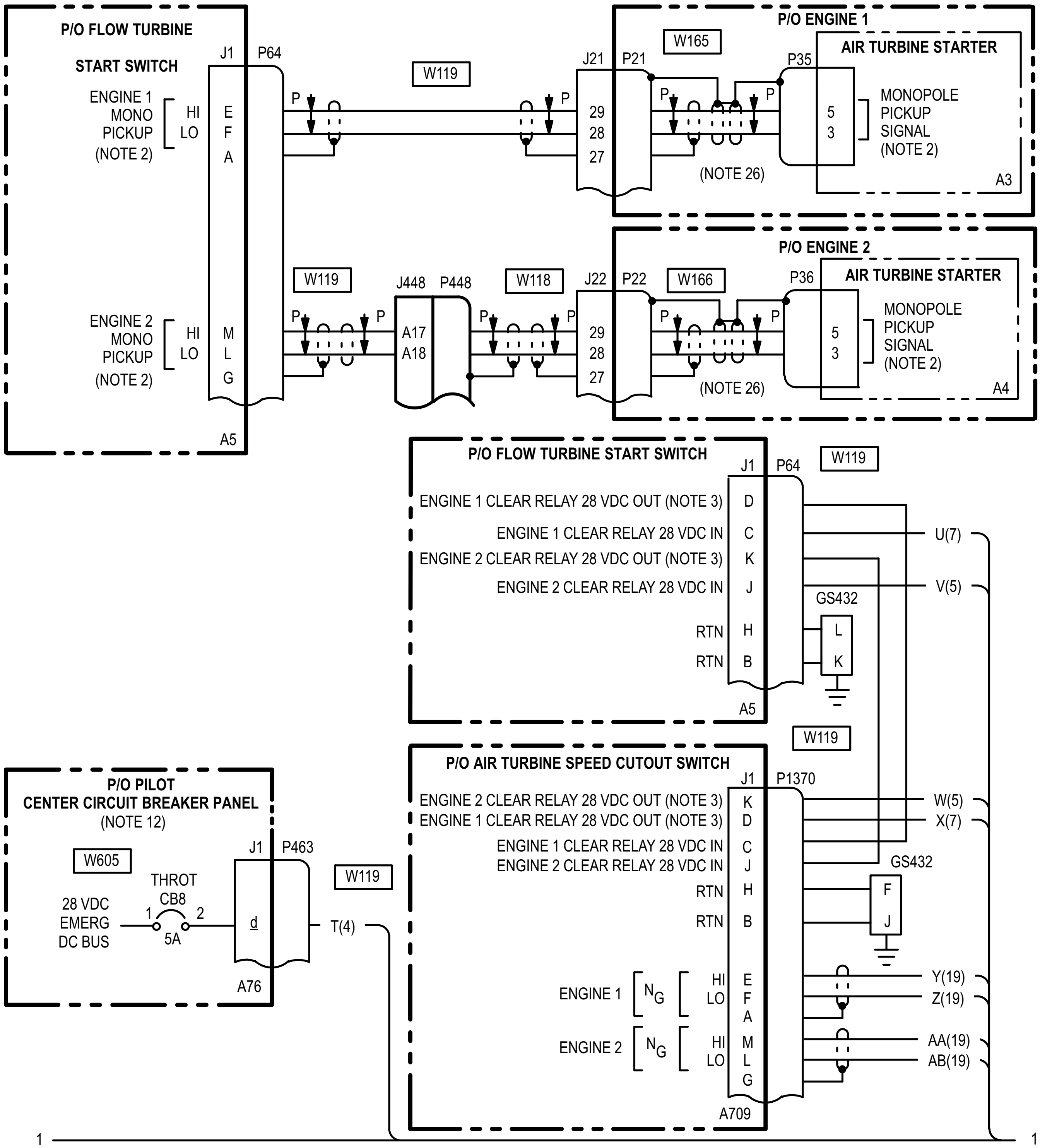
SHEET 2 OF 21

4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



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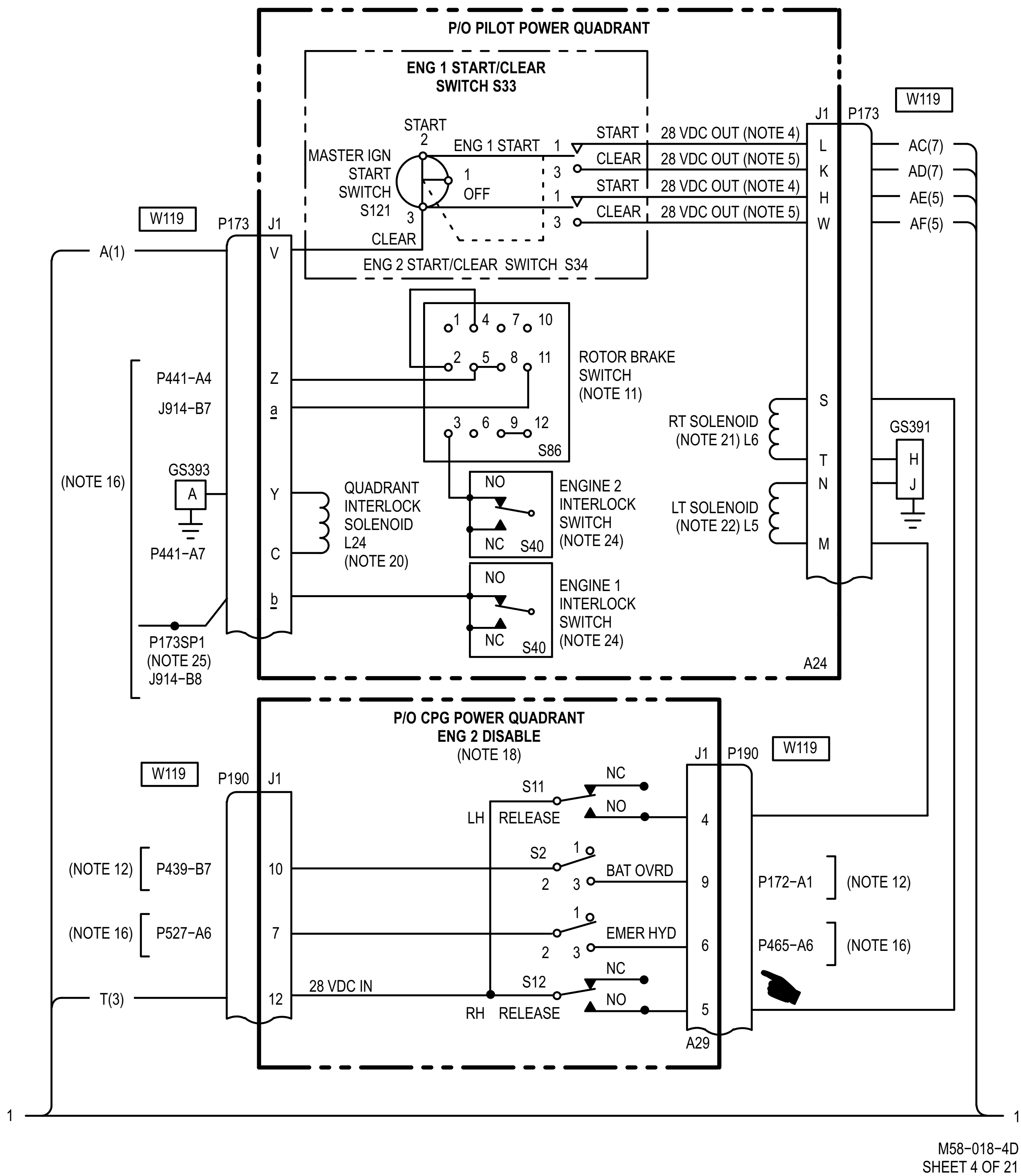
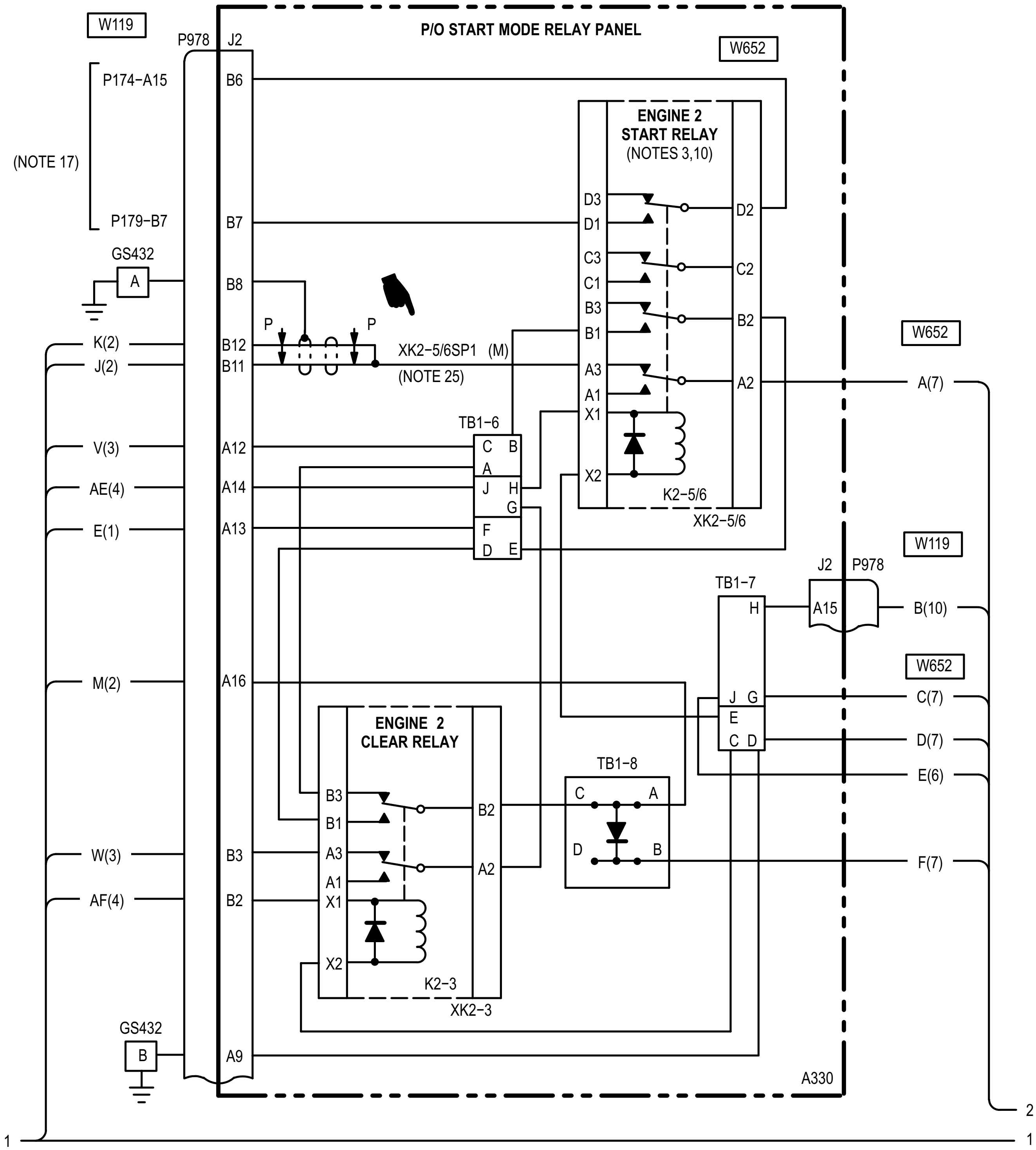
4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



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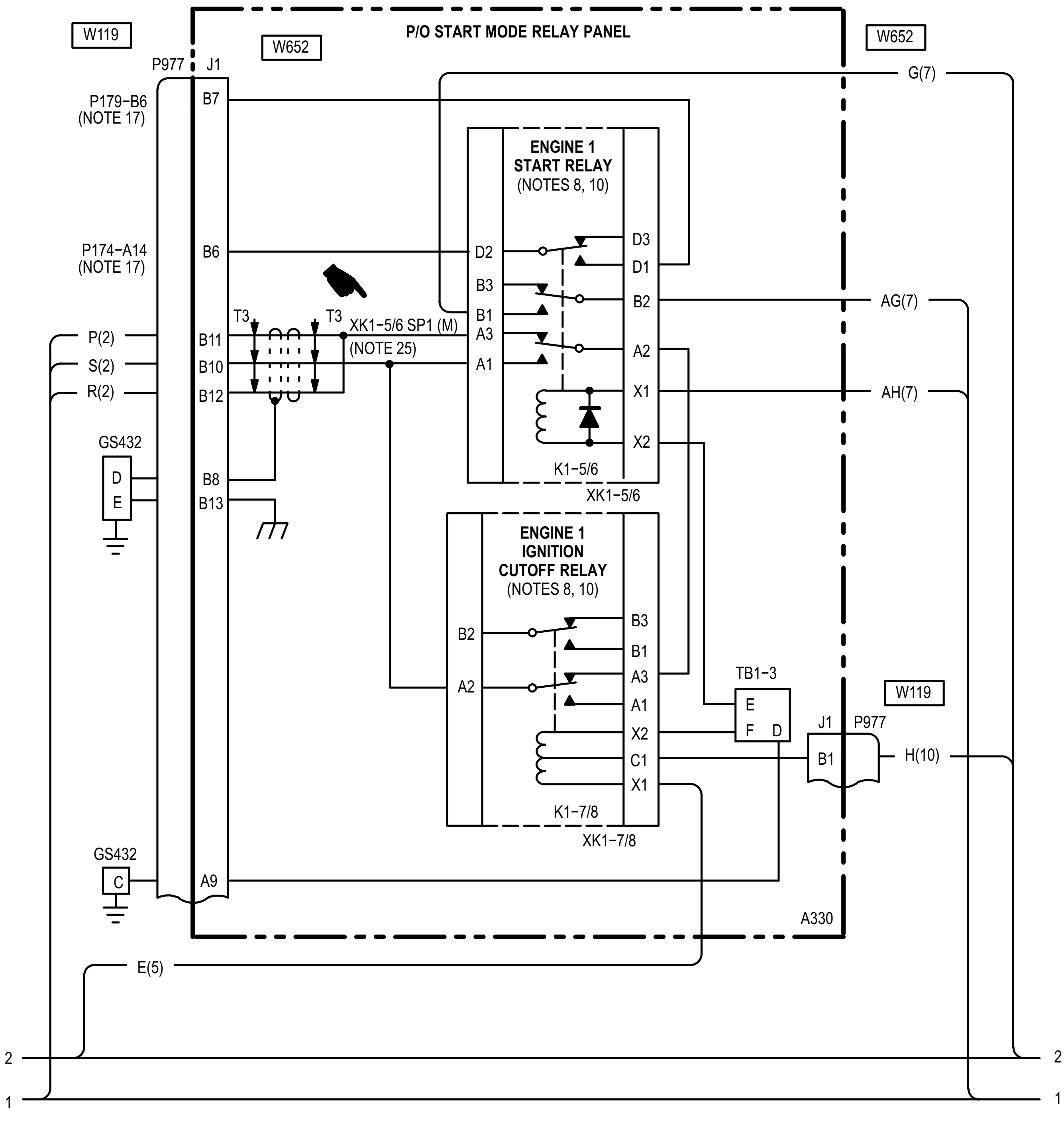
4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



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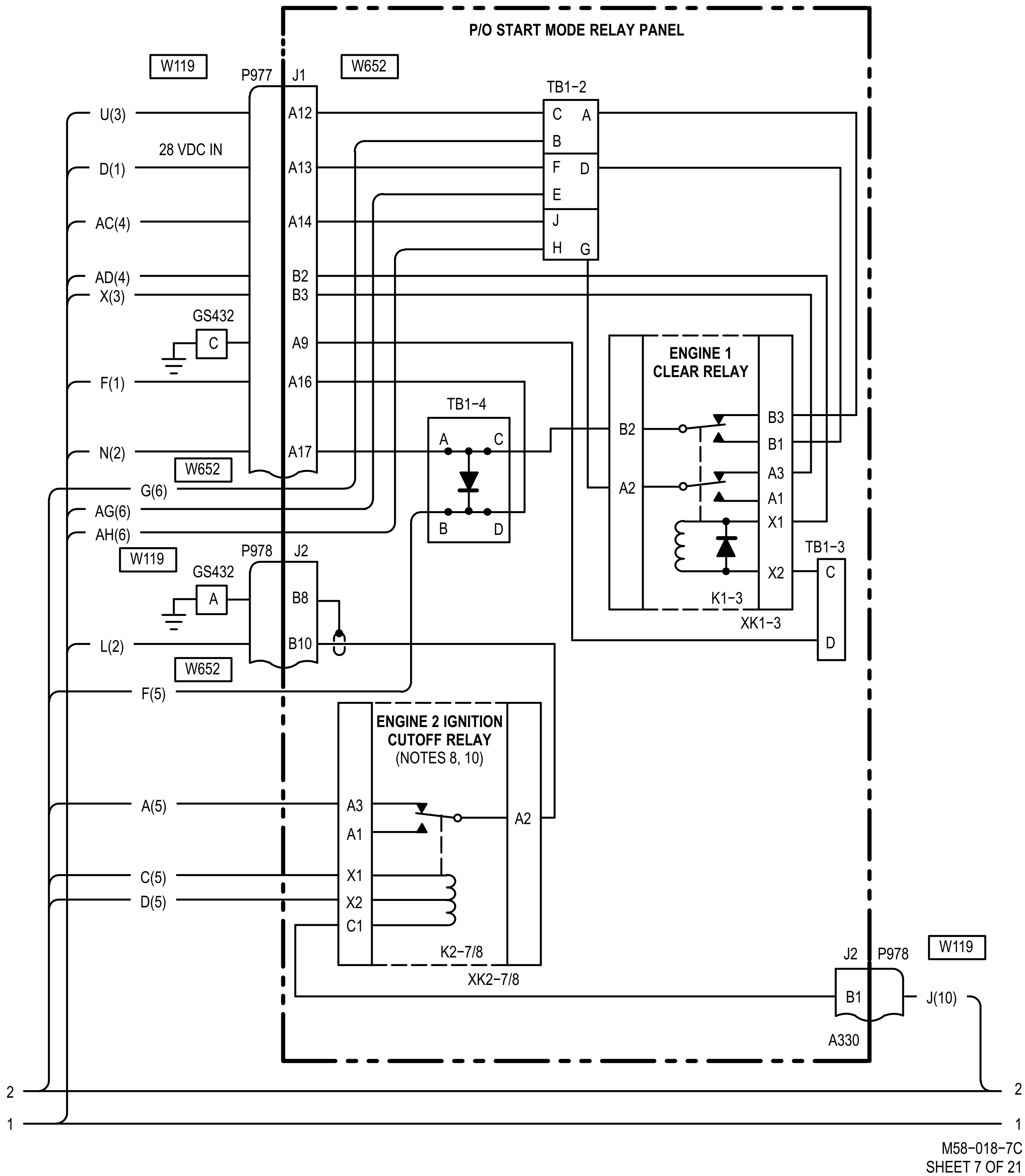
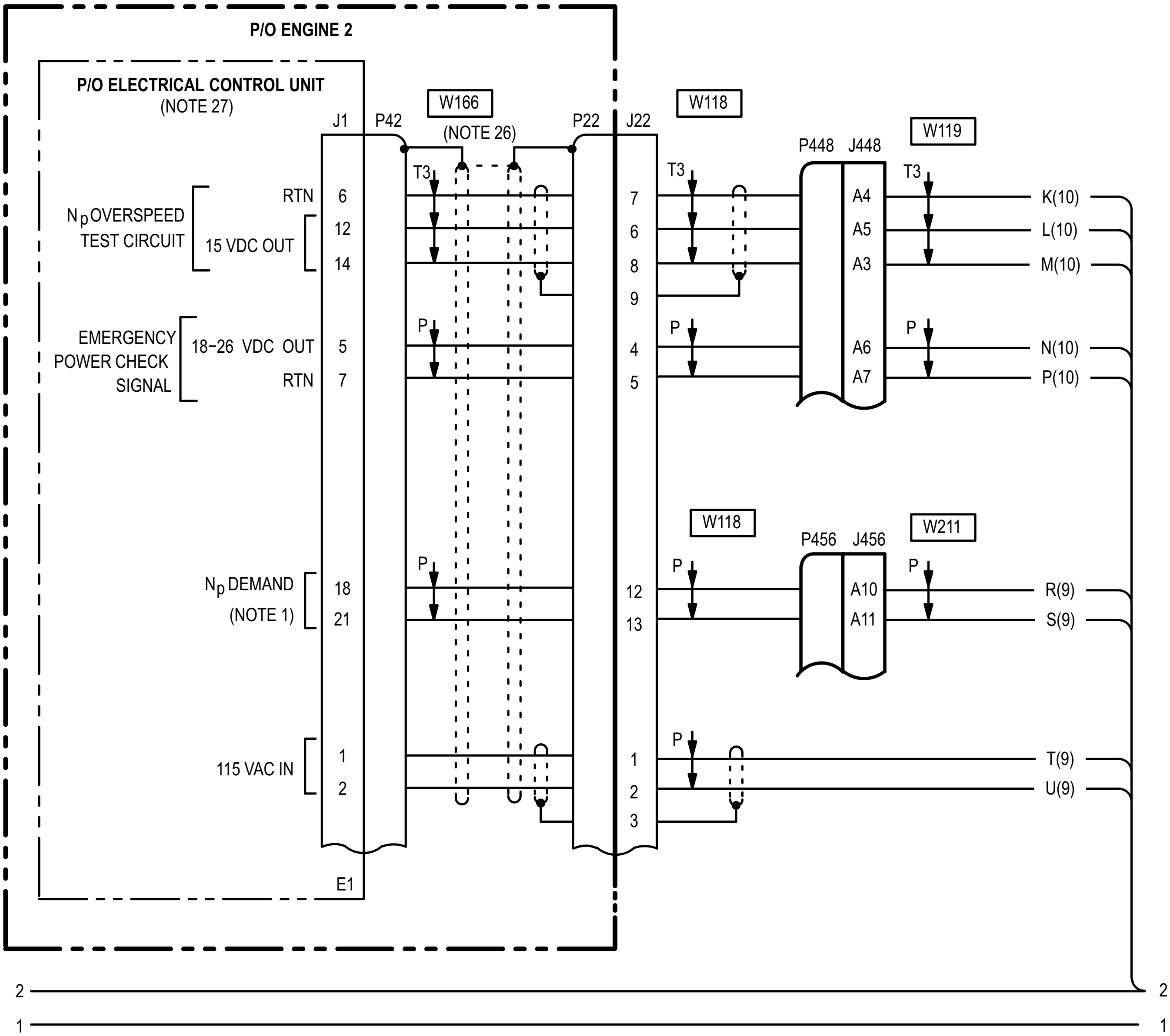
4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



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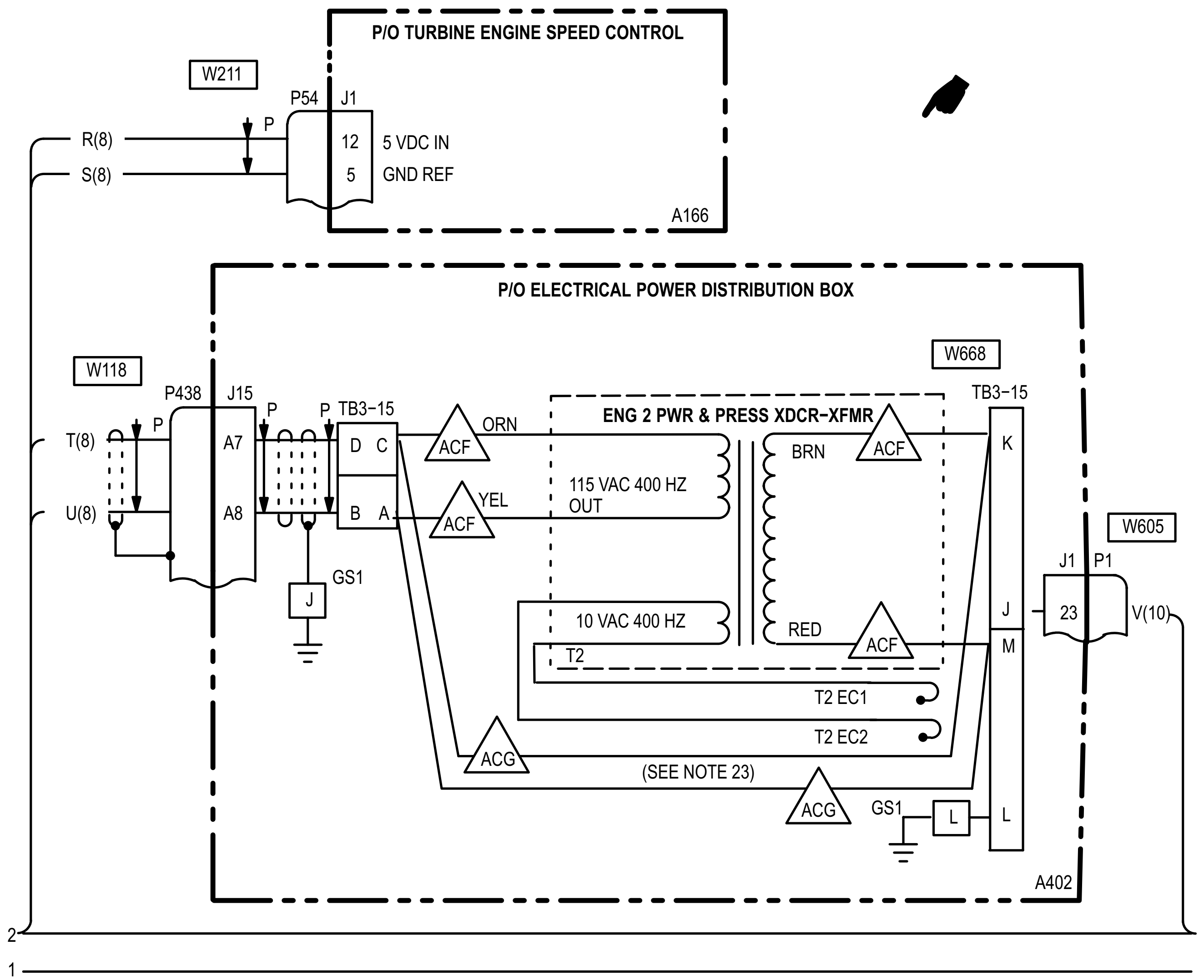
4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



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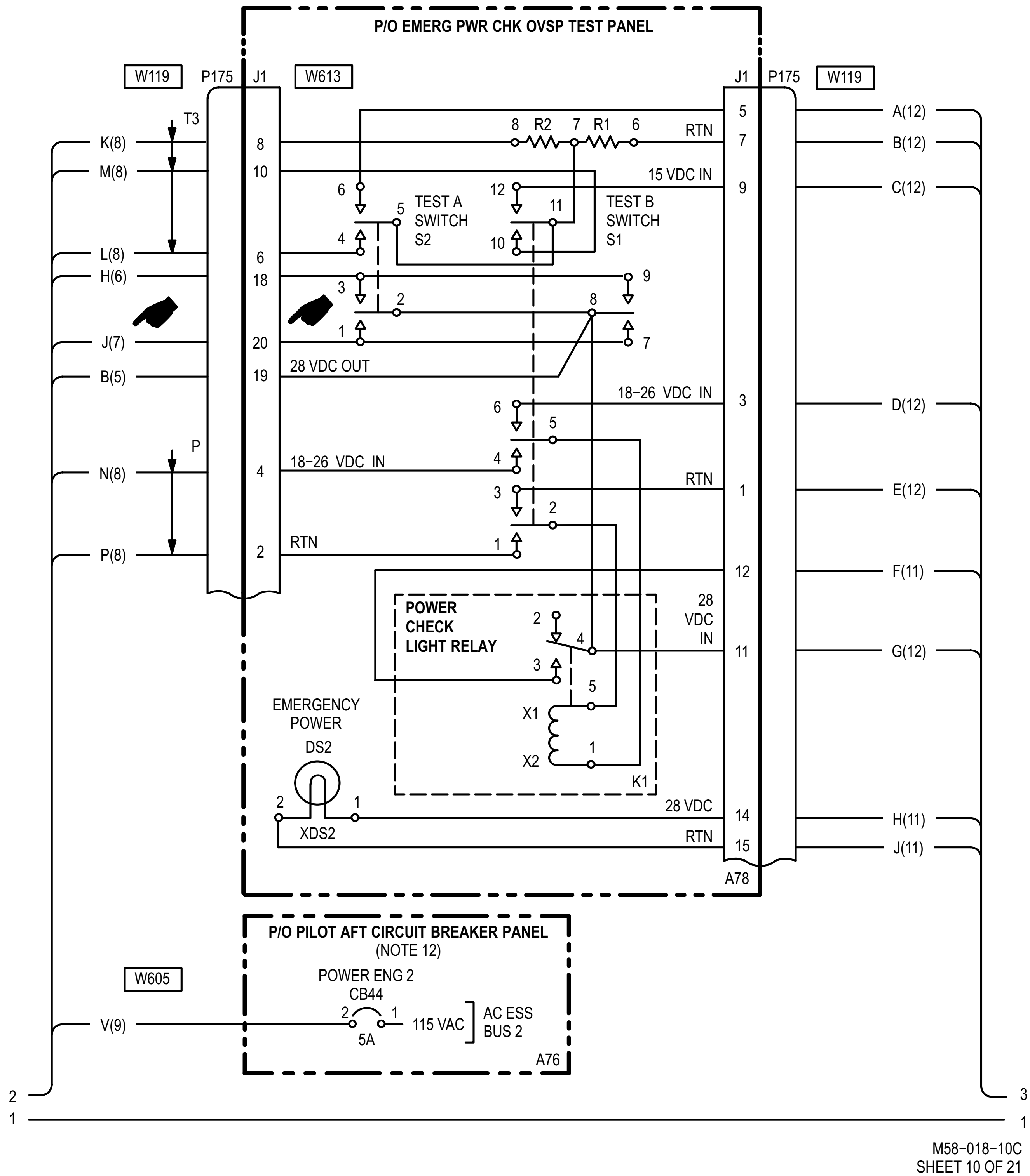
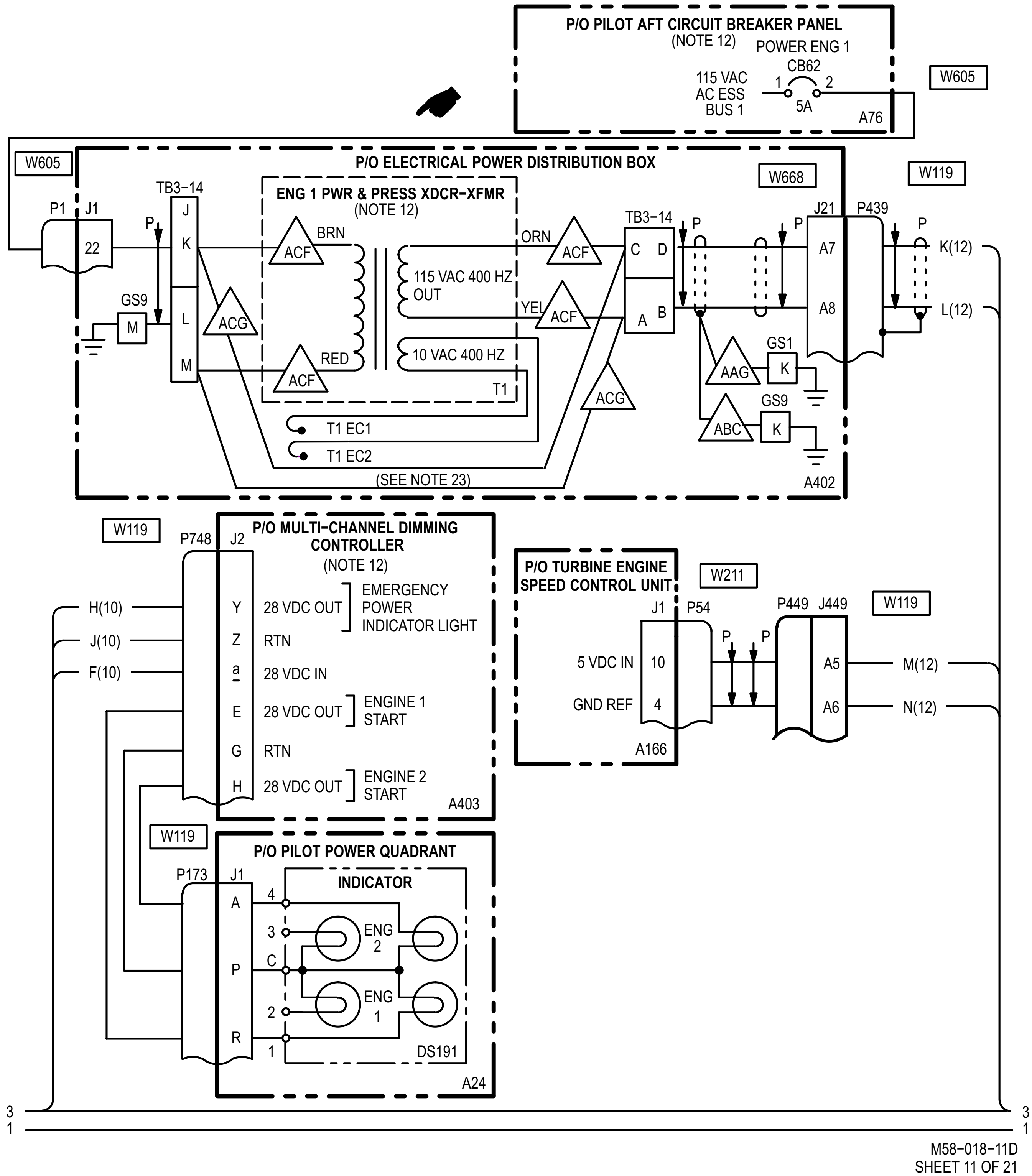
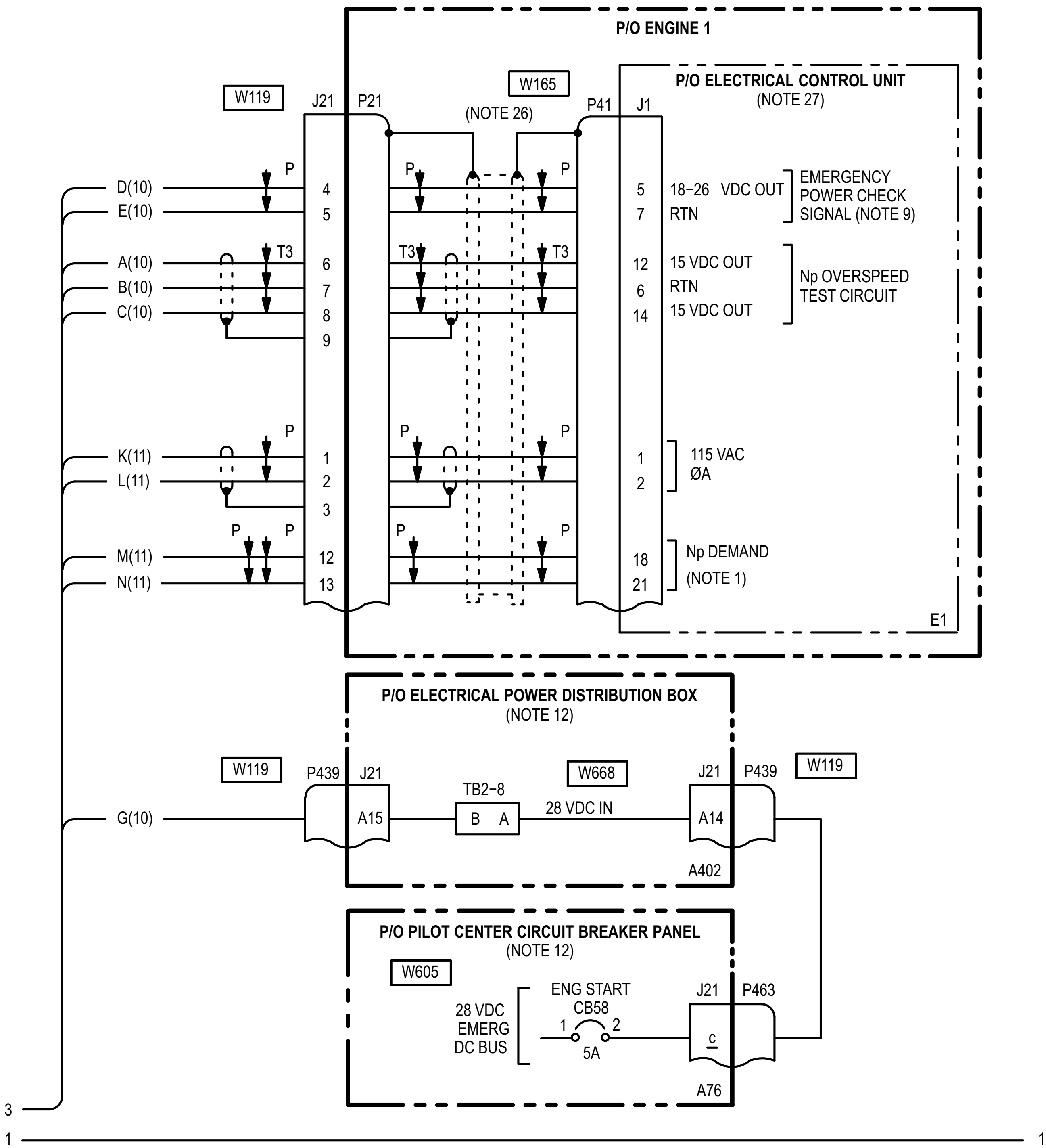
4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



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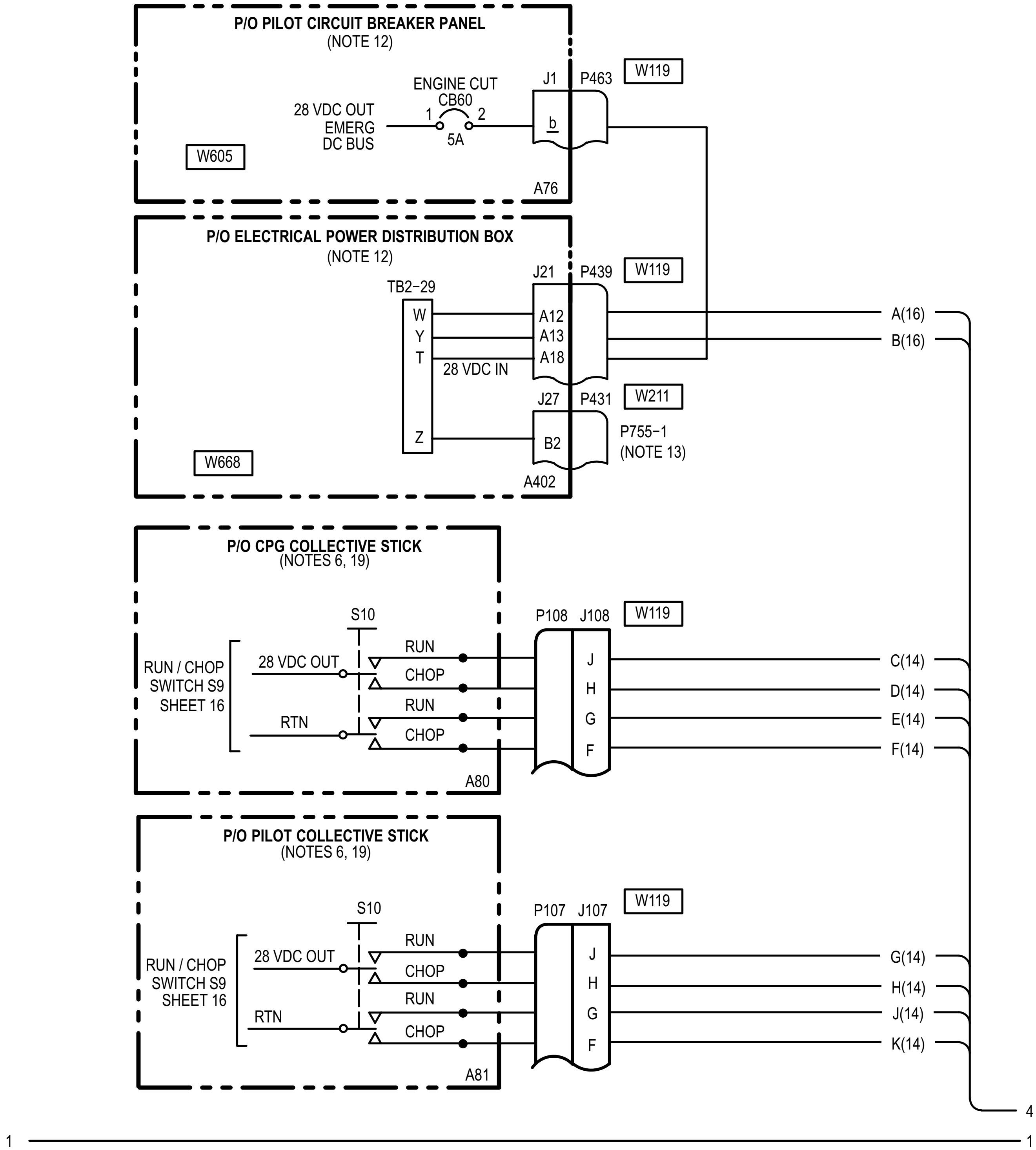
4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



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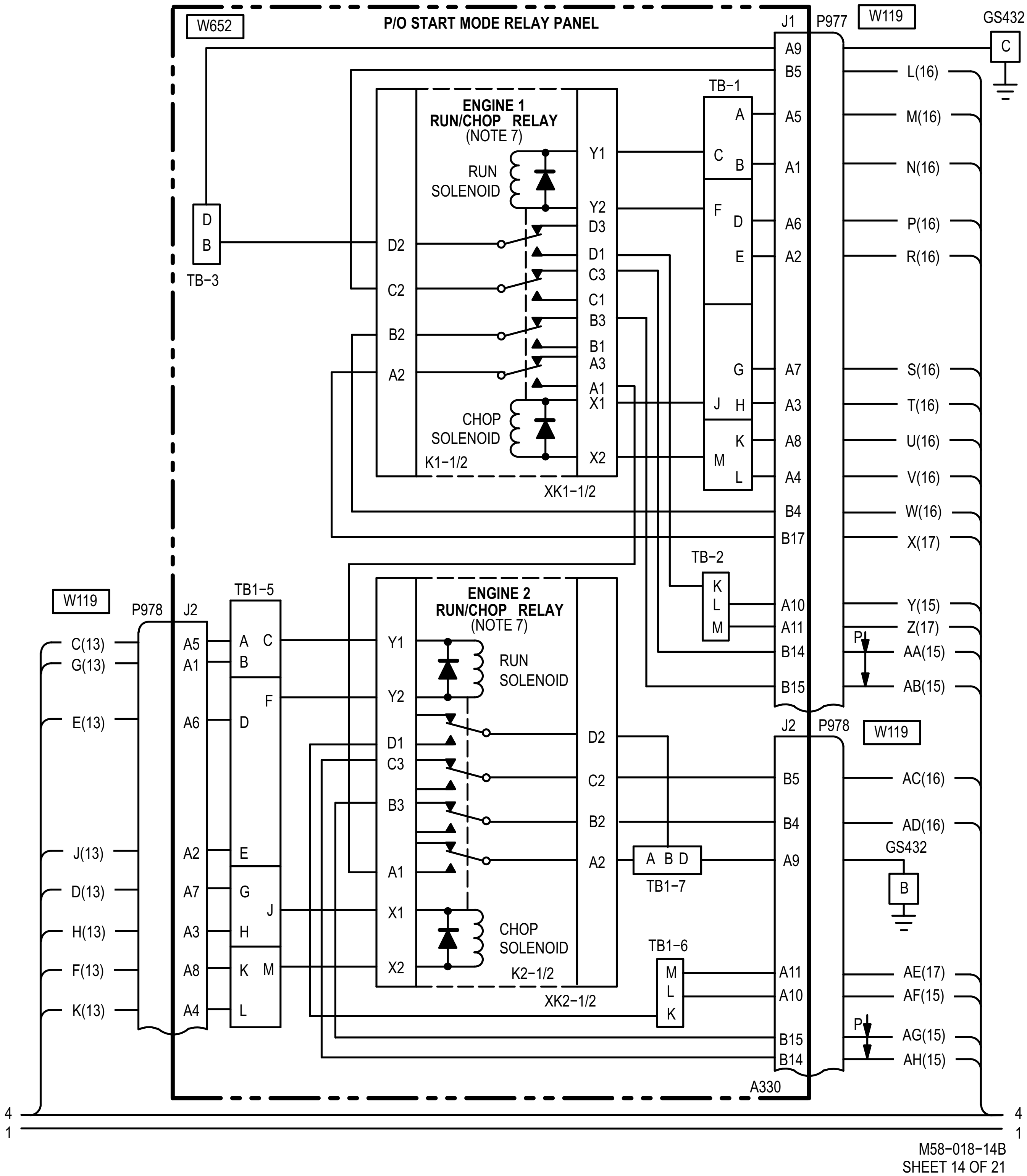
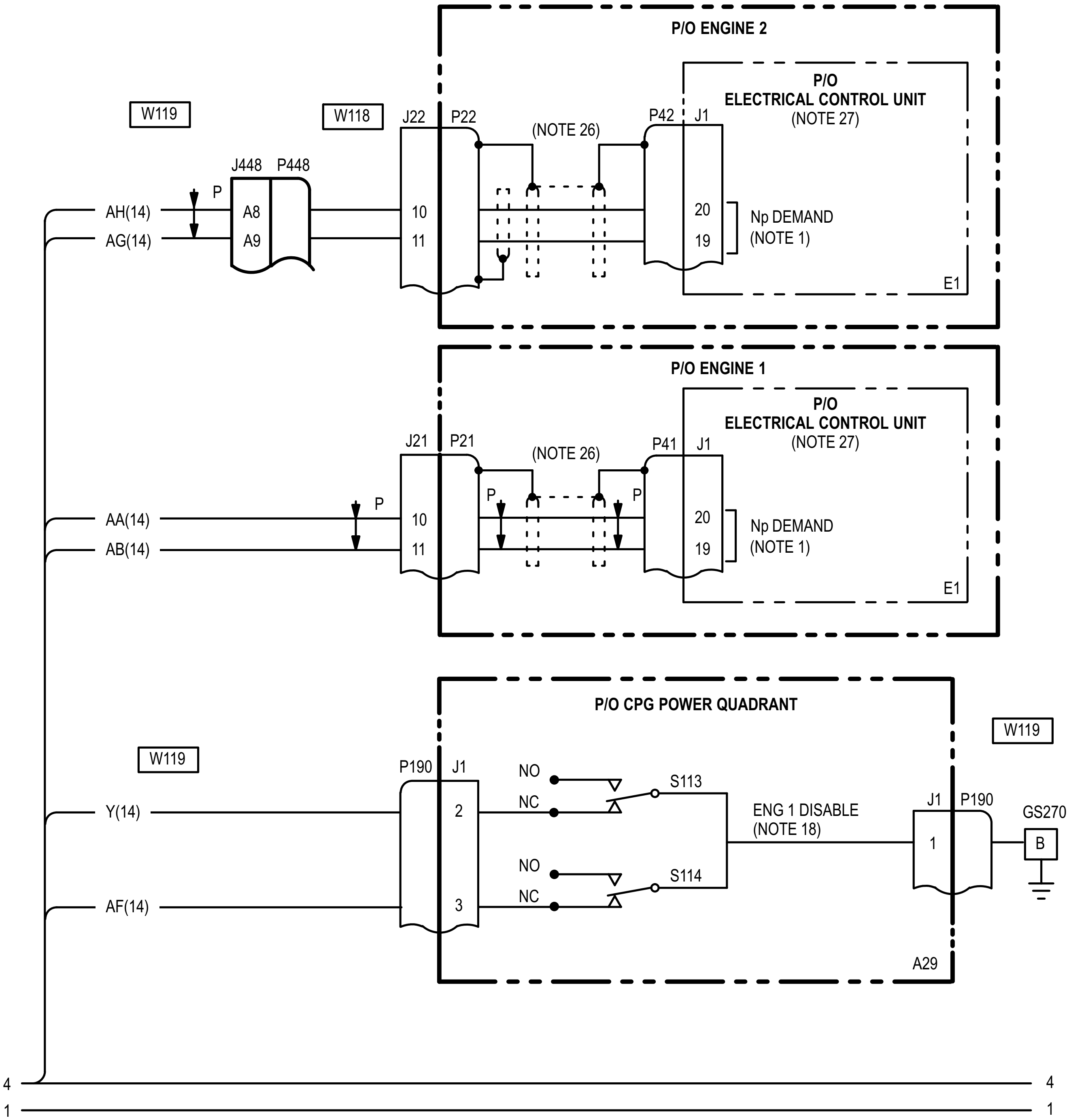
4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



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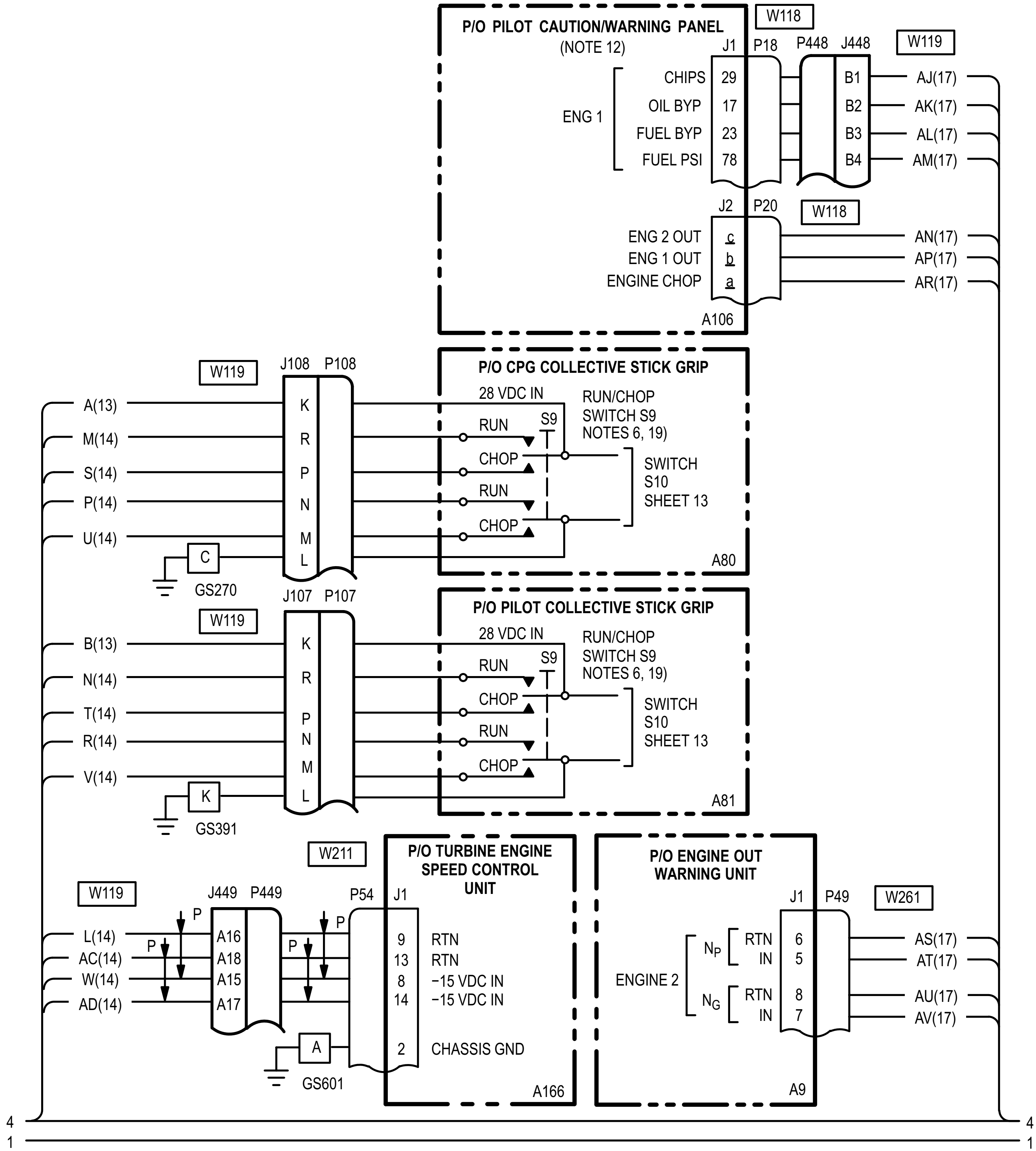
SHEET 15 OF 21

4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



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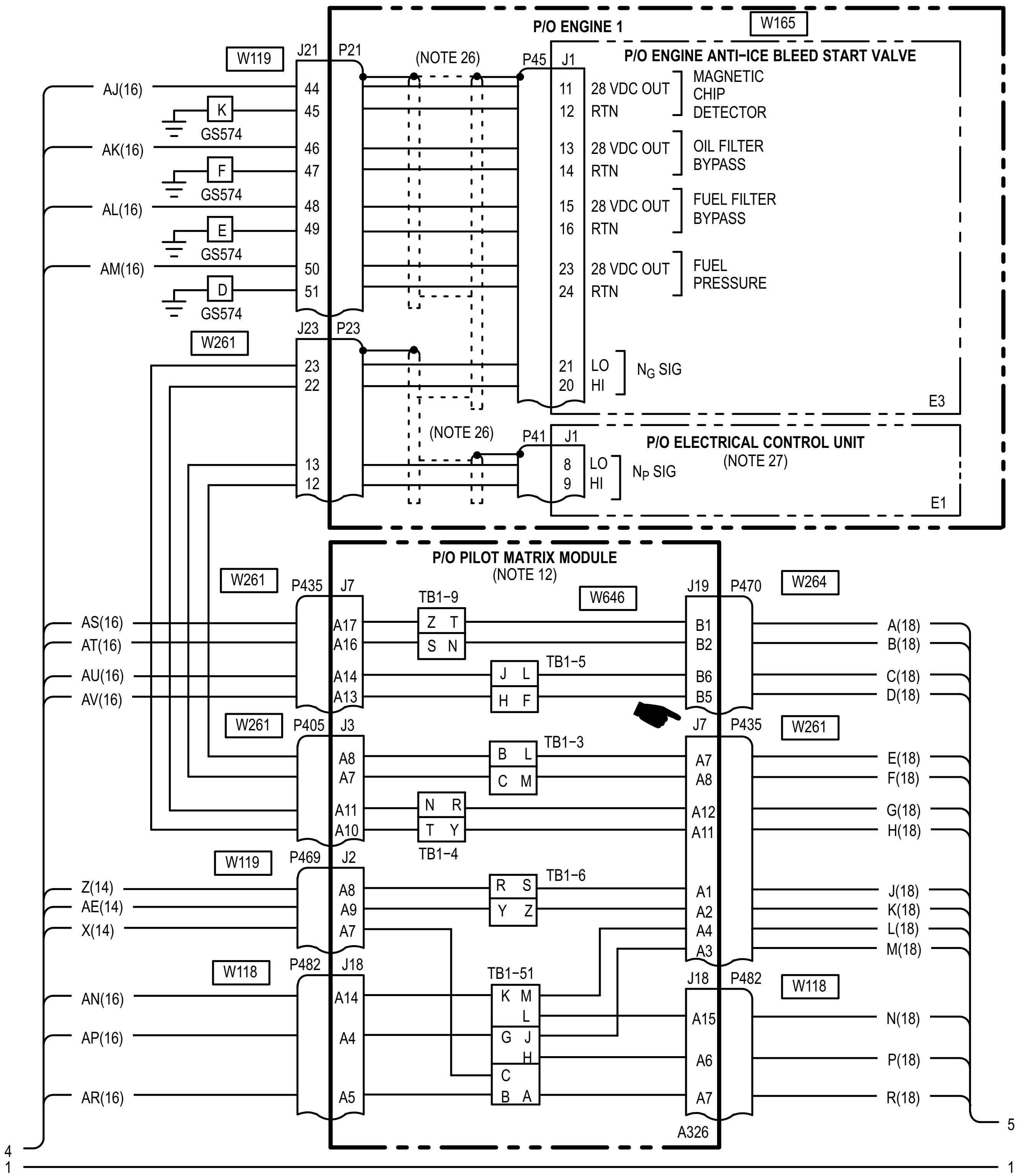
4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



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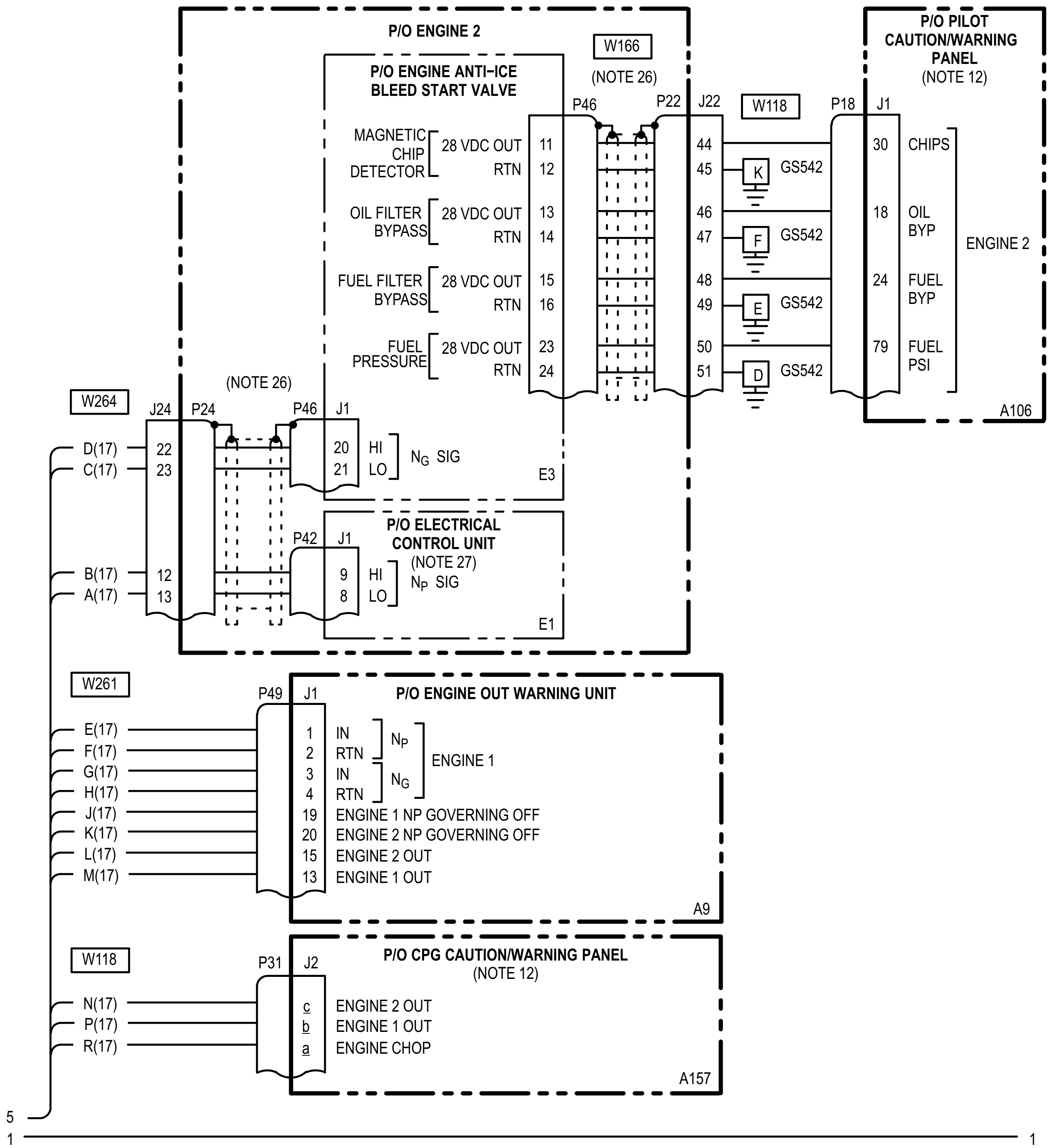
SHEET 17 OF 21

4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



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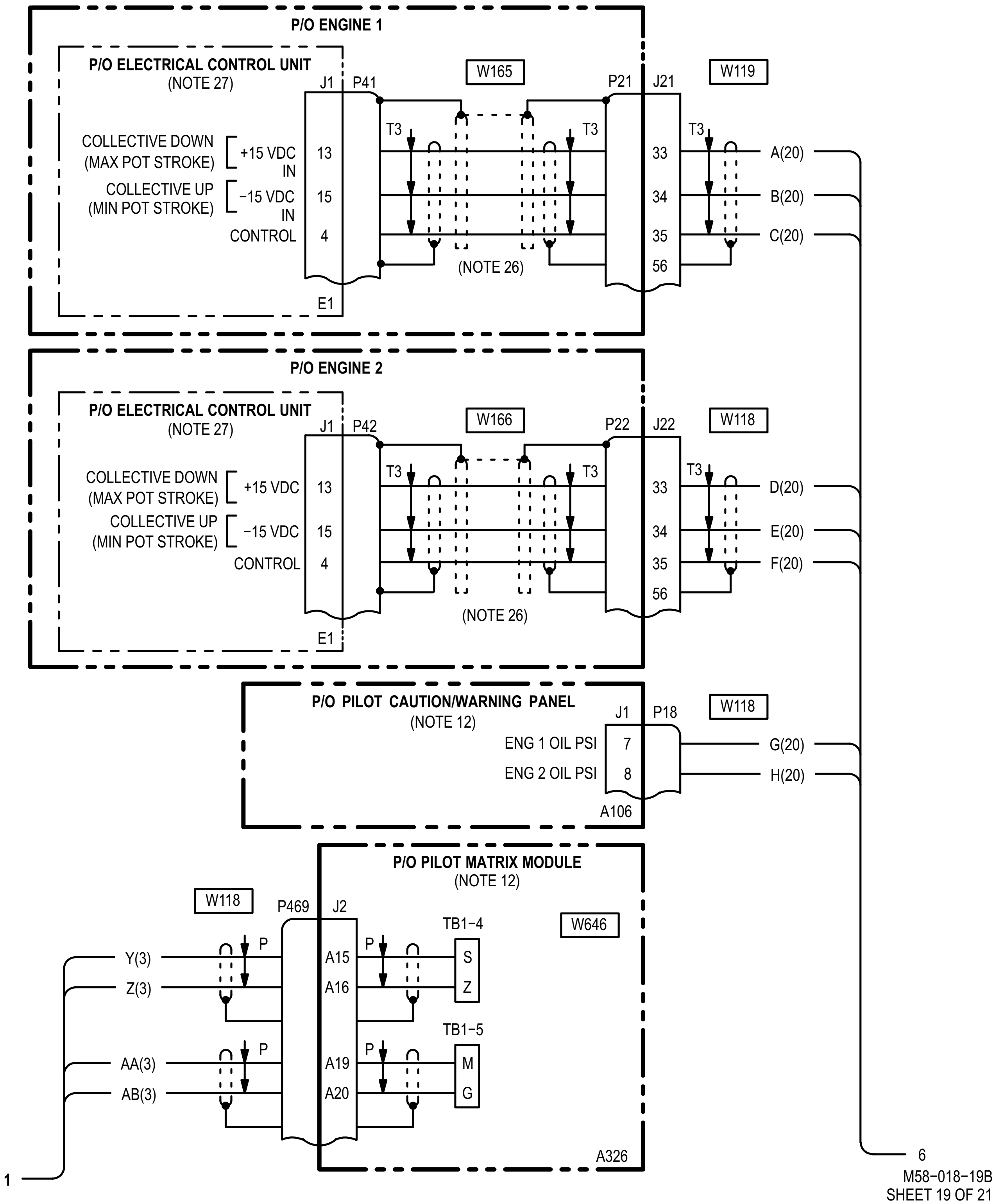
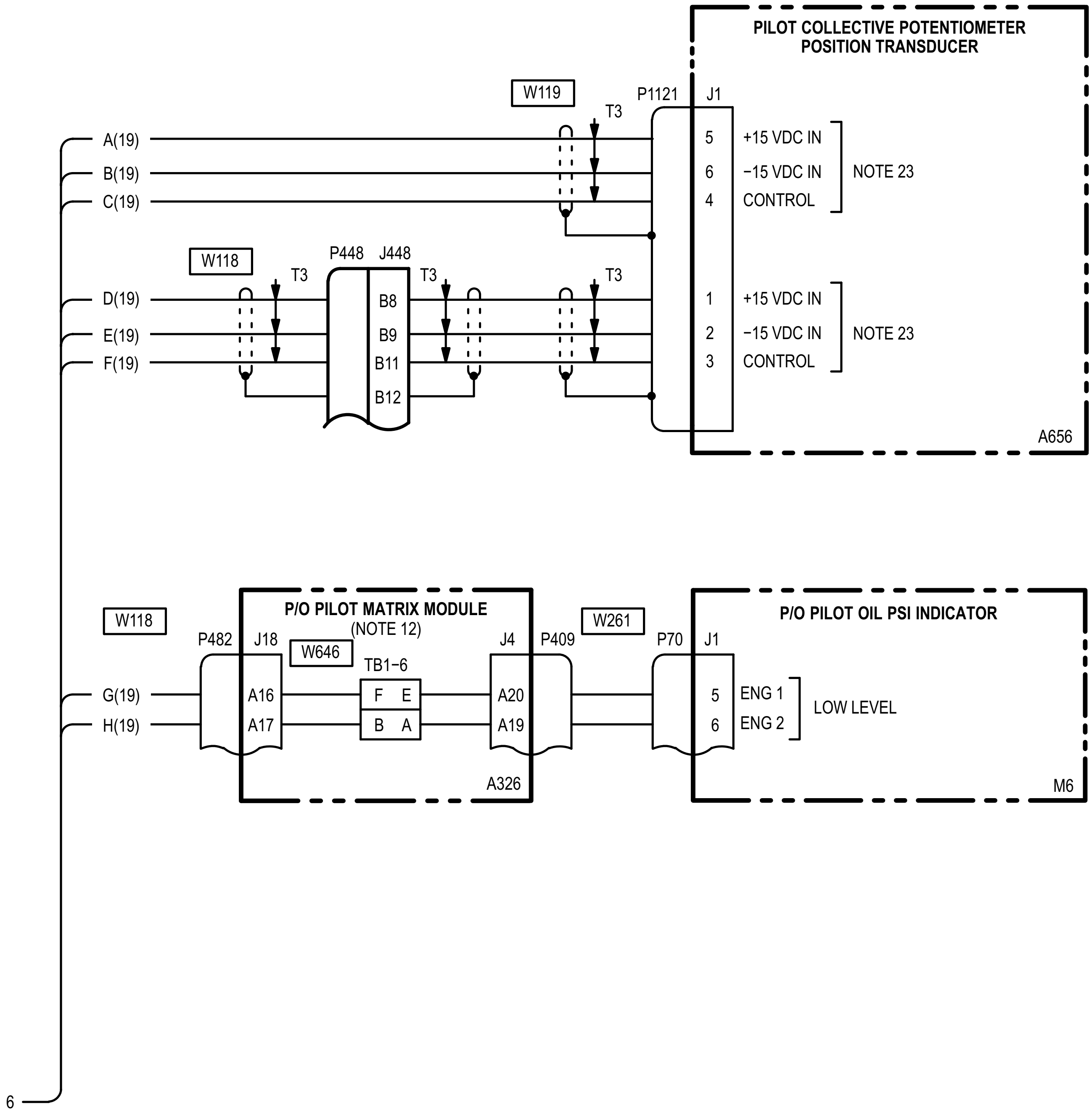
4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14



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4–14. POWER PLANTS – WIRING INTERCONNECT DIAGRAM (cont) 4–14

NOTES:

HIGHWAY USE: THE ALPHA CHARACTER IDENTIFIES A SPECIFIC LINE, AND THE NUMBER IN PARENTHESIS IDENTIFIES THE SHEET NUMBER WHERE THE SIGNAL TERMINATES.

1. Np DEMAND: PIN 18−20: 2.7 VDC.
   PIN 19−20: 0.3 VDC.
   PIN 20−21: 0 VDC AT ENGINE SPEED OF 20,900 RPM.
2. SIGNAL AT STARTER SPEED OF 15,000−16,000 RPM CAUSES TURBINE STARTER SWITCH A5 TO DEACTIVATE START CIRCUIT. (REMOVES 28 VDC OUTPUT FROM CLEAR RELAY−NOTE 3).
3. IN AUTO START SEQUENCE, TURBINE STARTER SWITCH A5 PROVIDES CLEAR RELAY 28 VDC OUTPUT TO HOLD ENGINE START RELAY K1−5/6 OR K2−5/6 CLOSED AFTER START SWITCH S33 OR S34 IS RELEASED.
4. 28 VDC OUT WITH MASTER IGNITION SWITCH S121 ON AND ENG 1 OR 2 START SWITCH S33 OR S34 AT START POSITION.
5. 28 VDC OUT WITH MASTER IGNITION SWITCH S121 ON AND ENG 1 START SWITCH S33 AT IGNITION OVRD POSITION.
6. COLLAR IS SPRING LOADED TO CENTER (OFF) POSITION.
   CHOP POSITION−COLLAR FORWARD AND ROTATED RIGHT.
   RESET POSITION−COLLAR FORWARD AND ROTATED LEFT.
7. HAS DETENTS AT RUN AND CHOP POSITIONS; REMAINS AT LAST SELECTED DETENT POSITION.
8. 28 VDC INTO C1 OF ENG 1 OR ENG 2 IGNITION CUTOFF RELAY K1−7/8 OR K2−7/8 ENERGIZES RELAY, WHICH ENABLES IGNITION CIRCUIT.
9. FROM ECU−ENERGIZES POWER CHECK LIGHT RELAY; APPLY 28 VDC TO MULTICHANNEL DIMMER CONTROLLER FOR POWER CHECK INDICATOR.
10. ENG 1 IGNITION SYSTEM IS DISABLED BY SHORTING J1−B10 TO J1−B1 (THRU CONTACTS ON ENG 1 START RELAY K1−5/6 AND ENG 2 IGNITION CUTOFF RELAY K1−7/8).
    ENG 2 IGNITION SYSTEM IS DISABLED BY SHORTING J2−B10 TO J2−B2 (THRU CONTACTS ON ENG 2 START RELAY K2−5/6 AND ENG 2 IGNITION CUTOFF RELAY K2−7/8).
11. SWITCH TERMINALS CONNECTED AS FOLLOWS:

POSITION	TERMINALS CONNECTED
OFF	2−3,5−6,8−9,11−12
BRAKE	2−3,4−5,7−8,11−12
LOCK	1−2,4−5,7−8,10−11

12. ELECTRICAL SYSTEM (TM 1−1520−238−T−6).
13. REFER TO PARAGRAPH 6−14. DRIVE SYSTEM − WIRING INTERCONNECT DIAGRAM.
14. UTILITY SYSTEM (TM 1−1520−238−T−8).
15. ENVIRONMENTAL CONTROL SYSTEM (TM 1−1520−238−T−8).
16. HYDRAULIC SYSTEM (TM 1−1520−238−T−5).
17. FUEL SYSTEM (TM 1−1520−238−T−7).
18. OPEN AT FLY (NORMAL FLIGHT) POSITION.
19. S9 AND S10 ARE GANGED SWITCHES AND OPERATE TOGETHER.
20. PREVENTS ENGINE 1 OR 2 POWER LEVERS FROM BEING ADVANCED PAST IDLE WITH ROTOR BRAKE ENGAGED.
21. ENGINE 2 POWER LEVER IDLE AND LOCKOUT STOPS WHEN ACTUATED BY CPG STOP RELEASE LEVER ON POWER LEVER.
22. ENGINE 1 POWER LEVER IDLE AND LOCKOUT STOPS WHEN ACTUATED BY CPG STOP RELEASE LEVER ON LOWER LEVER.
23. FROM ECU−PROVIDES + 15 VDC TO PILOT COLLECTIVE POTENTIOMETER POSITION TRANSDUCER.
24. SWITCH ACTIVATED BY ENGINE POWER LEVER POSITION.
    N.D.−WITH POWER LEVER POSITIONED BETWEEN OFF AND IDLE.
    N.C.−WITH POWER LEVER ADVANCED BEYOND IDLE.
25. HS DESIGNATES A HARD SPLICE WHICH CANNOT BE DISCONNECTED. M DESIGNATES A SOFT SPLICE WHICH CAN BE DISCONNECTED FOR A WIRING CHECK.
26. HELICOPTERS WITH T700−GE−701C ENGINES INSTALLED ARE EQUIPPED WITH EMI SHIELDING.
27. HELICOPTERS WITH T700−GE−701C ENGINES INSTALLED ARE EQUIPPED WITH A DECU.

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4–15. TORQUE SHARING SYSTEM – MAINTENANCE OPERATIONAL CHECK 4–15

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01

Personnel Required:

67R Attack Helicopter Repairer
152FG Pilot (2)

References:

TM 1-1520-238-T-3
TM 1-1520-238-T-5
TM 1-1520-238-23
TM 1-1520-238-CL
TM 1-1520-238-MTF

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Fuel system– fully serviced Power plants inspection performed
Paragraph 4–10	POWER PLANTS – POWER UP completed

WARNING

- **Make sure helicopter safing procedures are accomplished. Observe all safety precautions during troubleshooting or maintenance tasks. Failure to do so could result in death or serious injury.**
- **Jet engine fuel is explosive, flammable, and toxic to skin, eyes, and respiratory tract. Work in well ventilated area away from open flames. Wear protective clothing. If fuel comes in contact with the eyes or skin, flush with water and seek medical aid.**

NOTE

- **Refer to pilot station (fig. 4–19) and CPG station (fig. 4–20) for cockpit configuration and equipment.**
- **If referenced out of one paragraph or volume and into another for additional troubleshooting, upon completion of the task, return to the maintenance operational check for the original paragraph or volume.**

1. Start and operate both engines (TM 1-1520-238-CL).

4–15. TORQUE SHARING SYSTEM – MAINTENANCE OPERATIONAL CHECK (cont) 4–15

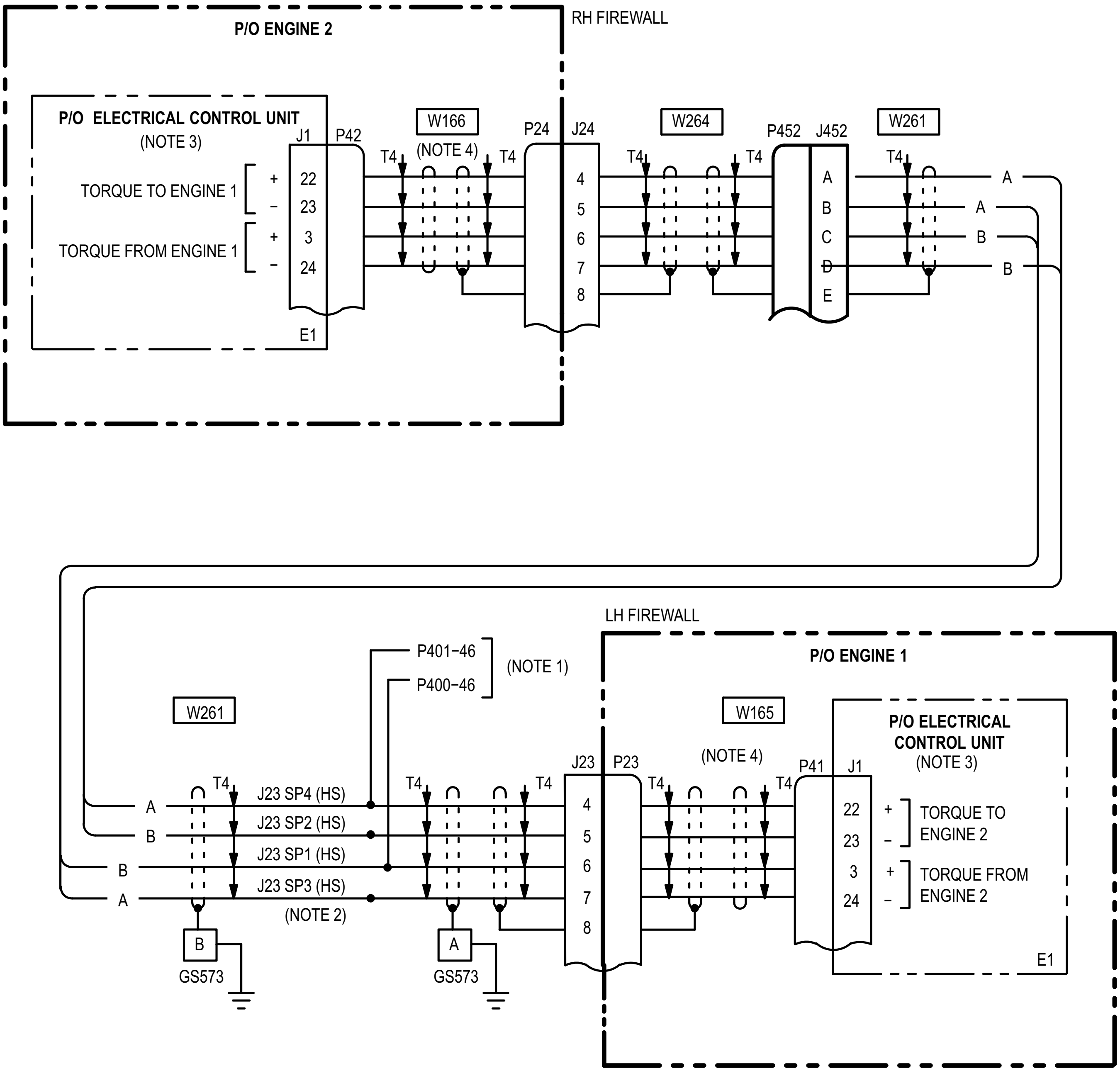
2. Complete the maintenance operational check as follows:

Task	Result
a. On the pilot's instrument panel (fig. 4–34), ensure **N_p1**, **N_p2**, and **N_R** vertical scales on the **ENG–RTR RPM%** indicator all indicate **100%**.	If **ENG–RTR RPM%** indications do not show **100%**, refer to TM 1-1520-238-T-5 to troubleshoot engine instruments.
b. Monitor that **TORQUE % 1** and **2** vertical scales and digital readouts indications are within 5% of each other.	If engine **1 TORQUE** indication is lower than engine **2 TORQUE** indication (indications not within 5% of each other), refer to TM 1-1520-238-T-3, Multiplex Read Codes, and perform troubleshooting. Then, if no fault is found, go to paragraph 4–17. If engine **2 TORQUE** indication is lower than engine **1 TORQUE** indication (indications not within 5% of each other), refer to TM 1-1520-238-T-3, Multiplex Read Codes, and perform troubleshooting. Then, if no fault is found, go to paragraph 4–18.
c. Perform limited test flight to verify TGT limited power check (TM 1-1520-238-MTF).	

3. Land and shut down helicopter (TM 1-1520-238-CL).
4. Perform helicopter safing procedures (TM 1-1520-238-23).

END OF TASK

4–16. TORQUE SHARING SYSTEM – WIRING INTERCONNECT DIAGRAM 4–16



NOTES:

1. INSTRUMENTS (TM 1–1520–238–T–5).
2. HS DESIGNATES A HARD SPLICE WHICH CANNOT BE DISCONNECTED FOR A WIRING CHECK.
3. HELICOPTERS WITH T700–GE–701C ENGINES INSTALLED ARE EQUIPPED WITH DECU.
4. HELICOPTERS WITH T700–GE–701C ENGINES INSTALLED ARE EQUIPPED WITH EMI SHIELDING.

4–17. ENGINE 1 TORQUE INDICATION IS LOWER THAN ENGINE 2 TORQUE INDICATION (INDICATIONS NOT WITHIN 5% OF EACH OTHER) 4–17

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-23
TM 55-2840-248-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – LN3, LN4, RN3, RN4 doors opened

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between:
J23–6 and J24–6,
J23–7 and J24–5.
Does open exist?

YES Repair open wire.
Go to paragraph 4–15.

NO Go to step 2.

2. Check for open between:
P23–6 and P41–3,
P24–6 and P42–3.
Does open exist?

YES **(ABY**) Repair open wire.
Go to paragraph 4–15.
(**ABZ**) Replace wire harness (TM 1-1520-238-23).

NO Go to step 3.

3. Detach P23 and P24. Check for short between:
P23–6 and ground,
P23–7 and ground,
P24–5 and ground,
P24–6 and ground.
Does short exist?

YES (**ABY**)Repair shorted wire.
Go to paragraph 4–15.
(**ABZ**) Replace wire harness (TM 1-1520-238-23).

NO Go to step 4.

4. Check for short between:
J23–6 and ground,
J23–7 and ground,
J24–5 and ground,
J24–6 and ground.
Does short exist?

YES Repair shorted wire between:
J24–6 and P452–C,
J452–C and J23 SP1,
J23 SP1 and P400–46,
J23 SP1 and J24–6,
J24–5 and P452–B,
J452–B and J23 SP3,
J23 SP3 and J23–7.
Go to paragraph 4–15.

NO Refer to TM 55-2840-248-23 to troubleshoot engine 2
(**ABY**) ECU.
(**ABZ**) DECU.

END OF TASK

4–18. ENGINE 2 TORQUE INDICATION IS LOWER THAN ENGINE 1 TORQUE INDICATION (INDICATIONS NOT WITHIN 5% OF EACH OTHER) 4–18

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-23
TM 55-2840-248-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – LN3, LN4, RN3, RN4 doors opened

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between:
   J23–4 and J24–4,
   J23–5 and J24–7.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–15.

   NO Go to step 2.

2. Check for open between:
   P23–4 and P41–22,
   P24–5 and P41–24.
   Does open exist?

   YES (**ABY**)Repair open wire.
   Go to paragraph 4–15.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Go to step 3.

3. Detach P23 and P24. Check for short between:
   P23–4 and ground,
   P23–5 and ground,
   P24–4 and ground,
   P24–7 and ground.
   Does short exist?

   YES **(ABY)**Repair shorted wire.
   Go to paragraph 4–15.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Go to step 4.

4. Check for short between:
   J23–4 and ground,
   J23–5 and ground,
   J24–4 and ground,
   J24–7 and ground.
   Does short exist?

   YES Repair shorted wire between:
   J24–4 and P452–A,
   J452–A and J23 SP1,
   J23 SP1 and P400–46,
   J23 SP1 and J24–6,
   J24–5 and P452–B,
   J452–B and J23 SP3,
   J23 SP3 and J23–7.
   Go to paragraph 4–15.

   NO Refer to TM 55-2840-248-23 to troubleshoot engine 2
   (ABY) ECU.
   (ABZ) DECU.

END OF TASK

4–19. ENGINE 1 – DOES NOT ACCELERATE TO OR REMAIN BETWEEN 23% AND 25% N_G IN IGN OVRD 4–19

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68F Aircraft Electrician

References:

TM 1-1520-238-T-5
TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – RN1 door opened
Paragraph 1–17	Maintenance headset connected

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check PAS manifold and engine 1 starter regulator valve lines for leaks.
   Are leaks present?

   YES Replace leaking components (TM 1-1520-238-23).

   NO Go to step 2.

2. Start and operate APU (TM 1-1520-238-23). On pilot caution/warning panel check **SHAFT DRIVEN COMP** indicator.
   Is SHAFT DRIVEN COMP fail indicator lighted?

   YES Refer to TM 1-1520-238-T-5 to troubleshoot PAS.

   NO Go to step 3.

3. Shutdown APU, then perform external power application – electrical (TM 1-1520-238-23). Set and hold **ENG START NO 1** switch in **IGN OVRD**, check for 28 VDC at J21–24.
   Is voltage present?

   YES Go to step 5.

   NO Go to step 4.

4. Set and hold **ENG START NO 1** switch in **IGN OVRD**, check for 28 VDC at P977–B2.
   Is voltage present?

   YES Go to step 8.

   NO Go to step 11.

5. Check for open between:
   P21–24 and P39–2,
   P21–23 and P39–1.
   Does open exist?

   YES (**ABY**) Repair open wire. Go to paragraph 4–12.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Go to step 6.

6. Check for open between:
   (**AAG**) J21–23 and ground,
   (**ABC**) J21–23 and ground.
   Does open exist?

   YES Repair open wire. Go to paragraph 4–12.

   NO Go to step 7.

4–19. ENGINE 1 – DOES NOT ACCELERATE TO OR REMAIN BETWEEN 23% AND 25% N_G IN IGN OVRD (cont) 4–19

7. Have assistant check engine 1 starter regulator valve operation while cycling **ENG START NO 1** switch between **OFF** and **IGN OVRD**.
   Does valve operate?

   YES Replace engine 1 air turbine starter (TM 1-1520-238-23).

   NO Replace engine 1 starter regulator valve (TM 1-1520-238-23).

8. Check for open between:
   J21–24 and P977–A17,
   P977–A13 and P439–A16 ,
   (A402)J21–A16 and (A402)TB2–8–E,
   (A402)TB2–8–A and (A402)J21–A14.
   Does open exist?

   YES Repair open wire. Go to paragraph 4–12.

   NO Go to step 9.

9. Check for 28 VDC at (A76)J1–X.
   Is voltage present?

   YES Go to step 10.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station).

10. Check for open between:
    P463–c and P439–A14 ,
    P173–K and P977–B2.
    Does open exist?

    YES Repair open wire. Go to paragraph 4–12.

    NO Replace pilot power quadrant (TM 1-1520-238-23).

11. Check for 28 VDC at (A402)TB2–8–A.
    Is voltage present?

    YES Go to step 13.

    NO Go to step 12.

12. Check for open between:
    P463–c and P439–A14.
    (A402):
    J21–A14 and TB2–8–A.
    Does open exist?

    YES Repair open wire. Go to paragraph 4–12.

    NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station).

13. Check for open between P977–A13 and (A402)TB2–8–E.
    Does open exist?

    YES Repair open wire. Go to paragraph 4–12.

    NO Replace start mode relay panel (TM 1-1520-238-23).

END OF TASK

4–20. ENG START CIRCUIT BREAKER – DOES NOT STAY CLOSED (WITH ENG START NO 1 SWITCH IN START POSITION) 4–20

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Open **ENG START** circuit breaker. Check for short between (A76):
   J1–c and ground,
   J1–X and ground.
   Does short exist?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station).

   NO Go to step 2.

2. Set and hold **ENG START NO 1** switch in **START** position. Check for short between P463–X and ground.
   Does short exist?

   YES Go to step 3.

   NO Go to step 4.

3. Detach P173. Check for short between P463–X and ground.
   Does short exist?

   YES Repair shorted wire between P463–X and P173–V. Go to paragraph 4–12.

   NO Go to step 5.

4. Detach P439. Check for short between P463–c and ground.
   Does short exist?

   YES Repair shorted wire between P463–c and P439–A14. Go to paragraph 4–12.

   NO Go to step 8.

5. Check for short between P173–L and ground.
   Does short exist?

   YES Go to step 6.

   NO Replace pilot power quadrant (TM 1-1520-238-23).

6. Check for short between between P977–B3 and ground.
   Does short exist?

   YES Go to step 11.

   NO Go to step 7.

7. Detach P463. Check for short between P977–A14 and ground.
   Does short exist?

   YES Repair shorted wire between P173–L and P977–A14. Go to paragraph 4–12.

   NO Replace start mode relay panel (TM 1-1520-238-23).

8. Check for short between P439–A2 and ground.
   Does short exist?

   YES Go to step 9.

   NO Go to step 12.

4–20. ENG START CIRCUIT BREAKER – DOES NOT STAY CLOSED (WITH ENG START NO 1 SWITCH IN START POSITION) (cont) 4–20

9. Detach P439. Check for short between P439–A2 and ground.
Does short exist?

YES Go to step 10.

NO Replace engine starter regulator valve (TM 1-1520-238-23).

10. Detach P21. Check for short between P21–25 and ground.
Does short exist?

YES (**ABY**) Repair shorted wire. Go to paragraph 4–12. (**ABZ**) Replace wire harness (TM 1-1520-238-23).

NO Repair shorted wire between P439–A2 and J21–25. Go to paragraph 4–12.

11. Detach P1370. Check for short between P977–B3 and ground.
Does short exist?

YES Repair shorted wire between P977–B3 and P64–D. Go to paragraph 4–12.

NO Replace air turbine speed starter switch (TM 1-1520-238-23).

12. Check for short between P438–A2 and ground.
Does short exist?

YES Go to step 13.

NO Go to step 15.

13. Detach P40. Check for short between P438–A2 and ground.
Does short exist?

YES Go to step 14.

NO Replace engine 2 starter regulator valve (TM 1-1520-238-23).

14. Detach P22. Check for short between P40–4 and ground.
Does short exist?

YES (**ABY**) Repair shorted wire. (**ABZ**) Replace wire harness (TM 1-1520-238-23). Go to paragraph 4–12.

NO Repair shorted wire between J22–25 and P438–A2. Go to paragraph 4–12.

15. Check for short between P439–A15 and ground.
Does short exist?

YES Go to step 16.

NO Go to step 17.

16. Detach P175. Check for short between P439–A15 and ground.
Does short exist?

YES Repair shorted wire between P439–A15 and P175–11. Go to paragraph 4–12.

NO Replace pilot **EMERG PWR CHK OVSP TEST** panel (TM 1-1520-238-23).

17. Check for short between P439–A11 and ground.
Does short exist?

YES Go to step 18.

NO Go to step 19.

18. Detach P978. Check for short between P439–A11 and ground.
Does short exist?

YES Repair shorted wire between P439–A11 and P978–A13. Go to paragraph 4–12.

NO Replace start mode relay panel (TM 1-1520-238-23).

4–20. ENG START CIRCUIT BREAKER – DOES NOT STAY CLOSED (WITH ENG START NO 1 SWITCH IN START POSITION) (cont) 4–20

19. Check for short between P439–A16 and ground.
Does short exist?

    YES Go to step 20.

    NO Go to step 21.

20. Detach P977. Check for short between P439–A16 and ground.
Does short exist?

    YES Repair shorted wire between P439–A16 and P977–A13. Go to paragraph 4–12.

    NO Replace start mode relay panel (TM 1-1520-238-23).

21. Identify and detach wires from (A402): TB2–8–A, TB2–8–B, TB2–8–E, TB2–8–F, TB2–8–J, and TB2–8–N. Check for short between (A402):
J21–A2 and ground,
J21–A11 and ground,
J21–A14 and ground,
J21–A15 and ground,
J21–A16 and ground,
J15–A2 and ground.
Does short exist?

    YES Repair shorted wire between (A402):
    J21–A2 and TB2–8–N,
    J21–A11 and TB2–8–F,
    J21–A14 and TB2–8–A,
    J21–A15 and TB2–8–B,
    J21–A16 and TB2–8–E,
    J15–A2 and TB2–8–J.
    Go to paragraph 4–12.

    NO Refer to paragraph 6–12 to troubleshoot drive system.

END OF TASK

4–21. ENG START NO 1 INDICATOR – IS NOT LIGHTED WITH ENGINE 1 STARTED 4–21

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 55-2840-248-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – LN1 door open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for 28 VDC at P39–4 .
   Is voltage present?

   YES Go to step 2.

   NO Go to step 3.

2. Check for open between P39–3 and P21–26.
   Does open exist?

   YES **(ABY)** Repair open wire. Go to paragraph 4–13.

   NO **(ABZ)** Replace wire harness (TM 1-1520-238-23).

3. Check for 28 VDC at J21–25.
   Is voltage present?

   YES (**ABY**) Repair open wire. Go to paragraph 4–13. (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Go to step 5.

4. Check for open between:
   P748–F and J21–26,
   P748–E and P173–R,
   P748–G and P173–P.
   Does open exist?

   YES Repair open wire. Go to paragraph 4–13.

   NO Go to step 6.

5. Check for 28 VDC at (A76)J1–c.
   Does open exist?

   YES Repair open wire between:
   P463–c and P439–A14,
   P439–A2 and J21–25.
   (A402):
   J21–A14 and TB2–8–A,
   J21–A2 and TB2–8–N.
   Go to paragraph 4–13.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station).

6. On pilot master caution/warning panel, depress **PRESS TO TEST** indicator.
   Is ENG START ENG 1 indicator lighted?

   YES Refer to TM 55-2840-248-23.to troubleshoot engine 1.

   NO Replace multi–channel dimming controller (TM 1-1520-238-23).

END OF TASK

4–22. ENG START ENG NO 1 INDICATOR – REMAINS LIGHTED ABOVE 52% N_G 4–22

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – LN1 door open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P64. Set and hold **ENG START NO 1** switch to **IGN OVRD**. Check for 1 ±0.1 VAC between P64–E and P64–F.
   Is voltage present?

   YES Go to step 3.

   NO Go to step 2.

2. Check for open between:
   P64–E and J21–29,
   P64–F and J21–28.
   Does open exist?

   YES Repair open wire. Go to paragraph 4–12.

   NO Go to step 5.

3. Place **ENG START NO 1** switch to **OFF**. Check for short between P21–25 and P21–26.
   Does short exist?

   YES Go to step 4.

   NO Go to step 6.

4. Detach P39. Check for short between:
   P39–3 and ground,
   P39–4 and ground.
   Does short exist?

   YES (**AFC**) Repair shorted wire. Go to paragraph 4–12. (**AFD**) Replace wire harness (TM 1-1520-238-23).

   NO Replace engine starter air pressure regulator valve (TM 1-1520-238-23).

5. Check for open between:
   P21–28 and P35–3,
   P21–29 and P35–5.
   Does open exist?

   YES (**ABY**) Repair open wire. Go to paragraph 4–12. (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Replace air turbine starter (TM 1-1520-238-23).

6. Have assistant place **ENG START NO 1** switch to **IGN OVRD**. Check for 28 VDC at P39–2.
   Is voltage present?

   YES Replace relay (A330)K1–5/6 (TM 1-1520-238-23).

   NO Go to step 7.

7. Have assistant set and hold **ENG START NO 1** switch in **IGN OVRD**. Check for 28 VDC at P21–24.
   Is voltage present?

   YES (**ABY**) Repair open wire. Go to paragraph 4–12. (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Replace flow turbine start switch (TM 1-1520-238-23).

END OF TASK

4–23. ENGINE 1 OUT INDICATORS – ARE LIGHTED WITH ENGINE 1 RUNNING 4–23

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P20.
   Does indicator stay lighted?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot pilot and CPG caution/warning system.

   NO Go to step 2.

2. Detach wire from (A326)TB1–51–J. Check for short between P49–13 and ground.
   Does short exist?

   YES Repair shorted wire.
   Go to paragraph 4–12.

   NO Go to step 3.

3. Check for 2.45 VDC or less at P49–3.
   Is voltage present?

   YES Refer to TM 55-2840-248-23 to troubleshoot engine 1.

   NO Go to step 4.

4. Check for 3.61 VDC or less at P49–1.
   Is voltage present?

   YES Refer to TM 55-2840-248-23 to troubleshoot engine 1.

   NO Replace engine out warning unit (TM 1-1520-238-23).

END OF TASK

4–24. ENGINE 1 N_G – DOES NOT REMAIN STABLE WITH CKT A SWITCH CLOSED 4–24

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

On pilot **EMERG PWR CHK OVSP TEST** panel, check for short between (A78):
J1–9 and J1–7.
Does short exist?

YES Replace pilot **EMERG PWR CHK OVSP TEST** panel (TM 1-1520-238-23).

NO Refer to TM 55-2840-248-23 to troubleshoot engine 1.

END OF TASK

4–25. ENGINE 1 N_G – DOES NOT REMAIN STABLE WITH CKT B SWITCH CLOSED 4–25

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

On pilot **EMERG PWR CHK OVSP TEST** panel, check for short between (A78):
J1–5 and J1–7.
Does short exist?

YES Replace pilot **EMERG PWR CHK OVSP TEST** panel (TM 1-1520-238-23).

NO Refer to TM 55-2840-248-23 to troubleshoot engine 1.

END OF TASK

4–26. ENGINE 1 N_G – DOES NOT DECREASE WITH CKT A AND CKT B SWITCHES CLOSED 4–26

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-23
TM 55-2840-248-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L230 fairing removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between:
   P21–7 and P41–6,
   P21–6 and P41–12,
   P21–8 and P41–14.
   Does open exist?

   YES (**ABY**) Repair open wire. Go to paragraph 4–12.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Go to step 2.

2. Check for open between:
   J21–7 and P175–7,
   J21–6 and P175–5,
   J21–8 and P175–9.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Go to step 3.

3. Have assistant set and hold **CKT A** switch in **ENG NO 1** position**.** Check for open between (A78): J1–5 and J1–7.
   Does open exist?

   YES Replace pilot **EMERG PWR CHK OVSP TEST** panel (TM 1-1520-238-23).

   NO Go to step 4.

4. Have assistant set and hold **CKT B** switch in **ENG NO 2** position**.** Check for open between (A78): J1–7 and J1–9.
   Does open exist?

   YES Replace pilot **EMERG PWR CHK OVSP TEST** panel (TM 1-1520-238-23).

   NO Refer to TM 55-2840-248-23 to troubleshoot engine 1.

END OF TASK

4–27. CHIPS ENG 1 INDICATOR – IS LIGHTED 4–27

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer’s	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P18 from pilot caution/warning panel.
Is CHIPS ENG 1 indicator lighted?

YES Replace pilot caution/warning panel (TM 1-1520-238-23).

NO Go to step 2.

2. Detach P21. Check for short between P18–29 and ground.
Does short exist?

YES Repair shorted wire.
Go to paragraph 4–12.

NO Go to step 3.

3. Detach P45. Check for short between P21–44 and ground.
Does short exist?

YES (**ABY**) Repair shorted wire.
Go to paragraph 4–12.
(**ABZ**) Replace wire harness (TM 1-1520-238-23).

NO Refer to TM 55-2840-248-23 to service engine 1 chip detector.

END OF TASK

4–28. OIL BYP ENG 1 INDICATOR – IS LIGHTED 4–28

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P18 from pilot caution/warning panel.
Is OIL BYP ENG 1 indicator lighted?

YES Replace pilot caution/warning panel (TM 1-1520-238-23).

NO Go to step 2.

2. Detach P21. Check for short between P18–17 and ground.
Does short exist?

YES Repair shorted wire between P448–B2 and P18–17, P448–B2 and J21–46. Go to paragraph 4–12.

NO Go to step 3.

3. Detach P45. Check for short between P21–46 and ground.
Does short exist?

YES (**ABY**) Repair shorted wire. Go to paragraph 4–12.
(**ABZ**) Replace wire harness (TM 1-1520-238-23).

NO Refer to TM 55-2840-248-23 to service engine 1 oil bypass filter.

END OF TASK

4–29. FUEL BYP ENG 1 INDICATOR – IS LIGHTED 4–29

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P18 from pilot caution/warning panel.
   Is FUEL BYP ENG 1 indicator lighted?

   YES Replace pilot caution/warning panel (TM 1-1520-238-23).

   NO Go to step 2.

2. Detach P21. Check for short between P18–23 and ground.
   Does short exist?

   YES Go to step 3.

   NO Go to step 4.

3. Detach P448. Check for short between P18–23 and ground.
   Does short exist?

   YES Repair shorted wire. Go to paragraph 4–12.

   NO Repair shorted wire between J448–B3 and J21–48. Go to paragraph 4–12.

4. Detach P45. Check for short between P21–48 and ground.
   Does short exist?

   YES (**ABY**) Repair shorted wire. Go to paragraph 4–12. (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Refer to TM 55-2840-248-23 to service engine 1 fuel bypass filter.

END OF TASK

4–30. FUEL PSI ENG 1 INDICATOR – IS LIGHTED 4–30

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer’s	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P18 from pilot caution/warning panel.
   Is FUEL PSI ENG 1 indicator lighted?

   YES Replace pilot caution/warning panel (TM 1-1520-238-23).

   NO Go to step 2.

2. Detach P21. Check for short between P18–78 and ground.
   Does short exist?

   YES Go to step 3.

   NO Go to step 4.

3. Detach P448. Check for short between P18–78 and ground.
   Does short exist?

   YES Repair shorted wire between J448–B4 and J21–50.
   Go to paragraph 4–12.

   NO Go to step 3.

4. Detach P45. Check for short between P21–50 and ground.
   Does short exist?

   YES (**ABY**) Repair shorted wire.
   Go to paragraph 4–12.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Refer to TM 55-2840-248-23 to troubleshoot engine 1.

END OF TASK

4–31. CPG ENGINE NO 1 PWR LEVER – CANNOT BE ADVANCED TO LOCKOUT 4–31

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. On CPG power quadrant, pull up on **ENG NO 1** stop release lever.
Does THROT circuit breaker stay closed?

    YES Go to step 3.

    NO Go to step 2.

2. Detach P173. Check for short between P173–M and ground.
Does short exist?

    YES Go to step 4.

    NO Replace pilot power quadrant (TM 1-1520-238-23).

3. Detach P463. Check for 28 VDC at (A76)J1–d.
Is voltage present?

    YES Go to step 5.

    NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station).

4. Detach P190. Check for short between P190–4 and ground.
Does short exist?

    YES Repair shorted wire between P190–4 and P173–M. Go to paragraph 4–12.

    NO Replace CPG power quadrant LH stop release switch (TM 1-1520-238-23).

5. Attach P463. Detach P173. On CPG **PWR NO 1** throttle, pull and hold stop release lever. Check for 28 VDC at P173–M.
Is voltage present?

    YES Go to step 6.

    NO Go to step 7.

6. Check for open between P173–N and ground.
Does open exist?

    YES Repair open wire between P173–N and GS391–J. Go to paragraph 4–12.

    NO Replace pilot power quadrant (TM 1-1520-238-23).

7. Detach P190. Check for 28 VDC at P190–12.
Is voltage present?

    YES Go to step 8.

    NO Repair open wire between P463–d and P190–12. Go to paragraph 4–12.

8. On CPG power quadrant, pull up on **ENG NO 1** stop release lever. Check for open between P173–M and P190–4.
Does open exist?

    YES Repair open between P173–M and P190–4. Go to paragraph 4–12.

    NO Replace CPG power quadrant (TM 1-1520-238-23).

END OF TASK

4–32. PILOT ENGINE CHOP INDICATOR – DOES NOT LIGHT WITH PILOT COLLECTIVE STICK IN CHOP 4–32

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200, R200 panels removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. At start mode relay panel, check for 5 VDC at P977–B17.
   Is voltage present?

   YES Go to step 3.

   NO Go to step 2.

2. Check for open between:
   P977–B17 and P469–A7,
   P482–A5 and P20–a.
   (A402): J2–A7 and J18–A5.
   Does open exist?

   YES Repair open wire. (Engine 1) Go to paragraph 4–12. (Engine 2) Go to paragraph 4–13.

   NO Replace pilot caution/warning panel (TM 1-1520-238-23).

3. At pilot collective stick, check for 28 VDC at J107–K.
   Is voltage present?

   YES Go to step 5.

   NO Go to step 4.

4. Check for open between:
   J107–K and P439–A13,
   J21–A13 and J21–A18,
   P439–A18 and P463–b.
   Does open exist?

   YES Repair open wire. (Engine 1) Go to paragraph 4–12. (Engine 2) Go to paragraph 4–13.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station)

5. Check for open between:
   J107–P and P977–A3,
   J107–M and P977–A4,
   J107–L and ground,
   J107–H and P978–A3,
   J107–F and P978–A4,
   P978–A9 and ground.
   Does open exist?

   YES Repair open wire. (Engine 1) Go to paragraph 4–12. (Engine 2) Go to paragraph 4–13.

   NO Go to step 6.

6. With pilot collective stick grip in **CHOP** position, check for open between:
   P107–K and P107–P,
   P107–K and P107–H,
   P107–L and P107–M,
   P107–L and P107–F.
   Does open exist?

   YES Replace pilot collective stick (TM 1-1520-238-23).

   NO Replace start mode relay panel (TM 1-1520-238-23).

END OF TASK

4–33. PILOT COLLECTIVE STICK – DOES NOT RESET CHOP FUNCTION 4–33

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200, R200 panels removed Pilot seat removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between:
   J107–R and P977–A1,
   J107–N and P977–A2,
   J107–J and P978–A1,
   J107–G and P978–A2.
   Does open exist?

   YES Repair open wire. (Engine 1) Go to paragraph 4–12. (Engine 2) Go to paragraph 4–13.

   NO Go to step 2.

2. With pilot collective stick grip in **RUN** position, check for open between:
   P107–K and P107–R,
   P107–K and P107–J,
   P107–L and P107–N,
   P107–L and P107–G.
   Does open exist?

   YES Replace pilot collective stick (TM 1-1520-238-23).

   NO Replace start mode relay panel (TM 1-1520-238-23).

END OF TASK

4–34. CPG ENGINE CHOP INDICATOR – DOES NOT LIGHT WITH CPG COLLECTIVE STICK IN CHOP 4–34

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Non–transparent barrier removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for 5 VDC at (A326)TB1–51–A.
   Is voltage present?

   YES Go to step 3.

   NO Go to step 2.

2. Check for open between:
   (A326)TB1–51–A and (A326)J18–A7,
   P482–A7 and P31–a.
   Does open exist?

   YES Repair open wire.
   (Engine 1) Go to paragraph 4–12.
   (Engine 2) Go to paragraph 4–13.

   NO Replace CPG caution/warning panel (TM 1-1520-238-23).

3. At CPG collective stick, check for 28 VDC at J108–K.
   Is voltage present?

   YES Go to step 4.

   NO Repair open wire between J108–K and (326)TB2–29–W.
   (Engine 1) Go to paragraph 4–12.
   (Engine 2) Go to paragraph 4–13.

4. Check for open between:
   J108–P and P977–A7,
   J108–L and ground,
   J108–M and P977–A8,
   J108–H and P978–A7,
   J108–F and P978–A8.
   Does open exist?

   YES Repair open wire.
   (Engine 1) Go to paragraph 4–12.
   (Engine 2) Go to paragraph 4–13.

   NO Go to step 5.

5. With CPG collective stick grip in **CHOP** position, check for open between:
   P108–K and P108–P,
   P108–K and P108–H,
   P108–L and P108–M,
   P108–L and P108–F.
   Does open exist?

   YES Replace CPG collective stick (TM 1-1520-238-23).

   NO Replace start mode relay panel (TM 1-1520-238-23).

END OF TASK

4–35. CPG COLLECTIVE STICK – DOES NOT RESET CHOP FUNCTION 4–35

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200, R200 panels removed CPG seat removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between:
   J108–R and P977–A5,
   J108–N and P977–A6,
   J108–J and P978–A5,
   J108–G and P978–A6.
   Does open exist?

   YES Repair open wire. (Engine 1) Go to paragraph 4–12. (Engine 2) Go to paragraph 4–13.

   NO Go to step 2.

2. With CPG collective stick in **RUN** position, check for open between:
   P108–K and P108–R,
   P108–K and P108–J,
   P108–L and P108–N,
   P108–L and P108–G.
   Does open exist?

   YES Replace CPG collective stick **RUN/CHOP** switch (TM 1-1520-238-23).

   NO Replace start mode relay panel (TM 1-1520-238-23).

END OF TASK

4–36. ENGINE 2 – DOES NOT ACCELERATE TO OR REMAIN BETWEEN 23% AND 25% N_G IN IGN OVRD 4–36

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68F Aircraft Electrician

References:

TM 1-1520-238-T-5
TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access Provisions – RN1 door opened

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check PAS manifold and engine 2 starter regulator valve lines for leaks.
   Are leaks present?

   YES Replace leaking components (TM 1-1520-238-23).

   NO Go to step 2.
2. Start and operate APU (TM 1-1520-238-23) on pilot caution/warning panel, check **SHAFT DRIVEN COMP** fail indicator.
   Is SHAFT DRIVEN COMP fail indicator lighted?

   YES Refer to TM 1-1520-238-T-5 to troubleshoot PAS.

   NO Go to step 3.
3. Shutdown APU. Perform external power application – electrical (TM 1-1520-238-23). Set and hold **ENG START NO 2** switch in **IGN OVRD**, check for 28 VDC at J22–24.
   Is voltage present?

   YES Go to step 5.

   NO Go to step 4.
4. Set and hold **ENG START NO 2** switch in **IGN OVRD**, check for 28 VDC at P978–B2.
   Is voltage present?

   YES Go to step 8.

   NO Go to step 11.
5. Check for open between:
   P22–23 and P40–1,
   P22–24 and P40–2.
   Does open exist?

   YES **(ABY)** Repair open wire. Go to paragraph 4–13. **(ABZ)** Replace wire harness (TM 1-1520-238-23).

   NO Go to step 6.
6. Check for open between J22–23 and ground.
   Does open exist?

   YES Repair open wire. Go to paragraph 4–13.

   NO Go to step 7.
7. Have assistant check engine 2 start regulator valve operation while cycling **ENG START NO 2** switch between **OFF** and **IGN OVRD**.
   Does valve operate?

   YES Replace engine 2 air turbine starter (TM 1-1520-238-23).

   NO Replace engine 2 starter regulator valve (TM 1-1520-238-23).

4–36. ENGINE 2 – DOES NOT ACCELERATE TO OR REMAIN BETWEEN 23% AND 25% N_G IN IGN OVRD (cont) 4–36

8. Check for open between:
J22–24 and P978–A16,
P978–A13 and P439–A11.
(A402):
J21–A11 and TB2–8–F,
J21–A14 and TB2–8–A.
Does open exist?

YES Repair open wire.
Go to paragraph 4–13.

NO Go to step 9.

9. Check for 28 VDC at (A76)J1–X.
Is voltage present?

YES Go to step 10.

NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station).

10. Check for open between:
P463–X and P173–V,
P173–W and P978–B2.
Does open exist?

YES Repair open wire.
Go to paragraph 4–13.

NO Replace pilot power quadrant (TM 1-1520-238-23).

11. Check for 28 VDC at (A402)TB2–8–A.
Is voltage present?

YES Go to step 13.

NO Go to step 12.

12. Check for open between:
P463–c and P439–A14.
(A402):
J21–A14 and TB2–8–A.
Does open exist?

YES Repair open wire.
Go to paragraph 4–13.

NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station)

13. Check for open between P978–A13 and (A402)TB2–8–F.
Does open exist?

YES Repair open wire.
Go to paragraph 4–13.

NO Replace start mode relay panel (TM 1-1520-238-23).

END OF TASK

4–37. ENG START CIRCUIT BREAKER – DOES NOT STAY CLOSED (WITH ENG START NO 2 SWITCH IN START POSITION) 4–37

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P978. Set and hold **ENG START NO 2** switch in **START** position. Check for short between P463–X and ground.
   Does short exist?

   YES Go to step 3.

   NO Go to step 2.

2. With grounding strap attached, check for short between (A330)J2–A14 and ground.
   Does short exist?

   YES Replace start mode relay panel (TM 1-1520-238-23).

   NO Go to step 4.

3. Check for short between P173–H and ground.
   Does short exist?

   YES Repair shorted wire. Go to paragraph 4–13.

   NO Replace pilot power quadrant (TM 1-1520-238-23).

4. Check for short between P978–B3 and ground.
   Does short exist?

   YES Repair shorted wire. Go to paragraph 4–13.

   NO Replace turbine starter switch (TM 1-1520-238-23).

END OF TASK

4–38. ENG START ENG 2 INDICATOR – IS NOT LIGHTED WITH ENGINE 2 STARTED 4–38

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – RN1 door open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. On pilot master caution/warning panel, press and hold **PRESS TO TEST** indicator.
Is ENGINE 2 START indicator lighted?

    YES Go to step 2.

    NO Go to step 6.

2. Check for 28 VDC at P40–3.
Is voltage present?

    YES Go to step 4.

    NO Go to step 3.

3. Check for open between P40–4 and (A402)TB2–8–N.
Does open exist?

    YES Repair open wire. Go to paragraph 4–13.

    NO Replace (A402)TB2–8 (TM 1-1520-238-23).

4. Check for open between P40–3 and P22–26.
Does open exist?

    YES (**ABY**) Repair open wire. Go to paragraph 4–13. (**ABZ**) Replace wire harness (TM 1-1520-238-23).

    NO Go to step 5.

5. Check for open between P748–J and J22–26.
Does open exist?

    YES Repair open wire. Go to paragraph 4–13.

    NO Replace engine start regulator valve (TM 1-1520-238-23). Go to paragraph 4–13.

6. Check for open between P748–H and P173–A.
Does open exist?

    YES Repair open wire. Go to paragraph 4–13.

    NO Go to step 7.

7. Check for open between (A24): J1–A and J1–P.
Does open exist?

    YES Replace pilots power quadrant (TM 1-1520-238-23).

    NO Replace multi–channel dimming controller (TM 1-1520-238-23).

END OF TASK

4–39. ENG START ENG 2 INDICATOR – REMAINS LIGHTED ABOVE 52% N_G 4–39

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 panel removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. With **MASTER IGNITION SWITCH to ON,** set and hold **ENG START NO 2** switch to **IGN OVRD**. Check for 1 ±0.1 VAC between P64–L and P64–M.
   Is voltage present?

   YES Go to step 3.

   NO Go to step 2.

2. Check for open between:
   P64–M and P36–5,
   P64–L and P36–3.
   Does open exist?

   YES Repair open wire between:
   P64–L and J448–A18,
   P64–M and J448–A17,
   P448–A18 and J22–28,
   P448–A17 and J22–29,
   P22–28 and P36–3,
   P22–29 and P36–5.
   Go to paragraph 4–12.

   NO Replace air turbine starter (TM 1-1520-238-23).

3. Place **ENG START NO 2** switch to **OFF**. Check for short between P22–25 and P22–26.
   Does short exist?

   YES Replace engine starter air pressure regulator valve (TM 1-1520-238-23).

   NO Go to step 4.

4. Temporarily install replacement turbine speed cutout switch and go to paragraph 4–12.
   Does problem still exist?

   YES Replace flow turbine start switch (TM 1-1520-238-23).

   NO Replace turbine speed cutout switch (TM 1-1520-238-23).

END OF TASK

4–40. ENGINE 2 OUT INDICATORS – ARE LIGHTED WITH ENGINE 2 RUNNING 4–40

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 55-2840-248-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L140 fairing removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P20.
Does indicator stay lighted?

YES Refer to TM 1-1520-238-T-6 to troubleshoot pilot and CPG caution/warning system.

NO Go to step 2.

2. Detach wire from (A326)TB1–51–M. Check for short between P49–15 and ground.
Does short exist?

YES Repair shorted wire. Go to paragraph 4–12.

NO Go to step 3.

3. Check for 2.45 VDC or less at P49–7.
Is voltage present?

YES Refer to TM 55-2840-248-23 to troubleshoot engine 1.

NO Go to step 4.

4. Check for 3.61 VDC or less at P49–5.
Is voltage present?

YES Refer to TM 55–2840–248–23 to troubleshoot engine 1.

NO Replace engine out warning unit (TM 1-1520-238-23).

END OF TASK

4–41. ENGINE 2 N_G – DOES NOT REMAIN STABLE WITH CKT A SWITCH CLOSED 4–41

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

Check for short between (A78): J1–10 and J1–8.
Does short exist?

YES Replace pilot **EMERG PWR CHK OVSP TEST** panel (TM 1-1520-238-23).

NO Refer to TM 55-2840-248-23 to troubleshoot engine 2.

END OF TASK

4–42. ENGINE 2 N_G – DOES NOT REMAIN STABLE WITH CKT B SWITCH CLOSED 4–42

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-23
TM 55-2840-248-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L140 fairing removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

Check for short between (A78): J1–6 and J1–8.
Does short exist?

YES Replace pilot **EMERG PWR CHK OVSP TEST** panel (TM 1-1520-238-23).

NO Refer to TM 55-2840-248-23 to troubleshoot engine 2.

END OF TASK

4–43. ENGINE 2 N_G – DOES NOT DECREASE WITH CKT A AND B SWITCHES CLOSED 4–43

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-23
TM 55-2840-248-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L140 fairing removed
Paragraph 1–17	Maintenance headset connected

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between:
   P22–7 and P42–6,
   P22–6 and P42–12,
   P22–8 and P42–14.
   Does open exist?

   YES (**ABY**) Repair open wire. Go to paragraph 4–12.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Go to step 2.

2. Check for open between:
   P22–7 and P175–8,
   P22–6 and P175–6,
   P22–8 and P175–10.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Go to step 3.

3. Set and hold **CKT A** switch in **ENG 2** position.
   Check for open between (A78):
   J1–6 and J1–8.
   Does open exist?

   YES Replace pilot **EMERG PWR CHK OVSP TEST** panel (TM 1-1520-238-23).

   NO Go to step 4.

4. Set and hold **CKT B** switch in **ENG 2** position.
   Check for open between (A78):
   J1–8 and J1–10.
   Does open exist?

   YES Replace pilot **EMERG PWR CHK OVSP TEST** panel (TM 1-1520-238-23).

   NO Refer to TM 55-2840-248-23 to troubleshoot engine 2.

END OF TASK

4–44. CHIPS ENG 2 INDICATOR – IS LIGHTED 4–44

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P18.
   Is CHIPS ENG 2 indicator lighted?

   YES — Replace pilot caution/warning panel (TM 1-1520-238-23).

   NO — Go to step 2.

2. Detach P22. Check for short between P18–30 and ground.
   Does short exist?

   YES — Repair shorted wire. Go to paragraph 4–13.

   NO — Go to step 3.

3. Detach P46. Check for short between P22–44 and ground.
   Does short exist?

   YES — (**ABY**) Repair shorted wire. Go to paragraph 4–13.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO — Refer to TM 55-2840-248-23 to service engine 2 magnetic chip detector.

END OF TASK

4–45. OIL BYP ENG 2 INDICATOR – IS LIGHTED 4–45

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P18.
Is OIL BYP ENG 2 indicator lighted?

YES Replace pilot caution/warning panel (TM 1-1520-238-23).

NO Go to step 2.

2. Detach P22. Check for short between P18–18 and ground.
Does short exist?

YES Repair shorted wire. Go to paragraph 4–13.

NO Go to step 3.

3. Detach P46. Check for short between P21–46 and ground.
Does short exist?

YES (**ABY**) Repair shorted wire. Go to paragraph 4–13. (**ABZ**) Replace wire harness (TM 1-1520-238-23).

NO Refer to TM 55-2840-248-23 to service engine 2 oil bypass filter.

END OF TASK

4–46. FUEL BYP ENG 2 INDICATOR – IS LIGHTED 4–46

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P18.
Is FUEL BYP ENG 2 indicator lighted?

   YES Replace pilot caution/warning panel (TM 1-1520-238-23).

   NO Go to step 2.

2. Detach P22. Check for short between P18–24 and ground.
Does short exist?

   YES Repair shorted wire. Go to paragraph 4–13.

   NO Go to step 3.

3. Detach P46. Check for short between P22–48 and ground.
Does short exist?

   YES (**ABY**) Repair shorted wire. Go to paragraph 4–13.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Refer to TM 55-2840-248-23 to service engine 2 fuel bypass filter.

END OF TASK

4–47. FUEL PSI ENG 2 INDICATOR – IS LIGHTED 4–47

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P18.
   Is FUEL PSI ENG 2 indicator lighted?

   YES Replace pilot caution/warning panel (TM 1-1520-238-23).

   NO Go to step 2.

2. Detach P22. Check for short between P18–79 and ground.
   Does short exist?

   YES Repair shorted wire between J22–50 and P18–79. Go to paragraph 4–13.

   NO Go to step 3.

3. Detach P46. Check for short between P22–50 and ground.
   Does short exist?

   YES (**ABY**) Repair shorted wire. Go to paragraph 4–13.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Refer to TM 55-2840-248-23 to troubleshoot engine 2.

END OF TASK

4–48. CPG ENGINE NO 2 PWR LEVER – CANNOT BE ADVANCED TO LOCKOUT 4–48

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. On CPG power quadrant, pull up on **ENG NO 2** stop release lever.
   Does THROT circuit breaker stay closed?

   YES Go to step 3.

   NO Go to step 2.

2. Detach P173. Check for short between P173–S and ground.
   Does short exist?

   YES Go to step 4.

   NO Replace pilot power quadrant (TM 1-1520-238-23).

3. Check for 28 VDC at (A76)J1–d.
   Is voltage present?

   YES Go to step 5.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station)

4. Detach P190. Check for short between P190–5 and ground.
   Does short exist?

   YES Repair shorted wire between P190–5 and P173–S. Go to paragraph 4–13.

   NO Replace CPG power quadrant (TM 1-1520-238-23).

5. Detach P173. On CPG **PWR NO 2** throttle, pull and hold stop release lever. Check for 28 VDC at P173–S.
   Is voltage present?

   YES Go to step 6.

   NO Go to step 7.

6. Check for open between P173–T and ground.
   Does open exist?

   YES Repair open wire between P173–T and GS391–H. Go to paragraph 4–13.

   NO Replace CPG power quadrant (TM 1-1520-238-23).

7. Check for 28 VDC at P190–12.
   Is voltage present?

   YES Go to step 8.

   NO Repair open wire between P463–d and P190–12. Go to paragraph 4–13.

8. Check for open between P173–S and P190–5.
   Does open exist?

   YES Repair open between P173–S and P190–5. Go to paragraph 4–13.

   NO Replace CPG power quadrant RH stop release switch (S12) (TM 1-1520-238-23).

END OF TASK

4–49. ENGINE 1 – DOES NOT START

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist
152FG Pilot

References:

TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. With power applied, set and hold **ENG START NO 1** switch in **START** position, check for open between:
   J21–17 and J21–18,
   J21–19 and J21–18.
   Does open exist?

   YES Go to step 2.

   NO Go to step 3.

2. Check for open between J21–17 and J21–19.
   Does open exist?

   YES Go to step 4.

   NO Go to step 6.

3. Remove relay (A402)K1–5/6. Set and hold **ENG START NO 1** switch in **START** position, check for 28 VDC at (A402)XK1–5/6–X1.
   Is voltage present?

   YES Go to step 5.

   NO Go to step 7.

4. Check for open between (A330):
   J1–B11 and J1–B12.
   Does open exist?

   YES Repair open wire between (A330):
   J1–B11 and J1–B12.
   Go to paragraph 4–12.

   NO Repair open wire between:
   J21–17 and P977–B11,
   J21–19 and P977–B12.
   Go to paragraph 4–12.

5. Check for open between (A402)XK1–5/6–X2 and ground.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Replace relay (A402)K1–5/6 (TM 1-1520-238-23).

6. Check for open between:
   P21–17 and P45–17,
   P2 1–19 and P45–19.
   Does open exist?

   YES (**ABY**) Repair open wire. Go to paragraph 4–12.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Refer to TM 55-2840-248-23 to troubleshoot engine ignition system.

4–49. ENGINE 1 – DOES NOT START (cont)

7. Set and hold **ENG START NO 1** switch in **START** position, check for 28 VDC at P977–A14.
   Is voltage present?

   YES Repair open wire between (A330)J1–A14 and (A402)XK1–5/6–X1. Go to paragraph 4–12.

   NO Go to step 8.

8. Check for open between P977–A14 and P173–L.
   Does open exist?

   YES Repair open wire. Go to paragraph 4–12.

   NO Go to step 9.

9. Check for open between (A24): J1–L and S33–1.
   Does open exist?

   YES Repair open wire. Go to paragraph 4–12.

   NO Replace **ENG START NO 1** switch (S33) (TM 1-1520-238-23).

END OF TASK

4–50. ENGINE 2 – DOES NOT START 4–50

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
152FG Pilot

References:

TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. With power applied, set and hold **ENG START NO 2** switch in **START** position, check for open between:
   J22–17 and J22–18,
   J22–19 and J22–18.
   Does open exist?

   YES Go to step 2.

   NO Go to step 3.

2. Check for open between J22–17 and J22–19.
   Does open exist?

   YES Go to step 4.

   NO Go to step 6.

3. With relay (A330)K2–5/6 removed (TM 1-1520-238-23), set and hold **ENG START NO 2** switch in **START** position. Check for 28 VDC at (A330)XK2–5/6–X1.
   Is voltage present?

   YES Go to step 5.

   NO Go to step 7.

4. Check for open between (A330):
   J2–B11 and J2–B12.
   Does open exist?

   YES Repair open wire between (A330):
   J2–B11 and J2–B12.
   Go to paragraph 4–13.

   NO Repair open wire between:
   J22–17 and P978–B11,
   J22–19 and P979–B12.
   Go to paragraph 4–13.

5. Check for open between (A330)XK2–5/6–X2 and ground.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Replace relay K2–5/6 (TM 1-1520-238-23).

6. Check for open between:
   P22–17 and P46–17,
   P22–19 and P46–19.
   Does open exist?

   YES (**ABY**) Repair open wire. Go to paragraph 4–12.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Refer to TM 55-2840-248-23 to troubleshoot engine ignition system.

7. Set and hold **ENG START NO 2** switch in **START**, check for 28 VDC at P978–A14.
   Is voltage present?

   YES Repair open wire between (A330)J2–A14 and (A330)XK2–5/6–X1.
   Go to paragraph 4–13.

   NO Go to step 8.

4–50. ENGINE 2 – DOES NOT START (cont) 4–50

8. Check for open between P978–A14 and P173–H.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Go to step 9.

9. Check for open between (A24):
   J1–H and S34–1.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Replace **ENG START NO 2** switch (S34) (TM 55-2840-248-23).

END OF TASK

4–51. OIL PSI ENG 1 INDICATOR – IS LIGHTED WITH ENGINE OIL PSI X 10 INDICATING MORE THAN 22 PSI 4–51

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-T-5
TM 1-1520-238-T-6

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P18.
   Is OIL PSI ENG 1 indicator lighted?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot pilot caution/warning system.

   NO Go to step 2.

2. Check for short between P18–7 and P70–5.
   Does short exist?

   YES Repair shorted wire. Go to paragraph 4–12.

   NO Refer to TM 1-1520-238-T-5 to troubleshoot engine instruments.

END OF TASK

4–52. OIL PSI ENG 2 INDICATOR – IS LIGHTED WITH ENGINE OIL PSI X10 INDICATING MORE THAN 22 PSI 4–52

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-T-5
TM 1-1520-238-T-6

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P18.
   Is OIL PSI ENG 2 indicator lighted?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot pilot caution/warning system.

   NO Go to step 2.

2. Check for short between P18–8 and P70–6.
   Does short exist?

   YES Repair shorted wire.
   Go to paragraph 4–13.

   NO Refer to TM 1-1520-238-T-5 to troubleshoot engine instruments.

END OF TASK

4–53. EMERG PWR INDICATOR – IS NOT LIGHTED WITH CKT B SWITCH SET TO ENG 1 4–53

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for 28 VDC at P175–11.
   Is voltage present?

   YES Go to step 3.

   NO Go to step 2.

2. Check for 28 VDC at P439–A14.
   Is voltage present?

   YES Repair open between:
   P439–A15 and P175–11.
   (A402):
   J21–A14 and TB1–8–A,
   J21–A15 and TB1–8–B.
   Go to paragraph 4–12.

   NO Go to step 4.

3. Set and hold **CKT B** switch in **ENG 1**, check for open between (A78):
   J1–3 and XK1–X2,
   J1–1 and XK1–X1.
   Does open exist?

   YES Go to step 5.

   NO Go to step 7.

4. Check for open between P439–A14 and P463–c.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station)

5. Check for open between (A78):
   J1–3 and S1–6,
   S1–5 and XK1–X2,
   J1–1 and S1–3,
   S1–2 and XK1–X1.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Go to step 6.

6. Check for open between (A78):
   K1–X1 and K1–X2,
   K1–2 and K1–4.
   Does open exist?

   YES Replace power check light relay (A78)K1 (TM 1-1520-238-23).

   NO Replace **CKT B** switch (A78)S1 (TM 1-1520-238-23).

4–53. EMERG PWR INDICATOR – IS NOT LIGHTED WITH CKT B SWITCH SET TO ENG 1 (cont) 4–53

7. Check for open between:
P175–15 and P748–Z,
P175–14 and P748–Y.
(A78):
K1–3 and J1–12,
J1–14 and J1–15.
Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Go to step 8.

8. Check for open between:
P21–4 and P41–5,
P21–5 and P41–7.
Does open exist?

   YES (**ABY**) Repair open wire.
   Go to paragraph 4–12.
   (**ABZ**) Replace wire harness
   (TM 1-1520-238-23).

   NO Go to step 9.

9. Check for open between:
J21–4 and P175–3,
J21–5 and P175–1.
Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Go to step 10.

10. Check for 18 to 28 VDC between P175–3 and P175–1.
Is voltage present?

   YES Go to step 12.

   NO Go to step 11.

11. Check for 115 VAC between P41–1 and P41–2.
Is voltage present?

   YES Refer to TM 55-2840-248-23 to troubleshoot engine 2, (**ABY**) ECU.
   (**ABZ**) DECU.

   NO Go to step 13.

12. Check for open between P175–12 and P748–a.
Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Replace multi–channel dimming controller (TM 1-1520-238-23).

13. Check for 115 VAC at P1–22.
Is voltage present?

   YES Go to step 14.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (ac essential bus 1 –pilot station).

14. Check for open between:
P21–1 and P41–1,
P21–2 and P41–2.
Does open exist?

   YES (**ABY**) Repair open wire.
   Go to paragraph 4–12.
   (**ABZ**) Replace wire harness
   (TM 1-1520-238-23).

   NO Go to step 15.

15. Check for open between:
(A402)J1–22 and J21–1
(A402)GS9–M and J21–2.
Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Refer to TM 55-2840-248-23 to troubleshoot engine 1, (**ABY**) ECU.
   (**ABZ**) DECU.

END OF TASK

4–54. EMERG PWR INDICATOR – IS NOT LIGHTED WITH CKT B SWITCH SET TO ENG 2 4–54

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 55-2840-248-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for 28 VDC at P175–11.
   Is voltage present?

   YES Go to step 3.

   NO Go to step 2.

2. Check for 28 VDC at P439–A14.
   Is voltage present?

   YES Repair open between:
   P439–A15 and P175–11.
   (A402):
   J21–A14 and TB1–8–A,
   J21–A15 and TB1–8–B.
   Go to paragraph 4–13.

   NO Go to step 4.

3. Set and hold **CKT B** switch in **ENG 2**, check for open between (A78):
   J1–4 and XK1–X2,
   J1–2 and XK1–X1.
   Does open exist?

   YES Go to step 5.

   NO Go to step 7.

4. Check for open between P439–A14 and P463–c.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station)

5. Check for open between (A78):
   J1–4 and S1–4,
   S1–5 and XK1–X2,
   J1–2 and S1–1,
   S1–2 and XK1–X1.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Go to step 6.

6. Check for open between (A78):
   K1–X1 and K1–X2,
   K1–2 and K1–4.
   Does open exist?

   YES Replace power check light relay (A78)K1 (TM 1-1520-238-23).

   NO Replace **CKT B** switch (A78)S1 (TM 1-1520-238-23).

4–54. EMERG PWR INDICATOR – IS NOT LIGHTED WITH CKT B SWITCH SET TO ENG 2 (cont) 4–54

7. Check for open between:
P175–15 and P748–Z,
P175–14 and P748–Y.
(A78):
K1–3 and J1–12,
J1–14 and J1–15.
Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Go to step 8.

8. Check for open between:
P22–4 and P42–5,
P22–5 and P42–7.
Does open exist?

   YES (**ABY**) Repair open wire.
   Go to paragraph 4–13.
   (**ABZ**) Replace wire harness
   (TM 1-1520-238-23).

   NO Go to step 9.

9. Check for open between:
J22–4 and P175–4,
J22–5 and P175–2.
Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Go to step 10.

10. Check for 18 to 28 VDC between P175–3 and P175–1.
Is voltage present?

   YES Go to step 12.

   NO Go to step 11.

11. Check for 115 VAC between P42–1 and P42–2.
Is voltage present?

   YES Refer to TM 55-2840-248-23 to troubleshoot engine 2, (**ABY**) ECU.
   (**ABZ**) DECU.

   NO Go to step 13.

12. Check for open between P175–12 and P748–a.
Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Replace multi–channel dimming controller (TM 1-1520-238-23).

13. Check for 115 VAC at P1–23.
Is voltage present?

   YES Go to step 14.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (ac essential bus 1 –pilot station).

14. Check for open between:
P22–1 and P42–1,
P22–2 and P42–2.
Does open exist?

   YES (**ABY**) Repair open wire.
   Go to paragraph 4–13.
   (**ABZ**) Replace wire harness
   (TM 1-1520-238-23).

   NO Go to step 15.

15. Check for open between:
(A402)J1–23 and J22–1
(A402)GS1–L and J22–2.
Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Refer to TM 55-2840-248-23 to troubleshoot engine 2, (**ABY**) ECU.
   (**ABZ**) DECU.

END OF TASK

4–55. ECS AIRFLOW PRESENT – WITH ENG START NO 1 SWITCH AT IGN OVRD 4–55

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-T-8
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – panel L200 removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Place **MASTER IGN** switch to **ON**. Set and hold **ENG START NO 1** switch to **IGN OVRD**. Check for 28 VDC at (A402)XK4–7–X1.
Is voltage present?

   YES Go to step 4.

   NO Go to step 2.

2. Check for open between (A402):
TB2–10–G and J20–B10,
XK4–7–X1 and TB2–10–J.
Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Go to step 3.

3. Check for open between P433–B10 and P977–A16.
Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Replace start mode relay panel (TM 1-1520-238-23).

4. Remove (A402)K4–7 (TM 1-1520-238-23), check for open between (A402)XK4–7–X2 and ground.
Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Go to step 5.

5. Set and hold **ENG START NO 1** switch set to **IGN OVRD**, check for 28 VDC at (A402)XK2–9/10–X1.
Is voltage present?

   YES Go to step 6.

   NO Repair open wire between (A402):
   XK4–7–X2 and TB2–10–H.
   Go to paragraph 4–12.

6. Check for open between (A402)XK2–9/10–X2 and ground.
Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Go to step 7.

7. Attach (A402)K4–7 (TM 1-1520-238-23), detach wire from (A402)XK4–7–A2. Set and hold **ENG START NO 1** switch to **IGN OVRD**, check for 28 VDC at (A402)XK4–7–A2.
Is voltage present?

   YES Replace relay (A402)K4–7 (TM 1-1520-238-23).

   NO Go to step 8.

4–55. ECS AIRFLOW PRESENT – WITH ENG START NO 1 SWITCH AT IGN OVRD (cont) 4–55

8. Detach wire from (A402)XK2–9/10–A2. Set and hold **ENG START NO 1** switch to **IGN OVRD**, check for 28 VDC at (A402)XK2–9/10–A2.
   Is voltage present?

   YES Replace relay (A402)K2–9 /10 (TM 1-1520-238-23).

   NO Refer to TM 1-1520-238-T-8 to troubleshoot ECS shutoff valve.

END OF TASK

4–56. ECS AIRFLOW PRESENT – WITH ENG START NO 2 SWITCH AT IGN OVRD 4–56

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-T-8
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 panel removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Place **MASTER IGN** switch to **ON**. Set and hold **ENG START NO 2** switch to **IGN OVRD**. Check for 28 VDC at (A402)XK4–7–X1.
   Is voltage present?

   YES Go to step 4.

   NO Go to step 2.

2. Check for open between (A402):
   TB2–10–G and J20–B10,
   XK4–7–X1 and TB2–10–J.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Go to step 3.

3. Check for open between P433–B10 and P977–A16.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Replace start mode relay panel (TM 1-1520-238-23).

4. Remove relay (A402)K4–7 (TM 1-1520-238-23). Check for open between (A402)XK4–7–X2 and ground.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Go to step 5.

5. Set and hold **ENG START NO 2** switch to **IGN OVRD**. Check for 28 VDC at (A402)XK2–9/10–X1.
   Is voltage present?

   YES Go to step 6.

   NO Repair open wire between (A402):
   XK4–7–X1 and TB2–10–H.
   Go to paragraph 4–13.

6. Check for open between (A402)XK2–9/10–X2 and ground.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Go to step 7.

7. Attach relay (A402)K4–7 (TM 1-1520-238-23), detach wire from (A402)XK4–7–A2. Set and hold **ENG START NO 2** switch to **IGN OVRD**. Check for 28 VDC in (A402)XK4–7–A2.
   Is voltage present?

   YES Replace relay (A402)K4–7 (TM 1-1520-238-23).

   NO Go to step 8.

4–56. ECS AIRFLOW PRESENT – WITH ENG START NO 2 SWITCH AT IGN OVRD (cont) 4–56

8. Detach wire from (A402)XK2–9/10–A2. Set and hold **ENG START NO 2** switch to **IGN OVRD**, check for 28 VDC at (A402)XK2–9/10–A2.
   Is voltage present?

   YES Replace relay (A402)K2–9/10 (TM 1-1520-238-23).

   NO Refer to TM 1-1520-238-T-8 to troubleshoot ECS.

END OF TASK

4–57. EXCESSIVE TORSIONAL VIBRATION AND N_R DROOP OCCURS DURING FLIGHT – (ENGINE 1 N_P LAGS BEHIND ENGINE 2 N_P DURING RECOVERY MANEUVER) 4–57

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer’s	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-23
TM 1-1520-238-MTF
TM 55-2840-248-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-MTF	Suspect engine identified
TM 1-1520-238-23	N_R droop compensator potentiometer adjustment – completed Access provisions – LN1, LN3, LN4 – doors opened

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between:
   P41–4 and P41–13,
   P41–4 and P41–15.
   Does open exist?

   YES Go to step 3.

   NO Go to step 2.

2. Detach P21. Check for short between:
   P41–4 and ground,
   P41–13 and ground,
   P41–15 and ground.
   Does short exist?

   YES (**ABY**) Repair shorted wire. Go to paragraph 4–12.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Go to step 4.

3. Check for open between:
   P41–4 and P21–35,
   P41–13 and P21–33,
   P41–15 and P21–34.
   Does open exist?

   YES (**ABY**) Repair open wire. Go to paragraph 4–12.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Go to step 6.

4. Check for short between:
   J21–33 and ground,
   J21–34 and ground,
   J21–35 and ground.
   Does short exist?

   YES Go to step 5.

   NO Refer to TM 55-2840-248-23 to troubleshoot engine 1 HMU,
   (ABY) ECU.
   (ABZ) DECU.

5. Detach P1121. Check for short between:
   P1121–4 and ground,
   P1121–5 and ground,
   P1121–6 and ground.
   Does short exist?

   YES Repair shorted wire. Go to paragraph 4–12.

   NO Replace collective potentiometer position transducer (TM 1-1520-238-23).

4–57. EXCESSIVE TORSIONAL VIBRATION AND N_R DROOP OCCURS DURING FLIGHT – (ENGINE 1 N_P LAGS BEHIND ENGINE 2 N_P DURING RECOVERY MANEUVER) (cont) 4–57

6. Check for open between:
   J21–35 and P1121–4,
   J21–33 and P1121–5,
   J21–34 and P1121–6.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Replace collective potentiometer position transducer (TM 1-1520-238-23).

END OF TASK

4–58. EXCESSIVE TORSIONAL VIBRATION AND N_R DROOP OCCURS DURING FLIGHT – (ENGINE 2 N_P LAGS BEHIND ENGINE 1 N_P DURING RECOVERY MANEUVER) 4–58

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-23
TM 1-1520-238-MTF
TM 55-2840-248-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-MTF	Suspect engine identified
TM 1-1520-238-23	N_R droop compensator potentiometer adjustment – completed Access provisions – LN1, LN3, LN4 – doors opened

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between:
   P42–4 and P42–13,
   P42–4 and P42–15.
   Does open exist?

   YES Go to step 3.

   NO Go to step 2.

2. Detach P22. Check for short between:
   P42–4 and ground,
   P42–13 and ground,
   P42–15 and ground.
   Does short exist?

   YES (**ABY**) Repair shorted wire.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).
   Go to paragraph 4–13.

   NO Go to step 4.

3. Check for open between:
   P42–4 and P22–35,
   P42–13 and P22–33,
   P41–15 and P22–34.
   Does open exist?

   YES (**ABY**) Repair open wire.
   Go to paragraph 4–13.
   (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO Go to step 6.

4. Check for short between:
   J21–33 and ground,
   J21–34 and ground,
   J21–35 and ground.
   Does short exist?

   YES Refer to TM 55-2840-248-23 to troubleshoot engine 1 HMU,
   (ABY) ECU.
   (**ABZ)** DECU.

   NO Go to step 5.

5. Detach P1121. Check for short between:
   P1121–1 and ground,
   P1121–2 and ground,
   P1121–3 and ground.
   Does short exist?

   YES Repair shorted wire.
   Go to paragraph 4–13.

   NO Replace collective potentiometer position transducer (TM 1-1520-238-23).

4–58. EXCESSIVE TORSIONAL VIBRATION AND N_R DROOP OCCURS DURING FLIGHT – (ENGINE 2 N_P LAGS BEHIND ENGINE 1 N_P DURING RECOVERY MANEUVER) (cont) 4–58

6. Check for open between:
   J22–33 and P1121–1,
   J22–34 and P1121–2,
   J22–35 and P1121–3.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–13.

   NO Replace collective potentiometer position transducer (TM 1-1520-238-23).

END OF TASK

4–59. ENGINE 1 DOES NOT RESTART – CKT A AND CKT B SWITCHES RELEASED 4–59

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-23
TM 55-2840-248-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 panel removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Visually inspect engine start relay panel for oil contamination of the start relay box.
   Is oil present?

   YES Clean engine start relay box (TM 1-1520-238-23).

   NO Go to step 2.

2. Check for open between:
   P45–17 and P45–19,
   P45–17 and P45–18.
   Does open exist?

   YES Go to step 4.

   NO Go to step 3.

3. With electrical power applied, set and hold **CKT A** switch in **ENG 1** position on pilot **EMERG PWR CHK OVSP TEST** panel. Check for open between:
   P45–17 and P45–19,
   P45–17 and P45–18.
   Does open exist?

   YES Go to step 6.

   NO Go to step 5.

4. Detach P21. Check for open between:
   J21–17 and J21–19,
   J21–18 and (A330)XK1–7/8–A2,
   (A330)XK1–5/6 SP1 and (A330)XK1–5/6–A3.
   Does open exist?

   YES Repair open wire. Go to paragraph 4–12.

   NO Go to step 8.

5. Remove relay (A330)K1–7/8 (TM 1-1520-238-23). Set and hold **CKT A** switch in **ENG 1** position. Check for 28 VDC between (A330):
   XK1–7/8–C1 and XK1–7/8–X2.
   Is voltage present?

   YES Replace relay (A330)K1–7/8 (TM 1-1520-238-23).

   NO Go to step 7.

6. Release **CKT A** switch. Wait 5 seconds minimum, then check for open between:
   P45–17 and P45–19,
   P45–17 and P45–18.
   Does open exist?

   YES Replace relay (A330)K1–7/8 (TM 1-1520-238-23).

   NO Refer to TM 55-2840-248-23 to troubleshoot engine ignition system.

4–59. ENGINE 1 DOES NOT RESTART – CKT A AND CKT B SWITCHES RELEASED (cont) 4–59

7. Check for open between P977–A9 and ground.
   Does open exist?

   YES — Repair open wire. Go to paragraph 4–12.

   NO — Go to step 9.

8. Check for open between:
   P21–17 and P45–17,
   P21–18 and P45–18,
   P21–19 and P45–19.
   Does open exist?

   YES — (**ABY**) Repair open wire. Go to paragraph 4–12. (**ABZ**) Replace wire harness (TM 1-1520-238-23).

   NO — Go to step 10.

9. Check for open between P977–B1 and P175–18.
   Does open exist?

   YES — Repair open wire. Go to paragraph 4–12.

   NO — Go to step 12.

10. Check for open between (A330):
    XK1–5/6–A2 and XK1–5/6–A3.
    Does open exist?

    YES — Replace relay (A330)K1–5/6 (TM 1-1520-238-23).

    NO — Go to step 11.

11. Remove relay (A330)K1–7/8. Check for open between (A330):
    XK1–7/8–A2 and XK1–7/8–A3.
    Does open exist?

    YES — Replace relay (A330)K1–7/8 (TM 1-1520-238-23).

    NO — Repair open wire between (A330):
    XK1–7/8–A2 and J1–B10,
    XK1–7/8–A3 and
    XK1–5/6 –A2.
    Go to paragraph 4–12.

12. Check for open between:
    (A330)XK1–7/8–X2 and ground,
    (A330)XK1–7/8–C1 and P175–18.
    Does open exist?

    YES — Repair open wire. Go to paragraph 4–12.

    NO — Replace pilot **EMERG PWR CHK OVSP TEST** panel (TM 1-1520-238-23).

END OF TASK

4–60. ENGINE 2 DOES NOT RESTART – CKT A AND CKT B SWITCHES RELEASED 4–60

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-23
TM 55-2840-248-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 panel removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Visually inspect engine start relay panel for oil contamination of the start relay box.
Is oil present?

   YES Clean engine start relay box (TM 1-1520-238-23).

   NO Go to step 2.

2. Check for open between:
P46–17 and P46–19,
P46–17 and P46–18.
Does open exist?

   YES Go to step 4.

   NO Go to step 3.

3. With electrical power applied, set and hold **CKT A** switch in **ENG 2** position on pilot **EMERG PWR CHK OVSP TEST** panel. Check for open between:
P46–17 and P46–19,
P46–17 and P46–18.
Does open exist?

   YES Go to step 6.

   NO Go to step 5.

4. Detach P22. Check for open between:
J22–17 and J22–19,
J22–18 and (A330)XK2–7/8–A2,
(A330)XK2–5/6 SP1 and (A330)XK2–5/6–A3.
Does open exist?

   YES Repair open wire. Go to paragraph 4–13.

   NO Go to step 8.

5. Remove relay (A330)K2–7/8 (TM 1-1520-238-23). Set and hold **CKT A** switch in **ENG 2** position. Check for 28 VDC between (A330):
XK2–7/8–C1 and XK2–7/8–X2.
Is voltage present?

   YES Replace relay (A330)K2–7/8 (TM 1-1520-238-23).

   NO Go to step 7.

6. Release **CKT A** switch. Wait 5 seconds minimum, then check for open between:
P46–17 and P46–19,
P46–17 and P46–18.
Does open exist?

   YES Replace relay (A330)K2–7/8 (TM 1-1520-238-23).

   NO Refer to TM 55-2840-248-23 to troubleshoot engine ignition system.

4–60. ENGINE 2 DOES NOT RESTART – CKT A AND CKT B SWITCHES RELEASED (cont) 4–60

7. Check for open between P978–A9 and ground.
Does open exist?

YES Repair open wire.
Go to paragraph 4–13.

NO Go to step 9.

8. Check for open between:
P22–17 and P46–17,
P22–18 and P46–18,
P22–19 and P46–19.
Does open exist?

YES (**ABY**)Repair open wire.
Go to paragraph 4–13.
(**ABZ**) Replace wire harness
(TM 1-1520-238-23).

NO Go to step 10.

9. Check for open between P978–B1 and P175–20.
Does open exist?

YES Repair open wire.
Go to paragraph 4–13.

NO Go to step 12.

10. Check for open between (A330):
XK2–5/6–A2 and XK2–5/6–A3.
Does open exist?

YES Replace relay (A330)K2–5/6
(TM 1-1520-238-23).

NO Go to step 11.

11. Remove relay (A330)K2–7/8
(TM 1-1520-238-23). Check for open between (A330):
XK1–7/8–A2 and XK1–7/8–A3.
Does open exist?

YES Replace relay (A330)K1–7/8
(TM 1-1520-238-23).

NO Repair open wire between
(A330):
XK2–7/8–A2 and J2–B10
XK2–7/8–A3 and XK2–5/6–A2.
Go to paragraph 4–13.

12. Check for open between:
(A330)XK2–7/8–X2 and ground,
(A330)XK2–7/8–C1 and P175–20.
Does open exist?

YES Repair open wire.
Go to paragraph 4–13.

NO Replace pilot **EMERG PWR CHK OVSP TEST** panel
(TM 1-1520-238-23).

END OF TASK

4–61. PILOT POWER QUADRANT PANEL EDGE–LIGHT – DOES NOT LIGHT 4–61

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Pilot **FUEL** panel – removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. On pilot circuit breaker panel, close **LT PRI** circuit breaker. On pilot **EXT LT/INTR LT** panel, set **L CSL** to **BRT**. Check for 5 VDC between P173–X and ground.
   Is voltage present?

   YES Replace pilot power quadrant panel (TM 1-1520-238-23).

   NO Go to step 2.

2. Check for open between (A326)TB1–28–B and P173–X.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot pilot edge–lights.

END OF TASK

4–62. CPG POWER QUADRANT PANEL EDGE–LIGHT – DOES NOT LIGHT 4–62

t

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Pilot **FUEL** panel – removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. On CPG circuit breaker panel 1, close **PRI LT** circuit breaker. On CPG **INTR LT** panel, set **L CSL** to **BRT**. Check for 5 VDC between P190–8 and ground.
   Is voltage present?

   YES Replace CPG power quadrant panel (TM 1-1520-238-23).

   NO Go to step 2.

2. Check for open between (A326)TB1–46–E and P190–8.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 4–12.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot CPG edge–lights.

END OF TASK

CHAPTER 5
ROTORS

CHAPTER INDEX

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SECTION I. EQUIPMENT DESCRIPTION AND DATA

5–1. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES 5–1

a. **Characteristics.**

(1) The main rotor assembly and tail rotor assembly each consists of a rotor head and four rotor blades.

(2) Droop stop followers on the main rotor head limit pitch housing downward movement when the rotor is stopped.

(3) The main rotor system is controlled by the collective and cyclic sticks at the pilot and copilot gunner (CPG) stations. The tail rotor is controlled by the pilot and CPG directional control pedals. Refer to chapter 11 for flight control system information.

(4) The main rotor provides lift and control for vertical, forward, rear, and side movement of the helicopter.

(5) The tail rotor provides directional control for the helicopter.

(6) The pitch angle of the main rotor blades can be controlled to increase or decrease the amount of lift the helicopter has when climbing or descending.

b. **Capabilities.**

(1) The rotor blades provide lift and directional flight control capabilities in flight.

(2) The four–blade configuration of the rotor head gives the helicopter the ability to bob up without drifting to a stop.

(3) The blades are fully articulated, with lead–lag capability. This balances the lift of the advancing and retreating blades which increases airspeed capability.

c. **Features.**

(1) Anti–icing provisions are installed on the main and tail rotor blades to prevent ice formation.

(2) Trim tabs are mounted along the trailing edge of the main rotor blades and are used to adjust the blade track through the air.

(3) The blades can be removed from the helicopter for transportation and storage.

5–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS 5–2

Rotor System. The rotor system (fig. 5–1) consists of the main rotor head assembly, four main rotor blades, tail rotor head assembly, and four tail rotor blades.

a. **Main Rotor Head Assembly.** The main rotor head assembly (fig. 5–2) is a single, fully articulated system. The major components consists of the hub assembly, four strap packs, the pitch housing assembly, a droop stop follower, blade attachment pins, dampers and lead–lag links.

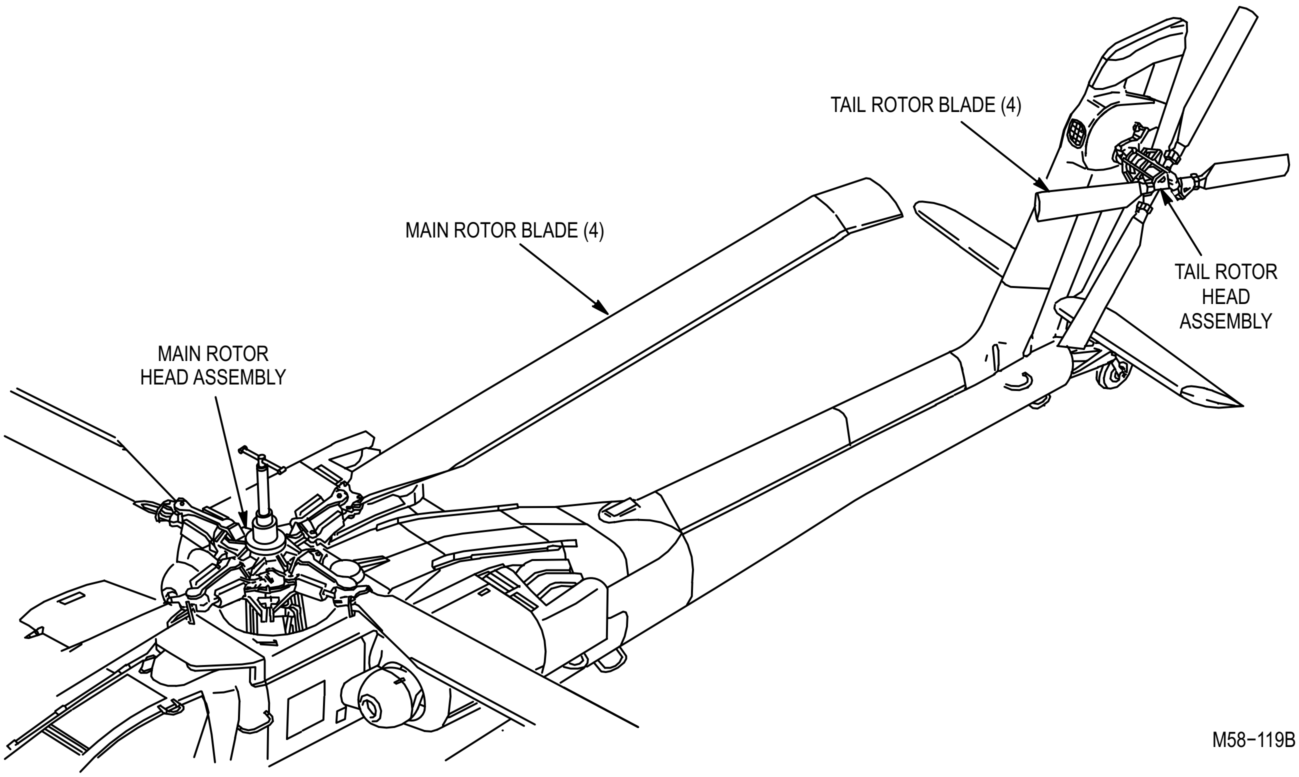


Figure 5–1. Rotor System

(1) The hub assembly is mounted on the main drive shaft static mast and provides attachment points for the four main rotor blade assemblies. It provides the means for feathering, flapping, and lead–lag movement of each blade. It transfers flight loads from the main rotor assembly to the static mast and into the airframe.

(2) Four strap packs are bolted to the hub. Each strap pack has V–shaped stainless steel straps. The lead–lag links are attached to the strap packs and pitch housing assemblies.

(3) The pitch housing assembly uses a feathering bearing assembly between the hub and housing assemblies. The feathering bearing allows the pitch housing assembly to move up and down. An arm on each pitch housing assembly is attached to the cyclic controls through a pitch link. Control inputs twist the pitch housing assembly to cause angle changes in main rotor blade assembly.

(4) The droop stop follower contacts the droop stop ring to limit the pitch housing downward movement when the main rotor blade assembly is stopped.

(5) The blade attachment pins are made of steel and are an adjustable bushing type that allows for easy removal or installation of the blades.

(6) Two dampers are attached between each pitch housing and its lead–lag link. The dampers are used to control the lead–lag movement of the rotor blades and prevent mass imbalance (unequal blade spacing).

(7) The lead–lag links (4 ea) are titanium mounts that provide mounting points for the main rotor blade assembly.

5–2 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 5–2

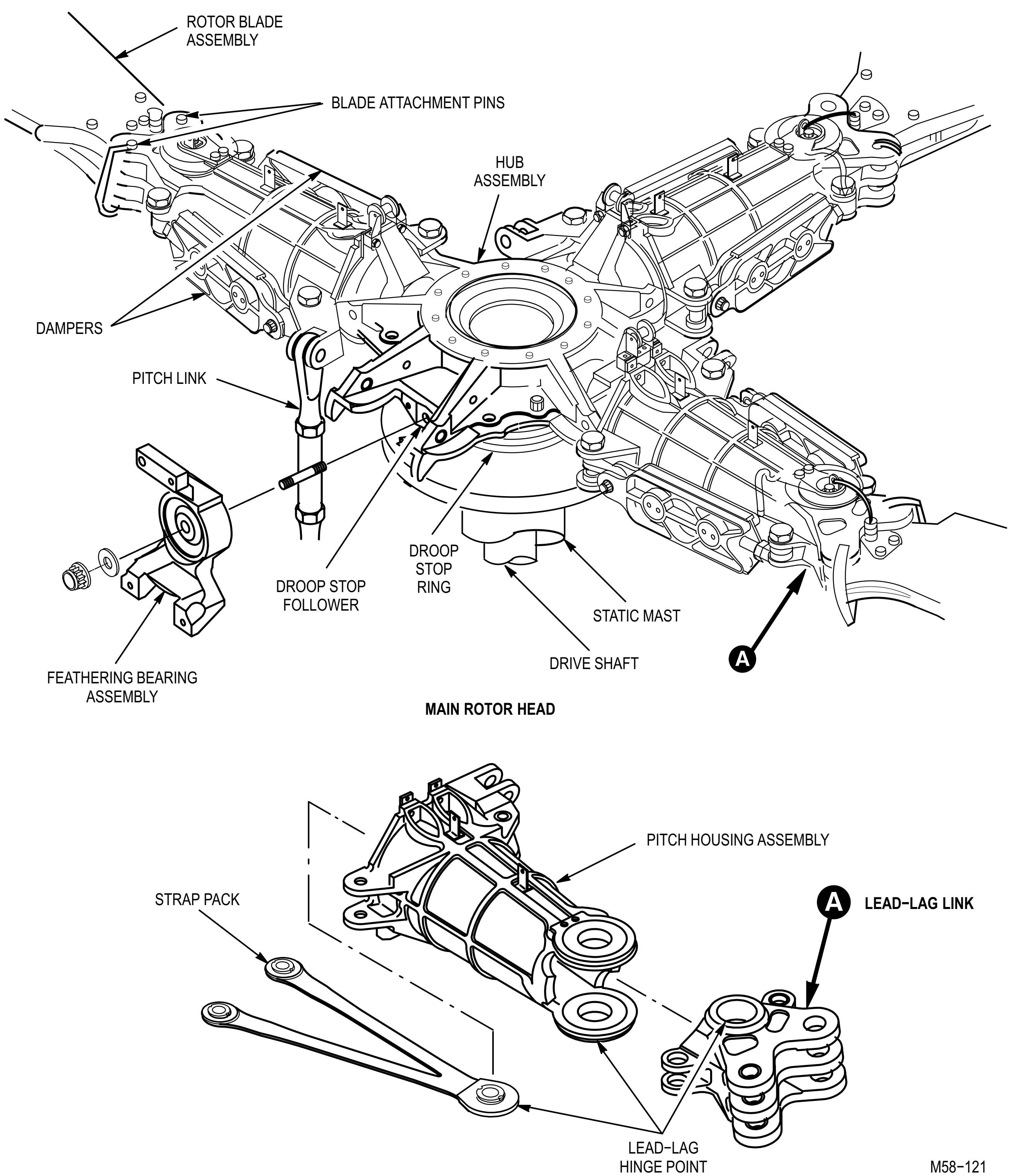


Figure 5–2. Main Rotor Head Assembly

5–2 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 5–2

b. **Main Rotor Blade Assembly.** The main rotor blade assembly (fig. 5–3) is attached to the main rotor head assembly lead–lag link by two blade attachment pins. It is constructed of stainless steel and fiberglass and consists of four stainless steel spars. The inboard end is the root section and is the attaching point for the blade to the main rotor head assembly. The outboard end has a static discharge wick and a swept back tip. The rotor blade assembly has an internal stainless steel balance bar in the leading edge, a nomex honeycomb core and a stainless steel trailing edge. The trailing edge has a bendable tab on the outboard end which is used to obtain the correct track path.

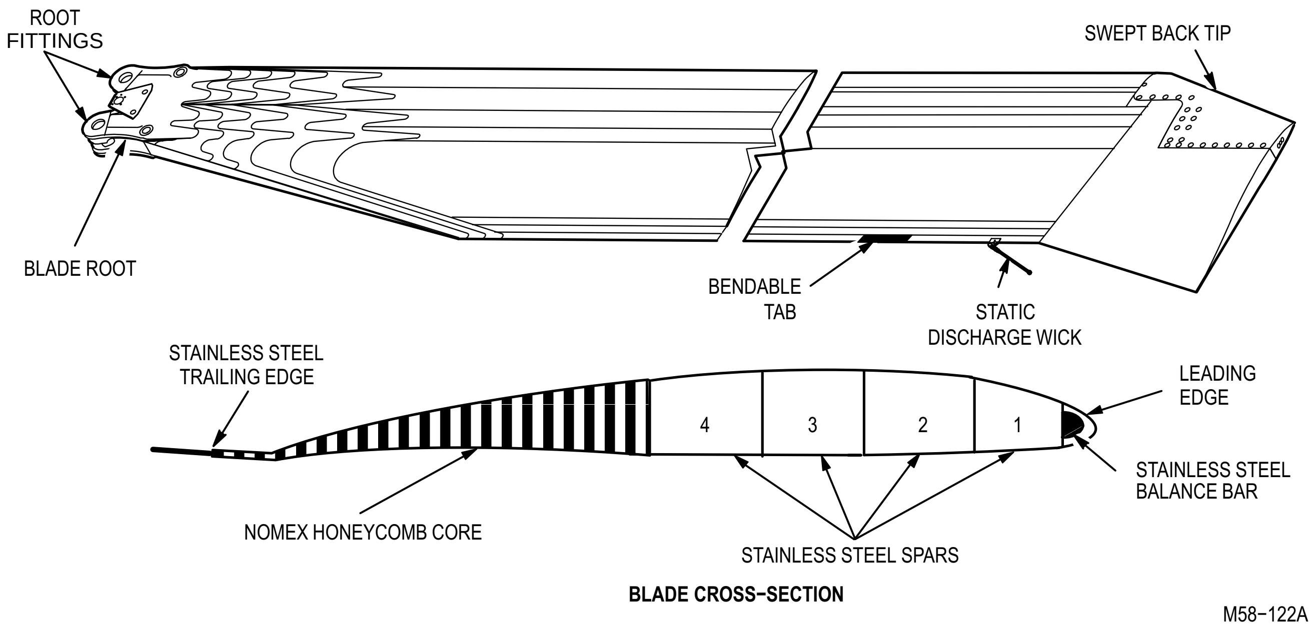


Figure 5–3. Main Rotor Blade Assembly

c. **Tail Rotor Assembly.** The tail rotor assembly (fig. 5–4) consists of the tail rotor head assembly and four tail rotor blades which are installed on the tail rotor gearbox output shaft, and is secured by three studs/nuts. The tail rotor head assembly consists of a fork, four elastomeric bearings, and four hubs. Each hub has a stainless steel strap pack that passes through the hub. The strap pack is attached to the tail rotor blade assembly and the hub.

(1) **Tail Rotor Blade Assembly.** Tail rotor blade assembly (fig. 5–5) is constructed of a stainless steel leading edge. Eleven aluminum honeycomb stiffeners are bonded into the spar, and the blade skin is aluminum with bonded doublers near the blade root fitting. A pitch horn which contains steel bushings, attaches to the pitch link. Tip weights are attached under a tip cap at the blade outboard end. Weights are added or removed for balance of the tail rotor blade assembly.

5–2 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 5–2

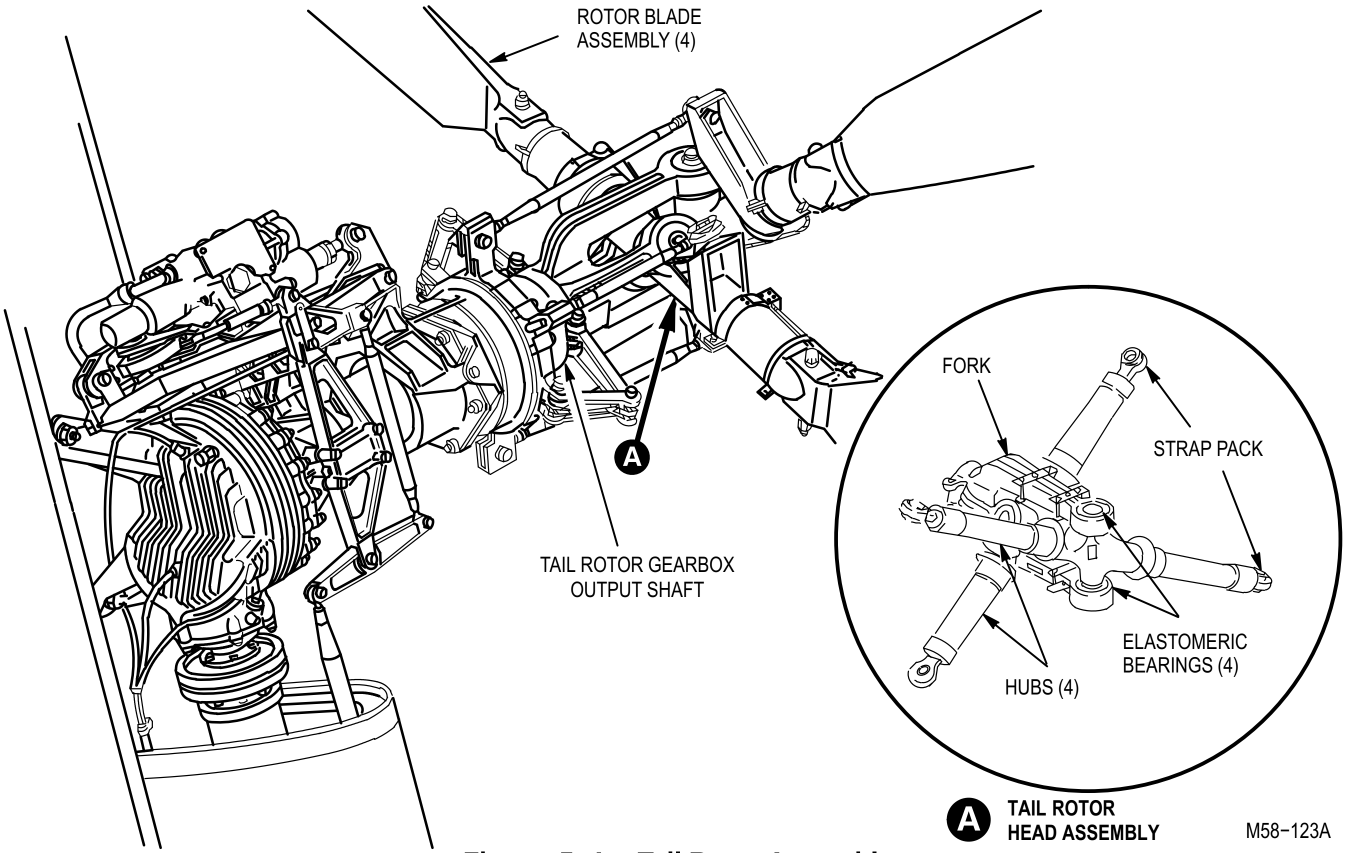


Figure 5–4. Tail Rotor Assembly

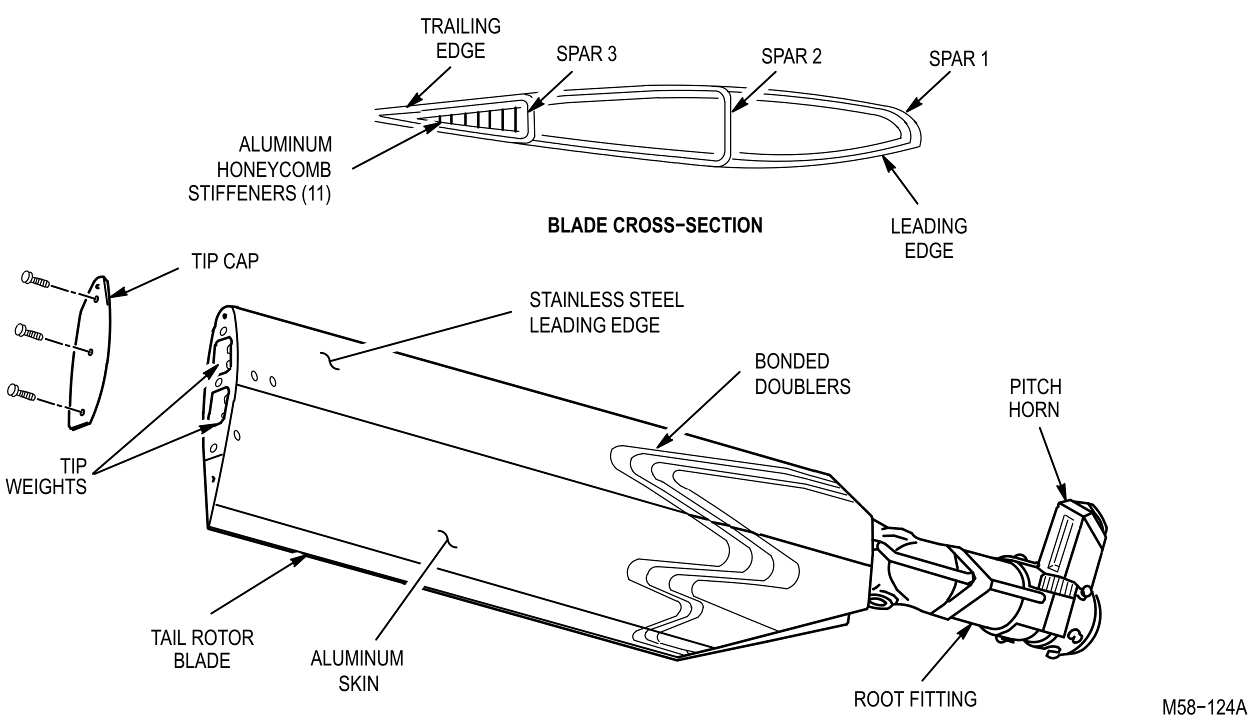


Figure 5–5. Tail Rotor Blade Assembly

5–3. EQUIPMENT DATA 5–3

Main rotor head assembly

Diameter . . . . 78 inches

Weight . . . . 607 lbs.

Main rotor blade assembly

Blade length . . . . 20 feet 10 inches

Blade weight . . . . 157 lbs.

Tail rotor fork assembly

Weight . . . . 39.1 lbs.

Tail rotor blade assembly

Blade length . . . . 51.4 inches

5–4. EQUIPMENT CONFIGURATION 5–4

Not applicable.

5–5. SAFETY, CARE AND HANDLING OF EQUIPMENT 5–5

Not applicable.

5–6. CONTROLS AND INDICATORS 5–6

The rotor system receives mode selects and remote switch inputs from various controls located in the pilot station (fig. 5–6) and CPG station (fig. 5–7). Table 5–1 provides a listing of the controls, switches and associated indicators pertaining to the rotor system along with a description of their function.

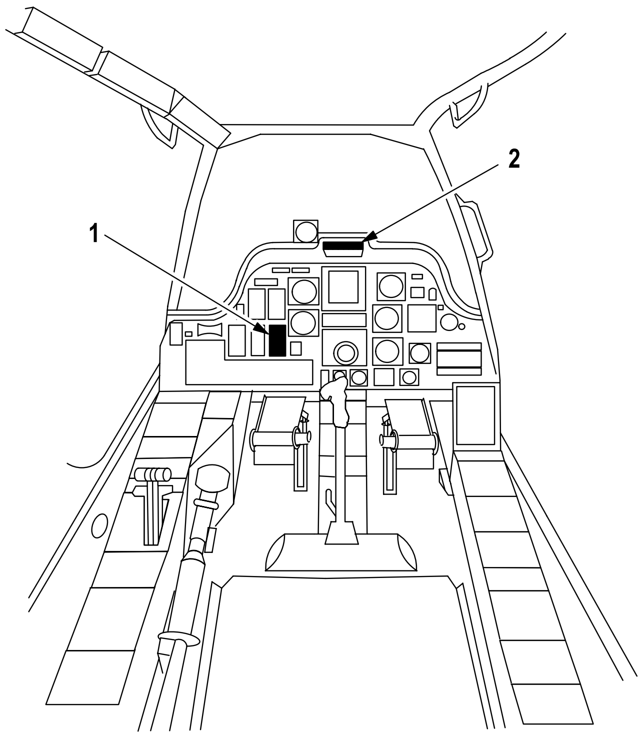


Figure 5–6. Pilot Station

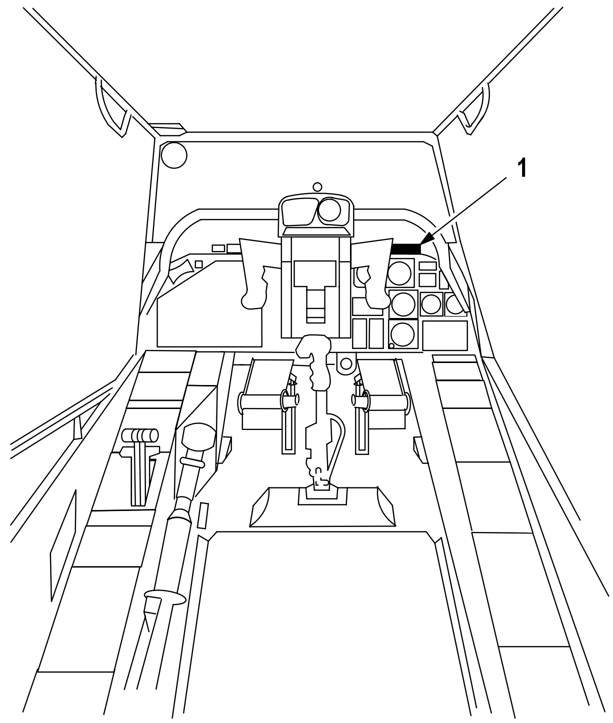


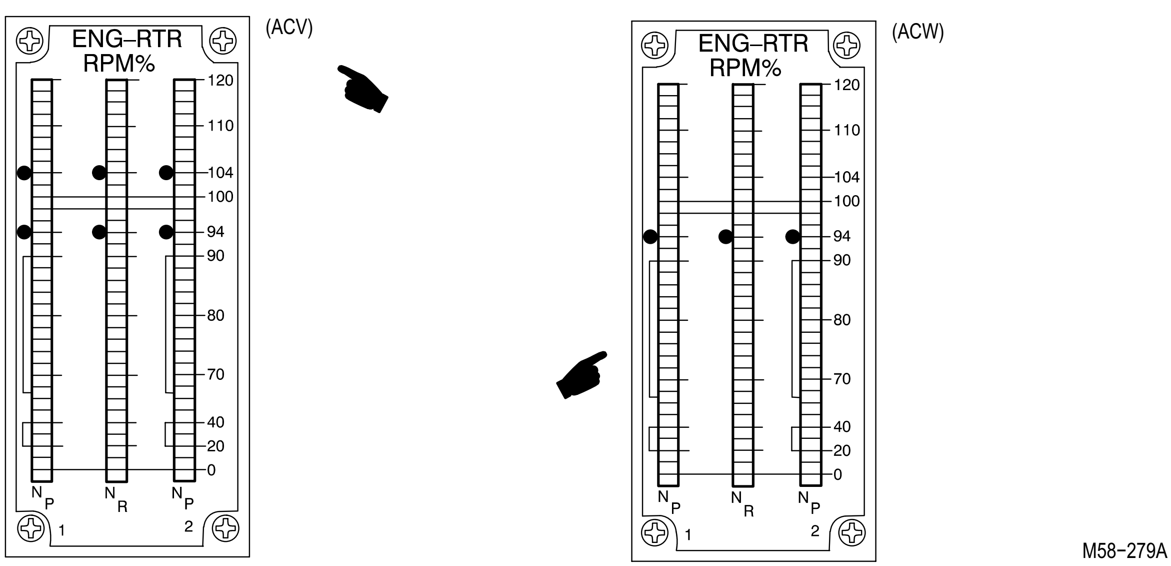
Figure 5–7. CPG Station

Table 5–1. Rotor System Controls And Indicators

Pilot ENG – RTR RPM% Indicator		
SWITCH/INDICATOR	POSITION	FUNCTION
N_P 1 and **N_P 2** vertical scales	RED (upper) . **(ACV)**	Lights when engine 1 speed is greater than 104%.
	RED (upper) . **(ACW)**	Lights when engine 1 speed is greater than 110%.
	AMBER (upper) . **(ACV)**	Lights when engine 1 speed is 100 – 104%.
	AMBER (upper) . **(ACW)**	Lights when engine 1 speed is 104 – 110%.
	GREEN **(ACV)**	Lights when engine 1 normal speed is 98 – 100%.
	GREEN **(ACW)**	Lights when engine 1 normal speed is 98 – 104%.

Table 5–1. Rotor System Controls And Indicators (cont)

Pilot ENG – RTR RPM% Indicator (cont)		
SWITCH/INDICATOR	POSITION	FUNCTION
N_P 1 and **N_P 2** vertical scales (cont)	AMBER (lower)	Lights when engine 1 speed is 94 – 98%.
	RED (lower)	Lights when engine 1 speed is 0 – 94%.
	BLUE	Lights when instrument power is applied.
	RED DOT	Lights at beginning of red range.
N_R vertical scale	RED (upper) . **(ACV)**	Lights when transient operation is 104 – 110%.
	RED (upper) . **(ACW)**	Lights when transient operation is 110%.
	AMBER **(ACW)**	Lights when normal operation is 104 – 110%.
	GREEN	Lights when normal operation is 94 – 104%.
	RED (lower)	Lights when transient power is removed 0 – 94%.
	BLUE	Lights when instrument power is applied.
	RED DOT	Lights at beginning of red range.

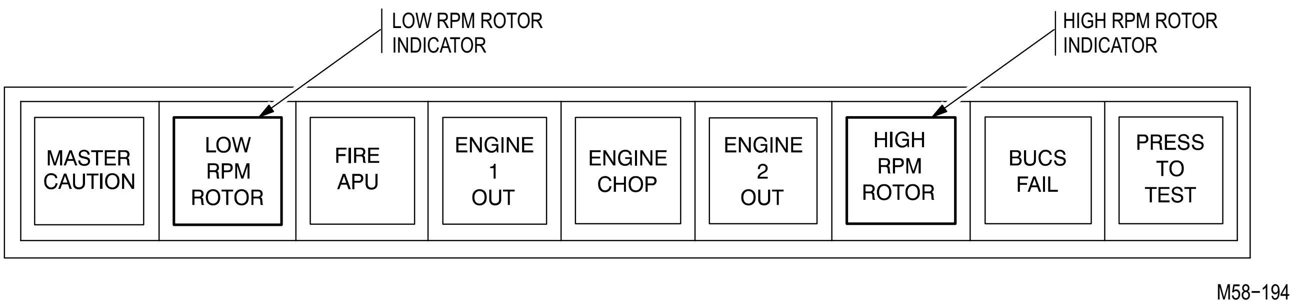


Pilot ENG – RTR RPM% Indicator

5–6. CONTROLS AND INDICATORS (cont) 5–6

Table 5–1. Rotor System Controls And Indicators (cont)

Master Caution/Warning Panel		
SWITCH/INDICATOR	POSITION	FUNCTION
HIGH RPM ROTOR indicator	RED **(ACV)**	Lights when rotor speed is greater than 104%.
	RED **(ACW)**	Lights when rotor speed is greater than 108%.
LOW RPM ROTOR indicator	RED	Lights when rotor speed is less than 92%.



Master Caution/Warning Panel

SECTION II. THEORY OF OPERATION

5–7. SYSTEM DESCRIPTION 5–7

Rotor System. The purpose of the rotor system (fig. 5–8) is to provide lift, thrust, directional flight, and anti–torque control for the helicopter. The rotor system consists of the main rotor assembly, the tail rotor assembly, and the controls and indicators used by the crew to operate the rotor system.

a. The main rotor assembly is secured to the top of the static mast so that it transfers the flight loads to the static mast and then to the airframe. The main rotor head is a four arm, fully articulated assembly that provides attachment points for the four main rotor blades. The main rotor blades attach to the rotor head by titanium lead–lag links and steel blade attachment pins.

b. Each main rotor blade outboard end is swept aft 20° and the blade is equipped with a de–ice heater blanket. A static discharger is mounted on the trailing edge at the point where the blade starts to sweep aft. The main rotor blades are designed to prevent catastrophic failure in the event of certain kinds of battle damage and cracks. The installed main rotor blades can also be folded into a special saddle for helicopter transportation or storage.

c. The tail rotor head assembly is a two arm, teetering assembly that provides attachment points for the four tail rotor blades. Flight loads are transferred from the tail rotor assembly to the static support and to the airframe. Each tail rotor blade is attached to the tail rotor head by a pre–load indicating (PLI) washer, bolt and nut combination.

d. The tail rotor blades are designed to prevent catastrophic failure in the event of certain kinds of battle damage and cracks and are also equipped with de–ice heaters.

e. The directional control pedals, located on the floor of the pilot and CPG stations, control the tail rotor system. The pilot and CPG cyclic and collective sticks work together to control the main rotor system.

f. The **ENG–RTR RPM%** indicator provides the aircrew with a visual reference of the main rotor speed (N_R) in %. The **HIGH** and **LOW RPM ROTOR** indicators on the pilot and CPG master caution/warning panels provide visual warning of main rotor speed.

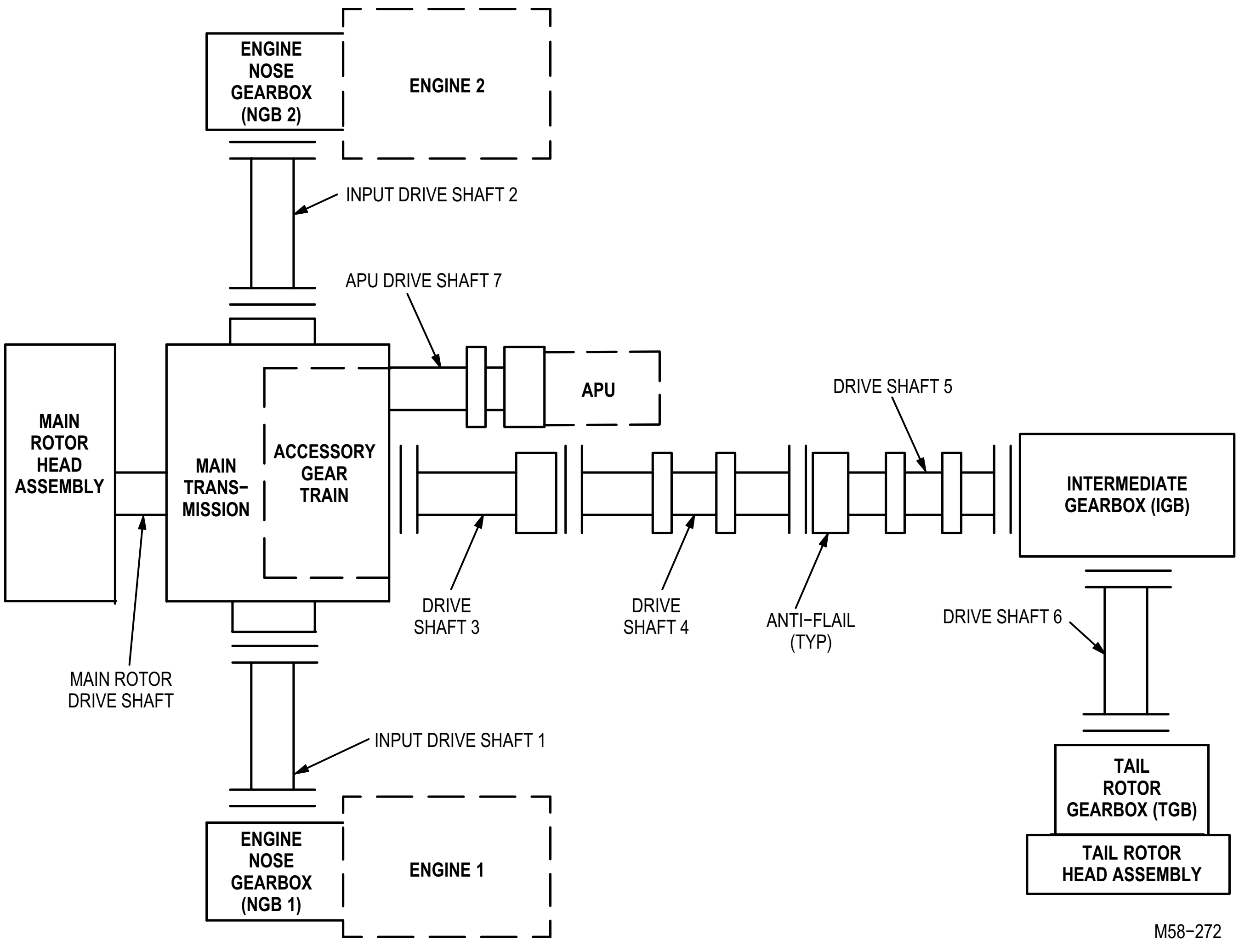


Figure 5–8. Rotor System Block Diagram

5–8. MULTIPLEX READ CODES 5–8

Not applicable.

 All data on pages 5-13 through 5-34 including Paragraphs 5-9 through 5-16 deleted

SECTION III. TROUBLESHOOTING PROCEDURES

5–17. MAIN ROTOR TRACK AND BALANCE USING AVA EQUIPMENT 5–17

a. GENERAL INSTRUCTIONS

1. Track and balance of main rotor blades should be performed when any of the following occurs:
   - One or more blades have been changed.
   - One or more tip caps have been changed.
   - One or more pitch control rods or rod end bearings have been changed.
   - The main rotor blades have been removed and the hub has been disassembled.
   - As per applicable maintenance manuals.

2. A typical track and balance mission from start to finish includes the following:
   - Phase main rotor blades (TM 1-1520-238-23).

   NOTE

   Phasing the main rotor blades cannot be emphasized enough, this is the base starting point for track and balance and if not performed, will not allow track and balance to be completed in a timely manner.

   - Installation of the Aviation Vibration Analyzer (TM 1-1520-238-23).
   - Recommended steps prior to aircraft operations (para 5–18).

   NOTE

   Tail rotor balance should be accomplished before any in-flight checks are performed. The tail rotor procedure can be performed during a ground run. If the tail rotor is wired, take the measurements during the first ground run, and make the adjustments and check the balance again on the next ground run.

   - Ground track and adjustments (para 5–19).
   - Initial check and adjustments (para 5–20).
   - Flight check and adjustments (para 5–21).

3. There may be cases when the aircraft can be flown to check the in-flight-vibrations, without performing the ground work. The following are some examples when this can be done:

   NOTE

   If the following procedures do not obtain proper results, refer to paragraph 2 and comply with all required steps to accomplish rotor track and balance.

   - Aircraft is written up for an in-flight one per rev vibration. It is possible that with utilizing the FLIGHT flight plan the aircraft can be brought back into limits.
   - One blade is changed and it may be possible to utilize the FLIGHT flight plan and adjust the rotor and bring it into limits.

END OF TASK

5–18. RECOMMENDED STEPS PRIOR TO AIRCRAFT OPERATION 5–18

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Aviation Vibration Analysis Test Set	6625-01-282-3746
Helicopter Rotor Head Balance and Blade Track Run Test Equipment	4920-01-180-7610

Personnel Required:

67R Attack Helicopter Repairer
67R3T Inspector

References:

TM 1-1520-238-23
TM 1-1520-238-MTF

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Helicopter safed Main rotor assembly inspection completed

a. **Prior to aircraft operation the following steps are recommended:**

(1) Check erosion of leading edge rotor blade in area that tracker views. If underside of leading edge paint is eroded, lightly paint (fog) the underside of leading edge in area of tracker view with flat black paint.

(2) Check accelerometer type. Select appropriate “AIRCRAFT TYPE” (AH64 OR AH64NB) from main screen on CADU. Select manager option (**F4**), then select “SETUP” and select “ACCELEROMETER”. For AH-64 script file, accelerometer channels 5 – 14 should be defined as “AH64 Acc”. For AH-64NB script file, accelerometers 1 – 14 should be set to “Wil M991”, or to the type that is being utilized for the wire around accelerometers.

(3) Check for **0.003 – 0.007 INCH** gap of magnetic pick-up, and check interrupters to ensure that they are not deformed.

(4) Verify main rotor blade trim tab markings (TM 1-1520-238-23).

(5) If new blades are installed, verify that trim tabs are set to 0 degrees for all blade pockets (#0–10).

(6) If previously tracked blades are installed, measure and record trim tab settings. If trim tabs are bent in a uniform direction, do not adjust tabs before flying blade to verify track. If trim tabs are bent in opposing directions, zero trim tabs for all blade pockets (#0–10). If trim tab in pockets #0–3 are not 0, this should be noted for possible future troubleshooting, see troubleshooting sections (para 5–22).

(7) The FM antenna on the tail should be removed before running aircraft for balance to prevent damage to antenna. The antenna should be installed when balance is complete.

END OF TASK

5–19. GROUND TRACK AND ADJUSTMENT USING AVA EQUIPMENT 5–19

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Aviation Vibration Analysis Test Set	6625-01-282-3746
Helicopter Rotor Head Balance and Blade Track Run Test Equipment	4920-01-180-7610
Adapter, Socket Wrench, 3/8, 1/2 Drive	A–A–2172
Crowfoot Attachment, 1–5/16, 3/8 Drive	FC42
Wrench, Open–end 1–1/4 & 1–5/16 (2)	A–A–1356
Wrench, Torque, 1/2 Drive	TCI–1600

Materials/Parts:

Lockwire, MS20995NC32

Personnel Required:

152FG Maintenance Test Pilot
152FG Pilot
67R Attack Helicopter Repairer
67R3T Inspector

References:

TM 1-1520-238-23
TM 1-1520-238-MTF

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Helicopter safed
	Main rotor assembly inspection completed
	Main rotor blade phase completed
	AVA track and balance kit installed

Special Environmental Conditions:
Wind velocity of 20 knots or more may affect accuracy of readings.

NOTE

- **Phasing the main rotor blades cannot be emphasized enough, this is the base starting point for track and balance and if not done, will not allow track and balance to be completed in a timely manner.**
- **The FM antenna on the tail should be removed before running the aircraft for track and balance to prevent damage to the antenna. The antenna should be installed when track and balance is complete.**
- **The GNDTRK flight plan's goal is to obtain a flat track on the ground by adjusting pitch links only. It should be emphasized that the better your ground track the better your starting point, which will greatly increase your success rate for track and balance.**
- **The tail rotor balance (paragraph 5–23) should be accomplished before any in flight checks are performed. The tail rotor balance procedure can be performed during a ground run. If the tail rotor is wired, just take the measurements during the first ground run, and make the adjustments and check the balance again on the next ground run.**

a. PREPARATION

(1) Apply aircraft power (TM 1-1520-238-23).ec

(2) Operate aircraft at 100% Nr, flat pitch.

(3) Turn DAU **ON**.

(4) Turn CADU **ON**.

b. PERFORM GROUND TRACK (GNDTRK) MEASUREMENT

(1) Press **QUIT** on CADU until all selections are undefined.

(2) Use cursor keys to highlight **Aircraft Type**, then press **DO**.

(3) Use cursor keys to highlight **AH64**, then press **DO**.

(4) **Tail Number** is highlighted, then press **DO**.

(5) Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.

(6) **Flight Plan** is highlighted, then press **DO**.

(7) Use cursor keys to highlight **GNDTRK**, press **DO**.

(8) Enter the **MEASURE** mode by pressing **F1**. Verify that test state **Fpg100** is highlighted.

NOTE

If tracker is pointed towards the sun, AVA might give a tracker error. To avoid possible delays while obtaining data, always try to point tracker away from the sun.

(9) Press **DO** when aircraft is stable at highlighted selection. Reverify that aircraft is at required test state and press **DO** again. AVA will acquire track data and return to selection menu.

(10) After measurement is completed, press **DO** on “finish”, then press **DO** on “diagnostics”. If measurements are within specified limits, press **QUIT** to return to main menu and perform paragraph 5–20, Initial Check and Adjustment.

(11) If measured values exceed specifications, press **DO**, perform pitch link corrections (step c) according to AVA, or utilize the **EDIT ADJUSTABLES** as follows:

(a) Track can be adjusted to any one blade (i.e., designated target) by using the **EDIT ADJUSTABLES** from the AVA diagnostic menu and toggling off the blade (target) that you want to adjust to. Example: If blade four is high and you want to adjust other blades up to four, just toggle off blade four in the **EDIT ADJUSTABLES** and press **DO** and AVA will give the solution to adjust other blades to blade four. The reason this is mentioned is that some users in the field have used dual engine torque readings to adjust track. This is done to prevent a large autorotation adjustment later during track and balance. The following are examples of this method.

- If torque is less than 15%, adjust blades up to highest blade by toggling off highest blade and obtaining a solution.
- If torque between 15% and 20%, use AVA recommended default solution to adjust track to the mean of the blades.
- If the torque is greater than 20%, adjust blades down to lowest blade, by toggling off lowest blade and obtaining a solution.

(12) Repeat steps (8) thru (11) until track is within limits, then proceed to paragraph 5–20.

NOTE

One flat is approximately 0.40 INCH of track.

c. ADJUSTMENT OF PITCH LINKS

(1) Mark barrel and upper rod end with a single vertical line for reference.

(2) Cut lockwire securing jam nuts to barrel of pitch link to be adjusted.

(3) Loosen upper jam nut while holding barrel of pitch link. Use two open–end wrenches.

(4) Loosen lower jam nut while holding barrel of pitch link. Use two open–end wrenches.

NOTE

- **To determine which way to turn the pitch link barrel to raise or lower the blade, grasp the barrel with right hand thumb extended up, turning the barrel the same direction as your fingers are pointed will raise the blade up. Turning barrel in the opposite direction will lower the blade.**
- **Shortening the pitch link moves the blade down, lengthening it moves the blade up.**

(5) Turn barrel specified amount displayed on the CADU (“+” means lengthen; “–” means shorten).

(6) Tighten jam nuts and torque to **900 INCH–POUNDS**. Use open–end wrench, torque wrench, and crowfoot.

(7) Safety jam nuts. Use lockwire.

(8) Inspect (QA).

END OF TASK

5–20. INITIAL CHECK AND ADJUSTMENT USING AVA EQUIPMENT 5–20

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Aviation Vibration Analysis Test Set	6625-01-282-3746
Helicopter Rotor Head Balance and Blade Track Run Test Equipment	4920-01-180-7610
Adapter, Socket Wrench, 3/8, 1/2 Drive	A–A–2172
Crowfoot Attachment, 1–5/16, 3/8 Drive	FC42
Wrench, Open–end 1–1/4 & 1–5/16 (2)	A–A–1356
Wrench, Torque 1/2 Drive	TCI–1600

Materials/Parts:

Lockwire, MS20995NC32

Personnel Required:

152FG Maintenance Test Pilot
152FG Pilot
67R Attack Helicopter Repairer
67R3T Inspector

References:

TM 1-1520-238-23
TM 1-1520-238-MTF

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Helicopter safed Main rotor assembly inspection completed

Special Environmental Conditions:
Wind velocity of 20 knots or more may affect accuracy of readings.

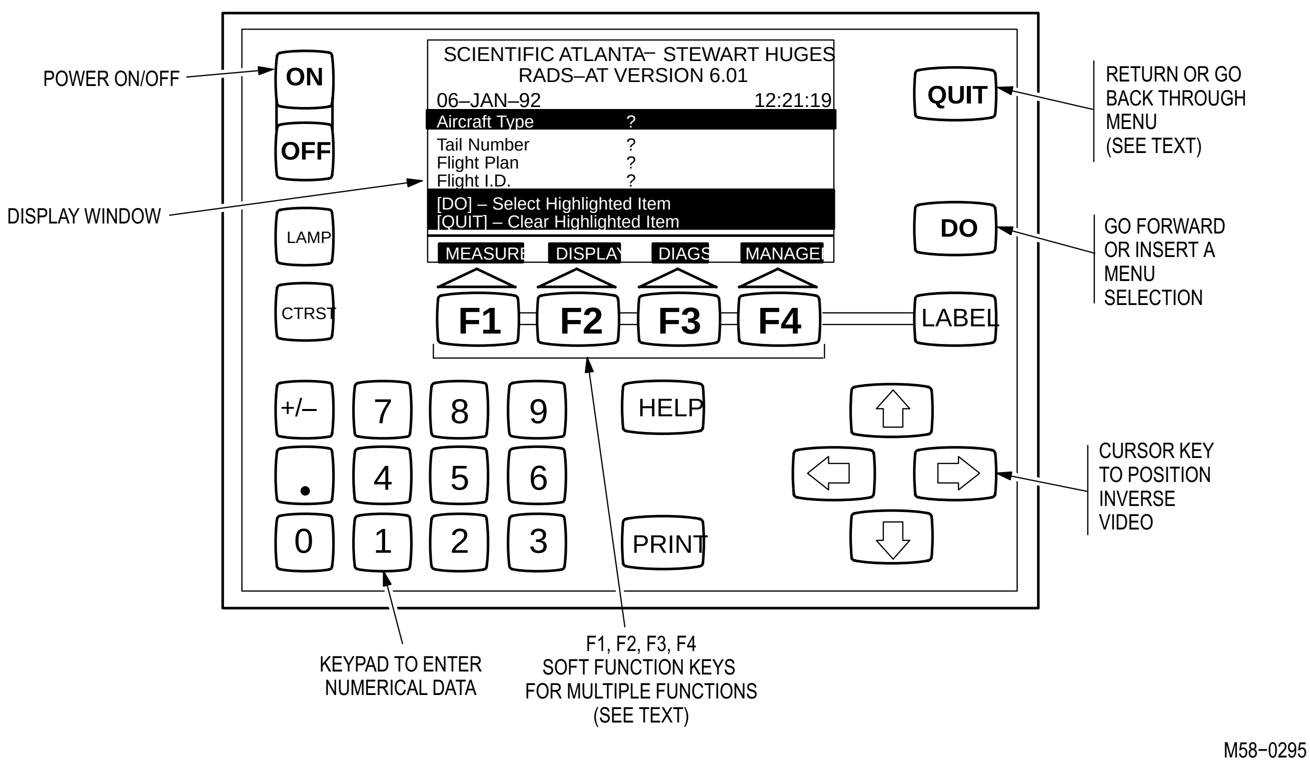


Figure 5–16. CADU Display and Keypad

5–20. INITIAL CHECK AND ADJUSTMENT USING AVA EQUIPMENT (cont) 5–20

a. PREPARATION

(1) Perform ground track and adjustment (paragraph 5–19).

b. PERFORM INITIAL MEASUREMENT

(1) Use cursor keys to highlight aircraft type on CADU display (Figure 5–16), then press **DO**.

(2) Use cursor keys to highlight **AH64**, then press **DO**.

(3) **Tail Number** is highlighted, press **DO**.

(4) Use cursor keys to highlight **Tail Number** used in para 5–19, then press **DO**.

(5) **Flight Plan** is highlighted. Press **DO**.

(6) Use cursor keys to highlight **INITIAL**. Press **DO**.

(7) Press **F1** to enter the **MEASURE** mode. Verify that test state **FPG100** is highlighted.

NOTE

If tracker is pointed towards the sun, AVA might give a tracker error. To avoid possible delays while obtaining data, always try to point tracker away from the sun.

(8) When aircraft is stable at highlighted selection, press **DO**.

(9) Reverify that aircraft is at required test state (**FPG100** or **Hover**), then press **DO** again each time a measurement is completed and another test state is highlighted. AVA will acquire track and vibration data and then return to selection menu.

NOTE

If any test state has “failed” or “partial” message next to the prompt, the AVA did not get a complete set of data for this test state. Arrow back to the test state and repeat measurement until all test states have “done” next to them.

(10) After last measurement is completed, press **DO** on finish, then press **DO** on **DIAGS** (diagnostics).

(11) If measurements are within specified limits, press **QUIT** to main menu and proceed to paragraph 5–21, Flight Track and Adjustment.

(12) If measured values exceed specifications, press **DO** to execute **DIAGS** (diagnostics). AVA will make recommendations to correct excessive vibration. Perform step c, Interpreting Results and Making Corrections.

c. INTERPRETING RESULTS AND MAKING CORRECTIONS

(1) AVA’s default solution will recommend adjusting both pitch links and weights at same time. Recommended method for **INITIAL** diagnostics is to do a weight only solution, if **GNDTRK** measurement has been conducted and track is within limits. This is accomplished by toggling off pitch link adjustment in edit adjustables screen of **DIAGS** (diagnostics) menu, and pressing **DO** to obtain a new solution.

NOTE

The reason that it is not recommended to adjust pitch links for hover track is that the flight adjustments should cause the hover track to fall within specified limits.

(2) Once ground and hover balance is adjusted to acceptable levels, proceed to paragraph 5–21, Flight Track and Adjustment. Do not continue making adjustments to fine tune for **INITIAL** program. If vibration levels are within limits normal procedure is to proceed to flight, because adjustments for flight will affect these levels.

(3) If a weight adjustment is required, go to step e.

(4) If a pitch link adjustment is required, go to paragraph 5–19, step c.

d. COMPARING MOVES BETWEEN FLIGHTS

(1) Compare vibration from one measurement to next (mainly to ensure that aircraft is responding in a normal manner). For **INITIAL** flight plan lateral readings should be trended. To trend more than one data set, perform the following:

- With latest **Flight ID** picked, enter the display mode by pressing **F2**.
- Select **Trend Flights** and press **DO**.
- Select desired channel to trend (either **FPGLAT** or **HOVLAT**) and press **DO**.
- Enter number of test states to trend (the easiest to understand is just trend the last two flights by entering 2, this will trend the most current flight with the previous flight), then arrow to **Draw Axis** and Change to **NO** by pressing the “right arrow” (this will make the polar chart easier to read), and then press **DO**.

(2) This will display vibration trend from the latest flight with previous flights on a polar chart. This process is displayed in Figure 5–17.

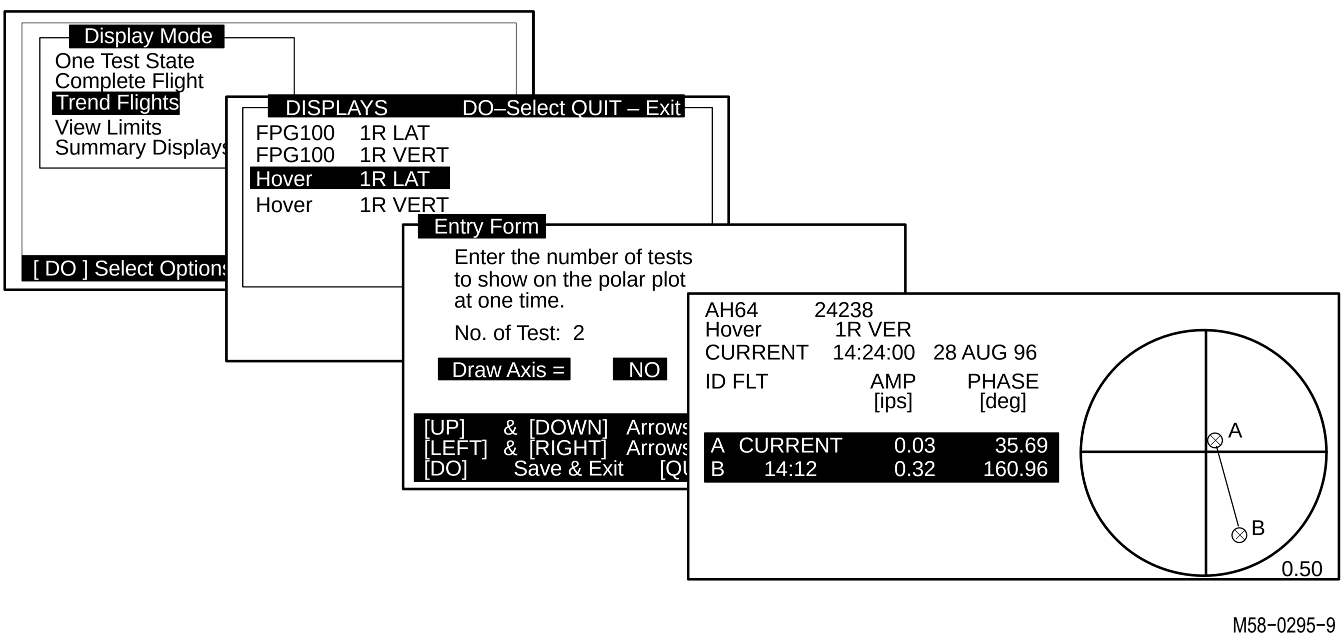


Figure 5–17. Polar Chart Trend

5–20. INITIAL CHECK AND ADJUSTMENT USING AVA EQUIPMENT (cont) 5–20

(3) AVA's goal is to give corrections that will drive vibration levels towards center of polar chart. The question you ask when you're viewing the polar chart is, did vibration levels move towards center of chart or go through center of chart. In some cases you will see vibration trend go through center of chart and overshoot to other side. This is a clear indication that the aircraft is responding to the moves in a normal manner, but the amount of move was too much. Phase information is very important and these polar charts should be used to verify reaction of aircraft. For example lets say there was an adjustment for initial, and Hover lateral went from a .40 ips to .38 ips. If the phase information was ignored one might think the vibration did not change at all, in fact this may have gone to other side of polar chart which is in fact a large move but it just went to far. See paragraph 5–21, for an example of this.

(4) If the vibration shoots to other side of polar plot through center, there are many variables that may have caused this (this particular aircraft had a stronger reaction than AVA is programmed for, or an incorrect move was made, etc.). If there was only one move made to the rotor and it made vibration levels shoot through center, then the fix would to be to take some of that particular move back out (the AVA will normally recommend this in diagnostics). If there were multiple moves performed on the rotor that made vibration levels shoot through center of polar plot, then is not as easy to determine which move caused overreaction. Recommended procedure in this case is to let AVA tell you what moves are required to bring vibration back, by utilizing custom solution options that were described earlier.

e. WEIGHT ADJUSTMENT

WARNING

FLIGHT SAFETY PART

The main rotor blade is a flight safety part. Failure to follow maintenance instructions may result in serious injury or death of crewmembers and/or serious damage to the helicopter.

NOTE

This task is typical for all four main rotor blades.

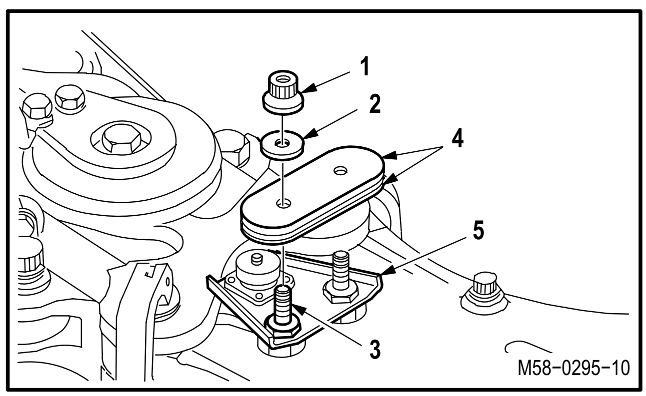
a. **Removal**

NOTE

Weights are added or subtracted to balance main rotor. A maximum of nine weights may be installed.

(1). Remove two nuts (1) and washers (2) from studs (3).

(2). Remove weights (4) from bracket (5).



b. **Cleaning**

a. Wipe bracket. Use cloth item 52, App F).

5–20. INITIAL CHECK AND ADJUSTMENT USING AVA EQUIPMENT (cont) 5–20

c. **Inspection**

(1). Check bracket for cracks and studs for stripped threads. None allowed.

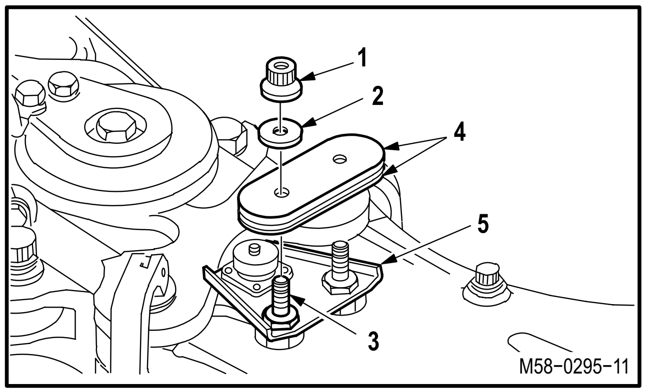
(2). Check bracket and weights for corrosion (TM 1-1520-238-23, para 1.49).

d. **Installation**

NOTE

Weights should be weighed to check the tolerance. AVA assumes that –3 weighs 113 grams and –5 weighs 52 grams.

(1). Install weights (4) on studs (3). Use counterbalance weight (item 215, App F) and/or counterbalance weight (item 216, App F).



(2). Install two washers (2) and nuts (1) on studs (3).

(3). Torque nuts (1) to **100 INCH-POUNDS**. Use torque wrench.

e. **Inspect (QA).**

f. **Make appropriate log book entry and continue track and balance.**

END OF TASK

5–21. FLIGHT CHECK AND ADJUSTMENT USING AVA EQUIPMENT 5–21

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Aviation Vibration Analysis Test Set	6625-01-282-3746
Helicopter Rotor Head Balance and Blade Track Run Test Equipment	4920-01-180-7610
Adapter, Socket Wrench, 3/8, 1/2 Drive	A–A–2172
Crowfoot Attachment, 1–5/16, 3/8 Drive	FC42
Wrench, Open–end 1–1/4 & 1–5/16 (2)	A–A–1356
Wrench, Torque, 1/2 Drive	TCI–1600

Materials/Parts:

Lockwire, MS20995NC32
Balance weights (as required)

Personnel Required:

152FG Maintenance Test Pilot
152FG Pilot
67R Attack Helicopter Repairer
67R3T Inspector

References:

TM 1-1520-238-23
TM 1-1520-238-MTF

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Helicopter safed Main rotor assembly inspection completed AVA rotor track and balance kit installed

NOTE

Main rotor in-flight vertical tracking should be performed when any of the following occurs:

- **One per/rev in-flight vertical vibration is unacceptable.**
- **Changes have been made to the track of one or more main rotor blades as a result of performing ground tracking or initial adjustment.**
- **One or more blades have been changed.**
- **As per maintenance manual.**

a. PREPARATION

NOTE

Aircraft ground track and initial balance are to be completed prior to performing in-flight test states, unless a tune up of the in-flight vibration levels are desired.

(1) Turn DAU **ON**.

(2) Turn CADU **ON**.

b. PERFORM FLIGHT MEASUREMENT

(1) Press **QUIT** on the CADU until all selections are undefined.

5–21. FLIGHT CHECK AND ADJUSTMENT USING AVA EQUIPMENT (cont) 5–21

(2) Use cursor keys to highlight **Aircraft Type**, then press **DO**.

(3) Use cursor keys to highlight **AH64**, then press **DO**.

(4) **Tail Number** is highlighted. Press **DO**.

(5) Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.

(6) **Flight Plan** is highlighted. Press **DO**.

(7) Use cursor keys to highlight **FLIGHT**. Press **DO**.

(8) Enter the **MEASURE** mode by pressing **F1**. Verify that **FPG100** is highlighted.

WARNING

Do not exceed any airspeed at which excessive vibration and/or 3-INCH track spread is present. If main rotor 1/REV vibration becomes objectionable, acquire data normally through the highest airspeed at which vibration can be tolerated. Press QUIT on the CADU and select “save and exit”. Land the aircraft and enter diagnostics and follow AVA steps to correct discrepancy. The AVA diagnostics will give a warning that the test states where data was not acquired, it will not take into account. Even though the higher airspeed test states were not taken the corrections will lower the vibration levels based on the other test states that were taken.

NOTE

- **If tracker is pointed towards the sun, AVA might give a tracker error. To avoid possible delays while obtaining data, always try to point tracker away from the sun.**
- **Autorotation RPM verification should be done as soon as the aircraft is capable of a forward airspeed of 80-100 knots indicated airspeed (KIAS).**

(9) Press **DO** when aircraft is stable at highlighted selection.

(10) Reverify that aircraft is at required test state (**FPG100**, **Hover**, **60Kts**, **80Kts**, **100Kts**, **120Kts**, or **140Kts**) and press **DO** again. Perform this operation each time a measurement is completed and another test state is highlighted. AVA will acquire track and vibration data at each test state and then return to selection menu.

NOTE

If any test state has a “failed” or “partial” message next to the prompt, the AVA did not get a complete set of data for this test state. Arrow back to the test state and repeat the measurement until all test states have “done” next to them.

(11) After last measurement is completed, press **DO** on “finish”, then press **DO** on “diagnostics”. If measurements are within specified limits, press **QUIT** to main menu and proceed to step (14).

5–21. FLIGHT CHECK AND ADJUSTMENT USING AVA EQUIPMENT (cont) 5–21

(12) If measured values exceed specifications, press **DO** to execute diagnostics. AVA will make recommendations to correct excessive vibration. Review “WHAT YOU SHOULD KNOW BEFORE ENTERING DIAGNOSTICS” and Step c., “INTERPRETING RESULTS AND MAKING CORRECTIONS.”

(13) After corrections are made, refly aircraft and repeat step b. to recheck the 1/REV vibrations through required flight conditions.

NOTE

- **If a weight adjustment is required, go to paragraph 5–20, step e.**
- **If a pitch link adjustment is required, go to paragraph 5–19, step c.**
- **If a trim tab adjustment is required, go to step d.**

(14) Remove Aviation Vibration Analysis equipment (TM 1-1520-238-23).

(15) Inspect (QA).

WHAT YOU SHOULD KNOW BEFORE ENTERING DIAGNOSTICS

Before entering diagnostics it may be beneficial to view the in flight vertical readings on the polar plot and the in flight track trend. By doing this before entering diagnostics, it will give a good indication of what will be required to smooth the aircraft.

Figure 5–18 illustrates a polar plot display of the in flight vertical vibration readings from the AVA:

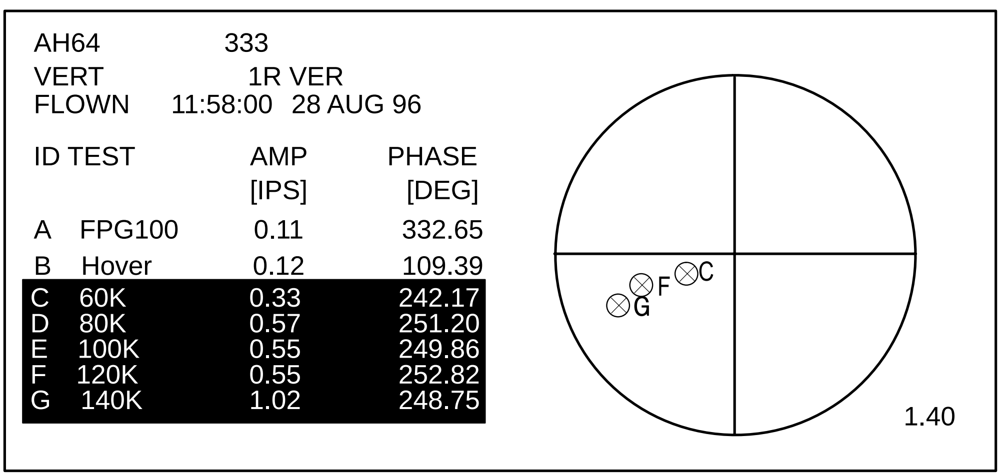


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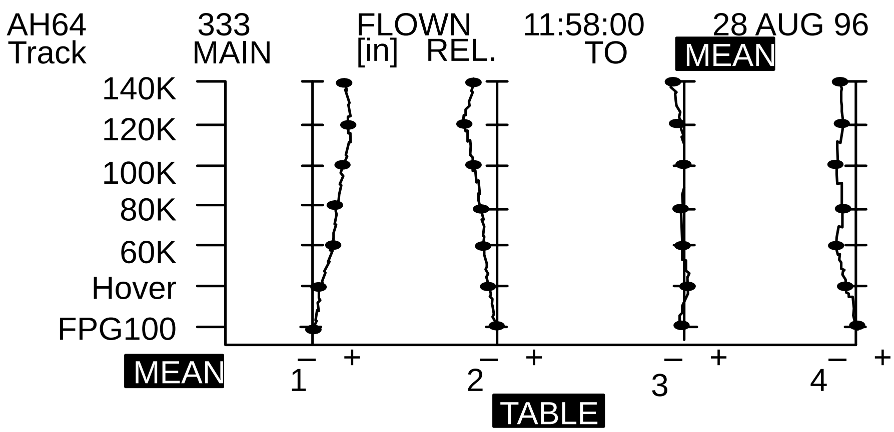
Figure 5–18. Polar Plot Display

By viewing the display above and the AH-64 coefficient polar chart for vertical vibration at the end of this section, this clearly shows that blade 1, blade 3, or both will require adjusting to move the vibration points towards the center. To move the vibrations points towards center for this example would required blade 1 to be tabbed down (or pitch linked down) or blade 3 to be tabbed up (or pitch linked up).

5–21. FLIGHT CHECK AND ADJUSTMENT USING AVA EQUIPMENT (cont) 5–21

To verify this further it helps to view the track data. Figure 5–19 illustrates the track trend for this example from the AVA:



AH64 333 FLOWN 11:58:00 28 AUG 96
Track [in] REL. TO MEAN

Track

TEST	1	2	3	4
FPG100	0.09	–0.10	–0.05	0.06
Hover	0.24	–0.17	–0.12	–0.20
60K	0.79	–0.28	–0.00	–0.50
80K	0.91	–0.42	–0.07	–0.42
100K	1.22	–0.72	–0.02	–0.52
120K	1.40	–0.90	–0.11	–0.39
140K	1.30	–0.64	–0.30	–0.36

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Figure 5–19. AVA Track Trend

5–21. FLIGHT CHECK AND ADJUSTMENT USING AVA EQUIPMENT (cont) 5–21

The polar chart showed that either blade 1 or 3 may need to be adjusted to move the vibration to the center, and this track trend shows that blade 1 is the blade that needs to be adjusted. Adjustments should not be made based on this track trend, the information from both the polar chart and the track trend should be used to make smart decisions when running AVA diagnostics. This is emphasized here by the fact that if adjustments were based on this track trend alone, blade 2 might also be adjusted, which will actually increase the vertical vibration as shown in Figure 5–20.

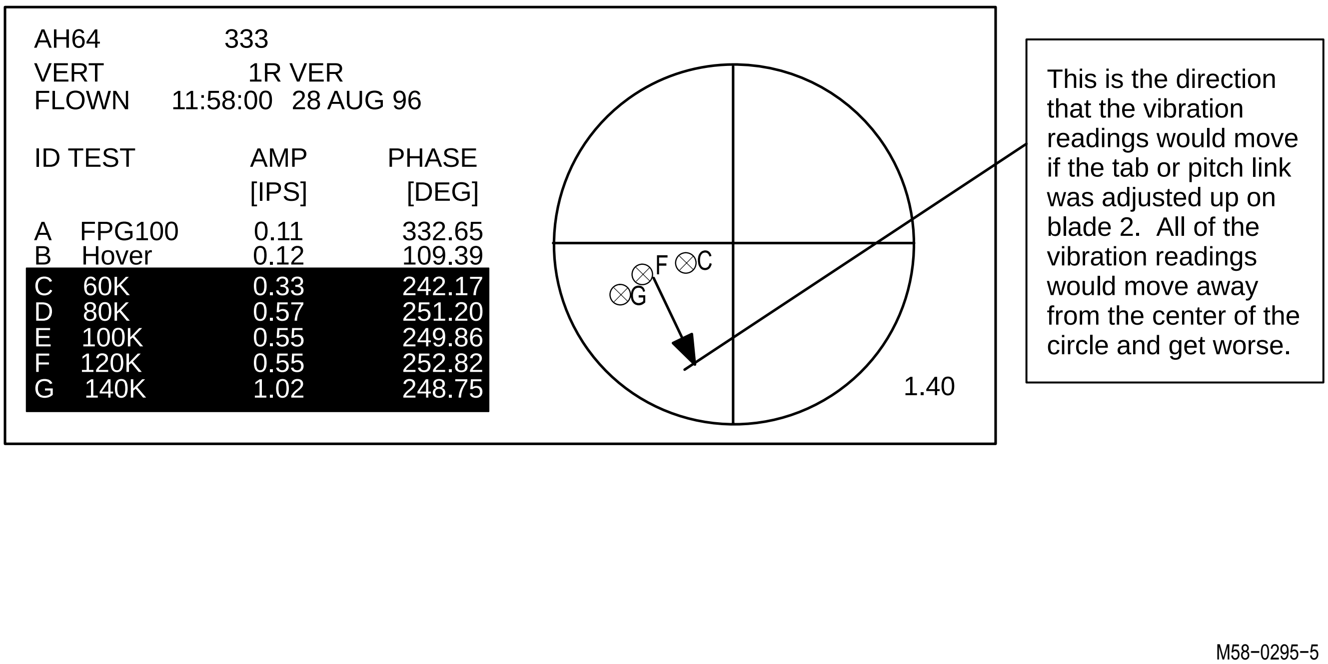


Figure 5–20. Polar Chart

As the caption says above, if blade 2 was adjusted to bring the aircraft into track that would be a mistake and would increase the vertical vibration (refer to the AH-64 coefficient polar chart for vertical vibration shown in figs. 5–21, 5–22, and 5–23).

In this particular example the default AVA solution had seven adjustments and after turning on the Resolve to Limit option (this option will be discussed in the custom solutions section) the solution was only one adjustment, which was -1.5 degrees tab on blade 1. This move made sense according to the previous displays, and after this adjustment was performed the aircraft was within limits.

All this information in the displays should not be used to make corrections, this should be used to make changes to the diagnostics to obtain a better solution. After all this information is reviewed it’s time to enter Diagnostics.

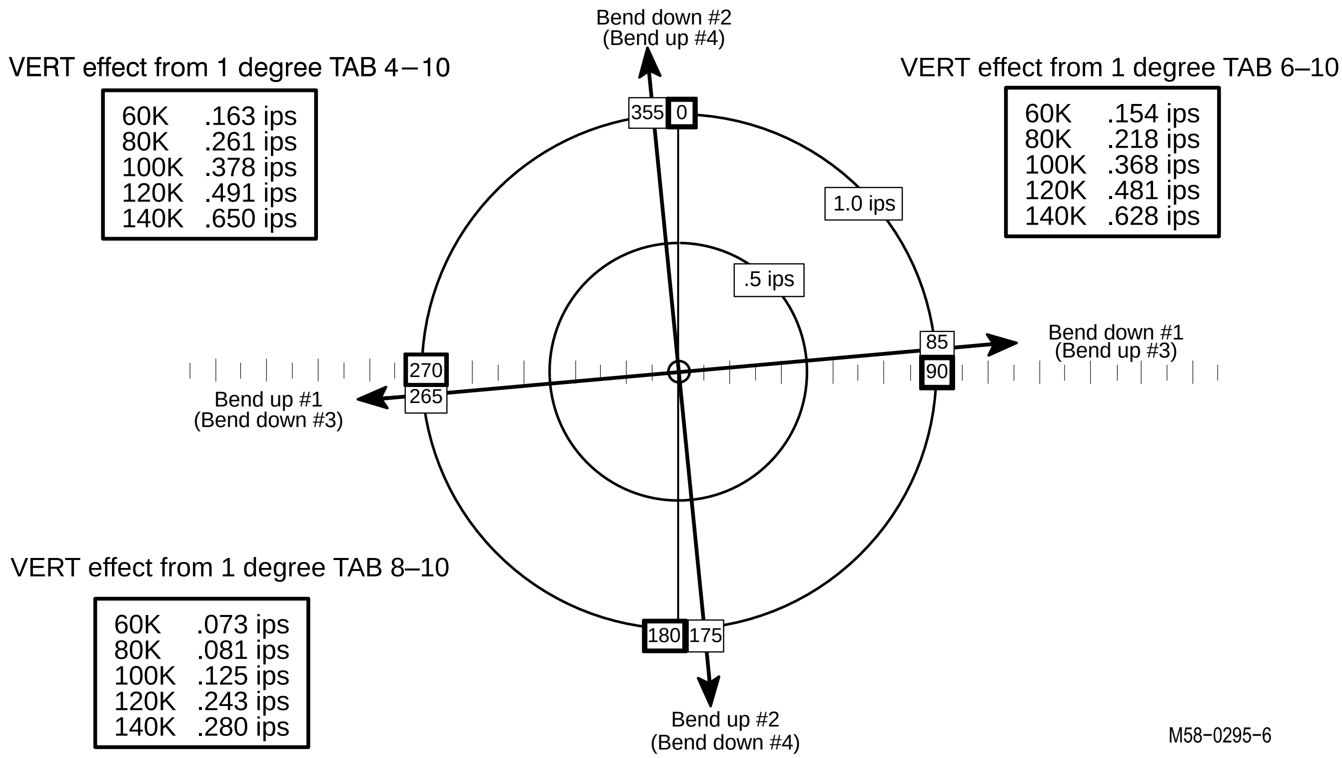


Figure 5–21. AH–64 Vertical Effect for TAB Changes

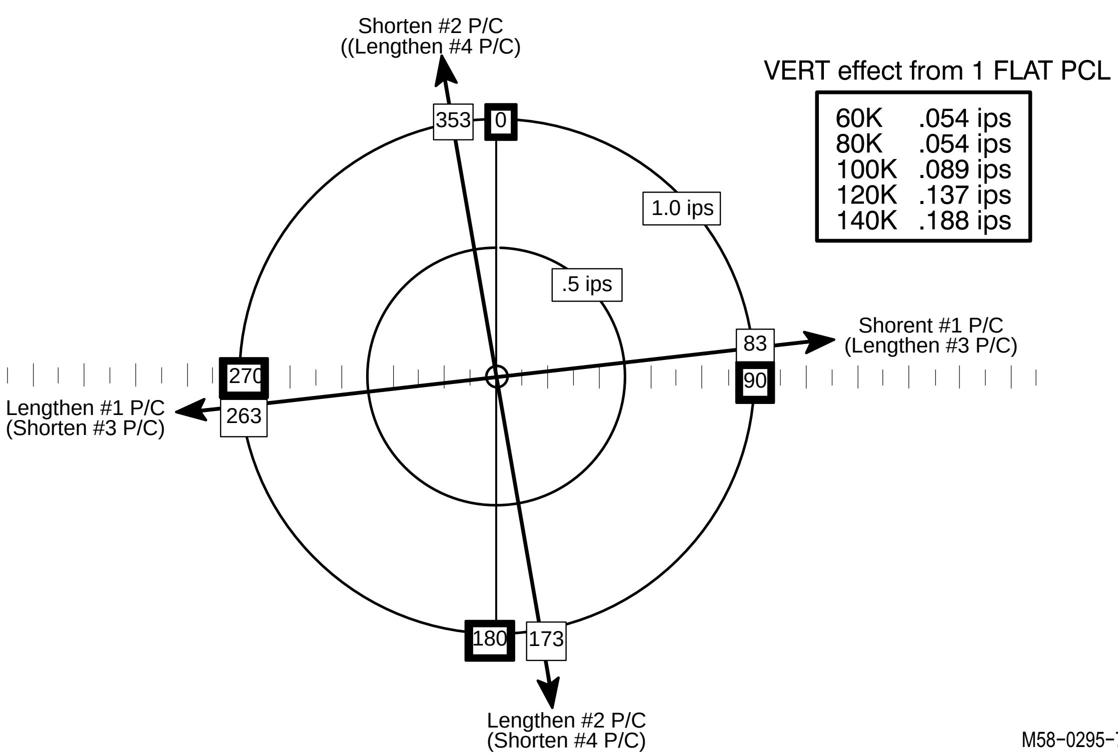


Figure 5–22. AH–64 Vertical Effect of a P/L

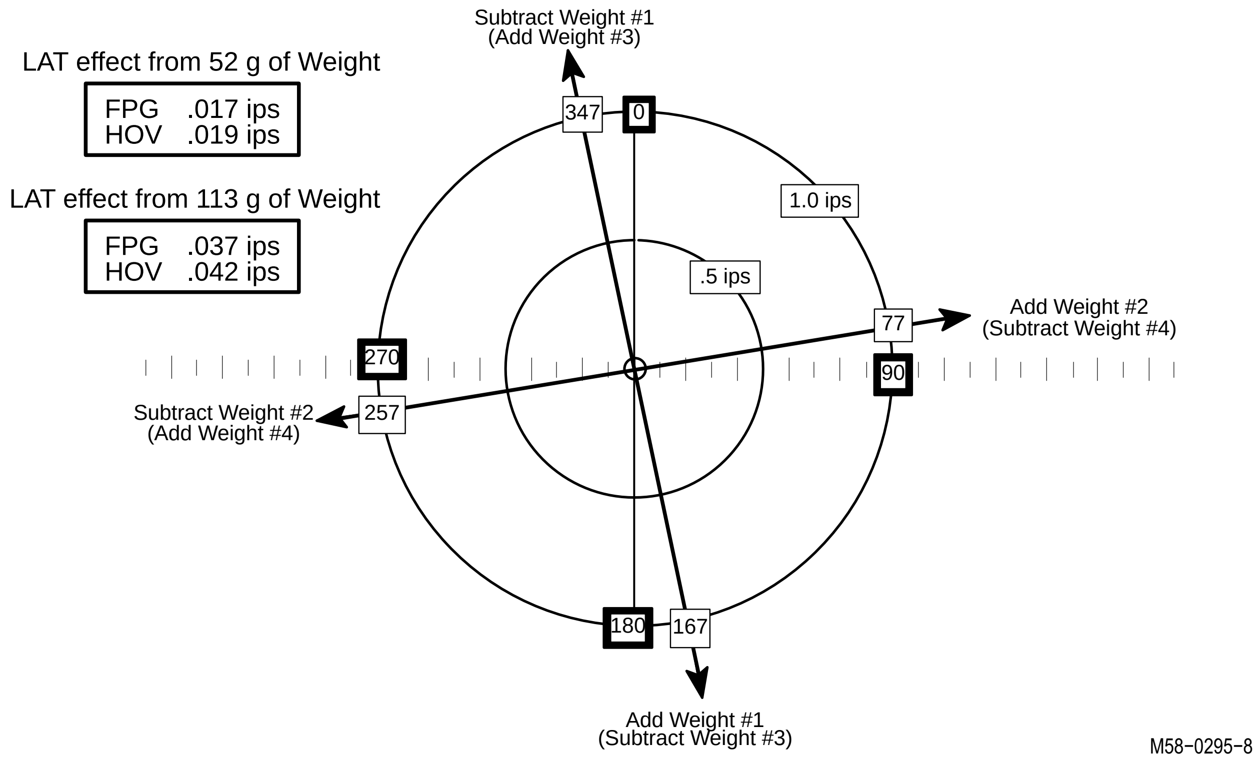


Figure 5–23. AH–64 Lateral Effect for Weight Changes

c. INTERPRETING RESULTS AND MAKING CORRECTIONS

(1) AVA will recommend pitch link, weight, and tab adjustments in the diagnostics for **FLIGHT**. The default solution can be utilized, but it is recommended that other solutions be obtained by using the EDIT ADJUSTABLES and EDIT DEFAULTS, and compare the predicted vibration levels with the default solution. By utilizing these options you will usually reduce the number of corrections, save time and still bring the vibration to acceptable levels. The other solutions are described in detail later in this section. The following is an explanation of the method that the AVA uses to obtain the default solution:

- When calculating the corrections, AVA only considers the present vibration environment. Previous flights have no effect on the calculation of adjustments.
- AVA's goal is to reduce overall vibration.
- WEIGHT: AVA recommends a weight correction based on ground and hover lateral measurements and pitch link adjustments if they are necessary. This adjustment is usually small, because this should have been minimized in the INITIAL flight plan. If the weight adjustment is small the usual procedure is to toggle WEIGHTS off in the EDIT ADJUSTABLES and press DO to obtain a new solution, or to reduce the number of corrections (see custom solutions below), which will eliminate small corrections and utilize more effective corrections. If weight is not adjusted during in–flight rotor smoothing and if at the end of rotor smoothing the balance needs to be adjusted, this can be accomplished by performing an INITIAL measurement that no adjustments were performed on and toggle everything off except weight. This will have little or no effect on the vertical vibration levels in flight.

5–21. FLIGHT CHECK AND ADJUSTMENT USING AVA EQUIPMENT (cont) 5–21

- TAB: AVA turns on pockets of tab based on track split at each airspeed. Even though tabs are turned on by the amount of track split, AVA will not try to fix the track split, it will utilize pockets that are turned on to reduce overall vibration. AVA's goal here is to minimize vibration, which may not produce a perfect flat track.
- PITCH LINK: AVA will utilize pitch links if a blade remains out of track the same amount at all airspeeds. AVA will also recommend pitch link against a tab move to effect vibration environment.

(2) If the default solution contains small moves or numerous moves it is always recommended to obtain a custom solution. The reason this is recommended is that if there are small moves or a lot of moves there is plenty of opportunity for errors to be introduced. Many times with fewer moves or even with one move the vibration environment can be reduced to acceptable levels. AVA was designed to give optimum solution to drive vibration levels to zero. The following are examples that can be utilized to obtain a custom solution that users have had success with in the field. Custom solutions usually will reduce the number of adjustments and still reduce the vibration to an acceptable level. Every adjustment made to the rotor system is an opportunity for an error to be introduced.

CUSTOM SOLUTIONS:

- Utilizing RESOLVE TO LIMITS from the Edit Defaults screen.
- The RESOLVE TO LIMITS option in the Edit Defaults is a very powerful feature of the AVA. For the AH–64 script file, the default for the Resolve to Limit feature is OFF. To utilize the RESOLVE TO LIMIT feature, the only change required to the Edit Defaults screen is to toggle the RESOLVE TO LIMIT to ON (Leave the MAXIMUM # OF ADJUSTMENTS set at) (zero) and the WEIGHTING MODE will change to AUTO once the DO key is pressed to obtain a solution (see NOTE below)). Once the RESOLVE TO LIMIT is toggled to ON, press DO and EDIT ADJUSTABLES screen will automatically be displayed. It is recommended that you press DO without making changes to the EDIT ADJUSTABLES screen, then AVA will pick the best solution without being restricted. If changes or restrictions are desired make them on the EDIT ADJUSTABLES screen (one example is if you did not want AVA to consider a WEIGHT adjustment you could toggle off weight in the EDIT ADJUSTABLES and AVA will not use WEIGHT adjustment for the calculation of the best adjustments). Once changes are made, or if none were made, press DO to obtain a solution. AVA diagnostics will start at the best one adjustment and check to see if the best one adjustment will bring the vibration environment into limits. If it will not bring the vibration environment into limits with the best one adjustment, it will start adding adjustments one at time until it obtains a solution that is within limits. Once a solution is obtained compare the predictions from the default adjustments to see if the vibration environment is going to be reduced to satisfactory level with less moves. Once a solution is compared it is recommended that you perform the Maximum # of Adjustments option and compare that solution.

5–21. FLIGHT CHECK AND ADJUSTMENT USING AVA EQUIPMENT (cont) 5–21

NOTE

The AUTO weighting feature for the 6.1 software will not cause vibration levels to increase. The WEIGHTING MODE in the Edit Defaults screen is set to DEFAULT for the AH–64 script file. If the RESOLVE TO LIMIT feature is utilized the WEIGHTING MODE will be automatically changed to AUTO during the diagnostic calculations. The AVA technical manual's definition for the AUTO weighting mode on page 2–45 and 2–46 is incorrect. This definition is for the old 3.1 software. The 6.1 software does not disregard the software presets. This feature 6.1 software was changed to utilize the script to script file presets with minor modifications. The CAUTION on page 46 and the restrictions for use of the AUTO weighting feature do not apply for the 6.1 software.

Utilizing the MAXIMUM # OF ADJUSTMENTS from the Edit Defaults screen

a. Another method that can be utilized is to use the MAXIMUM # OF ADJUSTMENTS from the Edit Defaults in the diagnostic menu. The AVA usually recommends multiple moves. Some of the moves are small and it may be worthwhile to obtain a solution with fewer adjustments. Remember, every adjustment made to the rotor system is an opportunity for an error to be introduced. In the Edit Defaults screen the MAXIMUM # OF ADJUSTMENTS is defaulted to 0. This means that the AVA is not restricted in the number of adjustments. When using MAXIMUM NUMBER OF ADJUSTMENTS it is recommended that RESOLVE TO LIMIT is toggled OFF and WAITING MODE is toggled to DEFAULT. For example, let's say the AVA is recommending 4 adjustments, and 2 of these adjustments are small. Enter the Edit Defaults and change the MAX # of ADJUSTMENTS TO 2 and press **DO**, then the EDIT ADJUSTABLES screen will appear so you can restrict the solution more if desired, but it is not recommended. Press DO and the AVA will choose the 2 best adjustments from all of the adjustables. once the solution is obtained compare the predictions from the default adjustments to see if the vibration environment is going to be reduced to a satisfactory level with only 2 moves. This is a very powerful feature of the AVA, and it's possible that the AVA would recommend 4 moves of which 3 of them are small, and with one move you can reduce the majority of vibration, save time, and lesson the chance of a wrong/backwards move. Many variations of this method are utilized in the field. Whatever solution is utilized, always view the Predictions to ensure that the vibration levels are decreasing to a satisfactory level.

b. TAB ONLY SOLUTION: One method that users have had success with is to only adjust tabs in flight. This procedure is more to line with the manufacturers procedure which did not measure or take into account vertical vibration levels. If this method is utilized, you must enter the EDIT ADJUSTABLES and toggle off the adjustments for weight and pitch links, and press **DO** to obtain a tab only solution.

COMPARING MOVES BETWEEN FLIGHTS

It is always recommended to compare the vibration from one measurement to the next (mainly to ensure that the aircraft is responding in a normal manner). For the FLIGHT flight plan the VERTICAL readings should be trended. To trend more than one data set, perform the following:

- With the latest flight ID picked enter the Display mode by pressing **"F2"**.
- Select "**Trend Flights**" and press "**DO**".
- Select the desired channel to trend (usually interested in vertical readings in flight, **60K**, **80K**, **100K**, **120K**) and press **"DO"**.
- Enter the number of test states to trend (the easiest to understand is just trend the last two flights by entering 2, which will trend the most current flight with the previous flight), then arrow down to "**Draw Axis**" and change to "**NO**" by pressing the "right arrow" (this will make the polar chart easier to read), and then press **DO**.

5–21. FLIGHT CHECK AND ADJUSTMENT USING AVA EQUIPMENT (cont) 5–21

Figure 5–24 displays the vibration trend from the latest reading with previous readings on a polar chart. This process is displayed below.

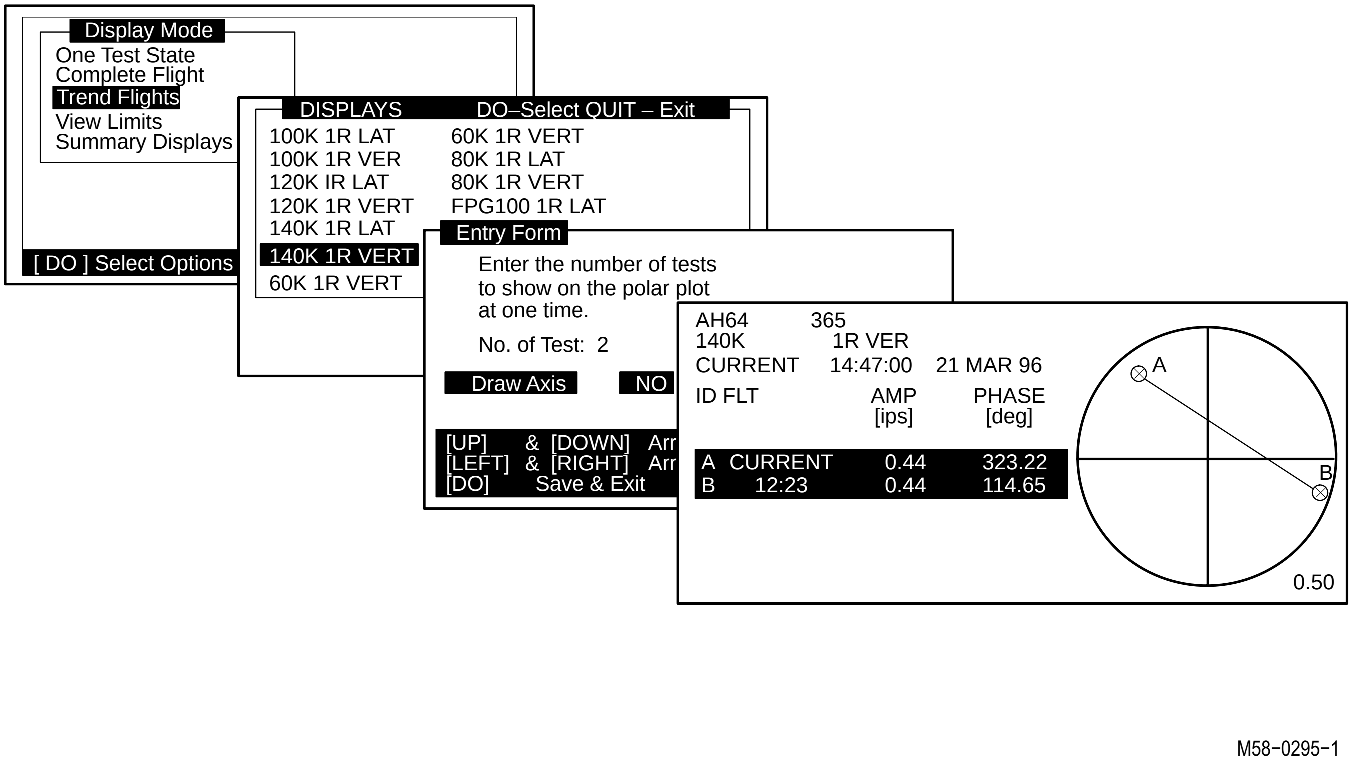
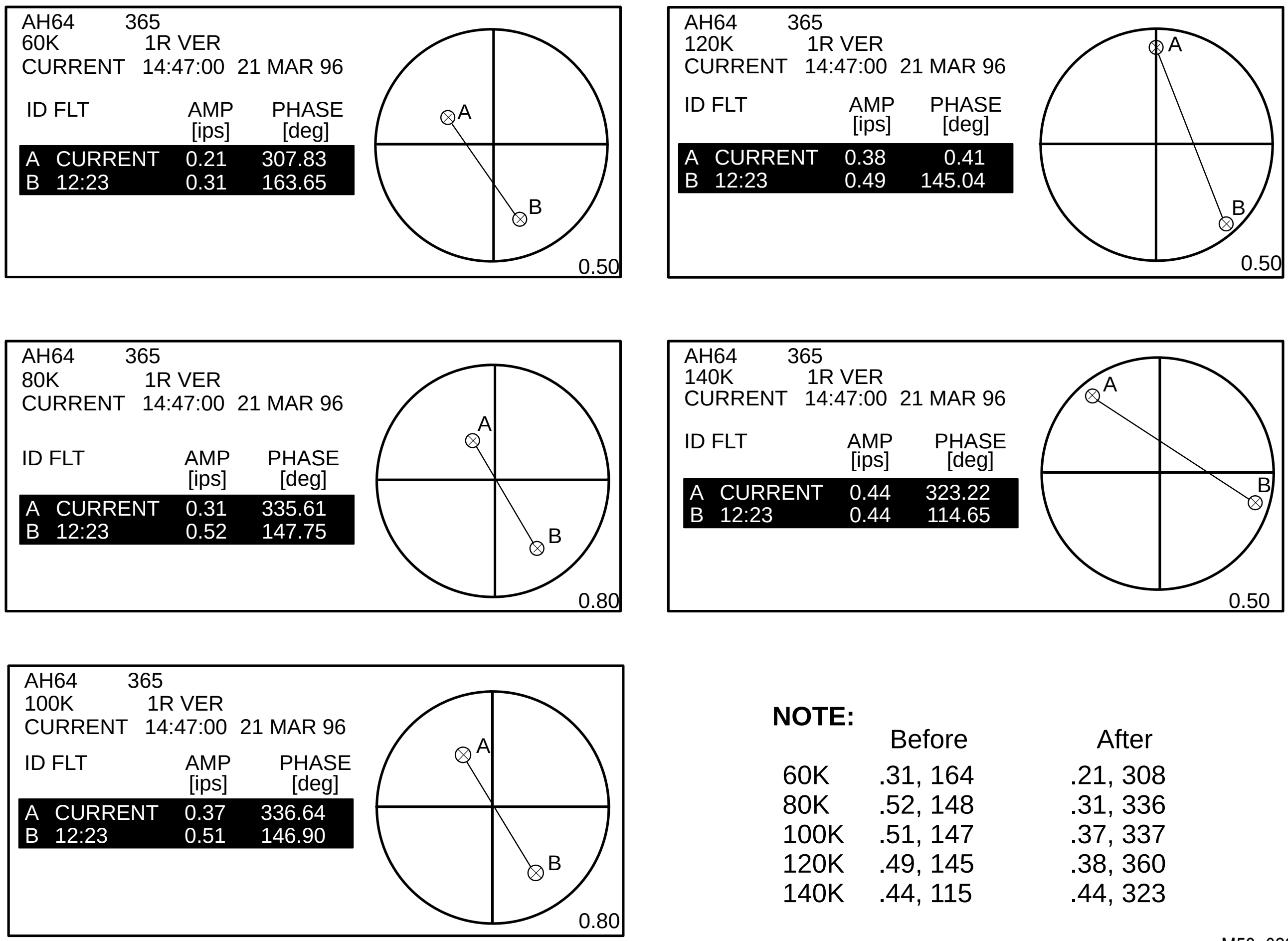


Figure 5–24. AVA Vibration Trend

The AVA's goal is to give corrections that will drive the vibration levels towards the center of the polar chart. The question you ask when you are viewing the polar chart is, did the vibration levels move towards the center of the chart of go through the center of the chart. In some cases you will see the vibration trend go through the center of the chart and overshoot to the other side. This is a clear indication that the aircraft is responding to the moves in a normal manner, but the amount of the move was too much. The phase information is very important and these polar charts should be used to verify the reaction of the aircraft.

5–21. FLIGHT CHECK AND ADJUSTMENT USING AVA EQUIPMENT (cont) 5–21

Example: This data is from an actual move made on and aircraft for the flight readings, done according to the AVA. The before and after vibration levels are per NOTE and illustration shown in Figure 5–25.



NOTE:

	Before	After
60K	.31, 164	.21, 308
80K	.52, 148	.31, 336
100K	.51, 147	.37, 337
120K	.49, 145	.38, 360
140K	.44, 115	.44, 323

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Figure 5–25. Before and After Vibration Levels on AVA

This is a perfect example of the vibration shooting across the center of the polar chart. If the phase information was ignored one might think the vibration didn't change much at all. At first glance of the vibration levels you would think that the aircraft only got marginally better or at 140 the level did not change. This is not the case; in fact, this was a substantial move that went to the other side of the polar chart (see polar charts above). This should not be considered to be a wrong adjustment. The adjustment went in the correct direction (which is the most important factor), but it just went to far. Remember the main thing that you view the trends for is to ensure that the move went in the correct direction (towards the center of the polar chart).

If the vibration shoots to the other side of the polar plot through the center, there are many variables that may have caused this (the trim tab or pitch link had a larger reaction on this particular blade, the trim tabs were bent more than was required, this particular aircraft had a stronger reaction than the AVA is programmed for, or an incorrect move was made, etc.). If there was only one move made to the rotor and it made the vibration levels shoot through center, then the suffix would to be to take some of that particular move back out (the AVA will normally recommend this in the diagnostics). If there were multiple moves performed on the rotor that made the vibration levels shoot through the center of the polar plot, then it is not as easy to determine which move caused this overreaction. The recommended procedure in this case is let the AVA tell you what moves are required to bring the vibration back, by utilizing the custom solution options that were described earlier in step c.(2).

Remember–if the vibration trend shows that the levels are moving toward the center of the polar chart, then everything is working properly. When the level moves towards the center, the only thing to obtain is whether the move was too much, not enough or just right. If the vibration does not move towards center, something was done wrong. If multiple moves were made it is very difficult to determine which move was done improperly (most likely to the wrong blade or in the wrong direction). If the vibration trend shows vibration levels moving in a direction other than towards center, you should stop and try to figure what was done wrong. If it cannot be determined what went wrong then it is recommended to make another adjustment, according to the AVA, but try to make as few of moves as possible (usually 1 to 2 moves) to reduce the vibration levels. See “Utilizing the MAXIMUM # OF ADJUSTMENTS” from step c.

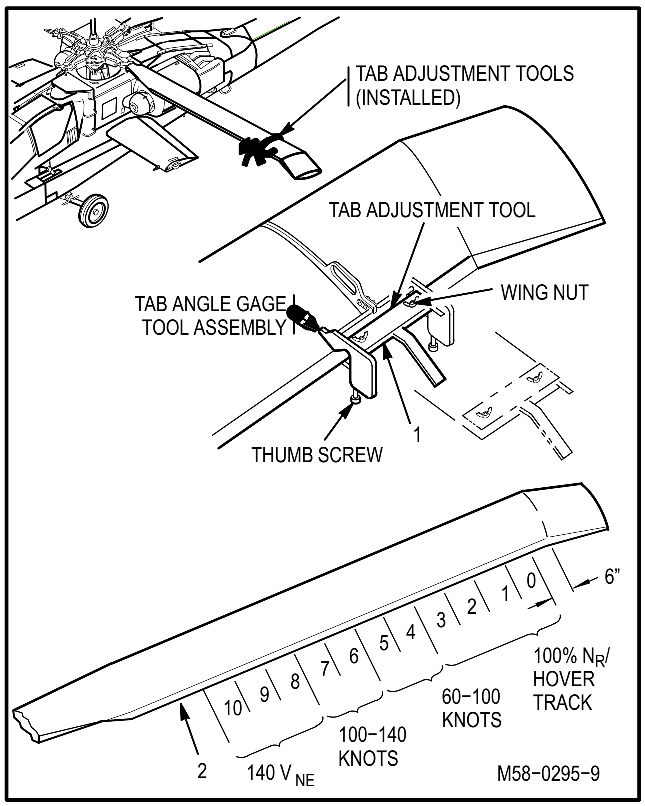
c. If a weight adjustment is required, follow paragraph 5–20, step e.

d. If a pitch link adjustment is required, follow paragraph 5–19 ,step c.

e. If a trim tab adjustment is required, follow step d.

d. TRIM TAB ADJUSTMENTS

1. Tab bend corrections called out on the diagnostics display will refer to the start point of a continuous bend. Example: If AVA recommends 1 degree up at pocket #4–10, bend should start at pocket #4 and continue through pocket #10.
   (a). Place tab adjustment tool in center of tab bend pocket which is to be bent.
   (b). Tab tracking locations (#0 through 10) are 10 inches in length, starting six inches inboard of swept tip. Do not bend inboard of pocket #10 (2). If trim tab pockets are not marked or improperly marked refer to (TM 1-1520-238-23) (Main Rotor Blade Trim Tab Markings).
   (c). Do not make bends in opposite direction in adjacent pockets. It is preferable to remove an upward bend (reset to Zero degrees) if adjacent pocket requires a downward bend.
   (d). Any noticeable deformity (kinks or sharp edges caused by tab bending tool) is cause for rejection of blade.
   (e). It is preferable to make two 1–degree bends in adjacent stations rather than one 2–degree bend in one station.



2. Perform tab adjustments on blades and pockets called out in AVA diagnostics.
3. Remove tab adjustment tools and repeat step b.
4. Perform limited test flight, including autorotational RPM check (TM 1-1520-238-MTF).

END OF TASK

5–22. MAIN ROTOR TRACK AND BALANCE TROUBLESHOOTING USING AVA EQUIPMENT 5–22

a. TROUBLESHOOTING

1. The following are possible indications of an out of phase condition, which may require main rotor blade phase to be checked per (TM 1-1520-238-23).
   - Excessive weight required (1000g).
   - Difference in thread count between dampers.
   - Adjustments for lead–lag should never be made utilizing data from AVA. The reason moves should not be made based on AVA dynamic measurement is that the dynamic phase of blades is a relative measurement. If blade one is out of phase statically, then dynamic phase date from AVA will show blade 1 and 3 both out of phase, because this is a relative measurement. If AVA indicates a possible phase problem, statically phase blades in accordance with (TM 1-1520-238-23).

2. If AVA recommends an excessive trim tab bend (greater than 4 deg), or there is an excessive hook in a blade track trend from hover to speed (greater than 3 inches), then the following following procedure may be utilized to avoid excessive trim tab bending.

NOTE

- **This is not normal procedure for track and balance and should only be used on blades that are climbing or diving excessively as described above.**
- **Utilize pockets #0–3 on this particular blade and put in a 1/2 degree bend in the appropriate direction. Once this is performed repeat the track and balance procedure starting at paragraph 5–19 (Ground Track and Adjustment). This procedure can be repeated twice with a maximum bend in pockets #0–3 of + or – 1 degree.**

3. If a blade does not respond correctly, check trim tabs to ensure that the blade has a uniform bend. If the tab is not uniform, tab it back to 0 (zero) and start track and balance over from paragraph 5–19 (Ground Track and Adjustment).

END OF TASK

5–23. TAIL ROTOR BALANCE – MAINTENANCE OPERATIONAL CHECK USING AVA EQUIPMENT 5–23

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Aviation Vibration Analysis Test Set	6625-01-282-3746
Helicopter Rotor Head Balance and Blade Track Run Test Equipment	4920-01-180-7610
Wrench, Torque 1/2 Drive	TCI–1600

Materials/Parts:

Balance weights (as required)

Personnel Required:

152FG Maintenance Test Pilot
152FG Pilot
67R Attack Helicopter Repairer
67R3T Inspector

References:

TM 1-1520-238-23
TM 1-1520-238-MTF

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Helicopter safed Tail rotor assembly inspection completed
TM 1-1520-238-23	Tail rotor AVA kit installed

Special Environmental Conditions:
Wind velocity of 20 knots or more may affect accuracy of readings.

5–23. TAIL ROTOR BALANCE – MAINTENANCE OPERATIONAL CHECK USING AVA EQUIPMENT (cont) 5–23

CAUTION

Ensure proper blade weight retaining hardware is installed in the tail rotor blades.

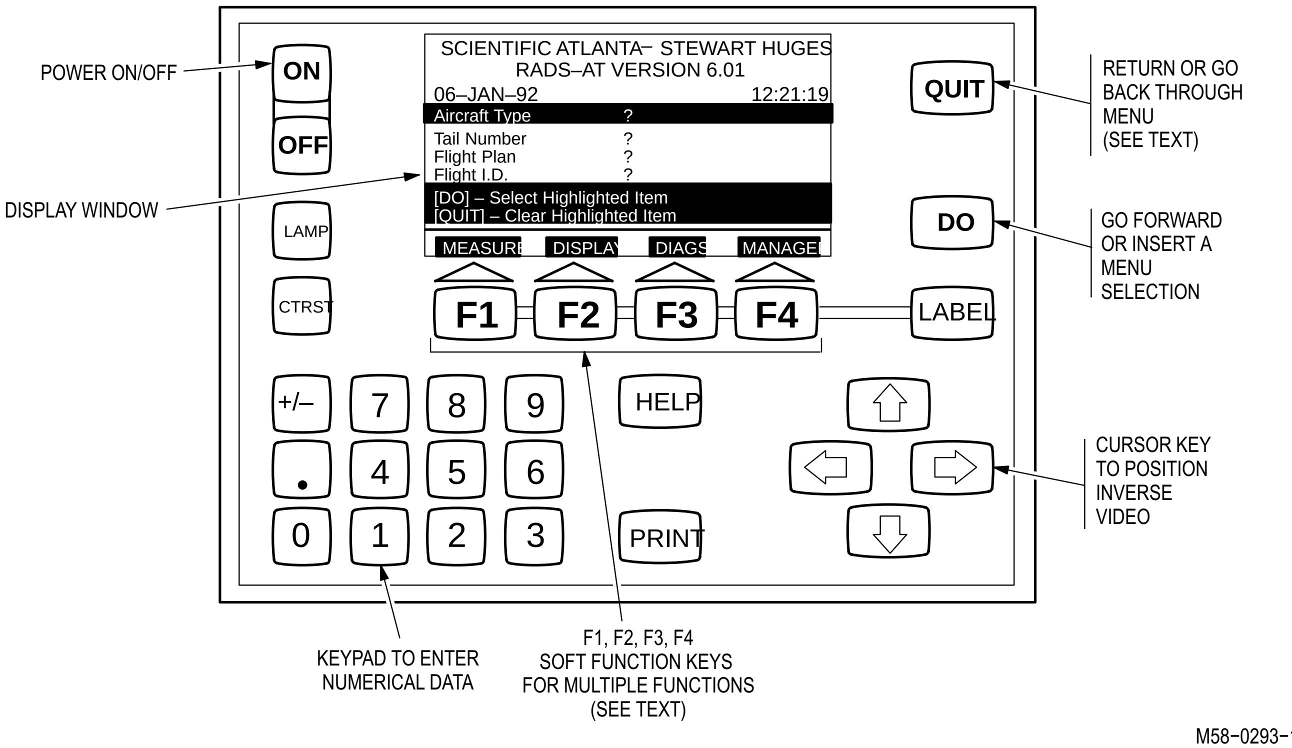


Figure 5–26. CADU Display and Keypad

1. **PERFORM TAIL MEASUREMENT**
   a. Operate aircraft at 100% Nr, flat pitch.
   b. Turn DAU **ON**.
   c. Turn CADU **ON**.
   d. Press **QUIT** on the CADU until all selections are underlined.

NOTE

To provide an accurate measurement, ensure tail rotor pedals are centered (flat pitch) during ground run.

   e. Use cursor keys to highlight **Aircraft Type**, then press **DO**.
   f. Use cursor keys to highlight **AH64**, then press **DO**.
   g. **Tail Number** is highlighted. Press **DO**.
   h. Use cursor keys to highlight a tail number or enter a new one (up to seven digits), then press **DO**.
   i. **Flight Plan** is highlighted. Press **DO**.
   j. Use cursor keys to highlight tail. Press **DO**.

5–23. TAIL ROTOR BALANCE – MAINTENANCE OPERATIONAL CHECK USING AVA EQUIPMENT (cont) 5–23

k. Enter the **MEASURE** mode by pressing **F1**. Verify that test state **FPGTL** is highlighted.

l. Press **DO** when aircraft is stable at highlighted selection. Reverify that aircraft is at required test state and press **DO** again. AVA will acquire balance data and return to selection menu.

m. After measurement is completed, press **DO** on “finish”, then press **DO** on “diagnostics”. If measurements are within specified limits, press **QUIT** to main menu.

n. If results are less than 0.2 ips, no corrections are required. However, AVA may offer corrections to smooth rotor further, at operator’s discretion. Even though limit is 0.2 ips, tail rotor can achieve 0.1 ips or below in most cases, and is recommended to try and obtain the 0.1 ips goal.

o. If measured values exceed specifications, press **DO** and perform corrections as shown.

p. Perform tail measurement again and verify corrections.

2. **COMPARE MOVES BETWEEN RUNS**

a. It is always recommended to compare the vibration from one measurement to the next (mainly to ensure that the aircraft is responding in a normal manner). For the TAIL flight plan there is only one reading to trend. To trend this, perform the following:

- With the latest flight id picked enter the Display mode by pressing **F2**.
- Select Trend Flights and press **DO**.
- Press **DO** on **1T POLAR**.
- Enter the number of test states to trend (the easiest to understand is just trend the last two flights by entering 2, this will trend the most current flight with the previous flight), then arrow down to **Draw Axis** and change to **NO** by pressing the right arrow (this will make the polar chart easier to read), and then press **DO**.

b. This will display a vibration trend from the latest reading with previous readings on a polar chart. This process is displayed in Figure 5–27.

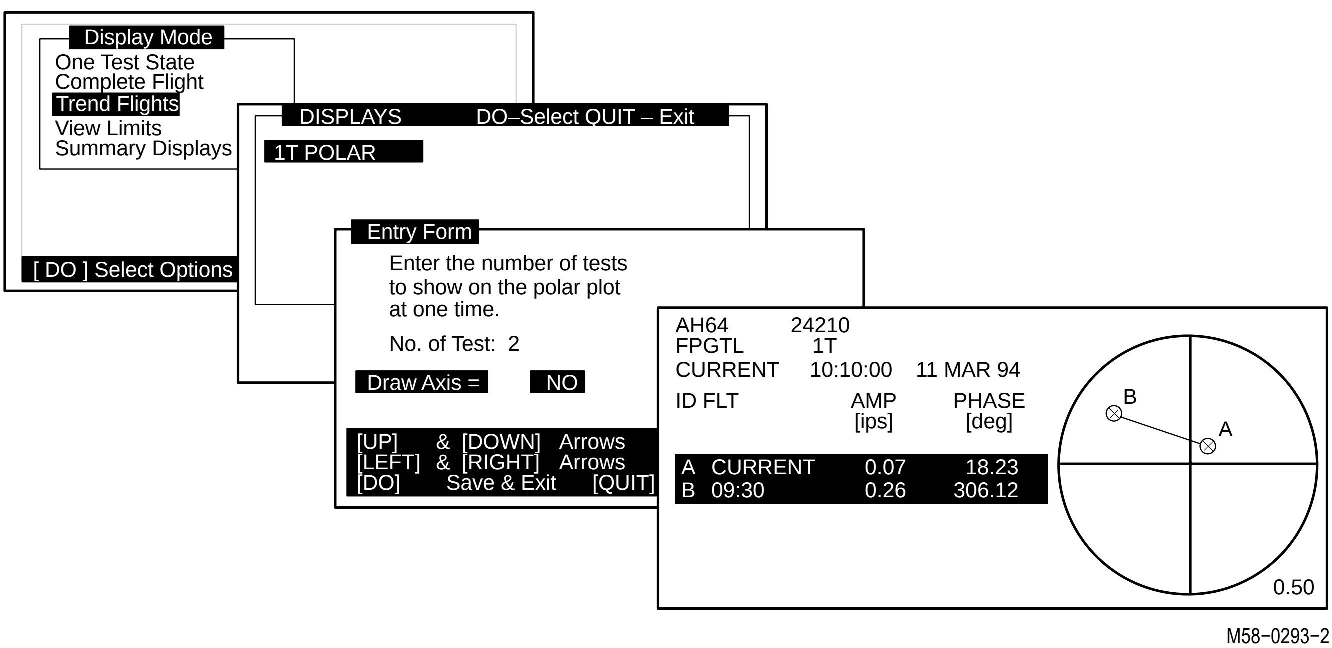


Figure 5–27. Vibration Trend Polar Chart

5–23. TAIL ROTOR BALANCE – MAINTENANCE OPERATIONAL CHECK USING AVA EQUIPMENT (cont) 5–23

c. AVA's goal is to give corrections that will drive vibration levels towards the center of the polar chart. This example is an almost ideal solution, as you can see on the polar chart with one move the vibration went almost directly towards the center of the polar chart. The question you ask when you're viewing the polar chart is this: did vibration levels move towards center of chart or go through center of chart? In some cases the vibration trend goes through center of chart and overshoots to other side. This is a clear indication that the tail rotor is responding to moves in a normal manner, but the amount of move was too much. If vibration does not move towards center, something was done wrong. If vibration trend shows vibration levels moving in a direction other than towards center, stop and determine what is wrong. If it cannot be determined, then make another adjustment, according to AVA, but try to make as few moves as possible (usually 1) to reduce vibration levels. Phase information is very important and these polar charts should be used to verify reaction of aircraft. View all trends to ensure that the move went in the correct direction (towards the center of the polar chart).

q. Remove AVA test equipment and make appropriate log book entries (TM 1-1520-238-23).

END OF TASK

5–24. ISOLATING/MONITORING OTHER VIBRATIONS USING AVA EQUIPMENT 5–24

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Aviation Vibration Analysis Test Set	6625-01-282-3746
Helicopter Rotor Head Balance and Blade Track Run Test Equipment	4920-01-180-7610

Personnel Required:

152FG Maintenance Test Pilot
152FG Pilot
67R Attack Helicopter Repairer
67R3T Inspector

References:

TM 1-1520-238-23
TM 1-1520-238-MTF

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Helicopter safed

1. **GENERAL INFORMATION**

There are two main sources of vibration in helicopters. The rotors produce low frequency vibrations, say 200–5000 RPM or 3 to 80 cycles per second (Hz), at multiples of rotor revolution, and drive train–transmission produces mid, say 5000 to 100,000 RPM or 80 to 1700 Hz, to high, above 100,000 RPM or 1700 Hz, frequency vibrations. Unusual low frequency vibrations are usually a human factors issue and do not indicate a safety of flight problem, but not always. Unusual Hi–Freq vibrations usually indicate an impending failure of some drive train component and so are a safety concern. Figure 5–28 is an example of a spectrum and some of the frequencies that you might see. No limits exist for any of these levels except main rotor once per rev (1P) and tail rotor once per rev (1T).

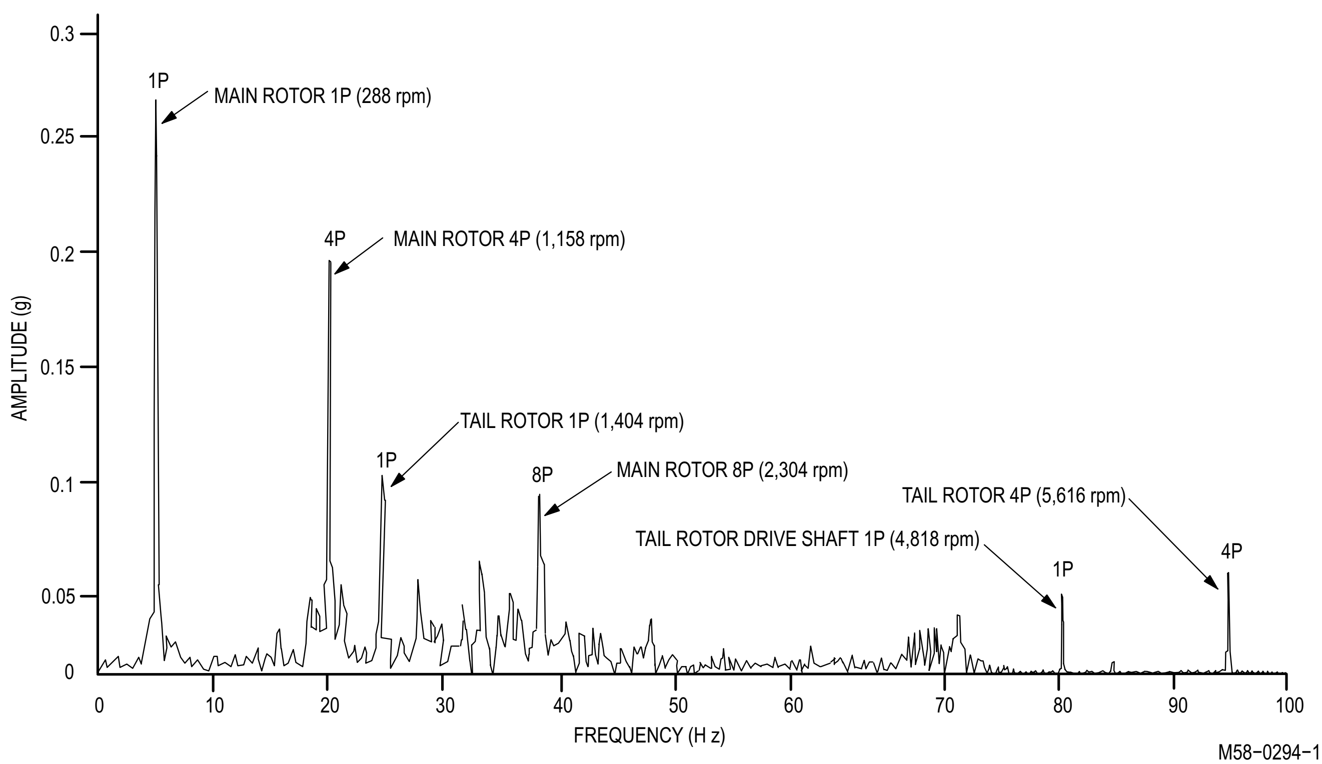


Figure 5–28. Spectrum Example

5–24. ISOLATING/MONITORING OTHER VIBRATIONS USING AVA EQUIPMENT (cont) 5–24

Spectrums

What is a spectrum? If you mount an accelerometer on a particular point on an airframe, a spectrum will show how that point is responding to the forces generated by the rotating components of the helicopter. A peak at a particular frequency associated with a rotating part is the amplitude of the response, the vibration of that point to the forces generated by that part. The higher the peak the more forces that part is generating. Low frequency vibrations come from the rotors. Mid frequency vibrations come from drive shafting, generators, pumps, oil cooler blowers, and engines. High frequency vibrations come from gears meshing and fan, turbine and compressor blade passage. The Aviation Vibration Analysis (AVA) system allows you to collect spectrums at any appropriate location by mounting an accelerometer on the airframe and utilizing the PROBES flight plan or the FFT (Fast Fourier Transform) Aircraft Type. The PROBES flight plan allows vibration data to be taken on accelerometers 1–4 for one flight plan, and the range is from 0–30,000 RPM (0–500 Hz). This range is usually sufficient to trouble shoot most of the vibrations problems on the AH–64. The FFT Aircraft Type has many different ranges, but it only allows measurements to be taken on accelerometer number one. The only reason that the FFT Aircraft Type needs to be utilized is if you know a source that you are looking for is above 30,000 RPM (500 Hz). This data can be used for troubleshooting High Freq vibration problems, however you are pretty much on your own in determining what is good and what is bad more on that latter.

The spectrum used in the PROBES or FFT flight plan is an asynchronous spectrum. This spectrum provides no phase information as sampling starts at an arbitrary time and is not keyed to anything like a tack signal. The spectrum displayed is an average of 16 spectra taken consecutively after you press measure and shows you the vibration amplitudes induced at your measuring point by the forces from each rotating part.

Mid–Freq Vibrations (Drive Train induced vibration)

So as not to confuse most vibrations above 60 to 80 Hz will be called Hi–Freq vibration by a pilot. When a Hi–Freq vibration is felt, maintenance action should be taken. The drive train has numerous rotating parts that produce vibration at many different frequencies, locating the bad part is not an easy task.

Here are some things that might help. The table at the end of this section contains the frequencies of most, not all, of the rotating parts of the AH–64. Once per revolution (rotational speed of the component) vibrations are associated with balance. Indexing a shaft at its mounting flange will change its balance. Two per rev (twice the rotational speed) vibrations are associated with the alignment of shafts. An increase, in several harmonics of a shaft (say 1R, 2R, 3R, and 4R) at the same time is indicative of bearing wear. A number of maintenance personnel are troubleshooting Hi–Freq problems by taking data at identical locations on a good aircraft and the Hi–Freq aircraft at the same time and comparing the differences. If there is a problem, comparing these two displays should show which component is the cause.

Following are a few comments on vibration management based on spectrum–based monitoring. This method simply identifies the amplitudes of vibration at frequencies associated with any rotating component (shaft rotation speed and multiples thereof, gear mesh frequency, bearing ball pass frequency). This technology is widely used in the industrial world for machinery monitoring and there are many vendors of both the hardware and software required for implementation. On helicopters, it is good for monitoring shafting imbalance and misalignment, bearing wear, and gross defects that a pilot would report as a Hi–Freq vibration (which can ground the aircraft until removed). Profitable implementation depends on proper selection of monitored limits. When a limit is exceeded, a maintenance action is required (replace, balance, align, or lubricate). Limits set too low affect maintenance cost adversely. Limits set too high allow failure which may produce auxiliary damage and, perhaps, loss of an aircraft. Spectrum–based monitoring has been touted by many as a valid tool for transmission health monitoring. It is not. It can only detect a small percentage of impending failures and has the potential of producing a large number of false alarms.

5–24. ISOLATING/MONITORING OTHER VIBRATIONS USING AVA EQUIPMENT (cont) 5–24

Source	RPM*	Hz*
Main rotor 1 per rev	289	4.82
Main rotor 2 per rev	578	9.6
Main rotor 3 per rev	867	14.4
Main rotor 4 per rev	1156	19.3
Main rotor 8 per rev	2312	38.4
Main rotor 12 per rev	3488	57.6
Main rotor 16 per rev	4624	76.8
Tail rotor 1 per rev	1403	23.4
Tail rotor 2 per rev	2806	46.8
Tail rotor 3 per rev	4210	70.2
Tail rotor 4 per rev	5616	93.6
Tail rotor drive shaft 1P	4815	80.3
Tail rotor drive shaft 2P	9630	160.6
Tail rotor vert drive shaft 1P	3636	60.6
Tail rotor vert drive shaft 2P	7272	121.2
Generator and SDC drive	12,251	204.2
Eng out drive shaft	20,952	349.2
Input drive shaft	9841	164.0
Hydraulic pump	12,635	210.6
APU drive shaft	8251	137.5
SDC Impeller	86,442	1440.7
M/R gearbox G3	1121	18.7
M/R gearbox G1	4391	73.2
M/R gearbox G2	4789	79.8
AGB Idler	4813	80.2
AGB Idler	4925	82.2
2 x SDC drive	24,503	408.4
Multiply by 1.01 for aircraft equipped with 701C engines.		

2. **EQUIPMENT INSTALLATION FOR PROBES OR FFT MEASUREMENT**

   a. Install Aviation Vibration Analysis (AVA) kit (TM 1-1520-238-23). Install DAU, CADU and associated cables per para 1.108A only.

5–24. ISOLATING/MONITORING OTHER VIBRATIONS USING AVA EQUIPMENT (cont) 5–24

b. Install accelerometer.

NOTE

For the AH64 program data can be acquired from six accelerometers for the PROBES measurement (ACC 1, ACC 2, ACC 3, ACC 4, VIBLAT, and VIBVRT). VIBLAT and VIBVRT are hard wired and come through the SPU on channels five and six. The AH64NB program can acquire data from four accelerometers (ACC 1 – ACC 4). The FFT program can only measure from ACC 1, but has multiple frequency ranges.

(1) Install accelerometer anywhere on airframe where an irregular or unusual vibration is detected.

(2) Connect accelerometer cable from accelerometer to DAU receptacle labeled **ACC 1**, **ACC 2**, **ACC 3**, and /or **ACC 4**, or if **FFT** is used only **ACC 1** is available.

(3) If the SPU is being utilized for the AH64 program and the **MULTI–CH** cable is connected, then accelerometers are already installed for measuring lateral and vertical vibration. These will appear as **VIBLAT** and **VIBVRT** on the measurement screen.

c. Perform probes or **FFT** measurements.

(1) Operate aircraft at desired flight condition. This should be RPM or airspeed at which the vibration is strongest.

(2) Turn DAU **ON**.

(3) Turn CADU **ON**.

(4) Press **QUIT** on the CADU until all selections are undefined.

(5) Use cursor keys to highlight Aircraft Type, then press **DO**.

(6) Use cursor keys to highlight AH64, AH64NB if the SPU has been bypassed, or **FFT** if a specific range is required, then press **DO**.

(7) **Tail Number** is highlighted. Press **DO**.

(8) Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.

(9) **Flight Plan** is highlighted. Press **DO**.

(10) Use cursor keys to highlight **PROBES**, or if **FFT** is utilized select appropriate range. Press **DO**.

(11) Enter **MEASURE** mode by pressing **F1**. Verify the following test states are displayed:

AH64	**AH64NB**	**FFT**
ACC 1	ACC 1	Different ranges depending on which test plan is selected
ACC 2	ACC 2	
ACC 3	ACC 3	
ACC 4	ACC 4	
VIBLAT		
VIBVRT		

5–24. ISOLATING/MONITORING OTHER VIBRATIONS USING AVA EQUIPMENT (cont) 5–24

(12) Press **DO** when aircraft is stable and ready for date collection. Press **DO** again to take measurement (**ACC 1**, **ACC 2**, **ACC 3**, **ACC 4**, **VIBLAT**, **VIBVRT**, or select range for **FFT**). The flight plan will measure data on one channel at a time. Perform this operation for each desired channel. AVA will acquire vibration data at each selected test state and then return to selection menu.

(13) If all of measurements were completed, press **DO** on finish, then press **DO** on main menu. If all of measurements were not taken and the other measurements are not desired, press **QUIT** and then select **SAVE** and **Exit** and press **DO**.

(14) Enter the Display mode by pressing **F2**. Select One Test State and press **DO**. Select desired channel and press **DO**. Review each of the spectrums measured for any unusual vibrations as described in step 1.

(15) Make appropriate logbook entries and remove Aviation Vibration Analysis kit (TM 1-1520-238-23).

END OF TASK

CHAPTER 6
DRIVE SYSTEM

CHAPTER INDEX

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SECTION I. EQUIPMENT DESCRIPTION AND DATA

6–1. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES 6–1

a. **Characteristics.** The drive system changes the angle of drive and converts the output rpm of the engines into usable power to drive the main rotor system, tail rotor system and the gear driven accessories.

b. **Capabilities.** The drive system uses power from the auxiliary power unit (APU) to drive aircraft accessories when the engines are not operating and can be operated with either engine.

c. **Features.** Operating conditions of the transmission and engine nose gearboxes (NGBs) are monitored by the fault detection and location system (FD/LS) via the multiplex subsystem.

6–2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS 6–2

Drive System. The drive system (fig. 6–1) consists of the engine NGB assemblies 1 and 2, the main transmission assembly, the intermediate gearbox (IGB) assembly, the tail rotor gearbox (TGB) assembly, and the drive shaft assembly (7 drive shafts).

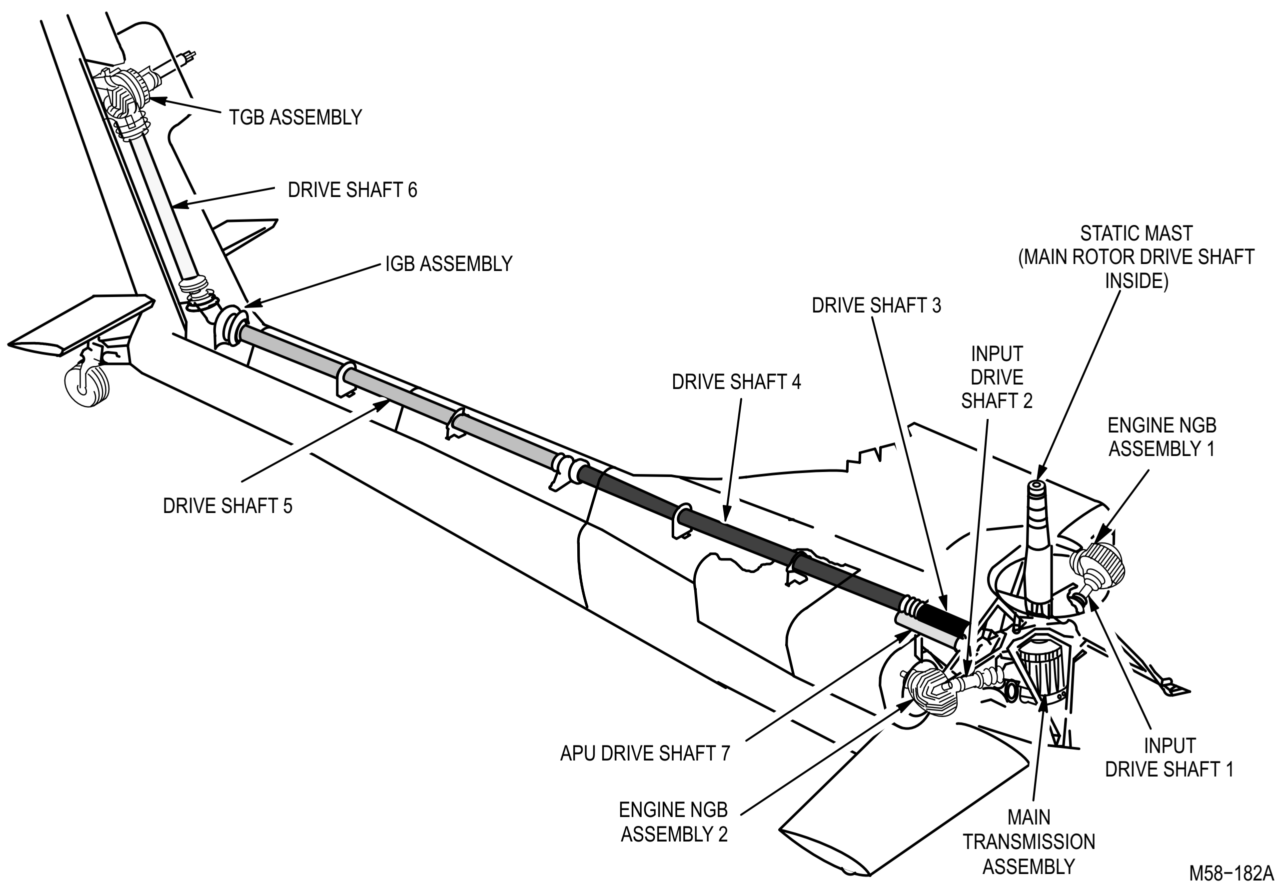


Figure 6–1. Drive System

6–2 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 6–2

a. **Engine NGB Assemblies.** The engine NGB assemblies (fig. 6–2) are connected to the main transmission through input drive shafts 1 and 2. The engine NGBs change the drive angle and reduce the engine rpm output to the main transmission. One engine NGB is mounted on the forward end of each engine nacelle. The input shaft of each NGB is splined to the output shaft of the engine. The engine NGB assembly consists of an engine NGB housing, NGB cooling fan, and lubrication system.

(1) The engine NGB housing is completely finned for cooling. The housing supports the major components of the engine NGB assembly. Each engine NGB has a self–contained oil system. A sight indicator, for checking the oil level in the engine NGB, is provided in the engine NGB housing.

(2) The engine NGB cooling fan mounts to the engine NGB fan mounting adapter. The mounting adapter is a round steel ring with five access holes to aid in removing and installing input drive shaft coupling retaining bolts.

(3) The lubrication system is self–contained with the lower housing forming the oil sump. Each engine NGB input and output shaft has an oil–soaked felt disc for emergency lubrication.

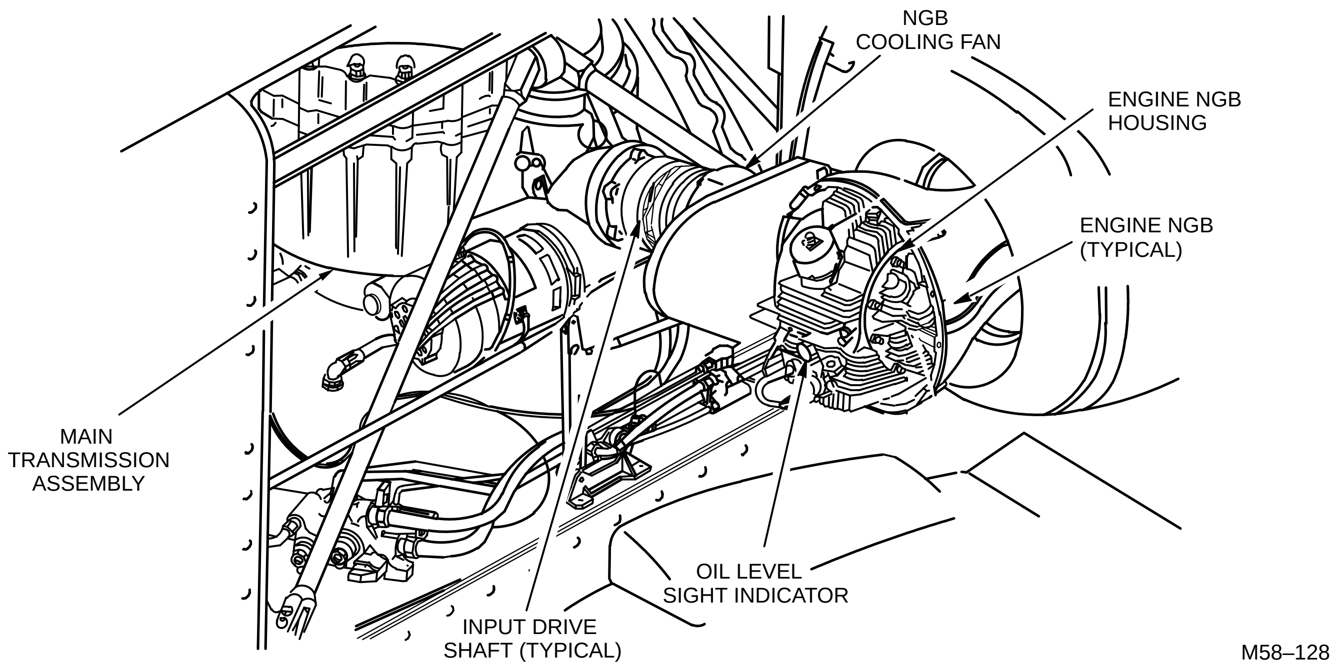
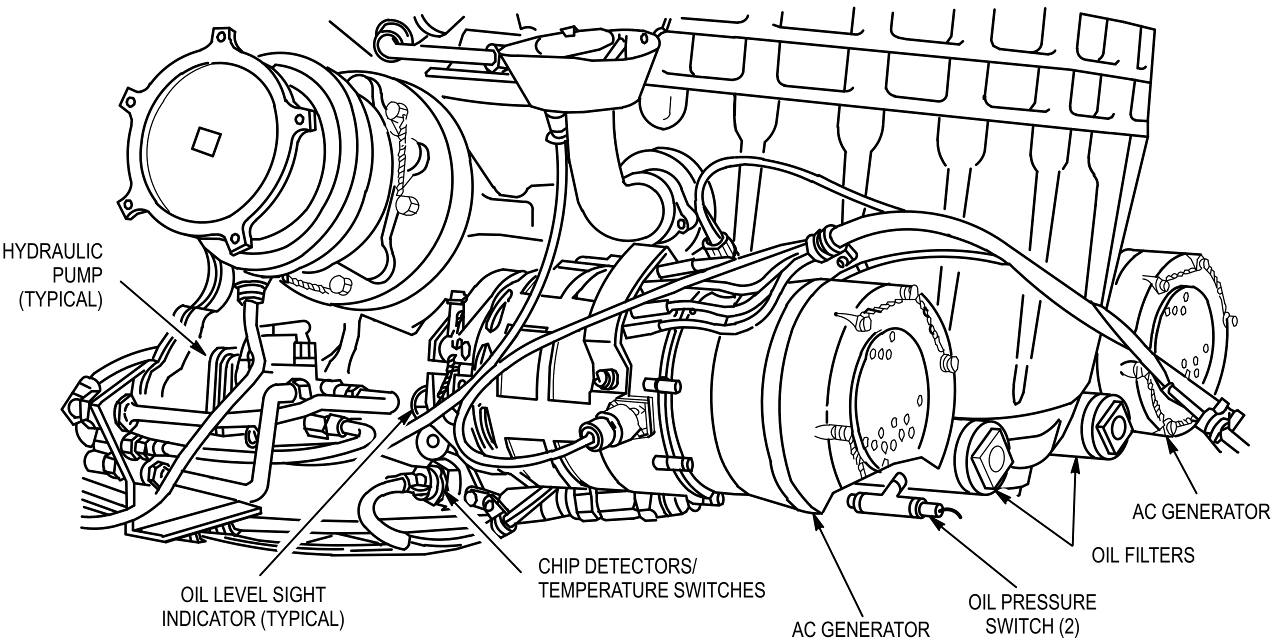


Figure 6–2. Engine NGB Assembly

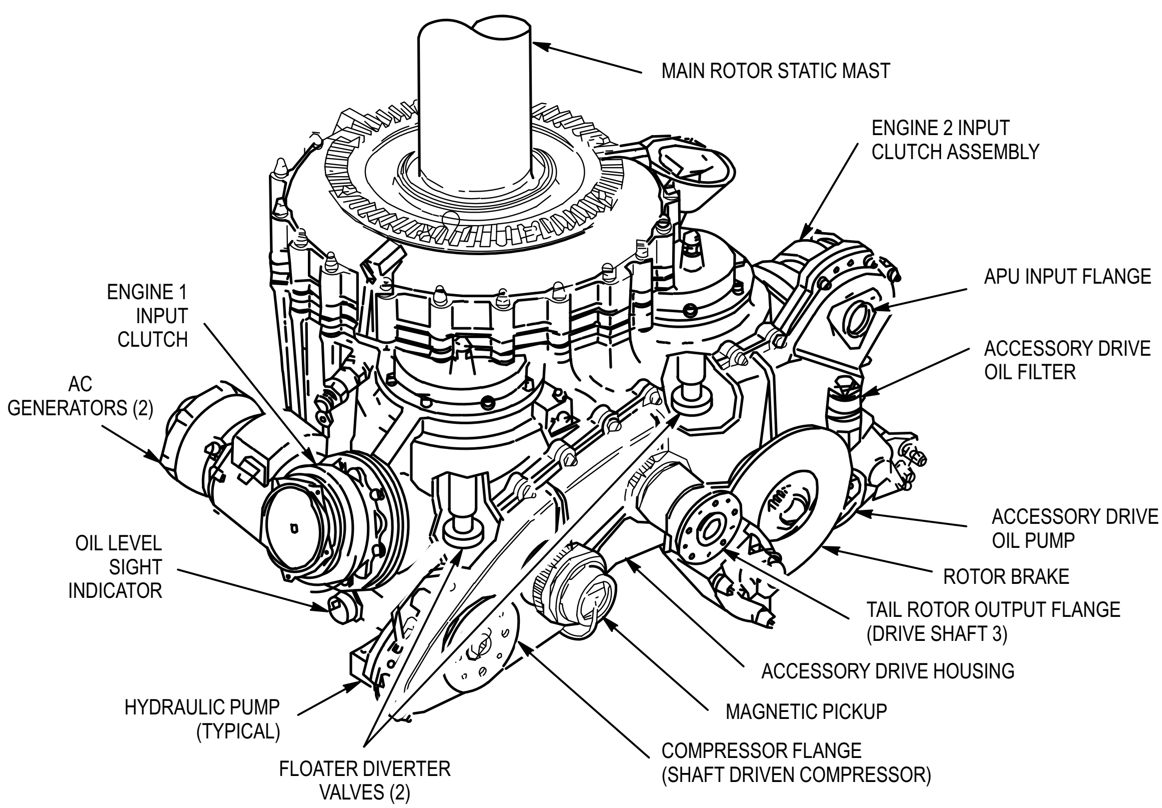
b. **Main Transmission Assembly.** The main transmission assembly (fig. 6–3) combines and reduces rpm from both engine NGBs and inputs usable engine power through the input clutch assemblies to the main rotor drive shaft and the main rotor head. It is mounted on the main rotor static mast support directly below the main rotor static mast. Primary and accessory gear trains are in the transmission housing and accessory drive housing assembly. They provide separate outputs for the main rotor, tail rotor, transmission oil pumps, accessories, and rotor brake.

(1) The main transmission assembly directs power from the APU to drive the accessories when the engines are not operating. It also provides accessory drives for two ac generators, two hydraulic pumps, an accessory drive oil pump, and a shaft driven compressor. It provides mounting for accessory drive oil filters, two oil pressure switches, chip detector/temperature switches, and an oil level sight indicator.

6–2 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 6–2



MAIN TRANSMISSION (RIGHT SIDE)



MAIN TRANSMISSION (AFT SIDE)

M58–129B

Figure 6–3. Main Transmission Assembly

(2) During normal operation, the main transmission drives the shaft driven compressor, the accessory drive lubrication pump, two ac generators, two hydraulic pumps, tail rotor output shaft, and the main rotor drive shaft.

(a) The shaft driven compressor draws ambient air through the particle separator. It is a single stage centrifugal compressor driven by the left generator spur gear.

(b) Two ac generators are mounted on spur gears, one on either side of the main transmission housing, which provide ac electrical power for the helicopter.

(c) Two hydraulic pumps pressurize the primary and utility hydraulic systems.

c. **IGB Assembly.** The IGB assembly (fig. 6–4) connects the main transmission to the TGB. The gearbox housing, mounted at the base of the vertical stabilizer, is finned for cooling. The housing assembly receives power from drive shaft 5 and supplies power to drive shaft 6. The IGB assembly consists of four theremistors, an accelerometer, a breather vent, and a cooling fan.

(1) Four temperature thermistors (sensors) are spring–loaded to maintain constant contact with the bearing housing.

(2) The accelerometer monitors vibration inside the IGB and is installed on the upper rear center section of the IGB.

(3) The breather vent prevents the IGB housing from being overpressurized. It is filled with curled steel mesh to provide a filter and is installed top of the housing assembly.

(4) The cooling fan and coupling assembly are mounted on the IGB input flange assembly. The cooling fan maintains the IGB assembly at normal operating temperature.

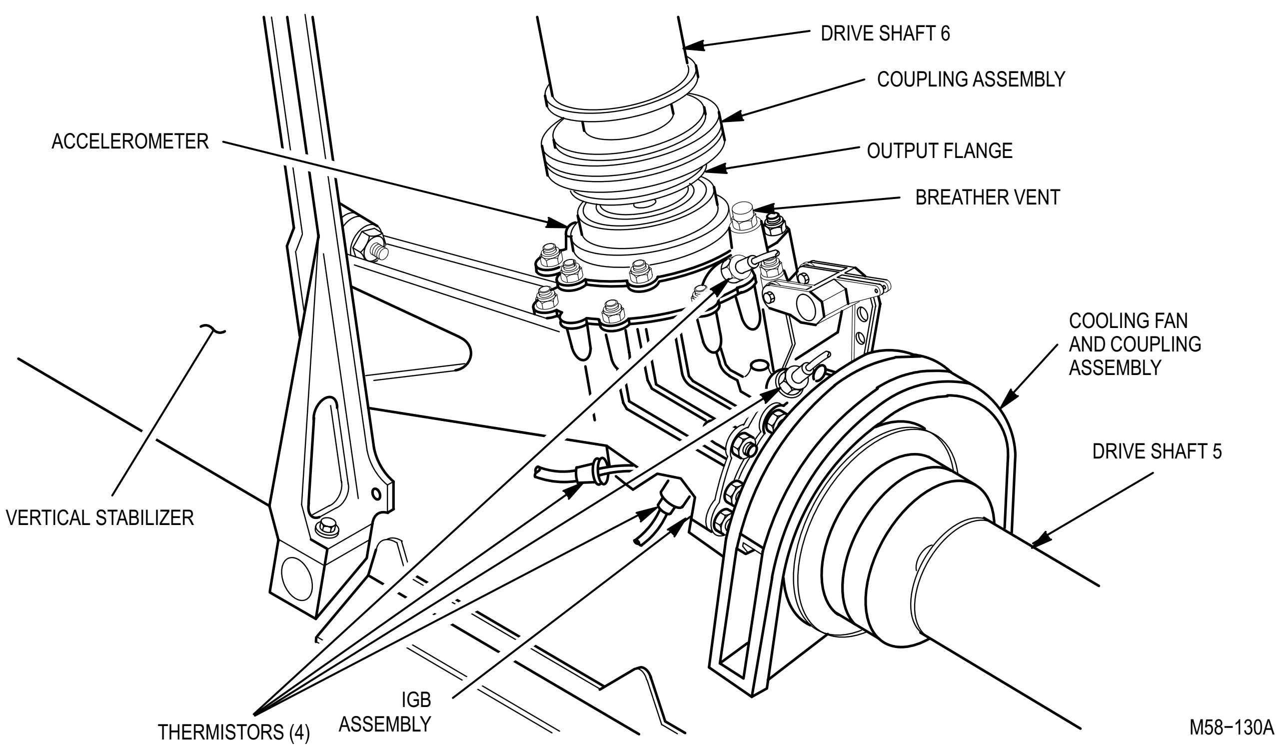


Figure 6–4. IGB Assembly

6–2 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 6–2

d. **TGB Assembly.** The TGB assembly (fig. 6–5) transmits power from the IGB to drive the TGB. The TGB, mounted on the vertical stabilizer, is coupled to the IGB by drive shaft 6. The tail rotor drive shaft, part of the gearbox, is located inside the static support. Some of the tail rotor components are mounted on the static supports which carry loads placed on the tail rotor drive shaft. The TGB assembly consists of the housing assembly, static support, four thermistors, and an accelerometer.

(1) The housing assembly supports the TGB components. The housing assembly includes a breather vent which prevents the TGB from being overpressurized. The vent is filled with curled steel mesh to provide a filter element.

(2) The static support, mounted to the output cover assembly and collar, supports the tail rotor swash plate assembly and the tail rotor assembly. The static support transmits all flight loads from the TGB to the housing assembly.

(3) The tail rotor drive shaft assembly has three studs to connect it to the tail rotor fork assembly.

(4) Four thermistors, installed to monitor the temperature of the duplex and roller bearings, are spring–loaded to maintain constant contact with the bearing housing.

(5) An accelerometer, installed on the lower end of the housing assembly, monitors vibrations inside the TGB. Excessive vibration causes the **VIB GRBX** indicator to light on the pilot's caution/warning panel.

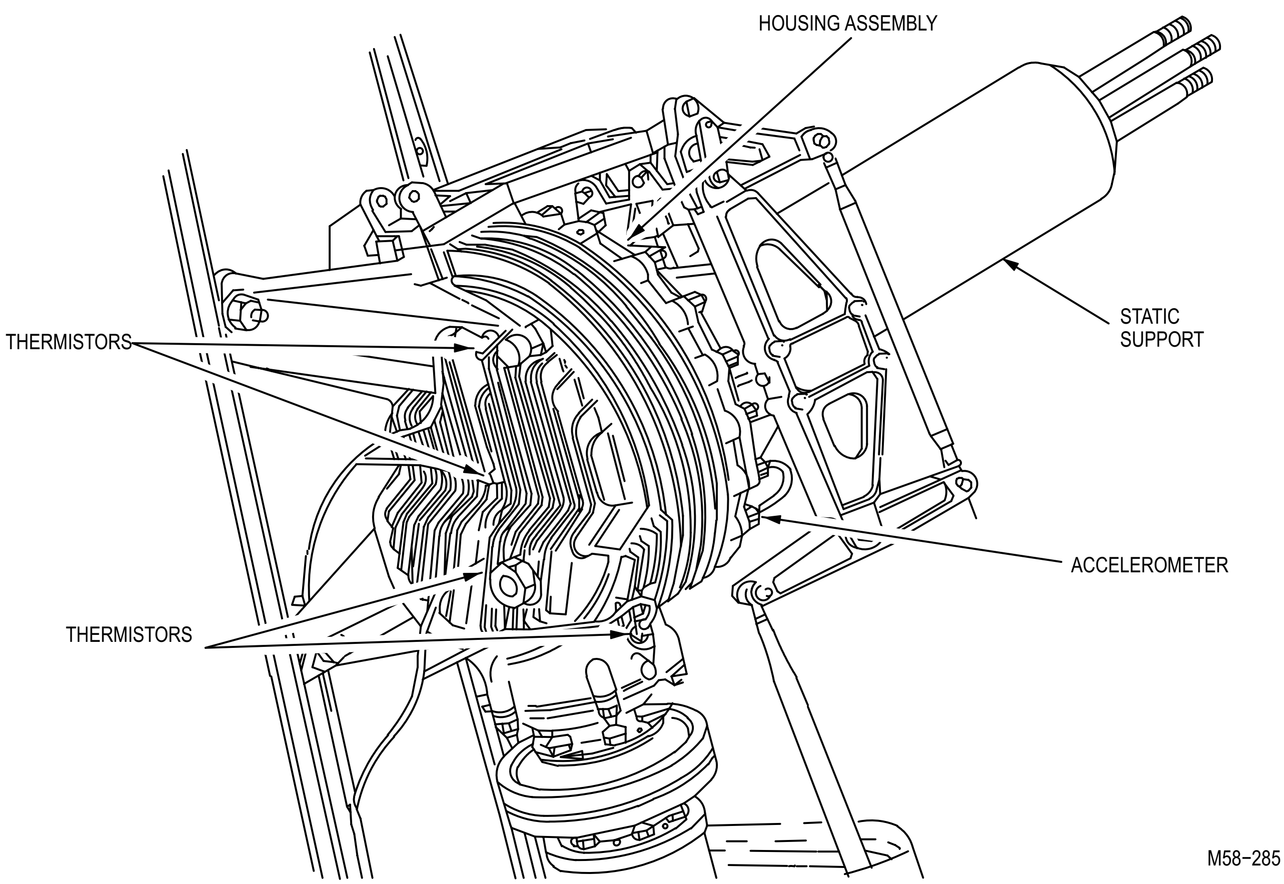


Figure 6–5. TGB Assembly

6–2 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 6–2

e. **Drive Shaft Assembly.** The drive shaft assembly (fig. 6–6) links the helicopter drive system gearboxes to the main transmission. The system consists of input drive shafts 1 and 2, drive shafts 3, 4, 5 and 6, forward and aft bearing hanger assemblies, damper assemblies, anti–flail assemblies, and APU drive shaft 7.

(1) Input drive shafts 1 and 2 are interchangeable and connect the engine NGBs to the main transmission assembly. The input drive shafts have a flange at each end with five equally–spaced floating anchor nuts. Flexible couplings, attached to each end of the shaft, incorporate an anti–flail bearing which supports the drive shaft sections in position if the flexible couplings fail.

(2) Tail rotor drive shaft assemblies 3, 4, 5 and 6 connect the main transmission to the TGB assembly. Flexible coupling assemblies on each end of the drive shafts mate with the main transmission assembly, two hanger bearing assemblies, two gearbox assemblies, and the main rotor drive shaft. Drive shaft 3 is a short section which connects to the main transmission and the forward hanger bearing assembly. Drive shafts 4 and 5 are joined by the aft hanger bearing assembly.

(3) Hanger bearing assemblies connect, support, and align drive shafts 3, 4, and 5. The forward hanger bearing assembly is a rigid A–frame which supports the sealed bearing. The aft hanger bearing assembly is semi–rigid consisting of a single support and a sealed bearing assembly. The support incorporates three spherical bearings in the mount holes which mount the support to the bracket.

(4) Damper assemblies detune the natural frequencies of drive shaft 5 to allow them to rotate through critical speeds. Spring–loaded dampers are installed on the drive shafts between the main transmission and the IGB.

(5) Anti–flail assemblies hold drive shafts 4 and 5 in position if partial or full separation of the drive shaft occurs. Anti–flail sleeves are installed on the drive shafts. They are between the main transmission and the IGB.

(6) APU drive shaft 7 transmits power from the APU to drive the accessory drive train. The APU drive shaft 7 has flexible couplings at each end.

(7) The main rotor drive shaft assembly, installed in the main rotor static mast, connects the main transmission to the main rotor head. The main rotor drive shaft is a semi–floating drive shaft which accepts torsional loads. The main rotor drive shaft is a tubular shaft with external splined steel forged couplings at each end. The tube shears in the event of a gear train seizure. The drive shaft is splined to a steel drive plate that bolts to the main rotor hub.

6–2 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS (cont) 6–2

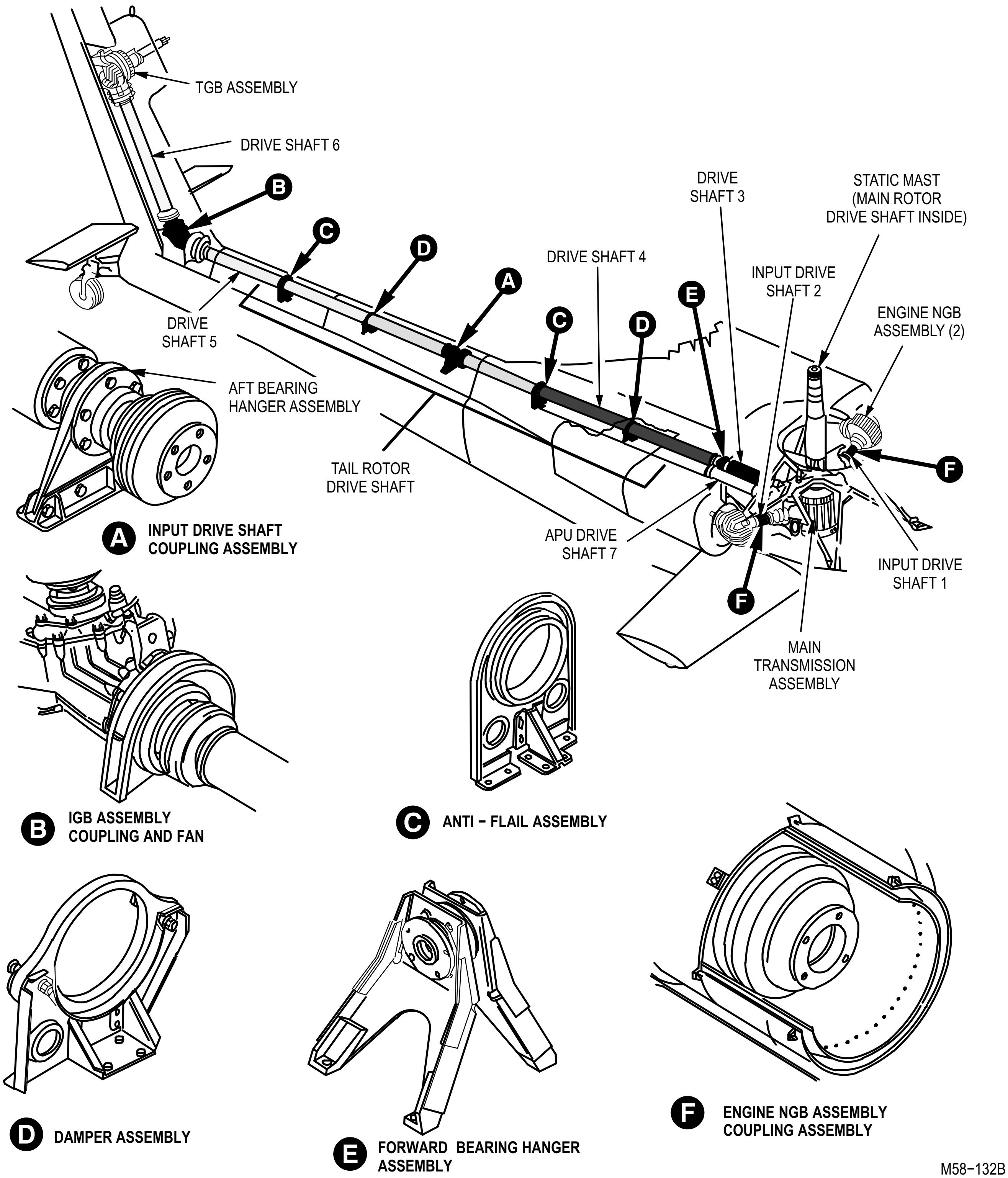


Figure 6–6. Drive Shaft Assembly

6–3. EQUIPMENT DATA 6–3

Engine NGB Assembly:

Oil sump capacity	5.5 pints
Oil pressure relief valve cracking pressure	68 ± 4 psi

Main Transmission Assembly:

Oil pressure relief valve cracking pressure	68 ± 4 psi
Lubrication oil capacity	45 pints
Oil pressure relief valve flow rate	7.5 gpm

IGB Assembly:

Weight	50 lbs.
Output ratings	3,636 rpm
Input ratings	4,815 rpm

TGB Assembly:

Weight	112 lbs.

6–4. EQUIPMENT CONFIGURATION 6–4

Not applicable.

6–5. SAFETY, CARE AND HANDLING OF EQUIPMENT 6–5

a. Drive shafts are thin–walled, tubular assemblies. Care should be taken not to allow any nicks on drive shaft assemblies.

b. Gearbox assemblies are heavy. Care should be exercised when handling gearbox assemblies.

6–6. CONTROLS AND INDICATORS 6–6

The drive system receives mode selects and switch inputs from various controls located in the pilot station (fig. 6–7) and CPG station (fig. 6–8). Table 6–1 provides a listing of the controls, switches and associated indicators pertaining to the drive system along with a description of their function.

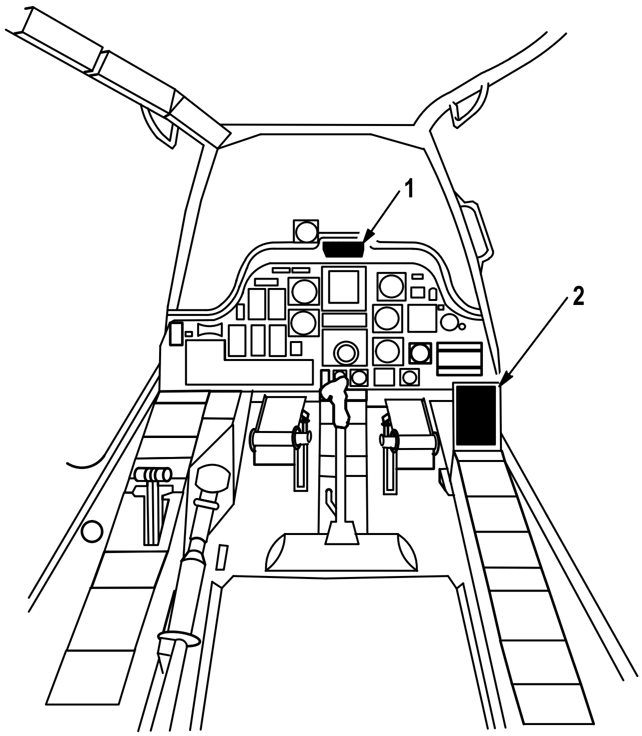


Figure 6–7. Pilot Station

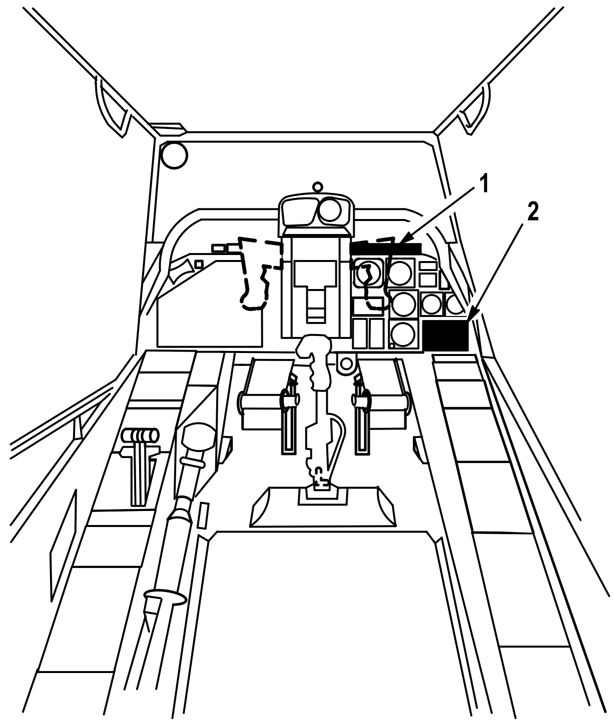
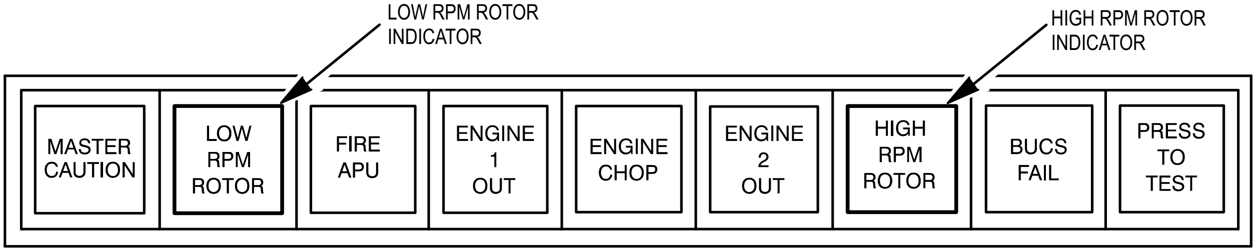


Figure 6–8. CPG Station

Table 6–1. Drive System Controls And Indicators

Master Caution/Warning		
SWITCH/INDICATOR	POSITION	FUNCTION
HIGH RPM ROTOR indicator	RED **(ACV)**	Lights when rotor speed is greater than 104%.
	RED **(ACW)**	Lights when rotor speed is greater than 108%.
LOW RPM ROTOR indicator	RED	Lights when rotor speed is less than 92%.



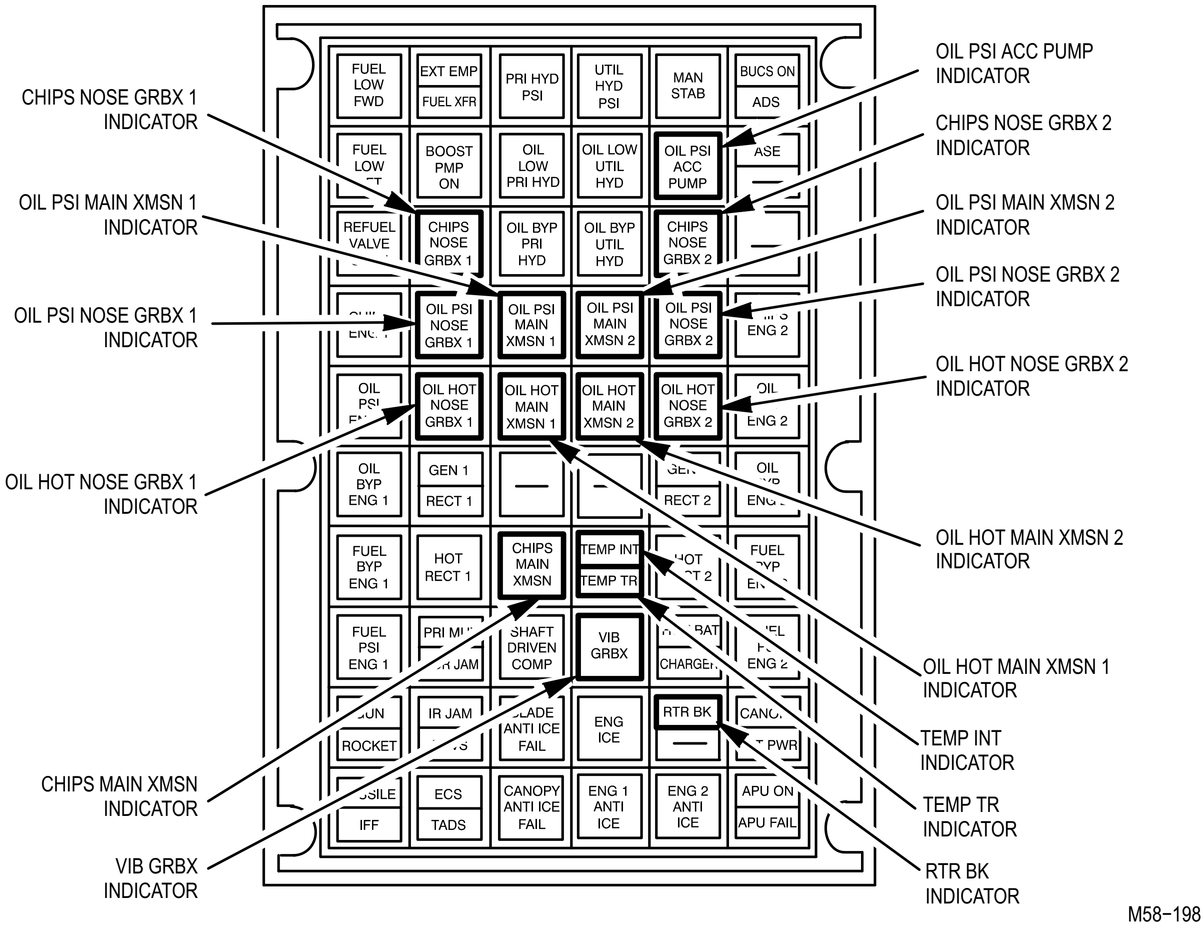
Master Caution/Warning Panel

Table 6–1. Drive System Controls And Indicators (cont)

Pilot Caution/Warning Panel		
SWITCH/INDICATOR	POSITION	FUNCTION
OIL PSI ACC PUMP indicator	AMBER	Lights when main transmission accessory gearbox oil pressure is below 26–30 psi.
CHIPS NOSE GRBX 2 indicator	AMBER	Lights when engine NGB 2 oil contains metal fragments.
OIL PSI MAIN XMSN 2 indicator	AMBER	Lights when main transmission 2 oil system oil pressure is below 26–30 psi.
OIL PSI NOSE GRBX 2 indicator	AMBER	Lights when oil pressure in engine NGB 2 is below 26 – 30 psi.
OIL HOT NOSE GRBX 2 indicator	AMBER	Lights when engine NGB 2 oil temperature is above 274°–294° F (134°–146° C).
OIL HOT MAIN XMSN 2 indicator	AMBER	Lights when main transmission 1 oil system temperature is above 274–294° F (134°–146° C).
OIL HOT MAIN XMSN 1 indicator	AMBER	Lights when main transmission 2 oil system temperature is above 274°–294° F (134°–146° C).
TEMP INT indicator	AMBER	Lights when IGB temperature is above 274°–294° F (134°–146° C).
TEMP TR indicator	AMBER	Lights when 90° gearbox temperature is above 274°–294° F (134°–146° C).
RTR BK indicator	AMBER	Lights when rotor brake switch is in brake or lock position.
VIB GRBX indicator	AMBER	Lights when IGB or TGB accelerometer reads excessive vibration.
OIL HOT NOSE GRBX 1 indicator	AMBER	Lights when engine NGB 1 oil temperature is above 274°–294° F (134°–146° C).
CHIPS MAIN XMSN indicator	AMBER	Lights when main transmission oil contains metal fragments.
OIL PSI NOSE GRBX 1 indicator	AMBER	Lights when oil pressure in engine NGB 1 is below 26 – 30 psi.
OIL PSI MAIN XMSN 1 indicator	AMBER	Lights when main transmission 1 oil system oil pressure is below 26–30 psi.
CHIPS NOSE GRBX 1 indicator	AMBER	Lights when engine NGB 1 oil contains metal fragments.

6–6. CONTROLS AND INDICATORS (cont) 6–6

Table 6–1. Drive System Controls And Indicators (cont)



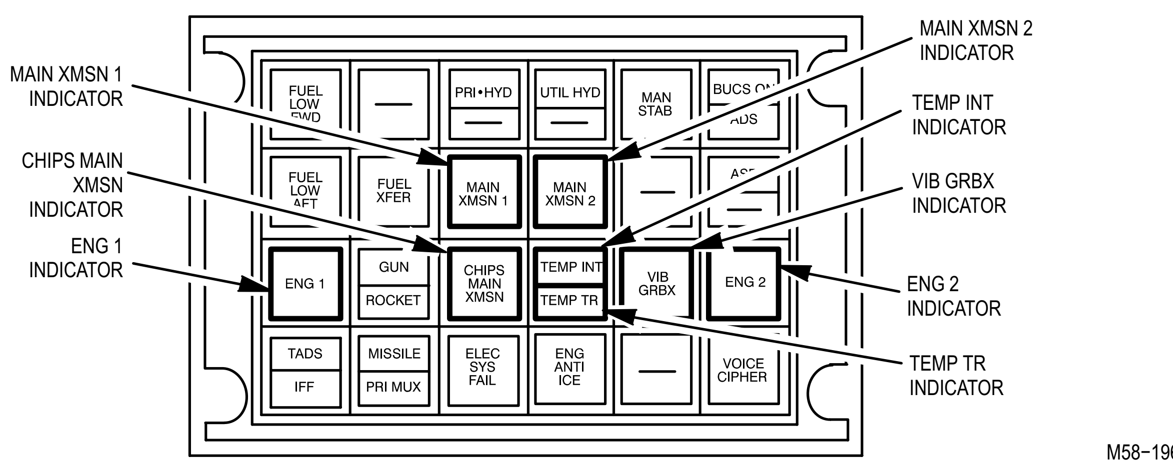
Pilot Caution/Warning Panel

CPG Caution/Warning Panel		
SWITCH/INDICATOR	POSITION	FUNCTION
MAIN XMSN 2 indicator	AMBER	Lights when main transmission oil system 2 oil temperature is high or oil pressure is low.
TEMP INT indicator	AMBER	Lights when IGB temperature is above 274°–294° F (134°–146° C).
VIB GRBX indicator	AMBER	Lights when IGB or TGB accelerometer reads excessive vibration.

6–6. CONTROLS AND INDICATORS (cont) 6–6

Table 6–1. Drive System Controls And Indicators (cont)

CPG Caution/Warning Panel (cont)		
SWITCH/INDICATOR	POSITION	FUNCTION
ENG 2 indicator	AMBER	Lights when one or more engine 2 condition occurs: low engine fuel pressure, low engine oil pressure, oil filter bypassed, engine chips, engine fuel filter bypassed, NGB chips, NGB oil pressure low, or NGB oil temperature is high.
TEMP TR indicator	AMBER	Lights when 90° gearbox temperature is above 274°–294° F (134°–146° C).
ENG 1 indicator	AMBER	Lights when one or more engine 1 condition occurs: low engine fuel pressure, low engine oil pressure, oil filter bypassed, engine chips, engine fuel filter bypassed, NGB chips, NGB oil pressure low, or NGB oil temperature is high.
MAIN XMSN 1 indicator	AMBER	Lights when main transmission oil system 1 oil temperature is high or oil pressure is low.
CHIPS MAIN XMSN indicator	AMBER	Lights when main transmission oil contains metal fragments.



CPG Caution/Warning Panel

SECTION II. THEORY OF OPERATION

6–7. SYSTEM DESCRIPTION 6–7

a. **The Drive System.** The drive system (fig. 6–9) transmits engine drive power from the engines to the main rotor and tail rotor assemblies, it also transmits APU drive power to the main transmission accessory section when the engines are not running.

(1) Engines 1 and 2 transfer drive power from each engine through an engine NGB assembly and an input drive shaft to the main transmission assembly. The main transmission changes the angle and reduces the speed of the drive input and transmits drive power to the main and tail rotor assemblies. The drive output is transferred directly from the main transmission assembly to the main rotor head assembly through the main rotor drive shaft. The drive output from the main transmission assembly is transferred to the tail rotor assembly through three drive shafts to the IGB assembly. The IGB changes the angle, reduces the speed, and applies drive power through a drive shaft to the TGB assembly. The TGB again changes the angle, reduces the speed, and transmits drive power directly to the tail rotor head assembly.

(2) When the engines are not running the APU transmits input power to the accessory gear box through the APU drive shaft 7 to drive the accessory drive section of the main transmission assembly. The accessory drive section can also be driven by one or both engines. The accessory drive section provides electrical power generation, pneumatic power, and hydraulic power.

(3) The drive system is designed to provide 30 minutes of operation with loss of lubricant. The shafts are designed to prevent catastrophic failure if struck by a bullet. Specially designed anti–flail assemblies prevent drive shaft whip if a coupling were to fail.

(4) The engine NGBs are equipped with cooling fans that draw air across the engine NGB cooling fins which directs the air down the drive shaft fairing into the transmission bay area. The IGB is fitted with a fan that draws cooling air over the TGB and IGB assemblies and then vents the warm air overboard.

b. **Purpose.** The drive system converts power from engine 1 and 2 to useful torque at the main rotor and tail rotor assemblies by reducing the high rpm of the engines into usable power. The drive system also supplies drive power to the electrical power generators and hydraulic system pumps.

c. **System Operation.**

(1) **Tail Rotor Drive Shafts**. The tail rotor drive shafts provide a means for the main transmission to drive the tail rotor. Drive shaft 3 transmits power from the main transmission to drive shaft 4. Drive shaft 4 transmits power from drive shaft 3 to drive shaft 5. Two bearing hangar assemblies support the drive shaft, allowing it to turn. Damper assemblies permit the drive shaft to rotate through critical speeds while damping natural frequencies. Drive shaft 5 transmits power from drive shaft 4 to the IGB assembly.

(a) The bearing hanger assemblies connect, support, and align drive shafts 3, 4, and 5. The forward bearing hanger assembly provides positive center alignment with flange bearings that oscillate when subjected to moving torque loads. Internal bearing clearance allows for a slight misalignment. The aft bearing hanger assembly provides positive center alignment and allows it to swing fore and aft for axial alignment.

(b) The input clutch assemblies are free–wheeling sprag type assemblies that provide drive and disengaging capabilities for the main transmission. During emergencies, the main transmission disengages the inoperative engine through the input overrunning clutch for single engine operation, or both engines can be disengaged for authorization. A two–hour overrunning is permissible without damage to the input clutches. Complete loss of lubrication does not prevent full overrunning for a minimum of 30 minutes of emergency operation. Increased backlash is provided in the bevel gears to accommodate for high thermal expansion which occurs during emergency operations after the complete loss of lubricating oil.

(2) **Accessory Drive Section.** The accessory drive section can be driven by one or both engines through the input drive shafts. When the engines are not operating, the APU drives the accessory drive section through drive shaft 7. The APU drives the accessory gear train during ground operations when the main transmission is operating at 95% N_R or stopped. The accessory drive section powers two generators, two hydraulic pumps, a SDC, and the accessory drive lubrication pumps.

(3) **IGB Assembly.** The IGB assembly transmits power from the main transmission to the TGB assembly while changing the drive angle. The IGB assembly reduces an input rpm of 4815 to an output rpm of 3636. The housing supports the IGB internal gears, bearings, and drive shaft and provides mounting points for the IGB assembly. Grease packed in the housing and static support provides cooling and lubrication during normal operations, after a rotating gear seal failure, or after a ballistic impact. A breather vent prevents the IGB assembly from being overpressurized. The assembly includes four temperature sensors (thermistors), accelerometer, and fan assembly.

(a) Four temperature sensors monitor IGB bearing temperatures. Each sensor is a coil–activated temperature sensing switch, spring–loaded to maintain contact with the bearing. When bearing temperatures exceed operating limits of 274° to 294° F (134° to 146° C), the temperature sensors close, lighting the pilot and CPG **TEMP INT** indicators.

(b) An accelerometer monitors vibrations inside the IGB assembly. Excessive vibration causes the accelerometer to light the pilot and CPG caution/warning panel **VIB GRBX** indicators.

(c) Cooling air is provided through the ram air inlet port on the leading edge of the vertical stabilizer. A cooling fan draws air through the fairing and down the stabilizer. The cooling air passes over the IGB housing. The diffuser housing directs the air overboard through vent ports in the lower stabilizer fairing.

(d) Drive shaft 6 transmits power from the IGB to the TGB assemblies to drive the tail rotor head. Couplings attach the drive shaft to the IGB and TGB assemblies and provide flexibility.

(4) **TGB Assembly.** The TGB transmits power from the IGB assembly to the tail rotor head by reducing the speed, increasing the torque, and changing the drive angle.

(a) The gear train in the TGB assembly changes the drive angle 90° and increases torque to the tail rotor. The TGB assembly reduces an input rpm of 3636 from drive shaft 6 to an output rpm of 1403 to the tail rotor. The gear train is packed with grease for lubrication and to aid in cooling.

(b) The static support transmits all drive loads to the tail rotor head through the center of the static support. The static support transmits all tail rotor head flight loads to the housing. A quill shaft transfers power from the gear train to the output shaft assembly. The output shaft assembly has a coupling for positive engagement and provides for positive alignment of the tail rotor.

(c) Four temperature sensors (thermistors) monitor TGB bearing temperatures. Each sensor is a coil–activated temperature sensing switch, spring–loaded to maintain positive contact with the bearing. When bearing temperatures exceed operating limits of 274° to 294° F(134° to 146° C), the temperature sensors close, lighting the pilot and CPG caution/warning panels **TEMP TR** indicators. A breather vent prevents TGB from being overpressurized.

(d) The accelerometer monitors vibrations inside the TGB assembly. Excessive vibration causes the accelerometer to light the pilot and CPG caution/warning panels **VIB GRBX** indicators.

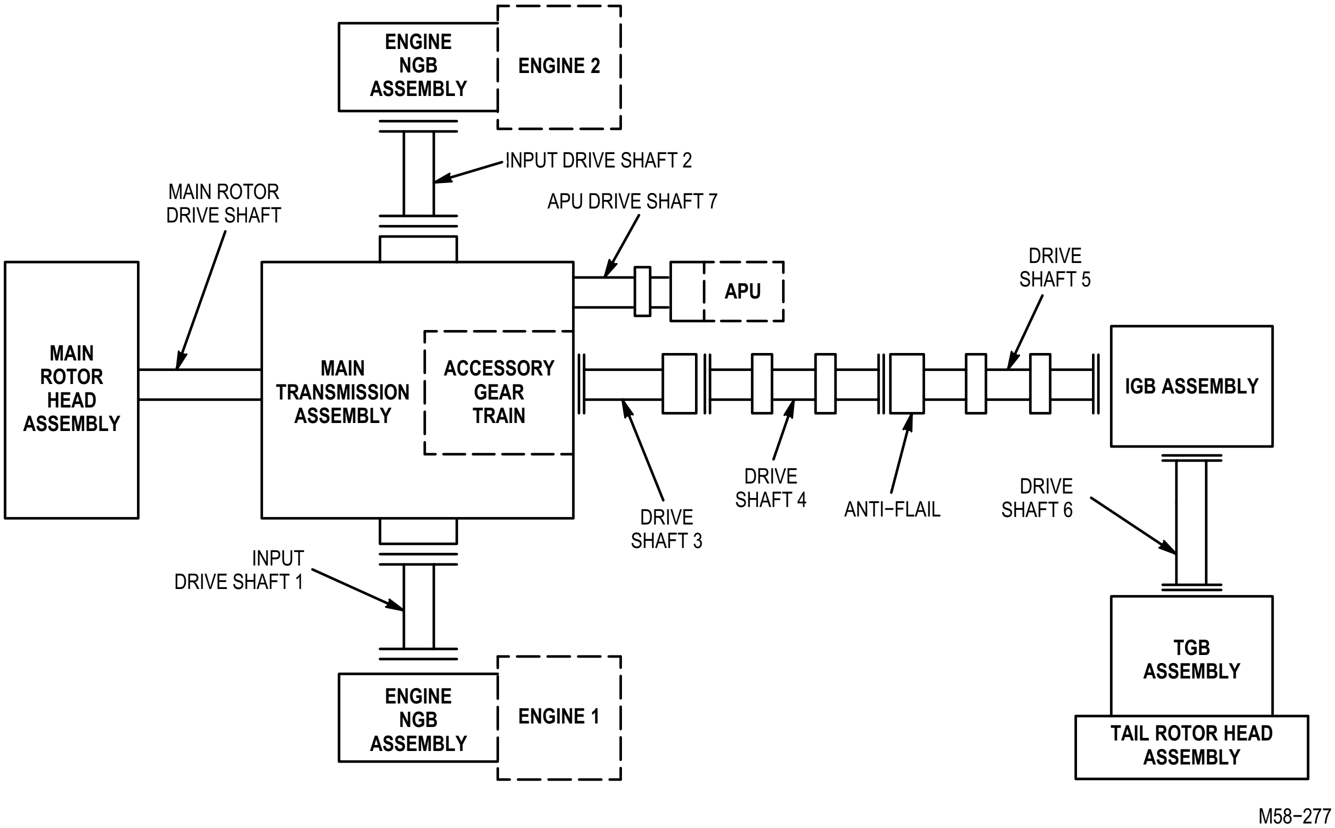


Figure 6–9. Drive System Functional Block Diagram

(5) **Engine NGB Assembly.** The Engine NGB assembly (fig. 6–10) drives the main transmission through input drive shafts 1 and 2 while changing the drive angle 90°. When the engine is operating at 100%, the engine NGB assembly reduces engine output from 20,952 to 9,841 rpm.

(a) The oil pump assembly sprays non–filtered oil on the bearing and felt wicking discs in the engine NGB assembly.

(b) The oil pressure switch monitors oil system pressure during engine NGB operation. When engine NGB oil pressure exceeds 45 psi and increasing, the oil pressure switch turns off the **OIL PSI NOSE GRBX 1** or **2** indicator on the pilot caution/warning panel and the **ENG 1** or **2** indicator on the CPG caution/warning panel. When NGB oil pressure drops within 30–26 psi and decreasing, the indicators light.

(c) The oil filter removes impurities from the oil and has an impending bypass indicator which visually warns of pressure differential problems in the oil filter, and bypasses oil around the filter when required. An impending bypass indicator pops out, providing visual indication, when a differential pressure across the filter is greater than 23 ±2 psid. If the oil filter becomes clogged, a bypass valve opens to allow the oil to bypass the filter when 38 ± 4 psid has been exceeded.

(d) The chip detector/temperature switch senses the presence of large metal chips in the oil and monitors oil temperature. The detector senses the presence of large metal particles in the gearbox oil and causes the pilot caution/warning panel **CHIPS NOSE GRBX 1** or **2** indicators to light. A capacitor discharges to burn off any accumulation of small metal particles (fuzz suppression) without causing the pilot caution/warning panel **CHIPS NOSE GRBX 1** or **2** indicators to light.

6–7. SYSTEM DESCRIPTION (cont) 6–7

(e) An engine NGB cooling fan forces cooling air around the engine NGB to maintain operating temperatures at 250° to 275° F (121° to 135° C) at 100% N_G. The vaneaxial fan pulls cooling air around the cooling fins on the NGB housing. The air is forced through NGB fairings down to the transmission deck, and exhausted through the IR suppression system.

(f) The oil pressure transducer monitors and transmits engine NGB operating oil pressure to FD/LS.

(g) The CPG can access a true temperature reading through the **DATA ENTRY** keyboard (DEK) (ADC) or control display unit (CDU) (ADD). The reading is obtained from the oil temperature transducer and is displayed on the CPG's heads out display (HOD).

(h) The oil level sight plug permits flight and maintenance personnel to visually inspect the oil level when the engines are not operating.

(i) Power to the main transmission assembly is received from engine NGB 1 via input drive shaft 1, and engine NGB 2 via input drive shaft 2.

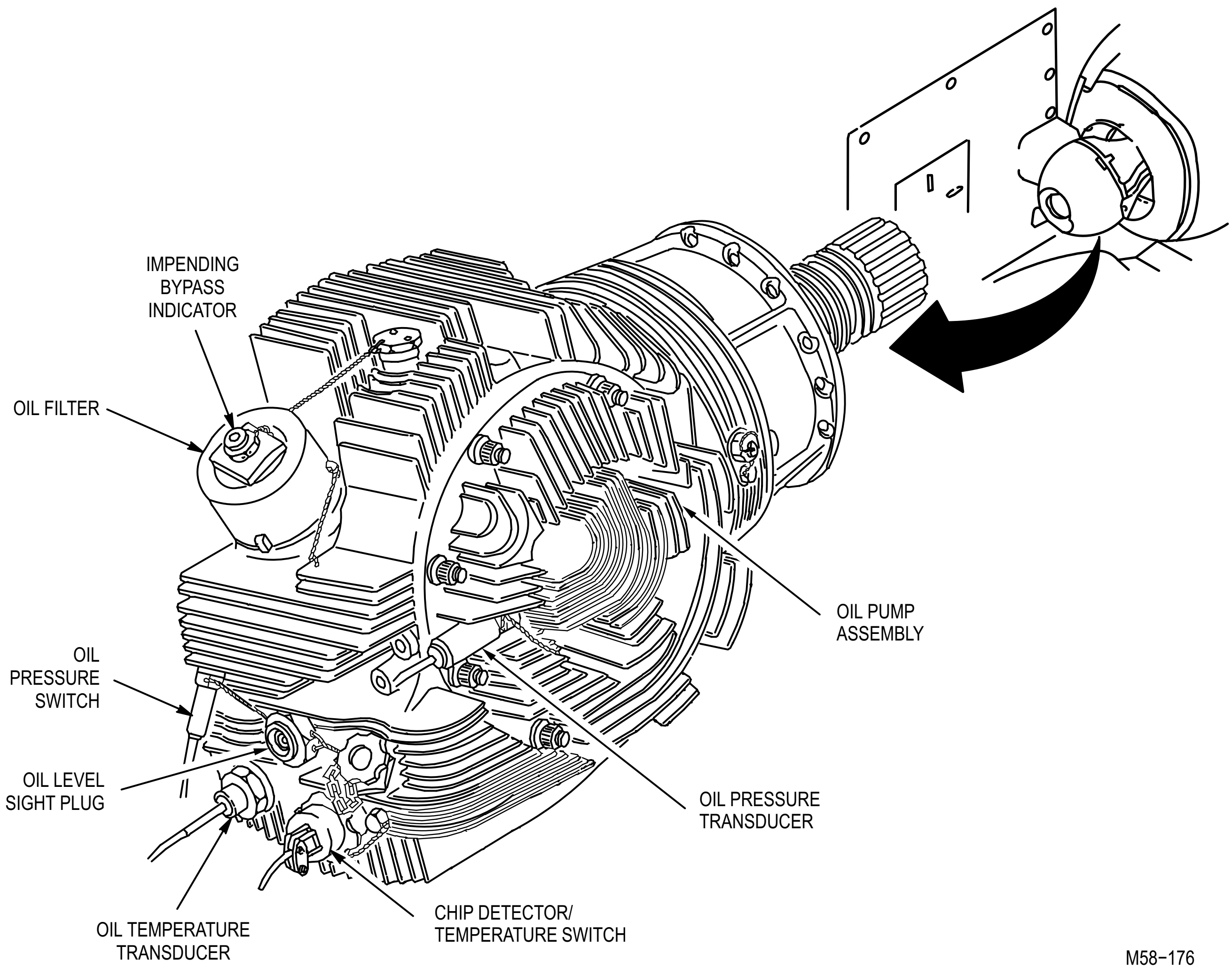


Figure 6–10. Engine NGB Assembly

6–7. SYSTEM DESCRIPTION (cont) 6–7

(6) **Main Transmission Assembly.** The main transmission assembly provides primary drive for the main and tail rotor drive shafts. The engine NGBs input 9841 rpm to the main transmission, which outputs 289 rpm to the main rotor and 4815 rpm to the tail rotor drive shaft while increasing torque.

(a) The primary gear train reduces input speed from the NGBs and changes the drive angles of the primary and accessory drives. The power takeoff clutches, two sprag clutch assemblies and a roller bearing, sets freewheel without turning the primary gear train or tail rotor drive shaft when the main transmission assembly operates at 100% N_R. The primary gear train drives the magnetic pickup, two generators, two hydraulic pumps, a shaft driven compressor, accessory oil pump, rotor brake disc, main rotor drive shaft and the tail rotor drive shaft. A magnetic pickup in the accessory section signals main rotor rpm readout on the pilot and CPG **ENG–RTR RPM%** indicators. The magnetic pickup creates electrical impulses from the primary gear train motion. Two ac generators provide ac electrical power for the helicopter. They also provide protection for the main transmission oil sumps from ballistic impact. The primary and utility hydraulic pumps are constant–pressure variable delivery, piston type pumps that incorporate a shear shaft. The shaft driven compressor provides pressurized air for the pressurized air system (PAS). The shaft driven compressor draws ambient air through the particle separator and compresses it to 35 psi and operates automatically while the main transmission is operating or while being driven by the APU. The shaft driven compressor is driven by the left generator spur gear. The rotor brake disc retards or prevents main rotor drive shaft rotation. A steel disc is splined to the rotor gear shaft. Grip assemblies on each side of the disc trap it when pressure is applied. The grip assembly incorporates self–return and self–adjusting features. The **RTR BK** indicator on the pilot caution/warning panel lights when the brake is applied.

(b) The lubrication system (fig. 6–11) consists of the main transmission lubrication system and the accessory lubrication system. Each system contains oil–saturated felt wicking devices inside beveled gears and around helical gears. Lubrication is provide for a minimum of 30 minutes during emergency operations. Bearings using silver–plated steel races provide lubrication during the start period and aid with emergency lubrication.

(c) The main transmission lubrication system includes the primary oil system with two oil sumps, two oil pumps, a gallery, two check valves, two pressure relief valves, two floater diverter valves, an oil filter assembly, two chip detector/temperature switches, two oil pressure switches, two oil temperature transducers, and two radial–type heat exchangers (mounted on the engine deck firewalls). Ten oil system jets are installed externally on the main transmission housing to spray filtered oil directly on the components requiring lubrication.

6–7. SYSTEM DESCRIPTION (cont) 6–7

(d) In the primary oil system, most of the oil drained is collected in the gallery. The gallery is a common area which accepts oil from both oil subsystems and diverts the oil to lubricate the main transmission assembly primary gear train. Two check valves are installed on the oil return line entry into the gallery which prevents oil from escaping the main transmission after an external oil line or component suffers an oil leak. Two pressure relief valves channel excess oil from the gallery back into the main transmission housing. Two floater diverter valves control oil flow into the oil sump. In case of a ballistic impact to the oil sump, the floater diverter valves close off the oil sump, preventing complete loss of oil. When the oil level in the oil sump drops, the floats drop, closing a 28 VDC switch. When the switch closes, a solenoid is energized forcing the valve up and closing off the oil sump. Oil level sight plugs, located on the left and right side of the main transmission housing, are bull's–eye type indicators that provide visual inspection of the oil quantity. The two oil pumps pressurize the oil system during operation by scavenging oil from internal oil passages that feed the accessory gear train. The pumps are rated at 6.25 to 6.75 gpm at 75 psi while running at 4391 rpm. The two oil filter assemblies have impending bypass indicators and oil bypass valves which remove contaminants from the main transmission oil system. The impending bypass indicator pops out when the pressure differential across the filter is greater than 21 to 25 psid. The oil bypass valve bypasses oil around the filter when a valve cracking pressure of 34 to 42 psid is reached. Two chip detector/temperature switches sense the presence of metal chips in the oil and monitor oil temperature. A capacitor discharges to burn off (fuzz suppression) any accumulation of small metal particles (ferromagnetic material) without turning on the caution indicators. Large metal particles attracted to the chip detector cause the **CHIPS MAIN XMSN** indicators on the pilot and CPG caution/warning panels to light. The pilot **OIL HOT MAIN XMSN 1** or **2** indicators, and the **CPG MAIN XMSN 1** or **2** indicators on caution/warning panels light when oil temperature reaches 274° to 294° F (134° to 146° C). Two oil pressure switches monitor main transmission oil pressure. The switches light the pilot caution/warning panel **OIL PSI MAIN XMSN 1** or **2** indicator, and the CPG caution/warning panel **MAIN XMSN 1** or **2** indicator when oil pressure is less than 26–30 psi. The switches turn the indicators off when oil pressure exceeds 45 psi. The oil temperature transducer monitors the operating temperature of the main transmission assembly and sends updated temperature readings through FD/LS to the CPG's HOD. A cooling fan maintains the main transmission assembly temperature within the requirement for normal operations. Cooling air from the rotor down wash and the engine NGBs flow around the main transmission assembly to aid in cooling. Main transmission oil is cooled by the heat exchangers mounted on each side of the catwalk on the center deck area. Cooling air flows around the core tubes, cooling the oil in the heat exchangers, then vents with engine exhaust air through the IR system. Thermal relief valves allow oil to bypass the heat exchanger's cooling cores until the oil reaches operating temperature. The valves automatically open as the oil cools after shut down.

(e) The accessory lubrication system provides oil for the accessory gear train and components during APU ground operations. The system includes the accessory oil pump, an accessory oil pressure switch, accessory oil pump and accessory oil filter assembly. The accessory oil pressure switch turns off the pilot caution/warning panel **OIL PSI ACC PUMP** indicator when oil pressure is at 45 psi and increasing. It also lights the pilot caution/warning panel **OIL PSI ACC PUMP** indicator when oil pressure is 30 to 26 psid and decreasing.

(f) The accessory oil pump pressurizes the system and lubricates the accessory housing assembly components and wicking disk. The oil pump is driven by the right generator spur gear. It is rated at 1.5 ± 0.3 gpm, 100 psig at 12,251 rpm. The system draws oil from the right oil sump.

(g) An accessory oil filter assembly, with impending bypass indicators and oil bypass valves, removes contaminants from the transmission's oil system. An impending bypass indicator pops out when the pressure differential across the filter is greater than 21 to 25 psid. An oil bypass valve bypasses oil around the filter when it becomes partially clogged and a valve cracking pressure of 34 to 42 psid is reached.

(7) **Transducers and Switches.** Transducers and switches are used in the transmission and nose gearbox oil systems to monitor pressures and temperatures. Transducers send a signal to the multiplex subsystem for a visual indication of pressures and temperatures on the CPGs HOD. Switches send ground signals to the pilot and the CPGs caution/warning panels that turn on caution lights.

(a) **Pressure Transducers.** All four pressure transducers (NGB 1, XMSN 1, XMSN 2, and NGB 2) are identical. Each has four wires but only three are used; the green is never connected. The black wire is connected to a –5 VDC signal and the white is connected to a +5 VDC signal. Both signals come from the appropriate MRTU in the multiplex subsystem. The red wire sends a signal to the MRTU that is –5 VDC at a 0 PSI state and is +5 VDC at 100 PSI. The OVDC state is defaulted to 50 PSI.

1. The characteristics of these transducers result in three typical failures displayed on the HOD when there is an open in the circuit. A 0 LB reading on the HOD is caused by an open in the white wire (–5 VDC signal from the black wire thru the red wire to the MRTU), a 50 LB reading by an open in the red wire (no signal is interpreted by the MRTU as OVDC), and a 99 LB reading is caused by interpreted by an open in the black wire (+5 VDC from the white wire thru the red wire to the MRTU). The highest reading on the HOD is 99 LB (read as greater than 99 LB).

(b) **Temperature Transducers.** All four temperature transducers (NGB 1, XMSN 1, XMSN 2, and NGB 2) are also identical. Each has four wires; two unshielded wires for power and two shielded wires for the output signal. The red wire is always the 28 VDC power signal from the engine start circuit breaker (CB58). The yellow wire is the output signal (0 – 10 VDC) to the appropriate MRTU. The other two wires are both blue; one inside the shield with the yellow wire and the other unshielded. Both are connected in the inside of the transducer.

1. The characteristics of these transducers result in one typical failure displayed on the HOD; a –32 °C reading that is caused by no signal to the MRTU (interpreted as OVDC). This can be the result of an open in the red wire (no power to the transducer), the yellow wire (no signal to the MRTU) or an open in both blue wires (no ground for the transducer). There is no failure noted as long as one of the blue wires terminates in a ground.

(c) **Pressure Switches.** There are five pressure switches; (NGB 1, XMSN 1, XMSN 2, NGB 2, and ACC GRBX) in the drivetrain system and all are identical. Each has two wires and all are wired the same; white to ground and red to the appropriate caution/warning indicator.

1. With no pressure applied (28 ± 2 PSI decrease) to the system, the pressure switch should be closed completing the circuit ground. If either of the wires has an open the caution light will not be illuminated. With pressure applied (45 PSI INCR) the switch should be open thus removing the ground and extinguishing the caution light.

(d) **Temperature Switches.** All four temperature switches (NGB 1, XMSN 1, XMSN 2, and NGB 2) are identical and are a part of the system chip detectors. The temperature switch function of the chip detectors used the white wire for the signal to the caution/warning system and the black wire for the ground. The red wire is for the chip detector function.

(e) **Troubleshooting.** Troubleshooting methodology should always start by attempting to divide the system between an actual oil system, transducer or switch electrical problem.

1. If two or more sensors agree then the problem is probable with the appropriate oil system. An example is the **OIL PSI NOSE GRBX 1** caution/warning light illuminates and the HOD shows NGB 1 at less than 28 LB oil pressure and the NGB 1 temperature is higher than NGB 2 temperature. These indications are mutually supportive of a problem with the NGB 1 oil system.

2. If only one sensor is indicating a fault then the problem is probably with that sensor or its associated wiring. An example is the **OIL TEMP MAIN XMSN 2** caution/warning light illuminated by the HOD shows XMSN 2 at normal system temperature and closely matching XMSN 1 temperature and the XMSN 2 oil pressure is normal. These indications support a problem with the temperature switch in the XMSN 2 chip detector.

6–7. SYSTEM DESCRIPTION (cont) 6–7

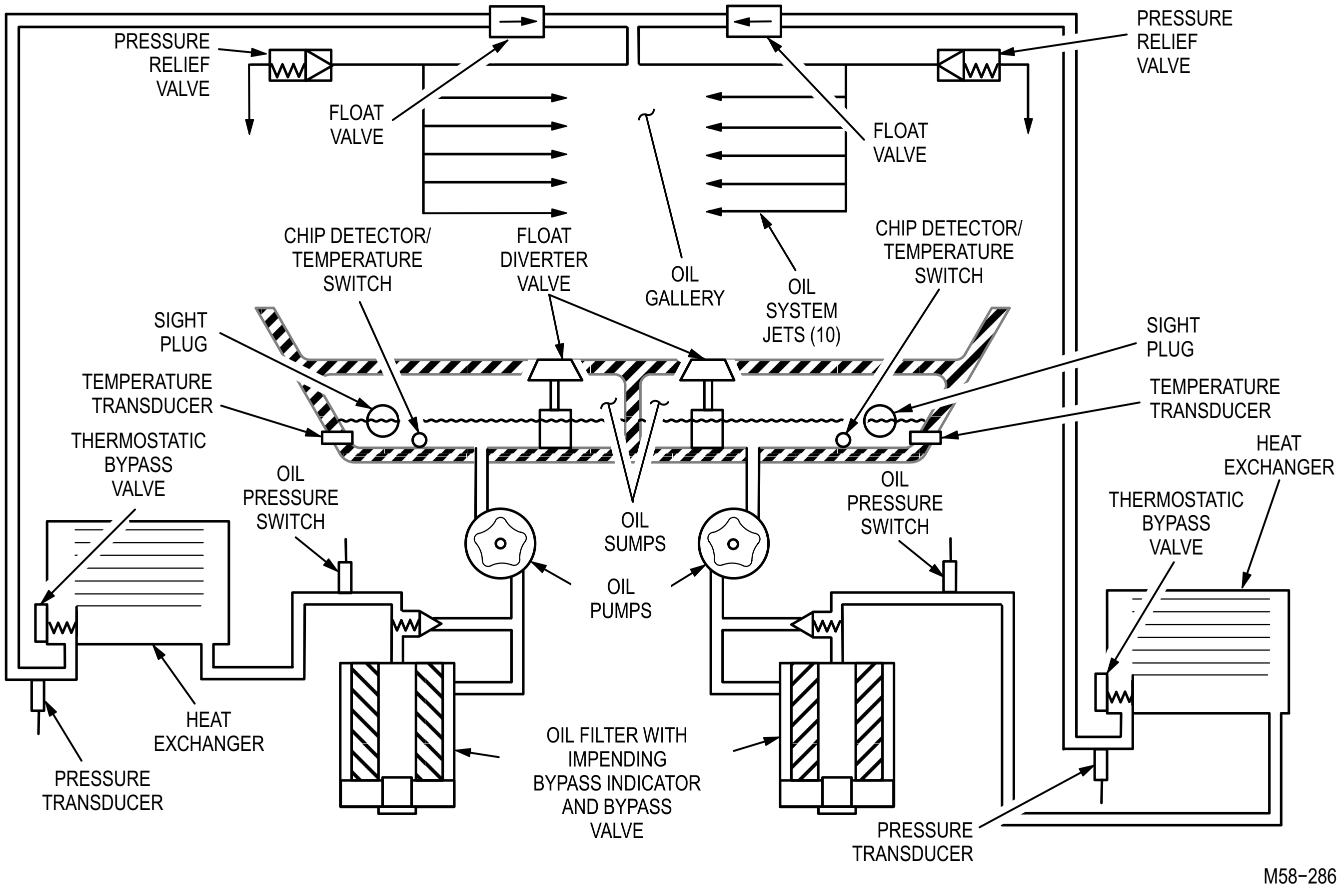


Figure 6–11. Lubrication System

6–8. MULTIPLEX READ CODES (cont) 6–8

The drive system transmits transmission oil pressure transducer excitation data, NGB oil pressure and temperature status, and transmission oil temperature status to the fire control computer (FCC) via the multiplex data (MUX) bus system. Integrated in the MUX bus system is the FD/LS. FD/LS utilizes the MUX bus system DEK (ADC) or CDU (ADD) for FD/LS command initialization and/or FCC memory read code accessing.

SECTION III. TROUBLESHOOTING PROCEDURES

6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX 6–9

Use the information in Table 6–2 to locate the electrical components and their connectors to perform the troubleshooting tasks in this chapter. Table 6–2 includes locater illustrations which supplement the ECLC listing. The listing entry in the grid area column in the listing tells you where to locate the component in the illustrations.

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing

FROM COLUMN		TO COLUMN			
Connector Ref Des	Component/ Harness	Connector Ref Des	Component/ Harness	Grid Area	Access
P1	W605/A76	J1	A402	40B	PLT STATION
P124	W171	J124	W170	71E	R510 FAIRING
P128	W118	J2	A141	15B	CPG STATION
P129	W118	J1	A141	15B	CPG STATION
P18	W118	J1	A106	25C	PLT STATION
P20	W118	J2	A106	25B	PLT STATION
P200	W170	J1	A419	72D	R545 COVER
P201	W170	J1	A418	71C	R545 COVER
P31	W118	J2	A157	1D	R40 COVER
P403	W119	J403	W117	20C	CL5 PANEL
P410	W170	J410	W211	65E	R295 DOOR
P431	W211	J27	A402	39D	L200 PANEL
P433	W119	J20	A402	39E	PLT STATION
P435	W261	J7	A326	32B	CPG STATION
P436	W102	J436	W118	51C	T205R FAIRING
P438	W118	J15	A402	38C	R200 PANEL
P439	W119	J21	A402	39E	L200 PANEL
P440	W118	J16	A402	38C	R200 PANEL
P448	W118	J448	W119	33C	PLT STATION

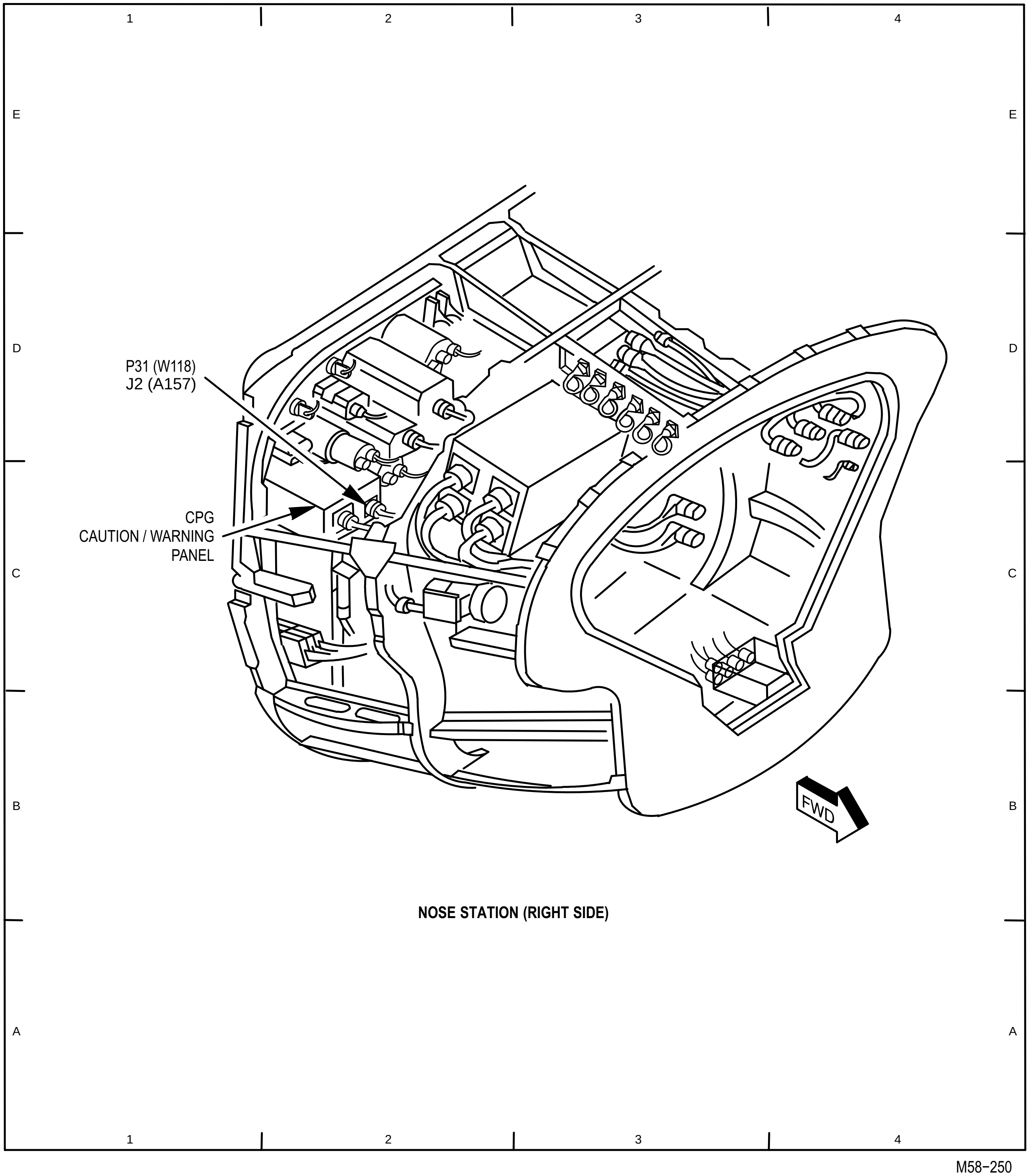
6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)

FROM COLUMN		TO COLUMN			
Connector Ref Des	Component/ Harness	Connector Ref Des	Component/ Harness	Grid Area	Access
P449	W211	J449	W119	59E	T205L FAIRING
P455	W170	J455	W211	65E	R295 DOOR
P456	W118	J456	W211	33C	PLT STATION
P463	W119	J1	A76	36D	PLT STATION
P473	W119	J6	A326	31D	CPG STATION
P477	W119	J8	A326	31D	CPG STATION
P482	W118	J18	A326	29C	CPG STATION
P49	W261	J1	A9	43B	L140 FAIRING
P524	W116	J524	W118	11B	R60 FAIRING
P578	W167	J578	W116	54E	R200 FAIRING
P579	W159	J579	W117	64D	R200 FAIRING
P58	W171	J1	MT34	75D	L540 FAIRING
P59	W171	J1	MT33	75C	L540 FAIRING
P60	W162	J60	W118	79E	R200 FAIRING
P61	W161	J61	W119	81E	L200 FAIRING
P672	W116	J3	A63	12C	R60 FAIRING
P673	W117	J3	A63	5C	L60 FAIRING
P682	W211	J3	A69	68D	R295 FAIRING
P755	W211	J755	W210	48D	TL250L DOOR
P766	W119	J1	A77	22B	CPG STATION
P910	W102	J910	W211	68B	R295 DOOR
P914	W118	J914	W119	17C	PLT STATION

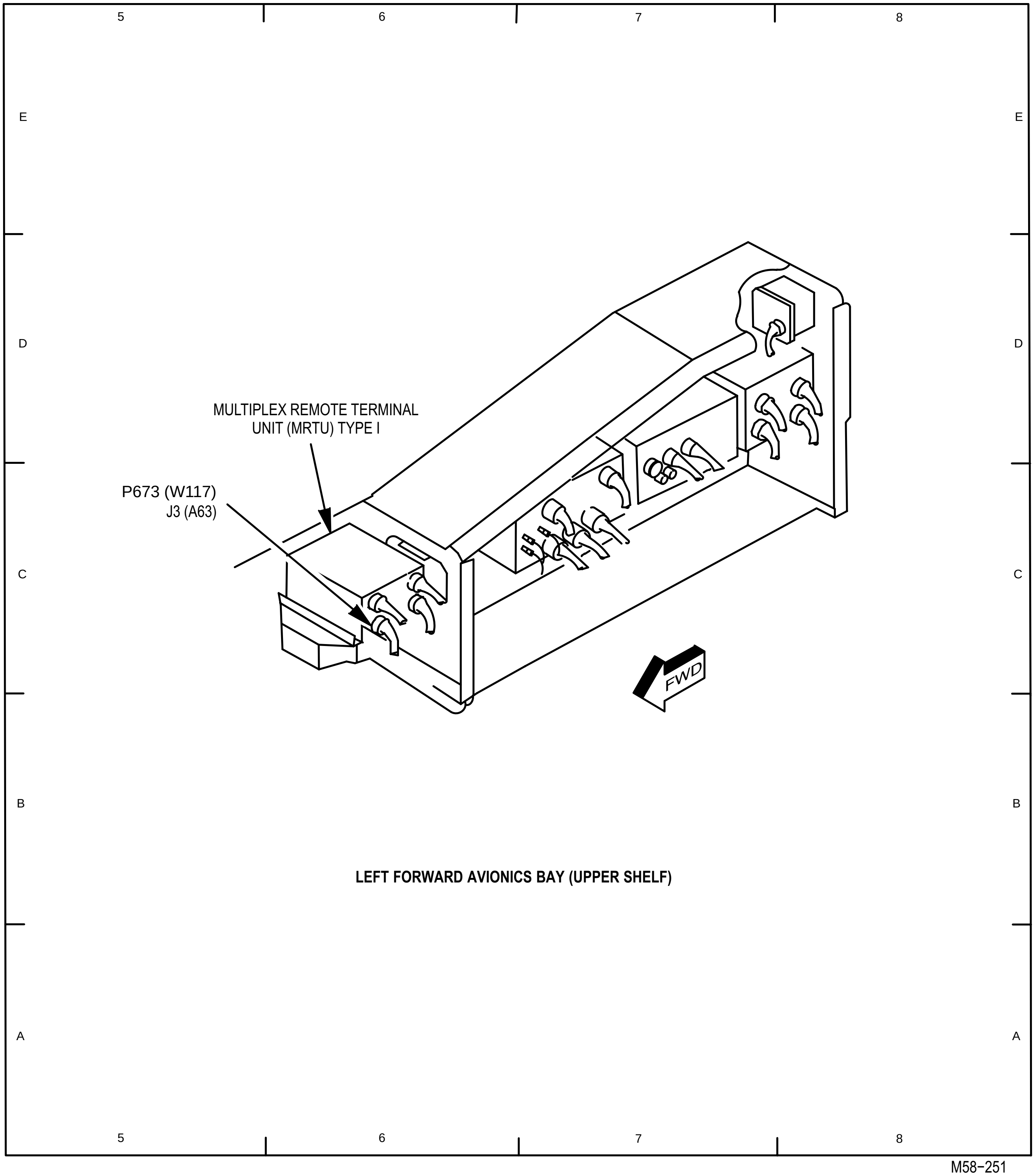
6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



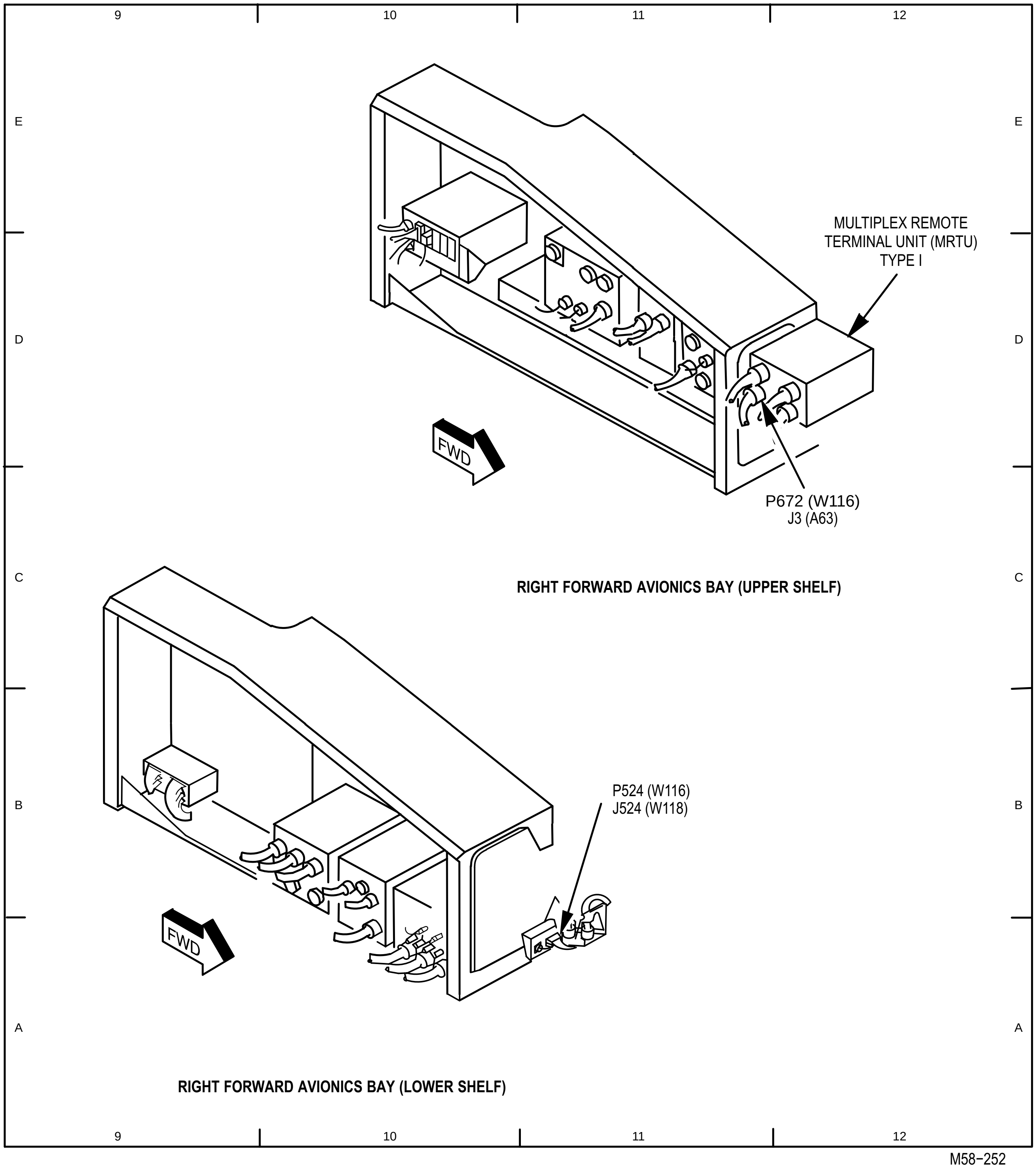
6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



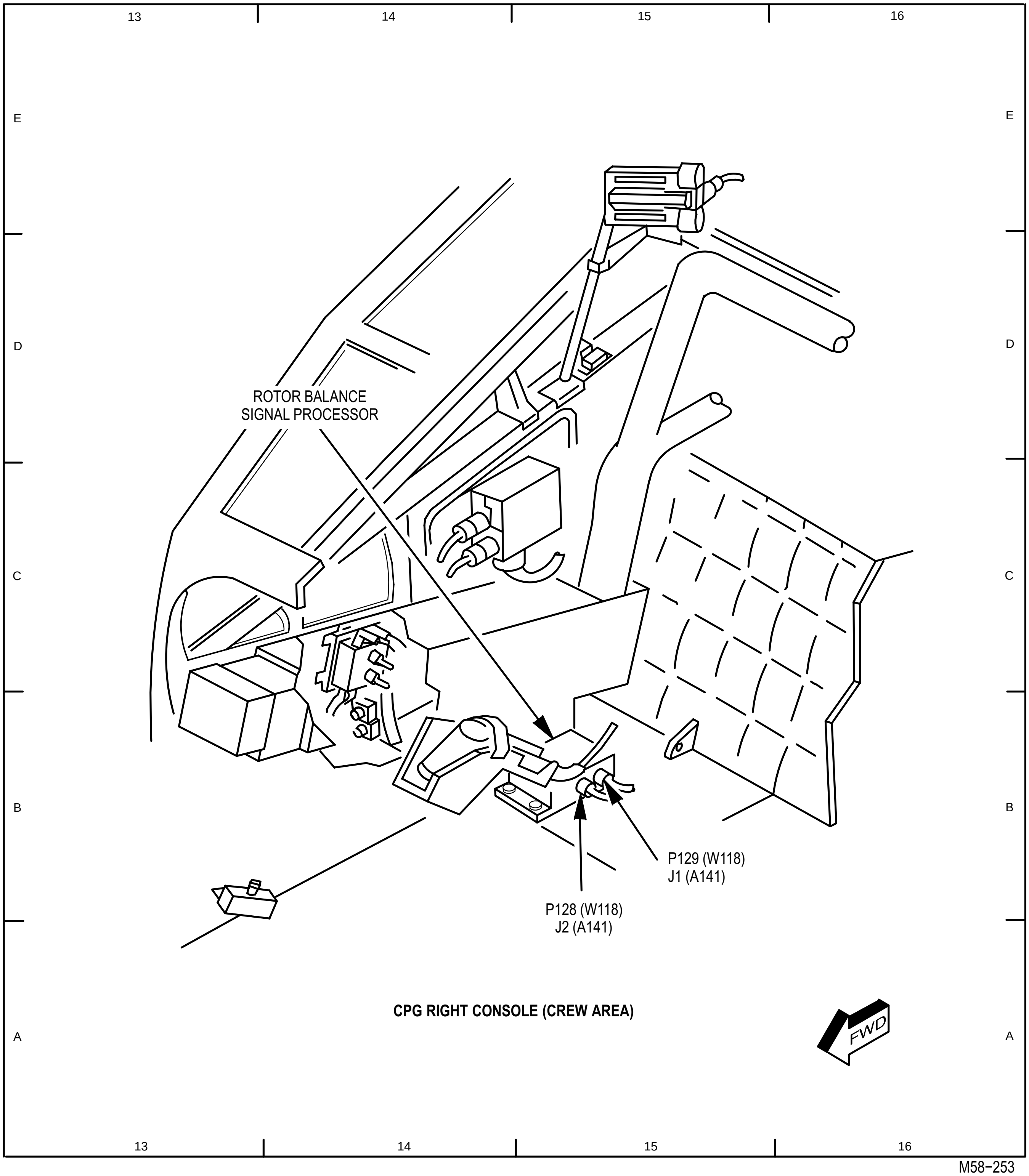
6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



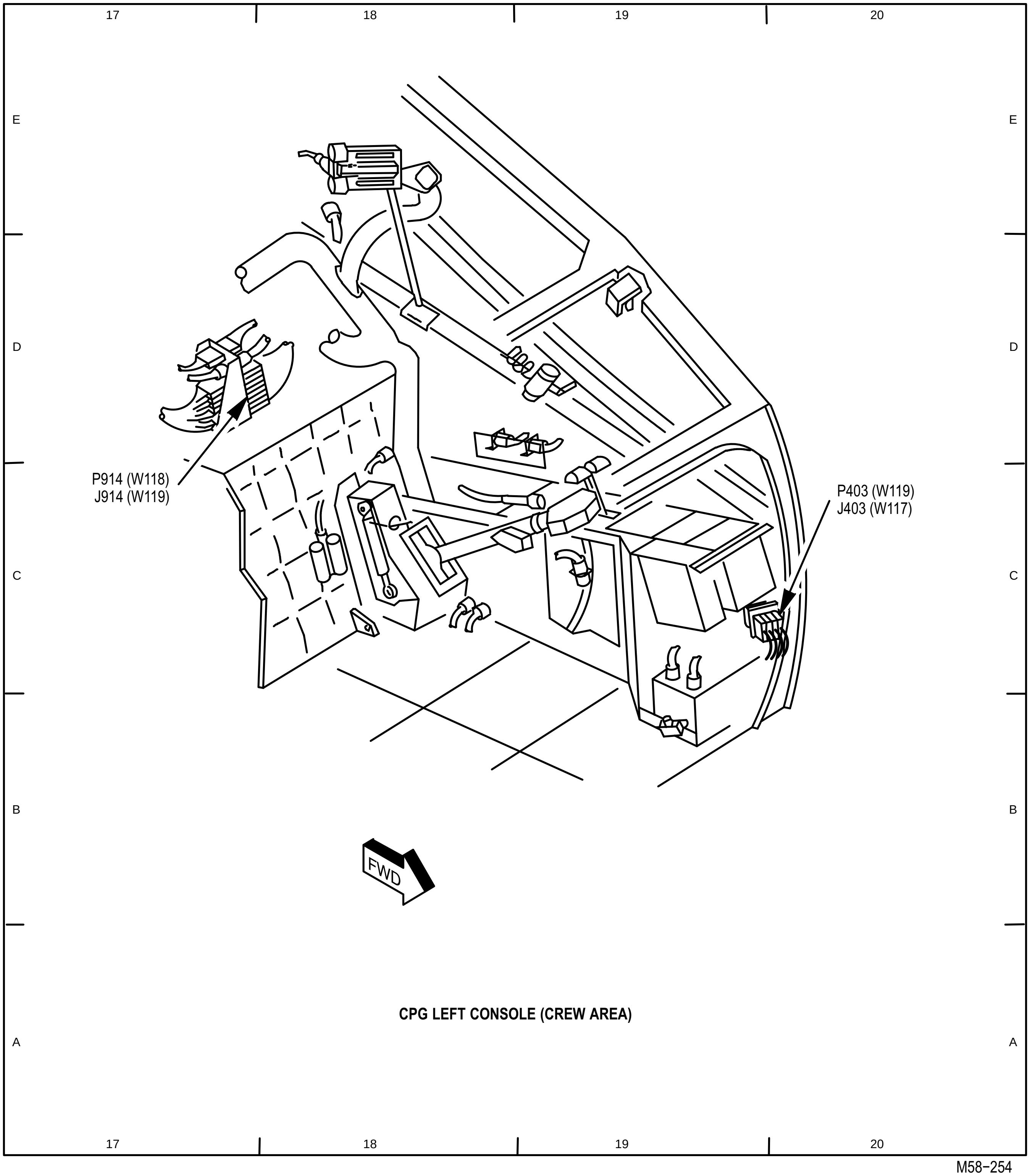
6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



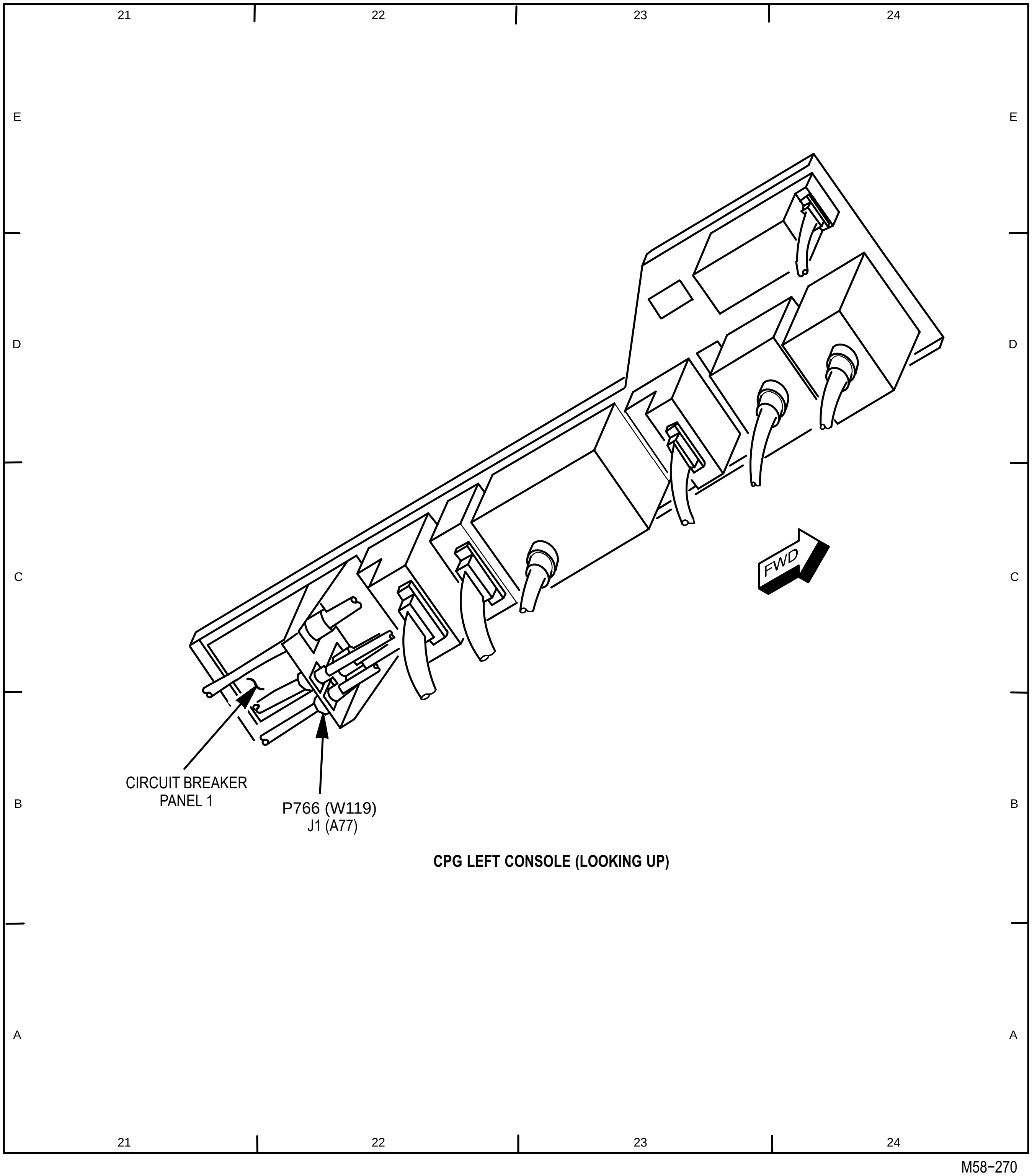
6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



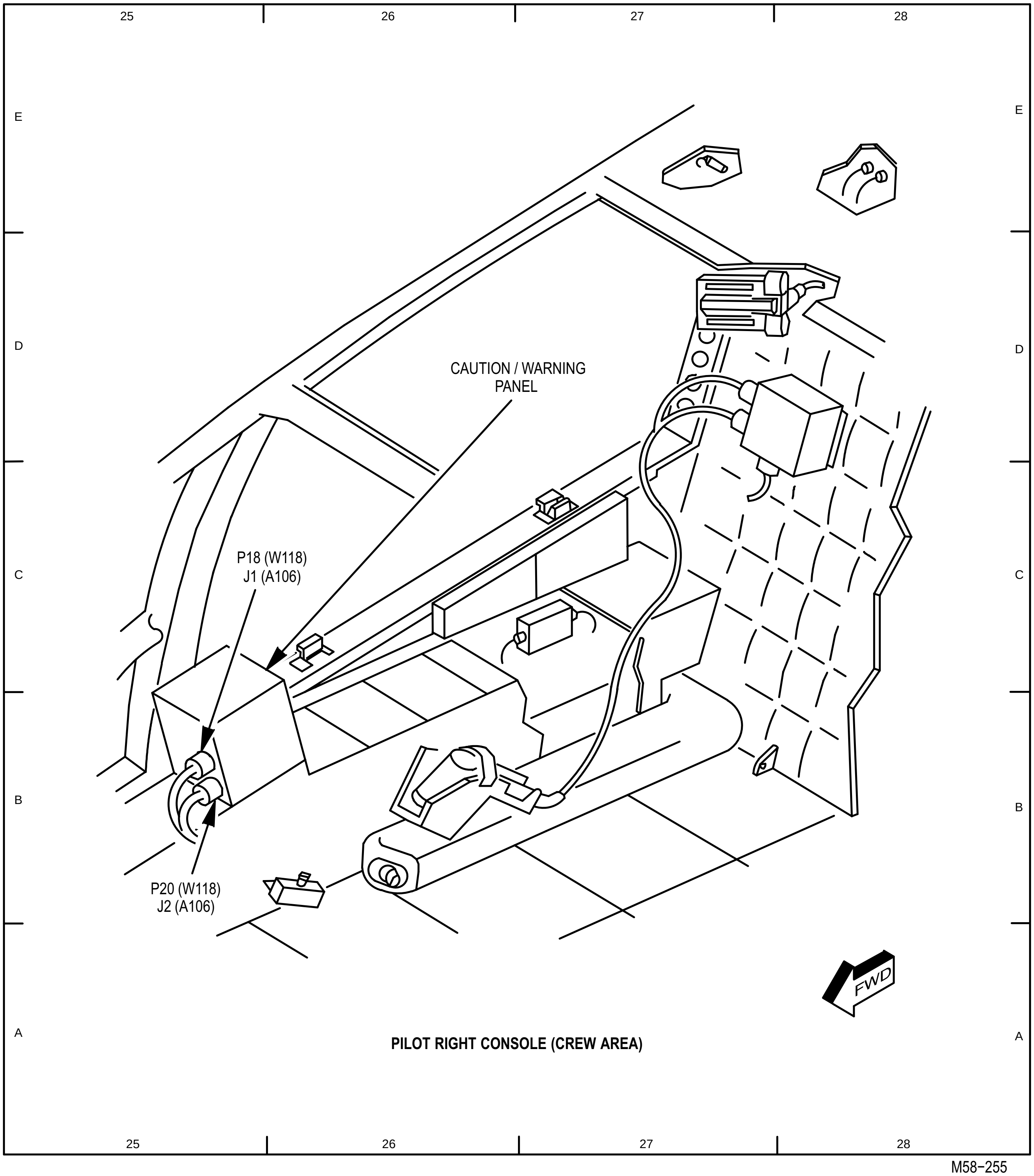
6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



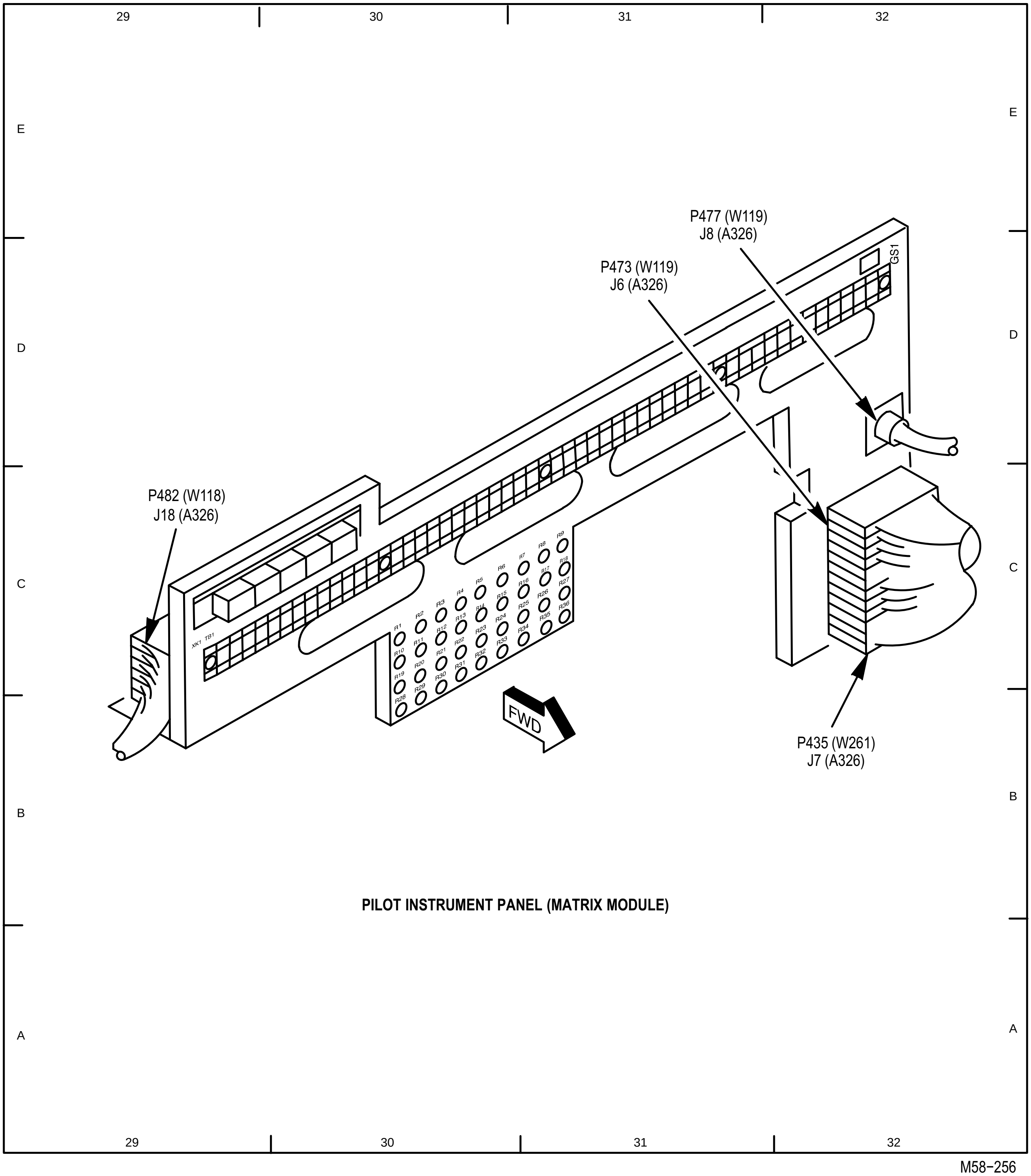
6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



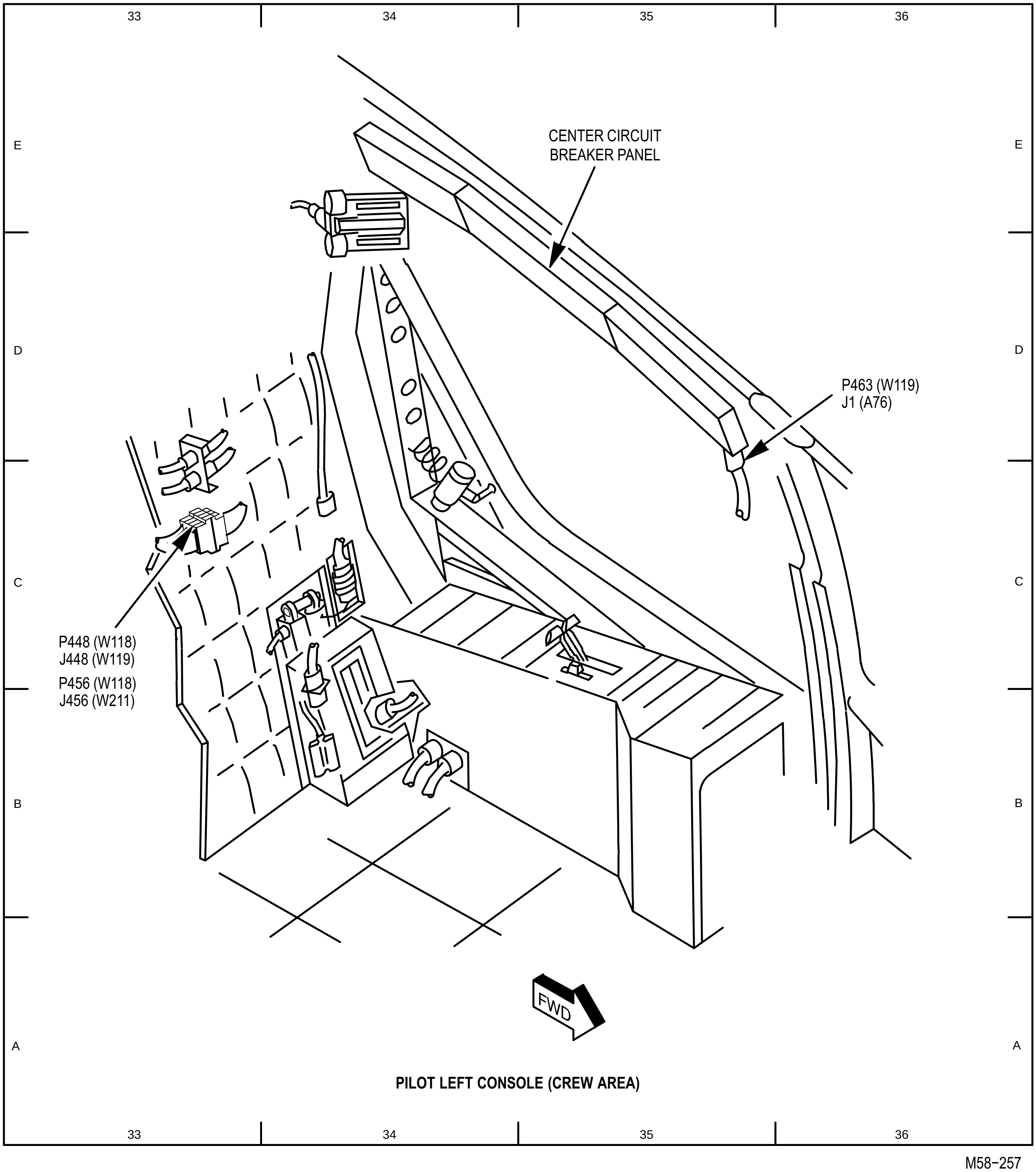
6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



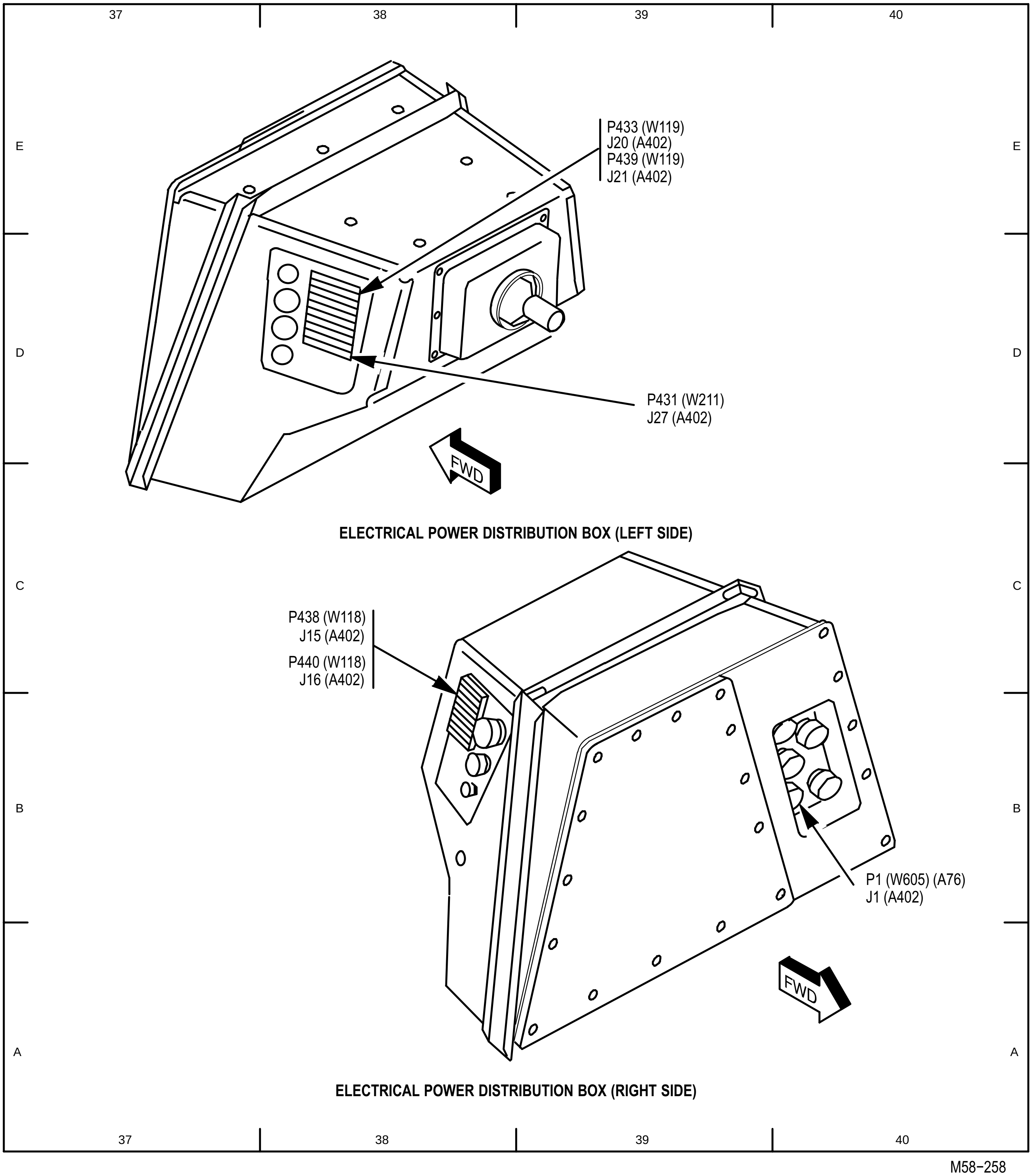
6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



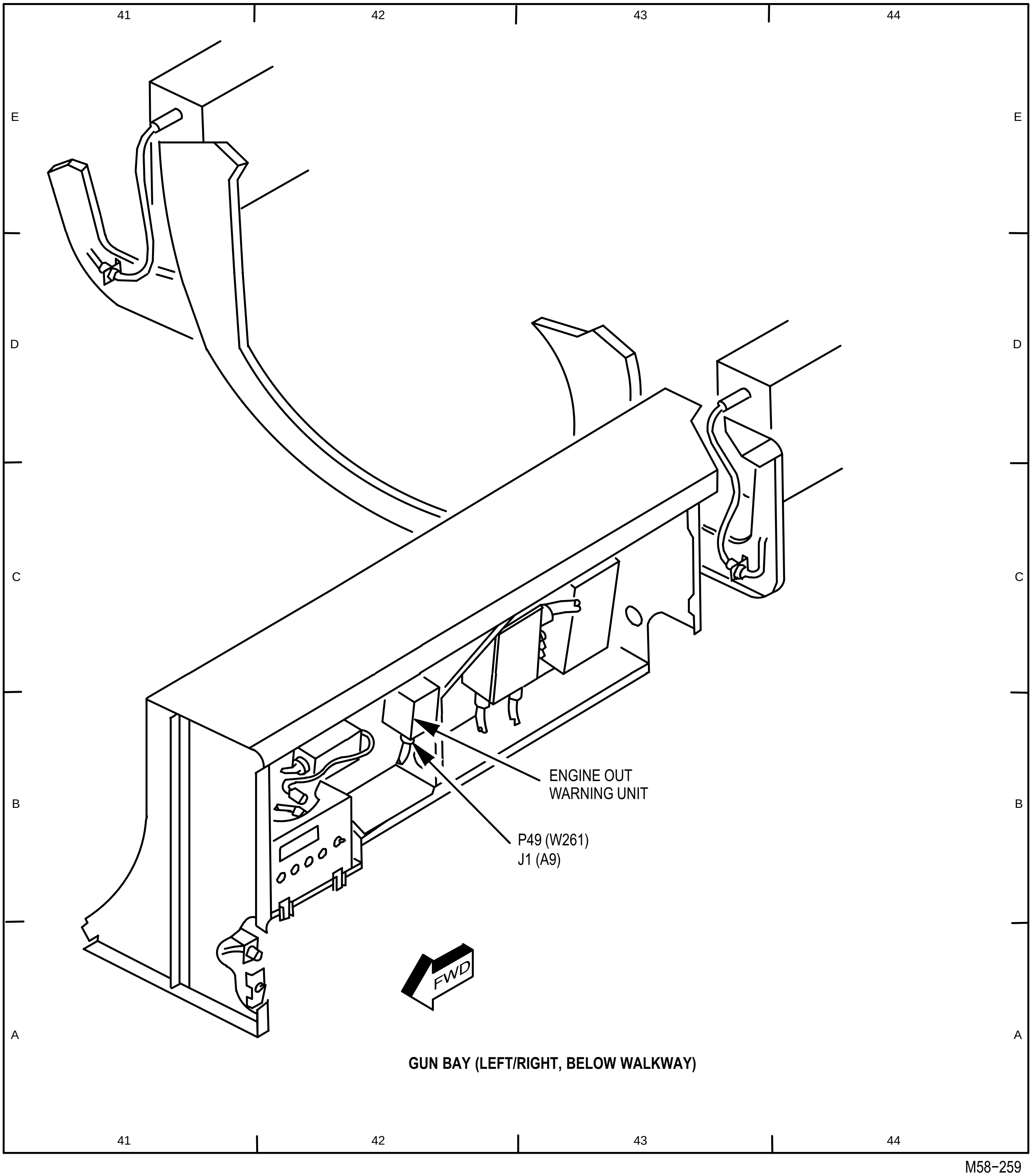
6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



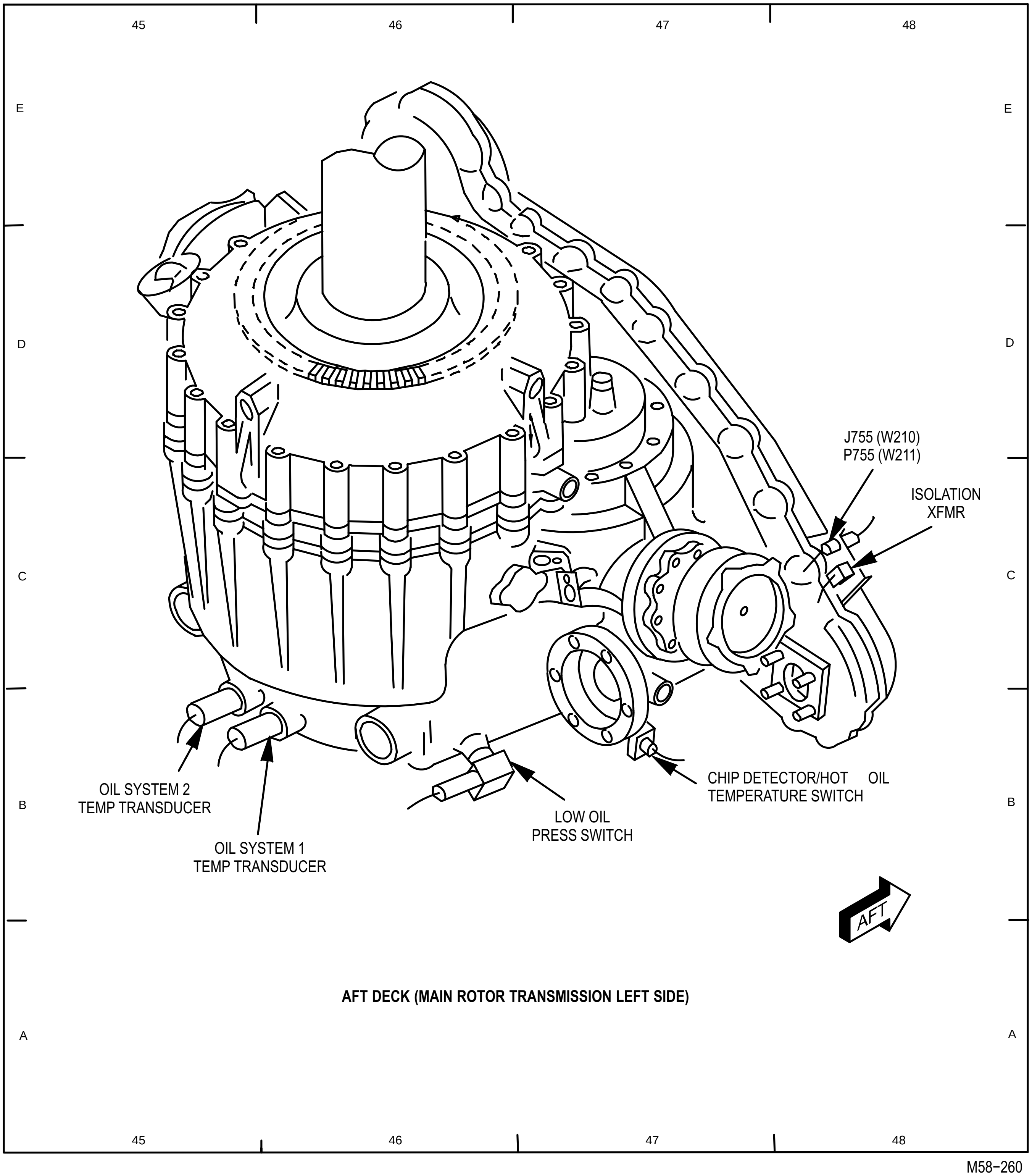
6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)

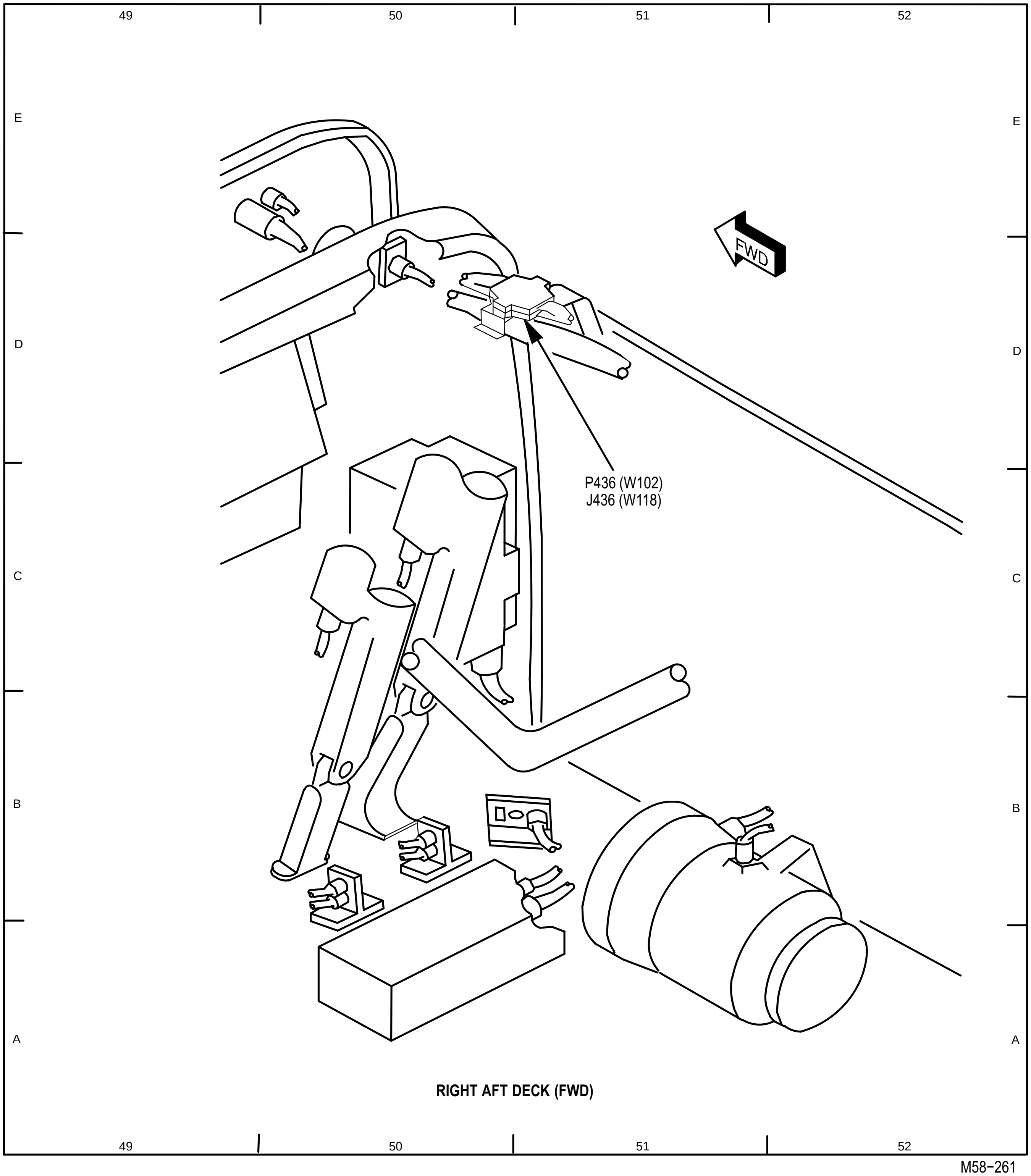


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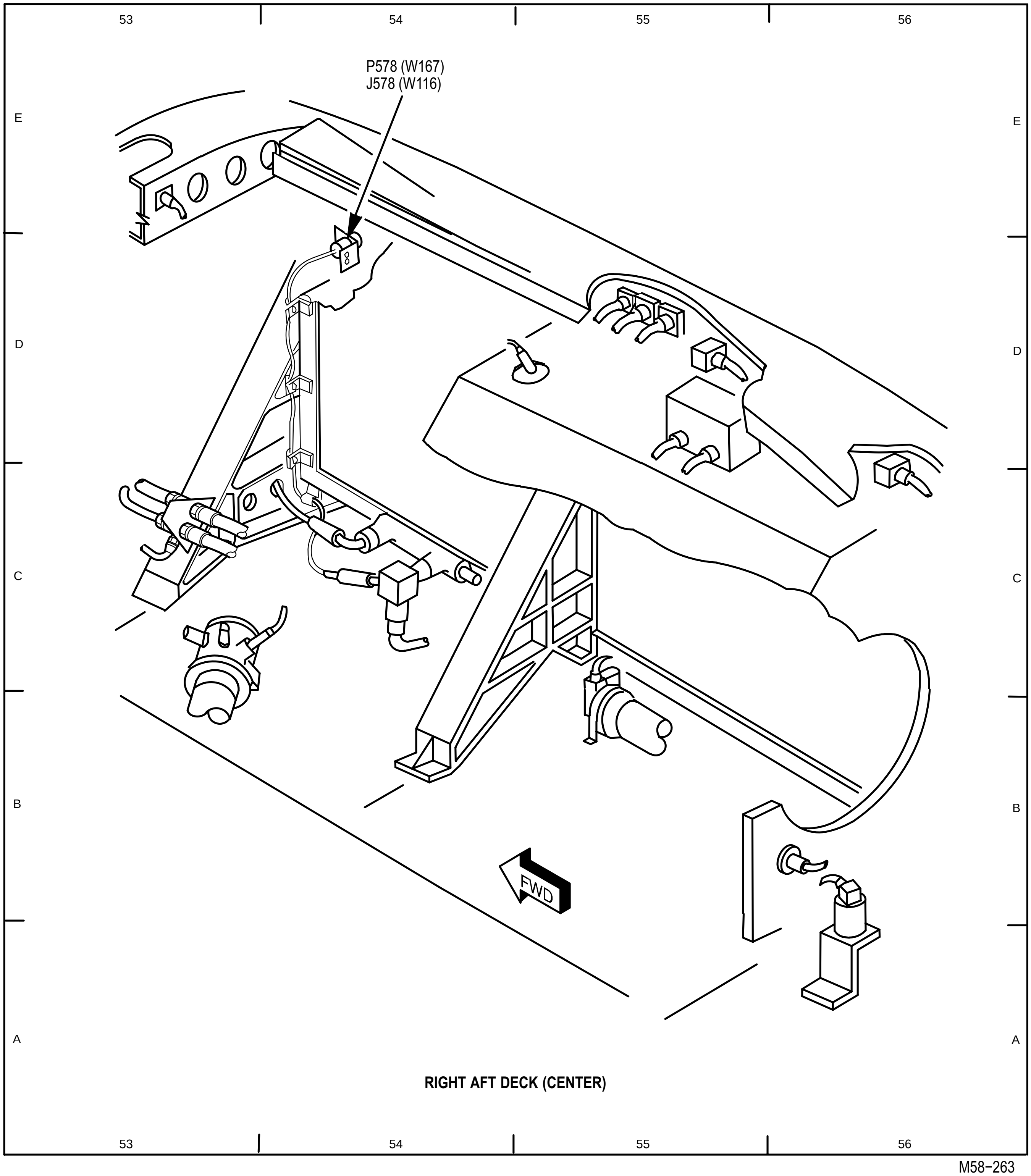
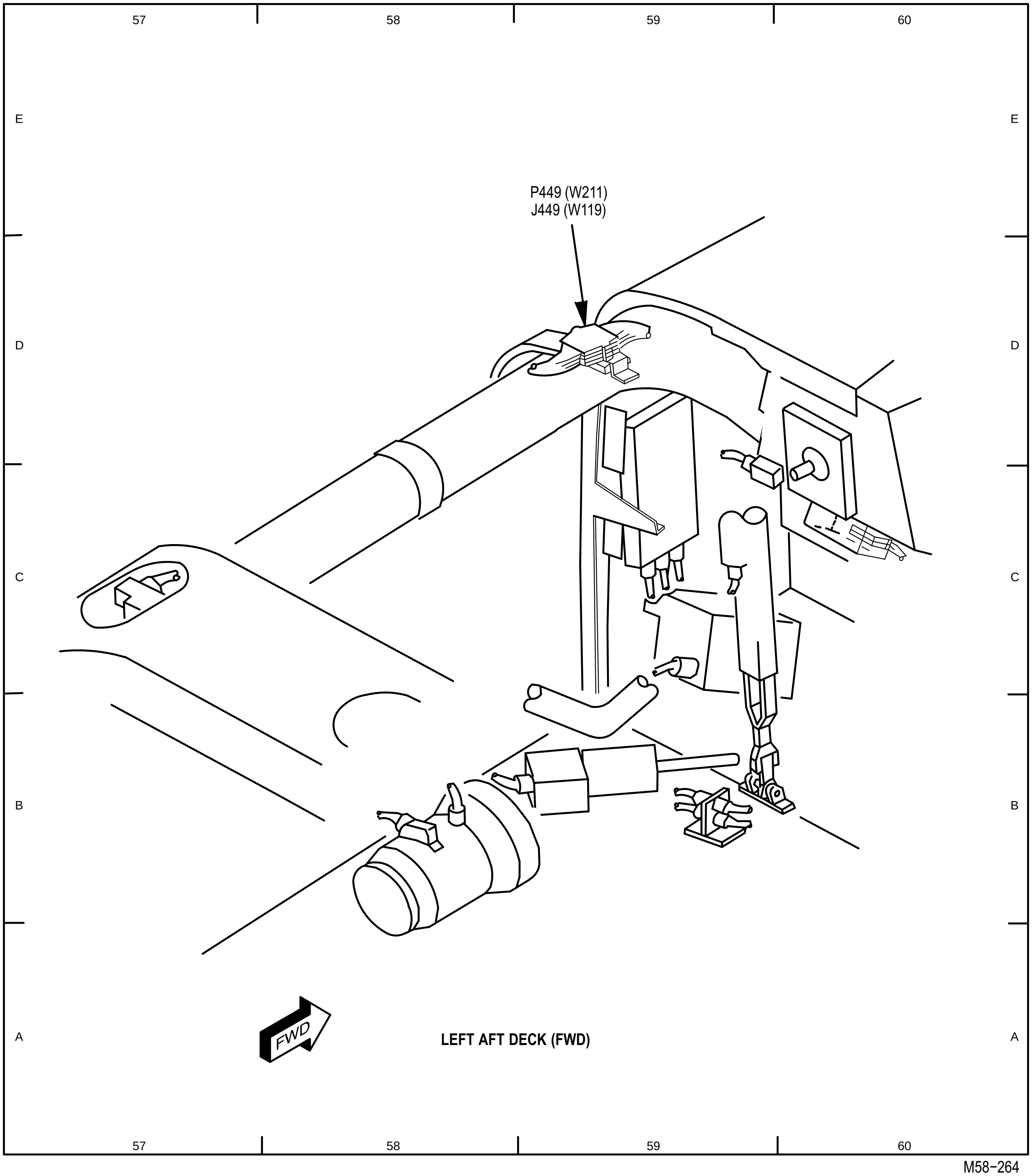
Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)

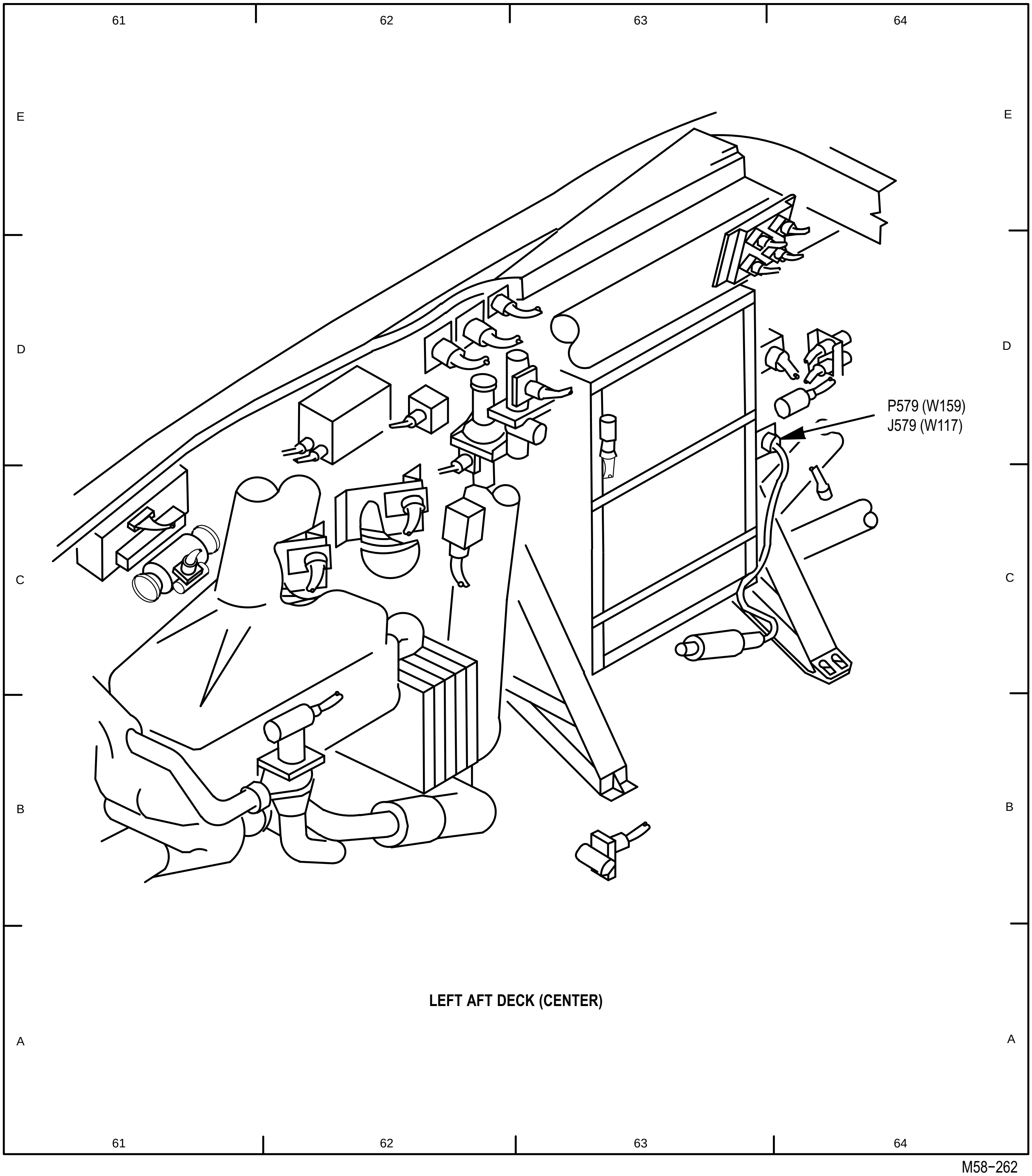


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Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)

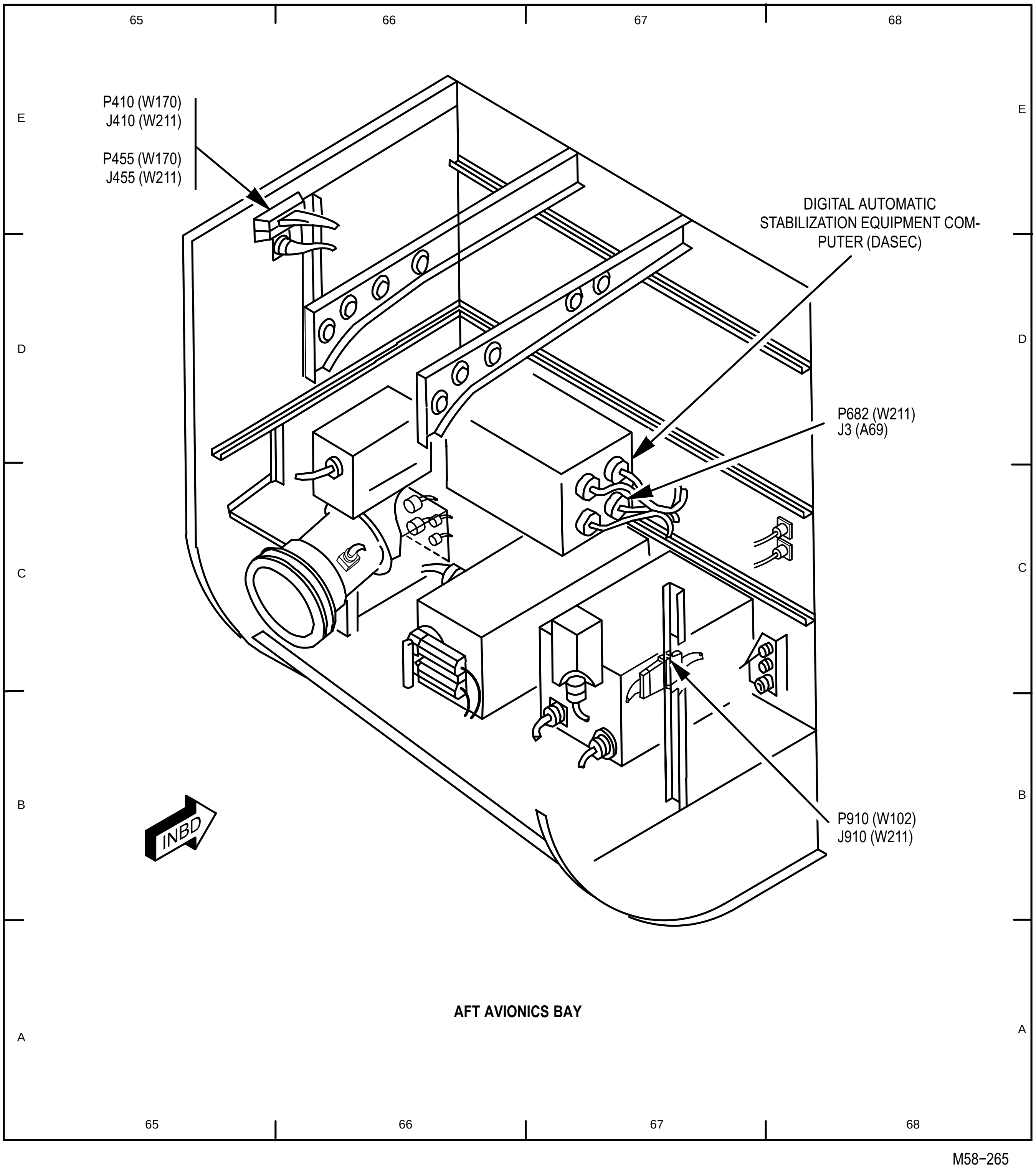

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Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)

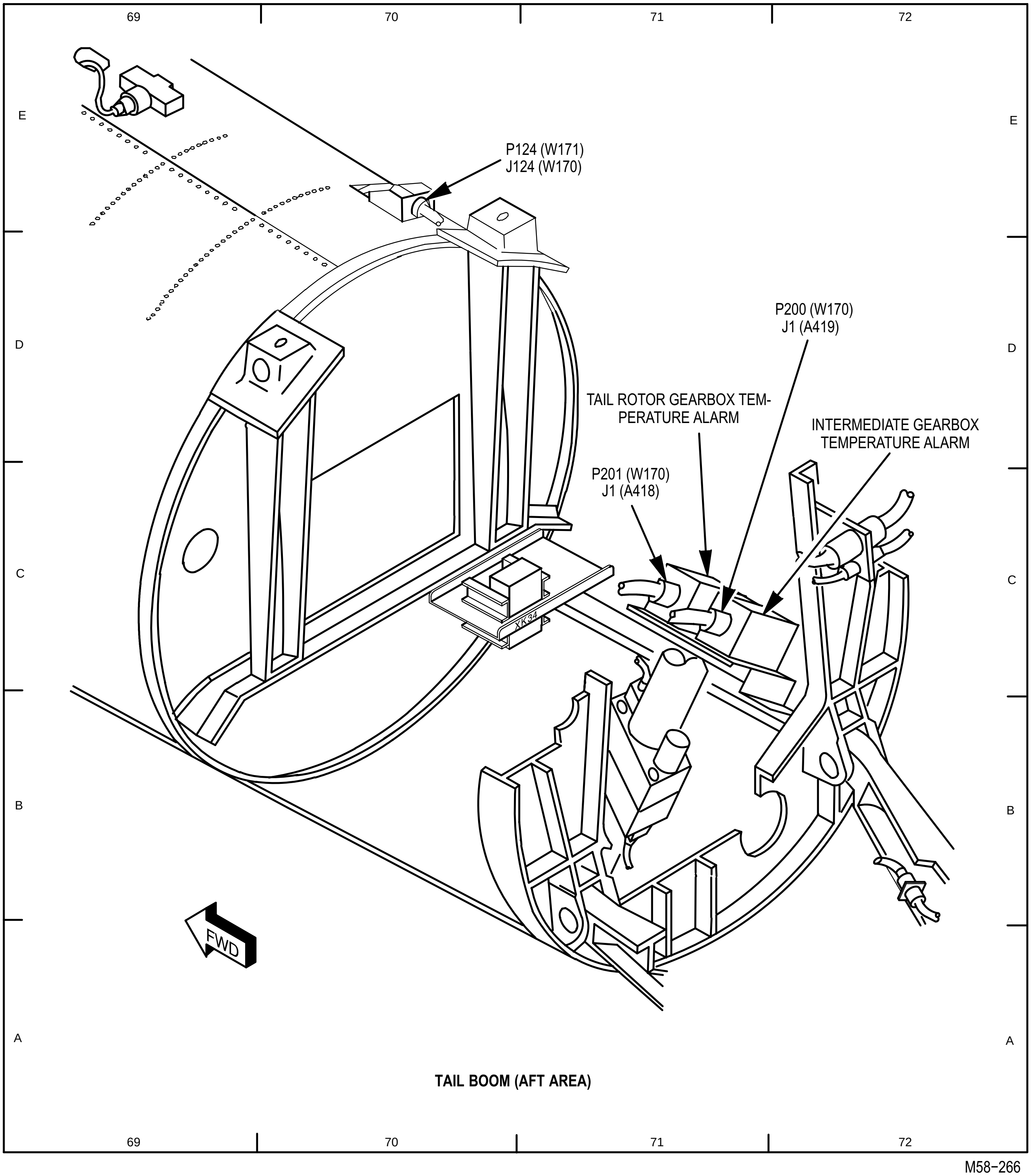

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Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)

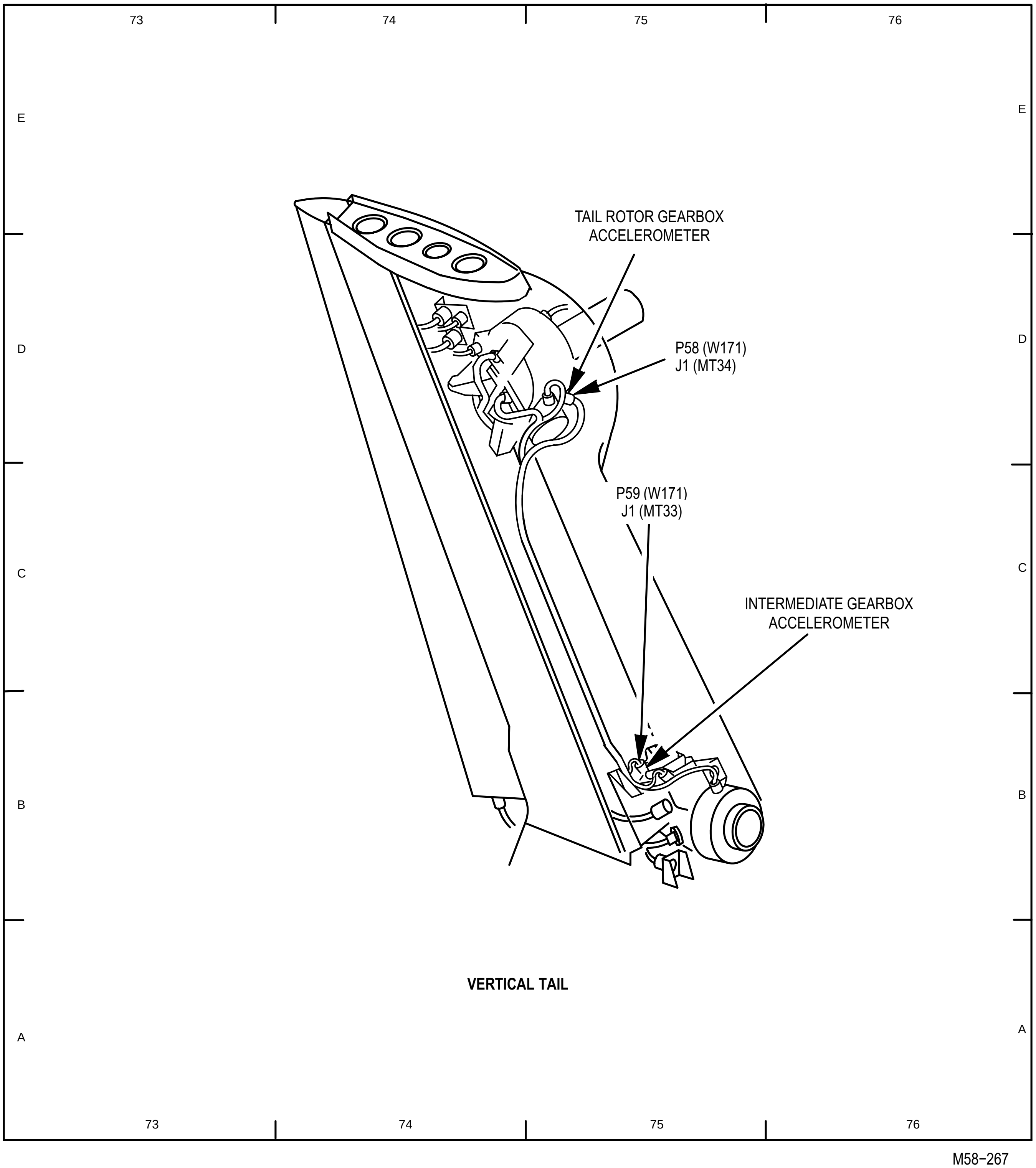

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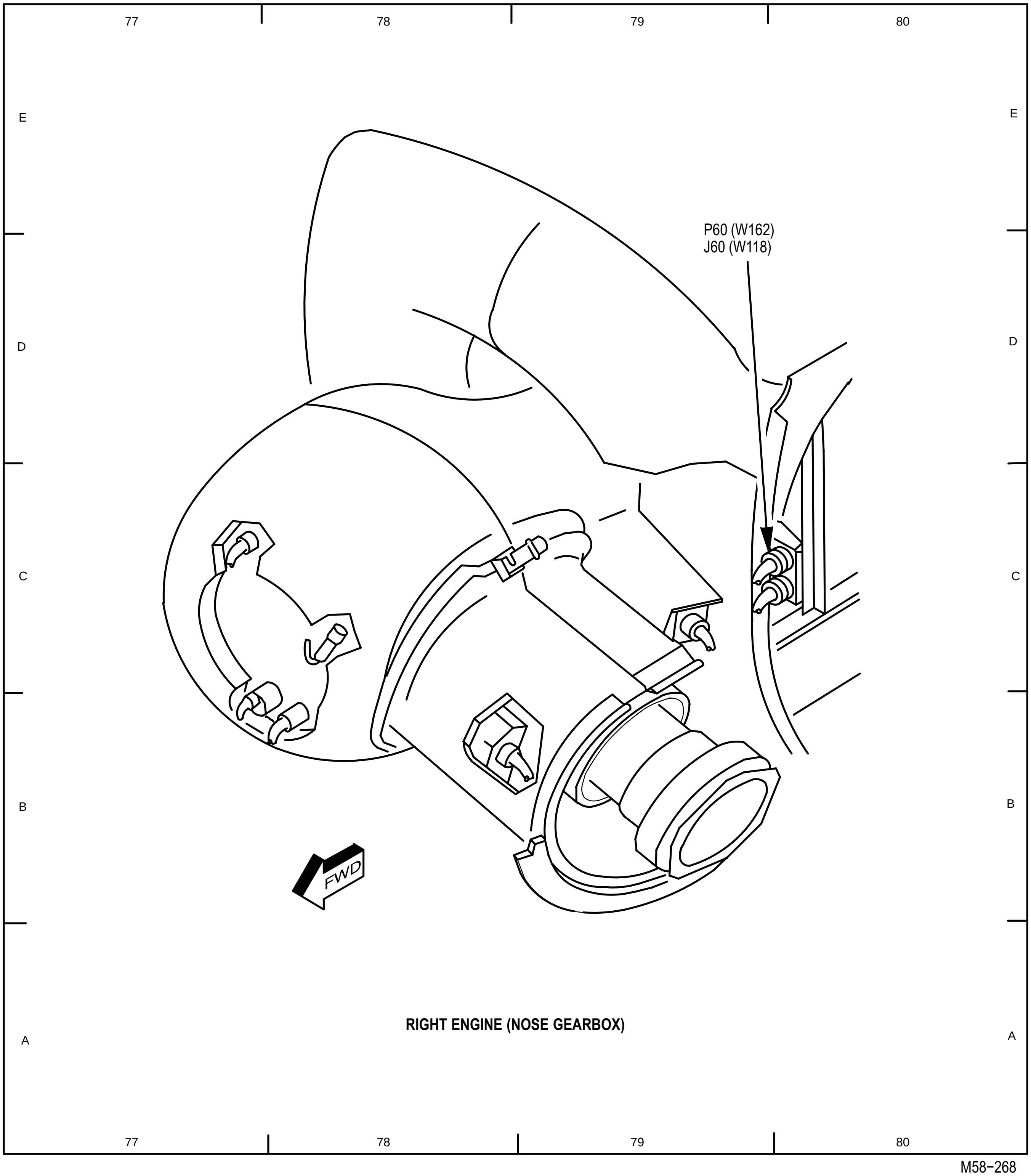
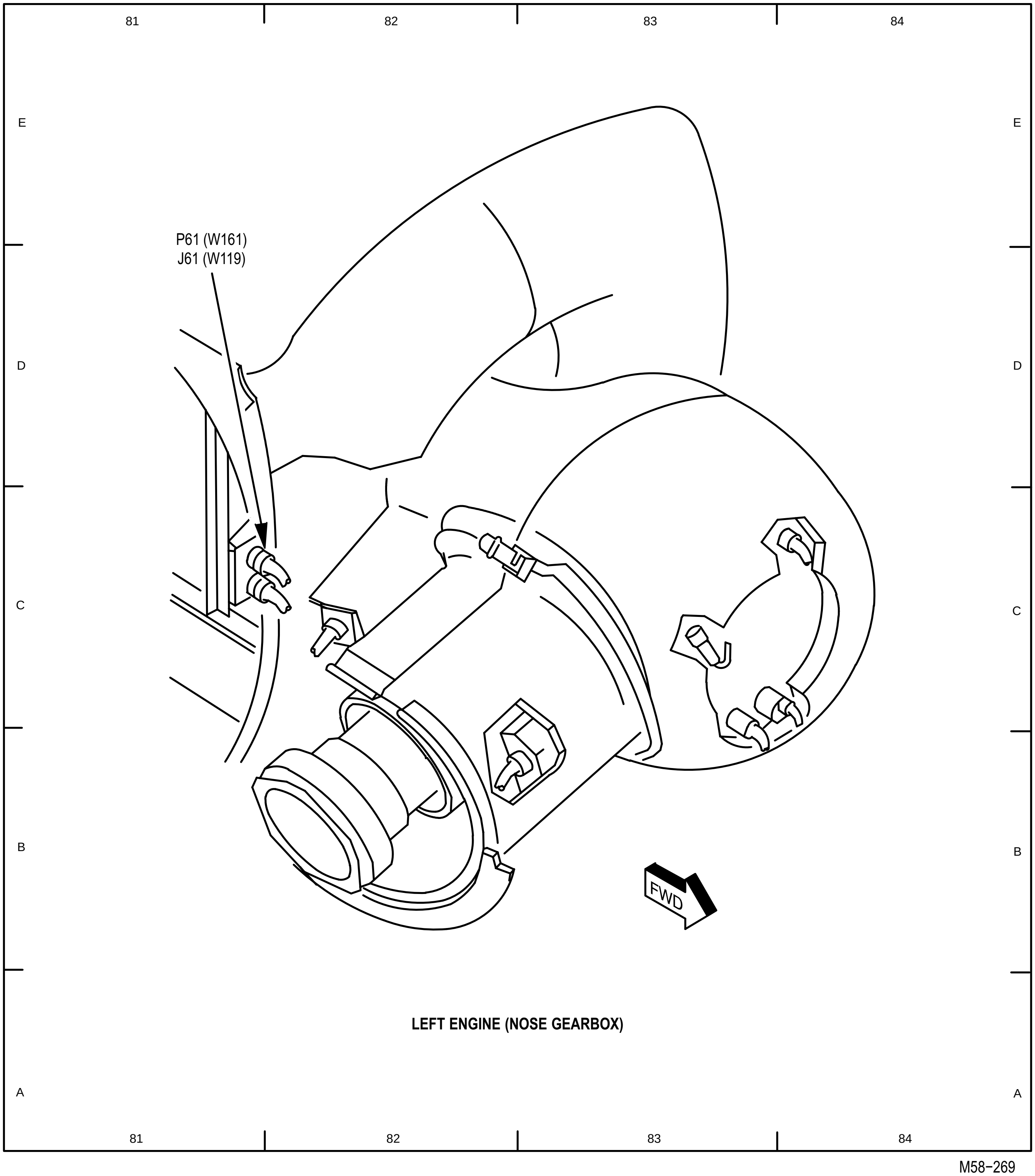
Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



6–9. ELECTRICAL COMPONENT LOCATION AND CONFIGURATION (ECLC) INDEX (cont) 6–9

Table 6–2. Electrical Component Location and Configuration (ECLC) Index Listing (cont)



6–10. DRIVE SYSTEM – POWER UP 6–10

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01

Personnel Required:

67R Attack Helicopter Repairer

References:

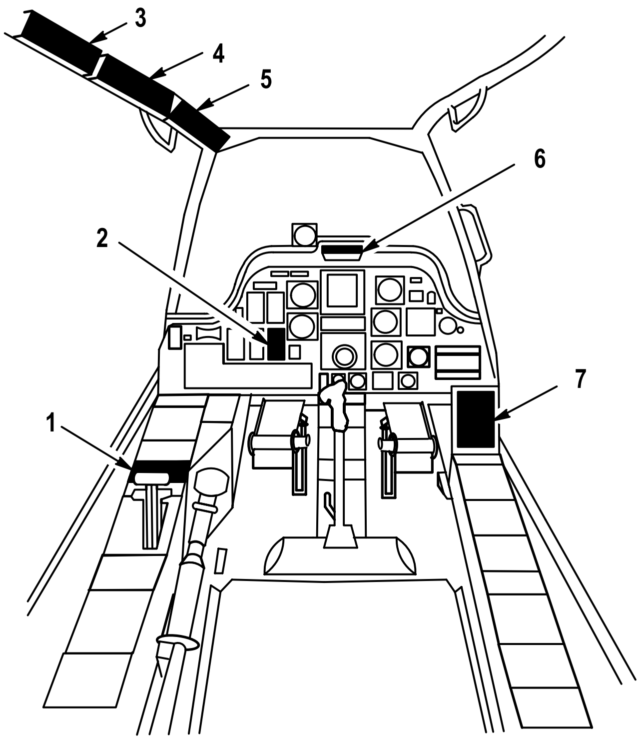
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Helicopter safed DRIVE SYSTEM VISUAL INSPECTION – completed External power application – Electrical

NOTE

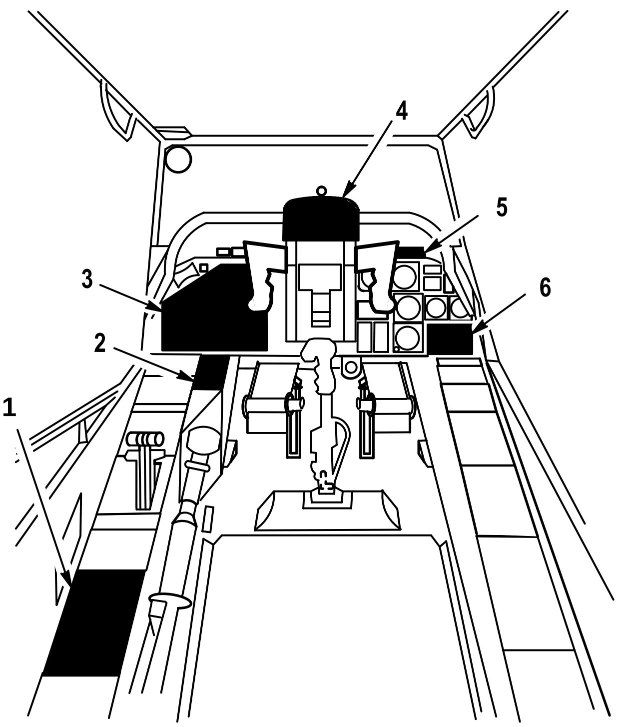
Refer to pilot station (fig. 6–12) and CPG station (fig. 6–13) for cockpit configuration and equipment.



1. PILOT ELECT PWR PANEL
2. PILOT ENG – RTR RPM% INDICATOR
3. PILOT AFT CIRCUIT BREAKER PANEL
4. PILOT CENTER CIRCUIT BREAKER PANEL
5. PILOT FORWARD CIRCUIT BREAKER PANEL
6. PILOT MASTER CAUTION / WARNING PANEL
7. PILOT CAUTION / WARNING PANEL

M58–134A

Figure 6–12. Pilot Station



1. CPG CIRCUIT BREAKER PANEL 1
2. CPG DEK
3. CPG FIRE CONTROL PANEL (FCP)
4. CPG OPTICAL RELAY TUBE (ORT)
5. CPG MASTER CAUTION / WARNING PANEL
6. CPG CAUTION / WARNING PANEL

M58–135

Figure 6–13. CPG Station

1. On pilot **ELEC PWR (**fig. 6–14) panel, set **BATT/EXT PWR** switch to **EXT PWR.**

6–10. DRIVE SYSTEM – POWER UP (cont) 6–10

2. On CPG circuit breaker panel 1 (fig. 6–14), check that the following circuit breakers are closed:

Circuit Breaker Name	Circuit Breaker Name
MUX FAB L	**FC FCC DC**
MUX FAB R	**FC FCC AC**
MUX CPG	**EMERG BATT CAUT**

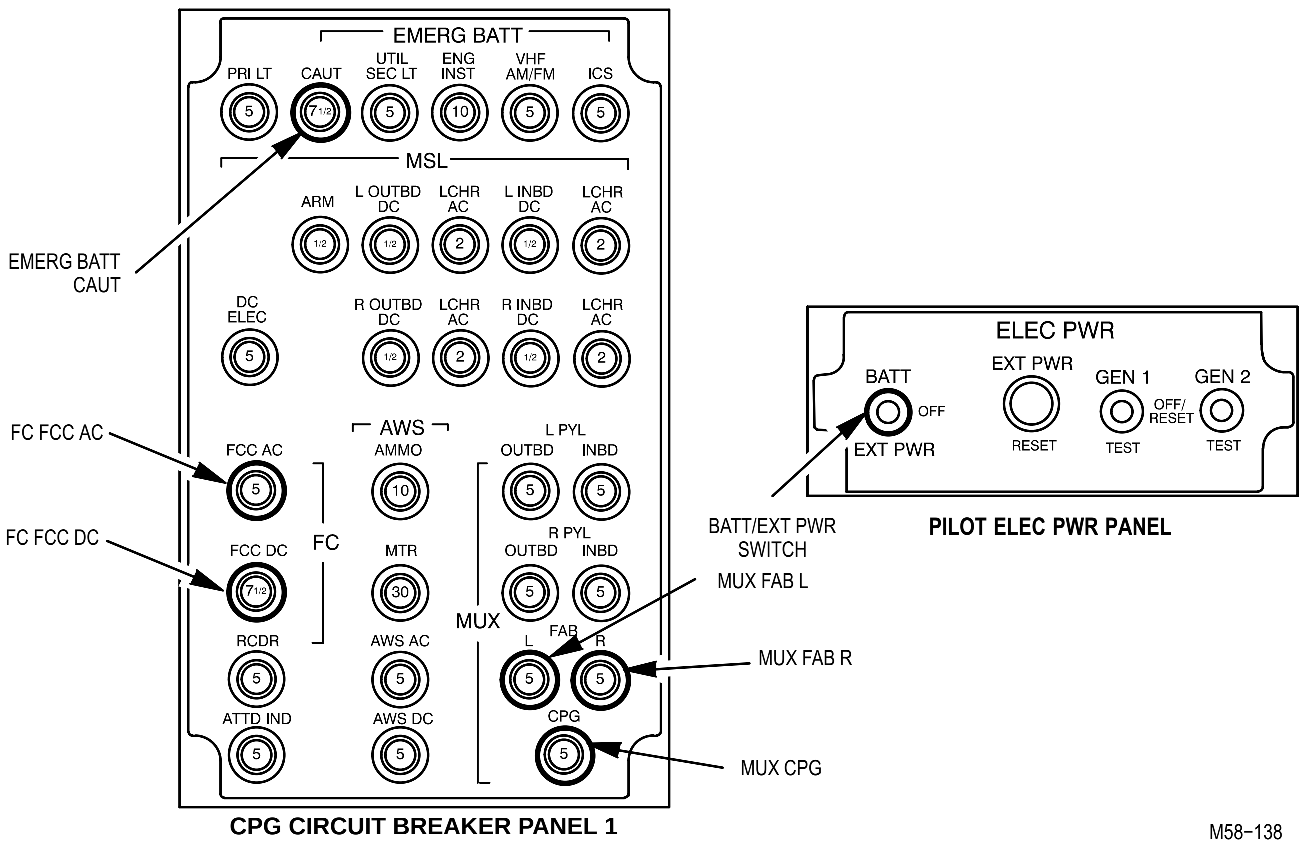


Figure 6–14. Pilot ELEC PWR Panel and CPG Circuit Breaker Panel 1

3. On pilot forward circuit breaker panel (fig. 6–15), check that the following circuit breakers are closed:

Circuit Breaker Name	Circuit Breaker Name
MISSION FC DC	**MISSION FC AC**

4. On pilot center circuit breaker panel, check that the following circuit breakers are closed:

Circuit Breaker Name	Circuit Breaker Name
ASE DC	**LT CAUT**
VIB MON	**ENG START**
ENG INST	**LT PRI**

6–10. DRIVE SYSTEM – POWER UP (cont) 6–10

5. On pilot aft circuit breaker panel, check that the following circuit breakers are closed:

Circuit Breaker Name	Circuit Breaker Name
ECS FAB FANS	**ECS AFT FAN**
ECS CAB	

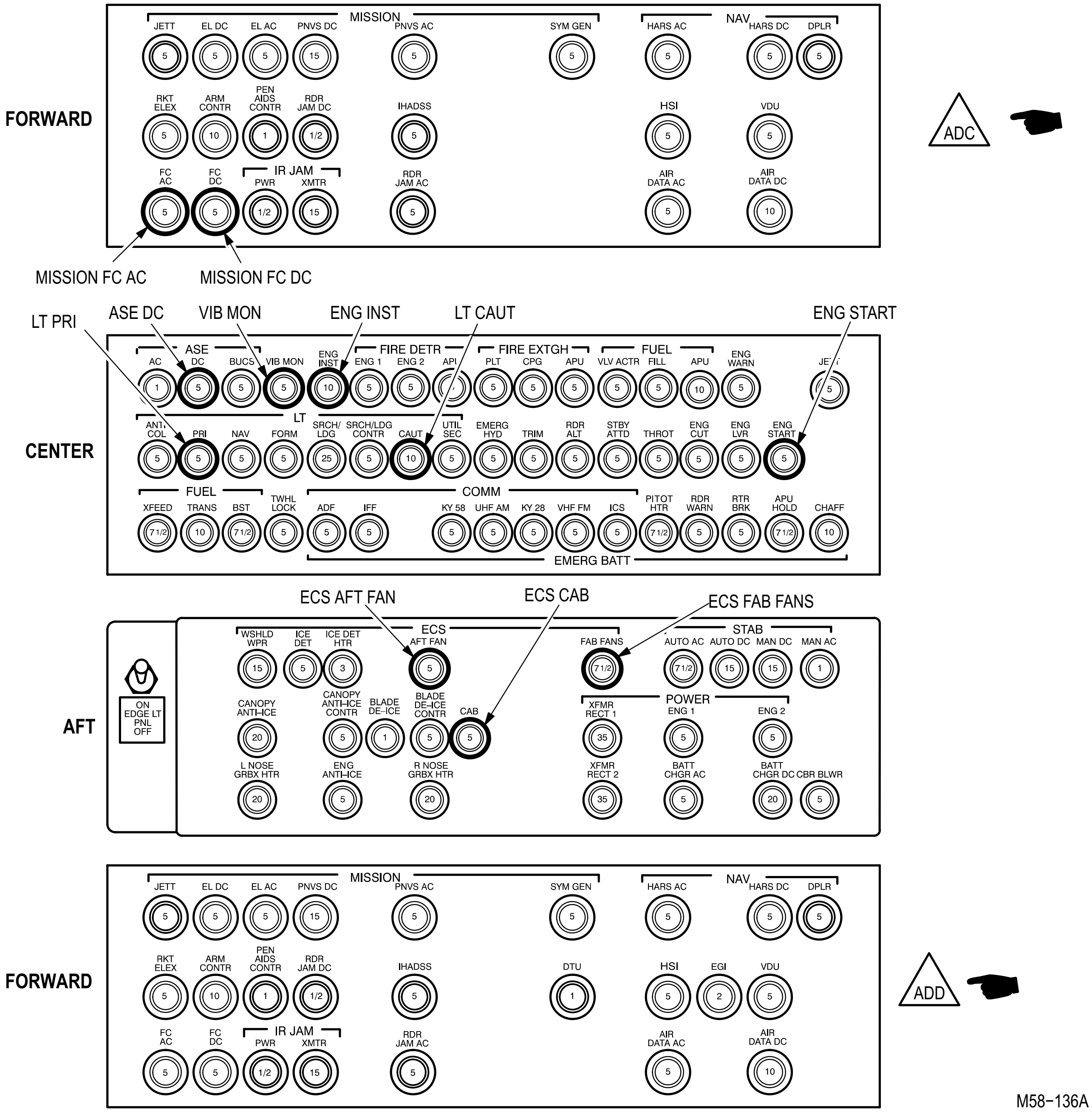


Figure 6–15. Pilot Forward, Center, and Aft Circuit Breaker Panels

6–10. DRIVE SYSTEM – POWER UP (cont) 6–10

6. On CPG **FIRE CONTROL** panel (fig. 6–16), set **PLT/GND** switch to **ORIDE**.

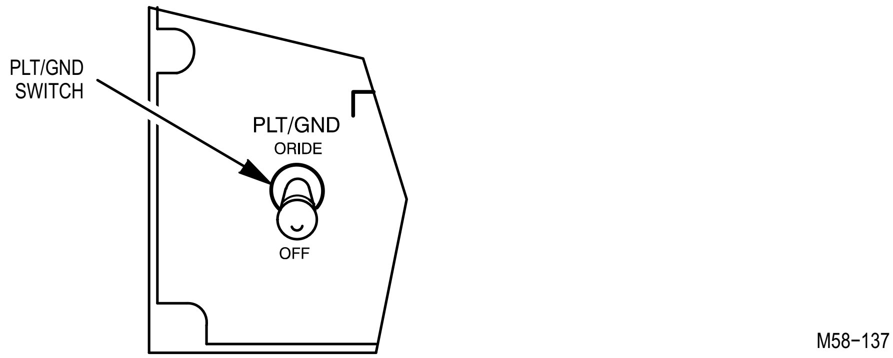


Figure 6–16. CPG FIRE CONTROL Panel

END OF TASK

6–11. DRIVE SYSTEM – POWER DOWN 6–11

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01

Personnel Required:

67R Attack Helicopter Repairer

References:

TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	DRIVE SYSTEM– POWER UP completed

NOTE

Refer to pilot station (fig. 6–12) and CPG station (fig. 6–13) for cockpit configuration and equipment.

1. On CPG **FIRE CONTROL** panel (fig. 6–16), set **PLT/GND** switch to **OFF**.
2. On pilot **ELEC PWR** panel (fig. 6–14), set **BATT/EXT PWR** switch to **OFF**.
3. Shut down and disconnect aviation ground power unit (AGPU) from the helicopter (TM 1-1520-238-23).

END OF TASK

6–12. DRIVE SYSTEM – INDICATORS MAINTENANCE OPERATIONAL CHECK 6–12

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06

Personnel Required:

67R Attack Helicopter Repairer
68F Aircraft Electrician

References:

TM 1-1520-238-T-5
TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
Paragraph 1–17	Maintenance headset connected
Paragraph 6–10	DRIVE SYSTEM – POWER UP completed

WARNING

Make sure that helicopter safing procedures are accomplished. Observe all safety precautions during troubleshooting or maintenance procedures. Failure to do so could result in death or serious injury.

NOTE

- **Refer to pilot station (fig. 6–12) and CPG station (fig. 6–13) for cockpit configuration and equipment.**
- **If referenced out of one paragraph or volume and into another for additional troubleshooting, upon completion of the task, return to the maintenance operational check for the original paragraph or volume.**

1. Perform drive system visual inspection (TM 1-1520-238-23).

NOTE

If APU is running, perform APU – POWER DOWN.

2. Complete the maintenance operational check as follows:

Task	Result
a. On pilot center circuit breaker panel (fig. 6–15), close **VIB MON** and **ENG START** circuit breaker.	If **VIB MON** circuit breaker does not stay closed, go to paragraph 6–43. If **ENG START** circuit breaker does not stay closed, refer to TM 1–1520–238–T–6 to troubleshoot PILOTS ELECT PWR PANEL.

6–12. DRIVE SYSTEM – INDICATORS MAINTENANCE OPERATIONAL CHECK (cont) 6–12

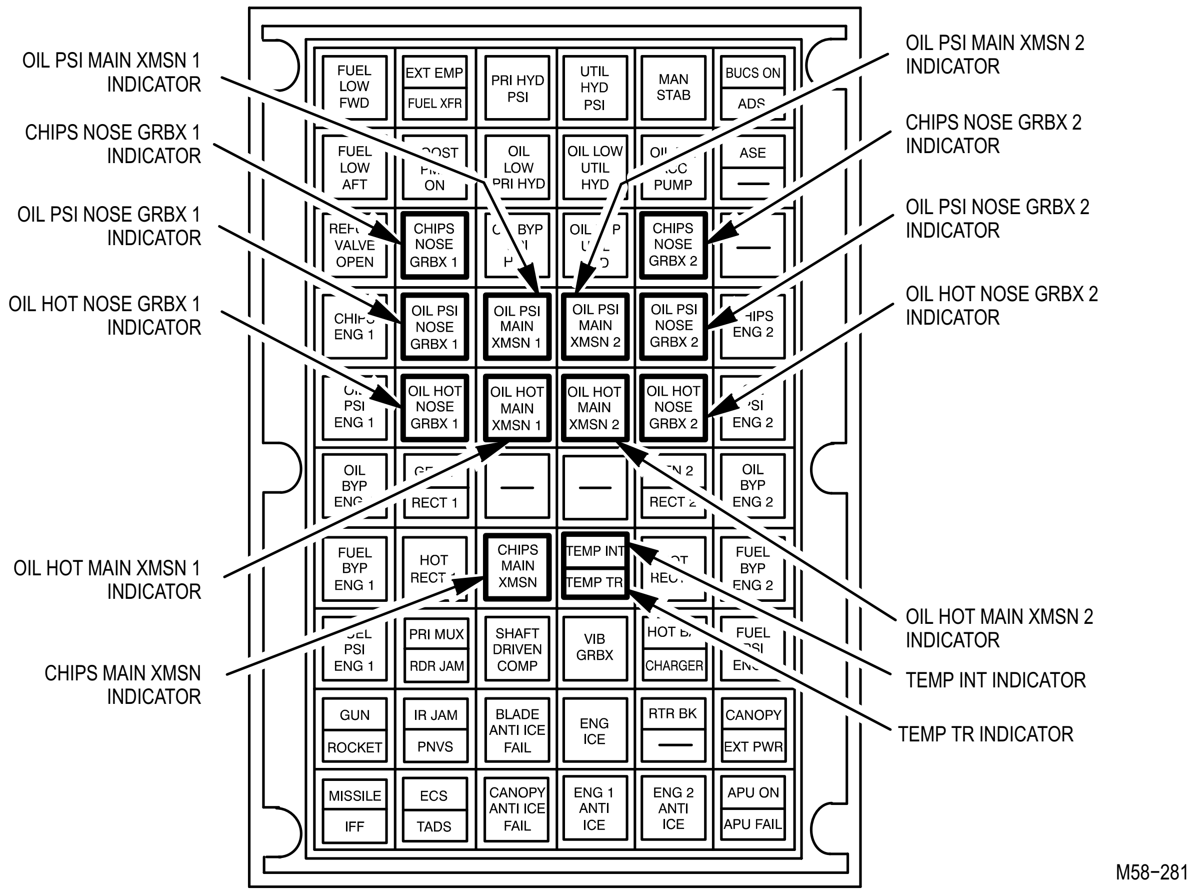


Figure 6–17. Pilot Caution/Warning Panel

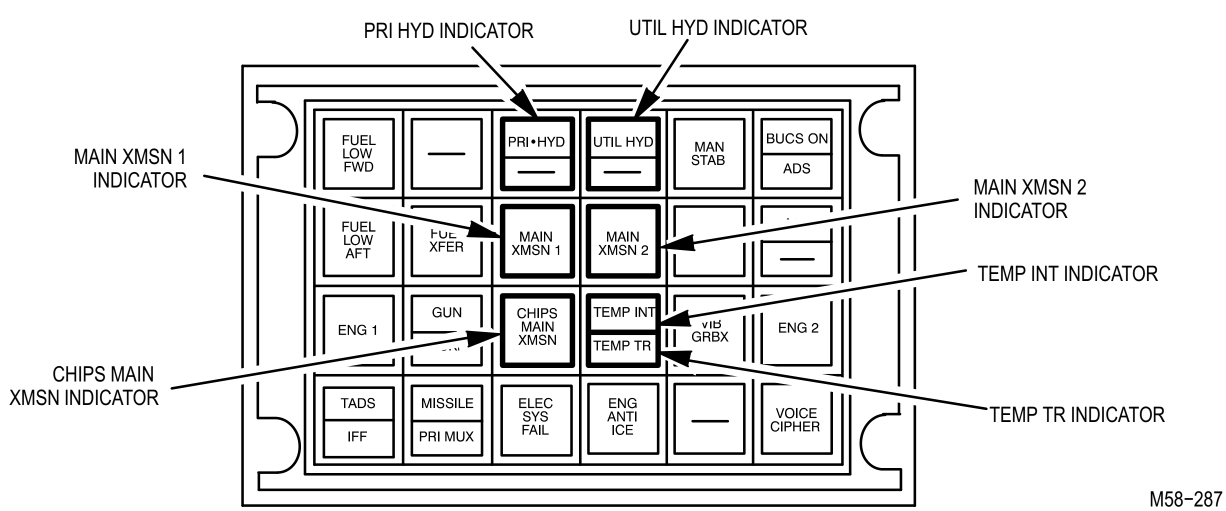


Figure 6–18. CPG Caution/Warning Panel

6–12. DRIVE SYSTEM – INDICATORS MAINTENANCE OPERATIONAL CHECK (cont) 6–12

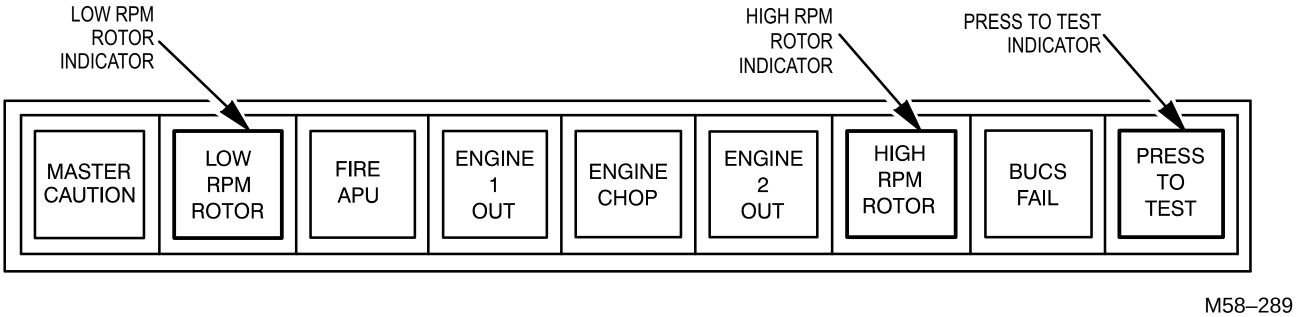


Figure 6–19. Master Caution/Warning Panel

Task	Result
b. On pilot master caution/warning panel (fig. 6–19), press and hold **PRESS TO TEST** indicator. Check pilot master caution/warning panel and pilot caution/warning panel (fig. 6–17).	If any indicators are not lighted, replace lamp (TM 1-1520-238-23). If lamp still does not light, refer to TM 1-1520-238-T-6 to troubleshoot pilot caution/warning system.
c. On CPG master caution/warning panel, press and hold **PRESS TO TEST** indicator. Check CPG master caution/warning panel and CPG caution/warning panel (fig. 6–18).	If any indicators are not lighted, replace lamp (TM 1-1520-238-23). If lamp still does not light, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system.
d. On pilot caution/warning panel (fig. 6–17), check **PRI HYD PSI** indicator.	If **PRI HYD PSI** indicator is not lighted, refer to TM 1-1520-238-T-5 to troubleshoot primary hydraulic system.
e. On CPG caution/warning panel, check **PRI HYD** indicator.	If **PRI HYD** indicator is not lighted, refer to TM 1-1520-238-T-5 to troubleshoot primary hydraulic system.
f. On pilot caution/warning panel, check **UTIL HYD PSI** indicator.	If **UTIL HYD PSI** indicator is not lighted, refer to TM 1-1520-238-T-5 to troubleshoot utility hydraulic system.
g. On CPG caution/warning panel, check **UTIL HYD** indicator.	If **UTIL HYD** indicator is not lighted, refer to TM 1-1520-238-T-5 to troubleshoot utility hydraulic system.
h. On pilot caution/warning panel, check **SHAFT DRIVEN COMP** indicator.	If **OIL PSI ACC PUMP** indicator is not lighted, go to paragraph 6–23.
i. On pilot caution/warning panel, check **OIL PSI ACC PUMP** indicator.	If **SHAFT DRIVEN COMP** indicator is not lighted, refer to TM 1-1520-238-T-5 to troubleshoot pneumatic system.
j. On pilot caution/warning panel, check **GEN 1** indicator.	If **GEN 1** indicator is not lighted, refer to TM 1-1520-238-T-6 to troubleshoot pilot caution/warning system.

6–12. DRIVE SYSTEM – INDICATORS MAINTENANCE OPERATIONAL CHECK (cont) 6–12

Task	Result
k. On pilot caution/warning panel (fig. 6–17), check **GEN 2** indicator.	If **GEN 2** indicator is not lighted, refer to TM 1-1520-238-T-6 to troubleshoot pilot caution/warning system.
l. On pilot caution/warning panel, check **CHIPS MAIN XMSN** indicator.	If **CHIPS MAIN XMSN** indicator is lighted, go to paragraph 6–24.
m. On CPG caution/warning panel (fig. 6–18), check **CHIPS MAIN XMSN** indicator.	If **CHIPS MAIN XMSN** indicator is lighted on CPG caution/warning panel, but not on pilot caution/warning panel, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system. If **CHIPS MAIN XMSN** indicator is lighted on both caution/warning panels, go to paragraph 6–24.
n. On pilot caution/warning panel, check **OIL HOT MAIN XMSN 1** indicator.	If **OIL HOT MAIN XMSN 1** indicator is lighted, go to paragraph 6–25.
o. On pilot caution/warning panel, check **OIL PSI MAIN XMSN 1** indicator.	If **OIL PSI MAIN XMSN 1** indicator is not lighted, go to paragraph 6–27.
p. On CPG caution/warning panel, check **MAIN XMSN 1** indicator.	If **MAIN XMSN 1** indicator is not lighted on CPG caution/warning panel, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system.
q. On pilot caution/warning panel, check **OIL PSI MAIN XMSN 2** indicator.	If **OIL PSI MAIN XMSN 2** indicator is not lighted, go to paragraph 6–28.
r. On pilot caution/warning panel, check **OIL HOT MAIN XMSN 2** indicator.	If **OIL HOT MAIN XMSN 2** indicator is lighted, go to paragraph 6–26.
s. On CPG caution/warning panel, check **MAIN XMSN 2** indicator.	If **MAIN XMSN 2** indicator is not lighted on CPG caution/warning panel, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system. If **MAIN XMSN 2** indicator is not lighted on CPG caution/warning panel, and **OIL HOT MAIN XMSN 2** indicator lights on pilot caution/warning panel, go to paragraph 6–26.
t. On pilot caution/warning panel, check **TEMP INT** indicator.	If **TEMP INT** indicator is lighted, go to paragraph 6–29.
u. On CPG caution/warning panel, check **TEMP INT** indicator.	If **TEMP INT** indicator is lighted on CPG caution/warning panel but not on pilot caution/warning panel, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system.

6–12. DRIVE SYSTEM – INDICATORS MAINTENANCE OPERATIONAL CHECK (cont) 6–12

Task	Result
v. On pilot caution/warning panel (fig. 6–17), check **TEMP TR** indicator.	If **TEMP TR** indicator is lighted, go to paragraph 6–30.
w. On CPG caution/warning panel (fig. 6–18), check **TEMP TR** indicator.	If **TEMP TR** indicator is lighted on CPG caution/warning panel but not on pilot caution/warning panel, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system. If **TEMP TR** indicator is lighted on both caution/warning panels, go to paragraph 6–30.
x. On pilot caution/warning panel, check **OIL HOT NOSE GRBX 1** indicator.	If **OIL HOT NOSE GRBX 1** indicator is lighted, go to paragraph 6–31.
y. On pilot caution/warning panel, check **OIL HOT NOSE GRBX 2** indicator.	If **OIL HOT NOSE GRBX 2** indicator is lighted, go to paragraph 6–32.
z. On pilot caution/warning panel, check **OIL PSI NOSE GRBX 1** indicator.	If **OIL PSI NOSE GRBX 1** indicator is not lighted, go to paragraph 6–33.
aa. On pilot caution/warning panel, check **OIL PSI NOSE GRBX 2** indicator.	If **OIL PSI NOSE GRBX 2** indicator is not lighted, go to paragraph 6–34.
ab. On pilot caution/warning panel, check **CHIPS NOSE GRBX 1** indicator.	If **CHIPS NOSE GRBX 1** indicator is lighted, go to paragraph 6–35.
ac. On pilot caution/warning panel, check **CHIPS NOSE GRBX 2** indicator.	If **CHIPS NOSE GRBX 2** indicator is lighted, go to paragraph 6–36.
ad. On pilot master caution/warning panel (fig. 6–19), check **LOW RPM ROTOR** indicator.	If pilot **LOW RPM ROTOR** indicator is not lighted, go to paragraph 6–37.
ae. On CPG master caution/warning panel, check **LOW RPM ROTOR** indicator.	If **CPG LOW RPM ROTOR** indicator is not lighted, go to paragraph 6–38.
af. On pilot and CPG master caution/warning panels, check **HIGH RPM ROTOR** indicators.	If either or both **HIGH RPM ROTOR** indicators is lighted, go to paragraph 6–39.
ag. On pilot and CPG caution/warning panels, check **VIB GRBX** indicators.	If both **VIB GRBX** indicators are lighted, go to paragraph 6–41. If **VIB GRBX** indicator is lighted on CPG caution/warning panel but not on pilot caution/warning panel, refer to TM 1-1520-238-T-6 to troubleshoot CPG caution/warning system.
ah. On pilot center circuit breaker panel (fig. 6–15), check **ENG CUT** circuit breaker.	If **ENG CUT** circuit breaker does not stay closed, go to paragraph 6–40.

6–12. DRIVE SYSTEM – INDICATORS MAINTENANCE OPERATIONAL CHECK (cont) 6–12

Task	Result
ai. Start and run APU (TM 1-1520-238-23).	
aj. Shut down AGPU (TM 1-1520-238-23).	
ak. On pilot caution/warning panel (fig. 6–17), check **PRI HYD PSI** indicator.	If **PRI HYD PSI** indicator is lighted refer to TM 1-1520-238-T-5 to troubleshoot hydraulic and pneumatic systems.
al. On CPG caution/warning panel (fig. 6–18), check **PRI HYD** indicator.	If **PRI HYD** indicator is lighted, refer to TM 1-1520-238-T-5 to troubleshoot hydraulic and pneumatic systems.
am. On pilot caution/warning panel, check **UTIL HYD PSI** indicator.	If **UTIL HYD PSI** indicator is lighted, refer to TM 1-1520-238-T-5 to troubleshoot hydraulic and pneumatic systems.
an. On CPG caution/warning panel (fig. 6–18), check **UTIL HYD** indicator.	If **UTIL HYD** indicator is lighted, refer to TM 1-1520-238-T-5 to troubleshoot hydraulic and pneumatic systems.
ao. On pilot caution/warning panel, check **OIL PSI ACC PUMP** indicator.	If **OIL PSI ACC PUMP** indicator is lighted, go to paragraph 6–42.
ap. On pilot caution/warning panel, check **SHAFT DRIVEN COMP** indicator.	If **SHAFT DRIVEN COMP** indicator is lighted, refer to TM 1-1520-238-T-5 to troubleshoot hydraulic and pneumatic systems.
aq. On pilot caution/warning panel, check **GEN 1** indicator.	If **GEN 1** indicator is lighted, refer to TM 1-1520-238-T-6 to troubleshoot pilot caution/warning system.
ar. On pilot caution/warning panel, check **GEN 2** indicator.	If **GEN 2** indicator is lighted, refer to TM 1-1520-238-T-6 to troubleshoot pilot caution/warning system.

NOTE

If drive system vibration or dynamic maintenance operational check is to be performed, omit steps 4 and 5.

3. Shut down APU (TM 1-1520-238-23).
4. Perform DRIVE SYSTEM – POWER DOWN (para 6–11).
5. Secure access doors and panels (TM 1-1520-238-23).
6. Disconnect maintenance headset (para 1–17).

END OF TASK

6–13. DRIVE SYSTEM – DYNAMIC MAINTENANCE OPERATIONAL CHECK 6–13

Tools:

Nomenclature	Part Number
Tool Kit, Powertrain Repairer's	SC518099CLA013

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-1
TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
Paragraph 6–12	DRIVE SYSTEM – INDICATORS MAINTENANCE OPERATIONAL CHECK completed

WARNING

Make sure that helicopter safing procedures are accomplished. Observe all safety precautions during troubleshooting and maintenance procedures. Failure to do so could result in death or serious injury.

NOTE

- **Refer to pilot station (fig. 6–12) and CPG station (fig. 6–13) for cockpit configuration and equipment.**
- **If referenced out of one paragraph or volume and into another for additional troubleshooting, upon completion of the task, return to the maintenance operational check for the original paragraph or volume.**

Task	Result
1. Perform **TRAN – INTERACTIVE** FD/LS(TM 1-1520-238-T-1)	

NOTE

If a discrepancy is noted during the FD/LS check, perform corrective action indicated in TM 1-1520-238-T-1. If the discrepancy still exists after performing the corrective action required, refer to the following listed failure symptoms and perform troubleshooting.

6–13. DRIVE SYSTEM – DYNAMIC MAINTENANCE OPERATIONAL CHECK (cont) 6–13

Task	Result
	If FD/LS displays other than **0, 50,** or **>99 LB** for **NGB 1** oil pressure, go to paragraph 6–15.
	If FD/LS displays **50 LB** for **NGB 1** oil pressure, go to paragraph 6–15.1.
	If FD/LS displays **>99 LB** for **NGB 1** oil pressure, go to paragraph 6–15.2.
	If FD/LS displays other than **0, 50,** or **>99 LB** for **XMSN 1** oil pressure, go to paragraph 6–16.
	If FD/LS displays **50 LB** for **XMSN 1** oil pressure, go to paragraph 6–16.1.
	If FD/LS displays **>99 LB** for **XMSN 1** oil pressure, go to paragraph 6–16.2.
	If FD/LS displays other than **0, 50,** or **>99 LB** for **XMSN 2** oil pressure, go to paragraph 6–17.
	If FD/LS displays **50 LB** for **XMSN 2** oil pressure, go to paragraph 6–17.1.
	If FD/LS displays **>99 LB** for **XMSN 2** oil pressure, go to paragraph 6–17.2.
	If FD/LS displays other than **0, 50,** or **>99 LB** for **NGB 2** oil pressure, go to paragraph 6–18.
	If FD/LS displays **50 LB** for **NGB 2** oil pressure, go to paragraph 6–18.1.
	If FD/LS displays **>99 LB** for **NGB 2** oil pressure, go to paragraph 6–18.2.
	If FD/LS does not display **ambient** (or higher if recently operated) for **NGB 1** oil temperature, go to paragraph 6–19.
	If FD/LS displays **–32 °C** for **NGB 1** oil temperature, go to paragraph 6–19.1.
	If FD/LS does not display **ambient** (or higher if recently operated) for **XMSN 1** oil temperature, go to paragraph 6–20.
	If FD/LS displays **–32 °C** for **XMSN 1** oil temperature, go to paragraph 6–20.1.
	If FD/LS does not display **ambient** (or higher if recently operated) for **XMSN 2** oil temperature, go to paragraph 6–21.

6–13. DRIVE SYSTEM – DYNAMIC MAINTENANCE OPERATIONAL CHECK (cont) 6–13

Task	Result
	If FD/LS displays **–32 °C** for **XMSN 2** oil temperature, go to paragraph 6–21.1.
	If FD/LS does not display **ambient** (or higher if recently operated) for **NGB 2** oil temperature, go to paragraph 6–22.
	If FD/LS displays **–32 °C** for **NGB 2** oil temperature, go to paragraph 6–22.1.
	If FD/LS displays **–32 °C** for **NGB 1, XMN 1, XMN 2,** and **NGB 2,** go to paragraph 6–22.3.

2. Start engines and run at 100% N_r until all components temperatures stabilize (TM 1-1520-238-CL). While ground running, check the instruments and caution/warning panels for abnormal drive system conditions.

CAUTION

Shut down helicopter if the HOD displays a 28 lbs. or less oil pressure reading on any component, or an oil temperature reading climb above 140 °C on any component. Failure to shut down helicopter can result in damage to the drive system.

3. Complete the maintenance operational check as follows:

Task	Result
a. On CPG HOD (fig. 6–20), check FD/LS display for **NGB 1** oil reading.	If HOD **NGB 1** oil pressure displays **0 LB** oil pressure, shutdown helicopter and go to paragraph 6–15.
	If HOD **NGB 1** oil pressure displays **50 LB** oil pressure, shutdown helicopter and go to paragraph 6–15.1.
	If HOD **NGB 1** oil pressure displays **>99 LB** oil pressure, shutdown helicopter and go to paragraph 6–15.2.
	If HOD **NGB 1** oil pressure displays **54 LB** oil pressure or less, shutdown helicopter and go to paragraph 6–15.3.

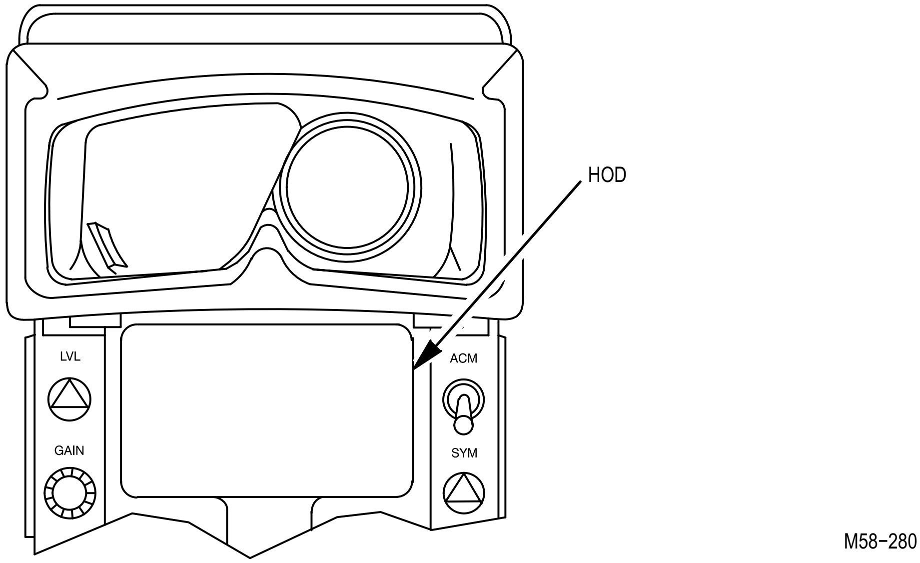


Figure 6–20. CPG HOD

Task	Result
b. On pilot caution/warning panel (fig. 6–17), check **OIL PSI NOSE GRBX 1** indicator.	If **OIL PSI NOSE GRBX 1** indicator lights, and HOD displays a **55 LB** to **85 LB (**normal) reading for **NGB 1**, shutdown helicopter and go to paragraph 6–47.
	If **OIL PSI NOSE GRBX 1** indicator lights, and HOD displays a **29 LB** to **54 LB** (low) reading for **NGB 1** oil pressure, go to paragraph 6–48.
c. On CPG HOD (fig. 6–20), check FD/LS display for **XMSN 1** oil pressure reading.	If HOD **XMSN 1** oil pressure displays **0 LB** oil pressure, shutdown helicopter and go to paragraph 6–16.
	If HOD **XMSN 1** oil pressure displays **50 LB** oil pressure, shutdown helicopter and go to paragraph 6–16.1.
	If HOD **XMSN 1** oil pressure displays **>99 LB** oil pressure, shutdown helicopter and go to paragraph 6–16.2.
	If HOD **XMSN 1** oil pressure displays **54 LB** oil pressure or less, shutdown helicopter and go to paragraph 6–16.3.

6–13. DRIVE SYSTEM – DYNAMIC MAINTENANCE OPERATIONAL CHECK (cont) 6–13

Task	Result
d. On pilot caution/warning panel (fig. 6–17), check **OIL PSI MAIN XMSN 1** indicator.	If **OIL PSI MAIN XMSN 1** indicator lights, and HOD displays a **55 LB** to **85 LB** (normal) reading for **XMSN 1**, shutdown helicopter and go to paragraph 6–51.
	If **OIL PSI MAIN XMSN 1** indicator lights, and HOD displays a **29 LB** to **54 LB** (low) reading for **XMSN 1** oil pressure, shutdown helicopter and go to paragraph 6–52.
e. On CPG HOD (fig 6–20), check FD/LS display for **XMSN 2** oil reading.	If HOD **XMSN 2** oil pressure displays **0 LB** oil pressure, shutdown helicopter and go to paragraph 6–17.
	If HOD **XMSN 2** oil pressure displays **50 LB** oil pressure, shutdown helicopter and go to paragraph 6–17.1.
	If HOD **XMSN 2** oil pressure displays **>99 LB** oil pressure, shutdown helicopter and go to paragraph 6–17.2.
	If HOD **XMSN 2** oil pressure displays **54 LB** oil pressure or less, shutdown helicopter and go to paragraph 6–17.3.
f. On pilot caution/warning panel (fig. 6–17), check **OIL PSI MAIN XMSN 2** indicator.	If **OIL PSI MAIN XMSN 2** indicator lights, and HOD displays a **55 LB** to **85 LB** (normal) reading for **XMSN 2**, shutdown helicopter and go to paragraph 6–55.
	If **OIL PSI MAIN XMSN 2** indicator lights, and HOD displays a **29 LB** to **54 LB** (low) reading for **XMSN 1** oil pressure, go to paragraph 6–56.
g. On CPG HOD (fig.6–20), check FD/LS display for **NGB 2** oil pressure reading.	If HOD **NGB 2** oil pressure displays **0 LB** oil pressure, shutdown helicopter and go to paragraph 6–18.
	If HOD **NGB 2** oil pressure displays **50 LB** oil pressure, shutdown helicopter and go to paragraph 6–18.1.
	If HOD **NGB 2** oil pressure displays **>99 LB** oil pressure, shutdown helicopter and go to paragraph 6–18.2.
	If HOD **NGB 2** oil pressure displays **54 LB** oil pressure or less, shutdown helicopter and go to paragraph 6–18.3.

6–13. DRIVE SYSTEM – DYNAMIC MAINTENANCE OPERATIONAL CHECK (cont) 6–13

Task	Result
h. On pilot caution/warning panel (fig 6–17), check **OIL PSI NOSE GRBX 2** indicator.	If **OIL PSI NOSE GRBX 2** indicator lights, and HOD displays a **55 LB** to **85 LB** (normal) reading for **NGB 2**, shutdown helicopter and go to paragraph 6–59. If **OIL PSI NOSE GRBX 2** indicator lights, and HOD displays a **29 LB** to **54 LB** (low) reading for **NGB 2** oil pressure, go to paragraph 6–60.
i. On CPG HOD, check FD/LS display for **NGB 1** oil temperature reading.	If HOD displays a **140** °**C** or more reading for **NGB 1** oil temperature, shutdown helicopter and go to paragraph 6–19.2. If HOD displays a reading between **121** °**C** and **139** °**C** for **NGB 1** oil temperature, go to paragraph 6–19.2.
j. On pilot caution/warning panel, check **OIL HOT NOSE GRBX 1** indicator.	If **OIL HOT NOSE GRBX 1** indicator lights, HOD displays a **121** °**C** and **139** °**C** (high) oil temperature reading for **NGB 1**, go to paragraph 6–63. If **OIL HOT NOSE GRBX 1** indicator lights, and HOD displays a **103** °**C** to **120** °**C** (normal) oil temperature reading for **NGB 1**, shutdown helicopter and go to paragraph 6–62.
k. On CPG HOD, check FD/LS display for **XMSN 1** oil temperature reading.	If HOD displays a **140** °**C** or higher reading for **XMSN 1** oil temperature, shutdown helicopter and go to paragraph 6–20.2. If HOD displays a reading between **096** °**C** and **139** °**C** for **XMSN 1** oil temperature, go to paragraph 6–20.2.
l. On pilot caution/warning panel, check **OIL HOT MAIN XMSN 1** indicator.	If **OIL HOT MAIN XMSN 1** indicator lights, HOD displays a **096** °**C** and **139** °**C** (high) oil temperature reading for **XMSN 1**, go to paragraph 6–67. If **OIL HOT MAIN XMSN 1** indicator lights, and HOD displays a **070** °**C** to **095** °**C** (normal) oil temperature reading for **XMSN 1**, shutdown helicopter and go to paragraph 6–66.
m. On CPG HOD, check FD/LS display for **XMSN 2** oil temperature reading.	If HOD displays a **140** °**C** or more reading for **XMSN 2** oil temperature, shutdown helicopter and go to paragraph 6–21.2. If HOD displays a reading between **096** °**C** and **139** °**C** (high) for **XMSN 2** oil temperature, go to paragraph 6–21.2.

6–13. DRIVE SYSTEM – DYNAMIC MAINTENANCE OPERATIONAL CHECK (cont) 6–13

Task	Result
n. On pilot caution/warning panel, check **OIL HOT MAIN XMSN 2** indicator.	If **OIL HOT MAIN XMSN 2** indicator lights, HOD displays a **096**° **C** and **139**° **C** (high) oil temperature reading for **XMSN 2**, shutdown helicopter and go to paragraph 6–71.
	If **OIL HOT MAIN XMSN 2** indicator lights, and HOD displays a **070**° **C** to **095**° **C** (normal) oil temperature reading for **XMSN 2**, go to paragraph 6–70.
o. On CPG HOD, check FD/LS display for **NGB 2** oil temperature reading.	If HOD displays a **140**° **C** or more reading for **NGB 2** oil temperature, shutdown helicopter and go to paragraph 6–22.2.
	If HOD displays a reading between **121**° **C** and **139**° **C** for **NGB 2**, go to paragraph 6–22.2.
p. On pilot caution/warning panel, check **OIL HOT NOSE GRBX 2** indicator.	If **OIL HOT NOSE GRBX 2** indicator lights, HOD displays a **121**° **C** and **139**° **C** (high) oil temperature reading for **NGB 2**, go to paragraph 6–75.
	If **OIL HOT NOSE GRBX 2** indicator lights, and HOD displays a **103**° **C** to **120**° **C (**normal) oil temperature reading for **NGB 2** , shut down helicopter and go to paragraph 6–74.
q. On pilot caution/warning panel (fig. 6–17), check **CHIPS MAIN XMSN** indicator.	If **CHIPS MAIN XMSN** indicator lights, shut down helicopter and go to paragraph 6–24.
r. On pilot caution/warning panel, check **CHIPS NOSE GRBX 1** indicator.	If **CHIPS NOSE GRBX 1** indicator lights, shut down helicopter and go to paragraph 6–76.
s. On pilot caution/warning panel, check **CHIPS NOSE GRBX 2** indicator.	If **CHIPS NOSE GRBX 2** indicator lights, shut down helicopter and go to paragraph 6–77.
t. On pilot caution/warning panel, check **TEMP INT** indicator.	If **TEMP INT** indicator lights, shut down helicopter and go to paragraph 6–78.
u. On pilot caution/warning panel, check **TEMP TR** indicator.	If **TEMP TR** indicator lights, shut down helicopter and go to paragraph 6–79.
v. Shut down helicopter (TM 1-1520-238-CL).	

NOTE

If all indicators remain retracted, go to step 3.

6–13. DRIVE SYSTEM – DYNAMIC MAINTENANCE OPERATIONAL CHECK (cont) 6–13

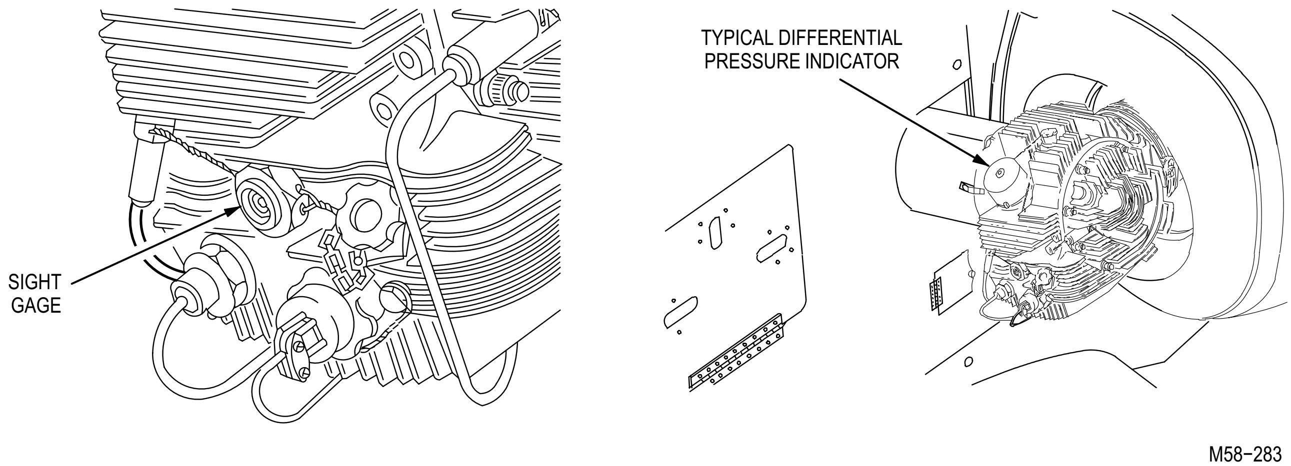


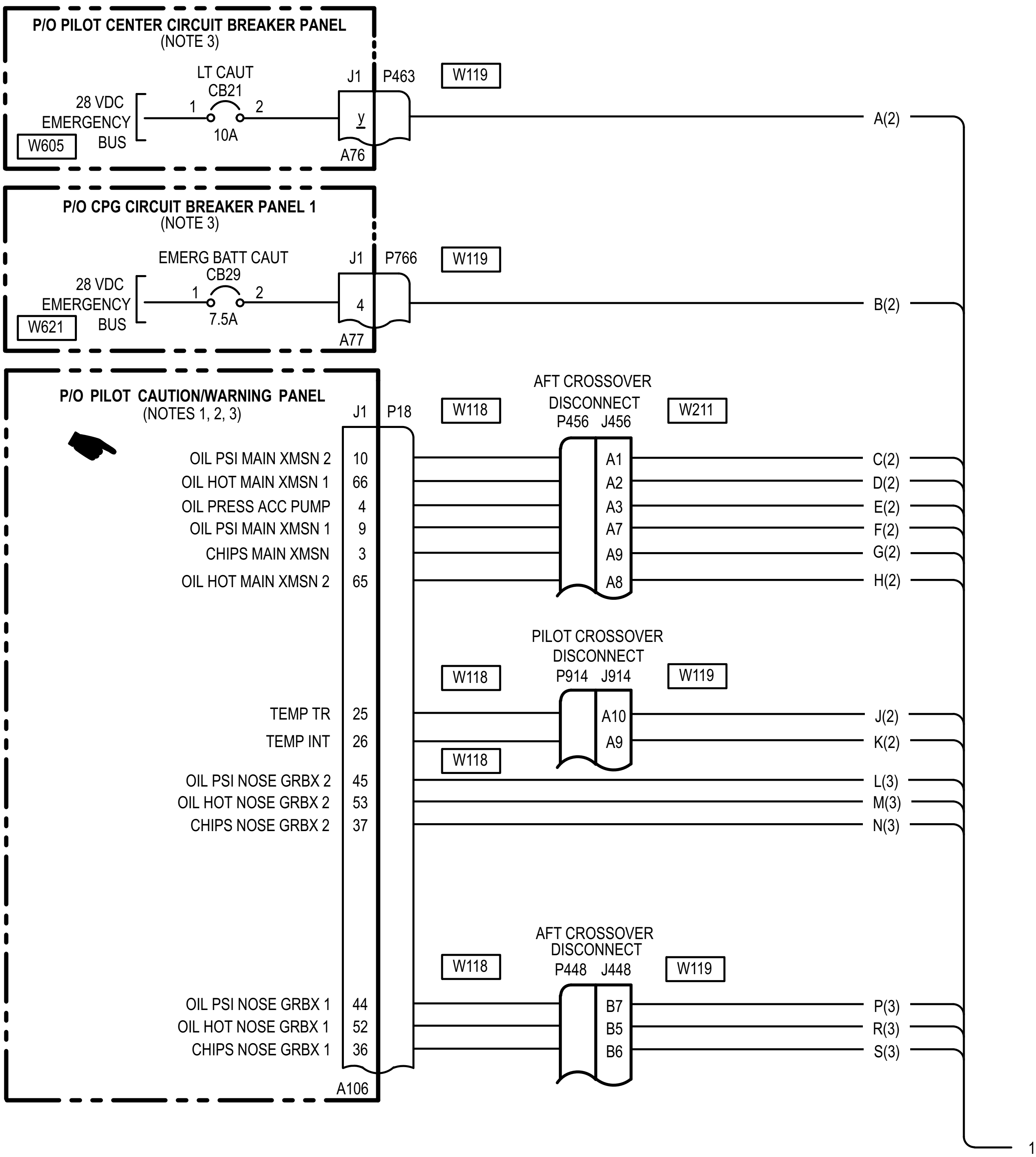
Figure 6–21. Engine NGBs Sight Gage and Typical Differential Pressure Indicator

Task	Result
w. On engine NGBs, check oil level in sight gage (fig. 6–21).	If engine nose gearboxes oil loss is indicated, go to paragraph 6–80.
x. Visually inspect differential pressure indicators (fig. 6–21) located on the left NGB, right NGB, accessory oil pump and main transmission. Are all indicators in the retracted position?	If any indicator is extended, reset indicator and go to step y.
y. Start/operate engines 1 and 2 (TM 1-1520-238-CL). Ground run at 100% N_R for five minutes.	
z. Shut down helicopter (TM 1-1520-238-CL).	
aa. Visually inspect differential pressure indicators located on the left NGB, right NGB, accessory oil pump and main transmission. Are all indicators in the retracted position?	If indicator is extended, remove filter element (TM 1-1520-238-23) and check for contamination. If contaminated replace filter element (TM 1-1520-238-23). If contamination is not present, replace differential pressure indicator (TM 1-1520-238-23).

4. Perform DRIVE SYSTEM – POWER DOWN (para 6–11).

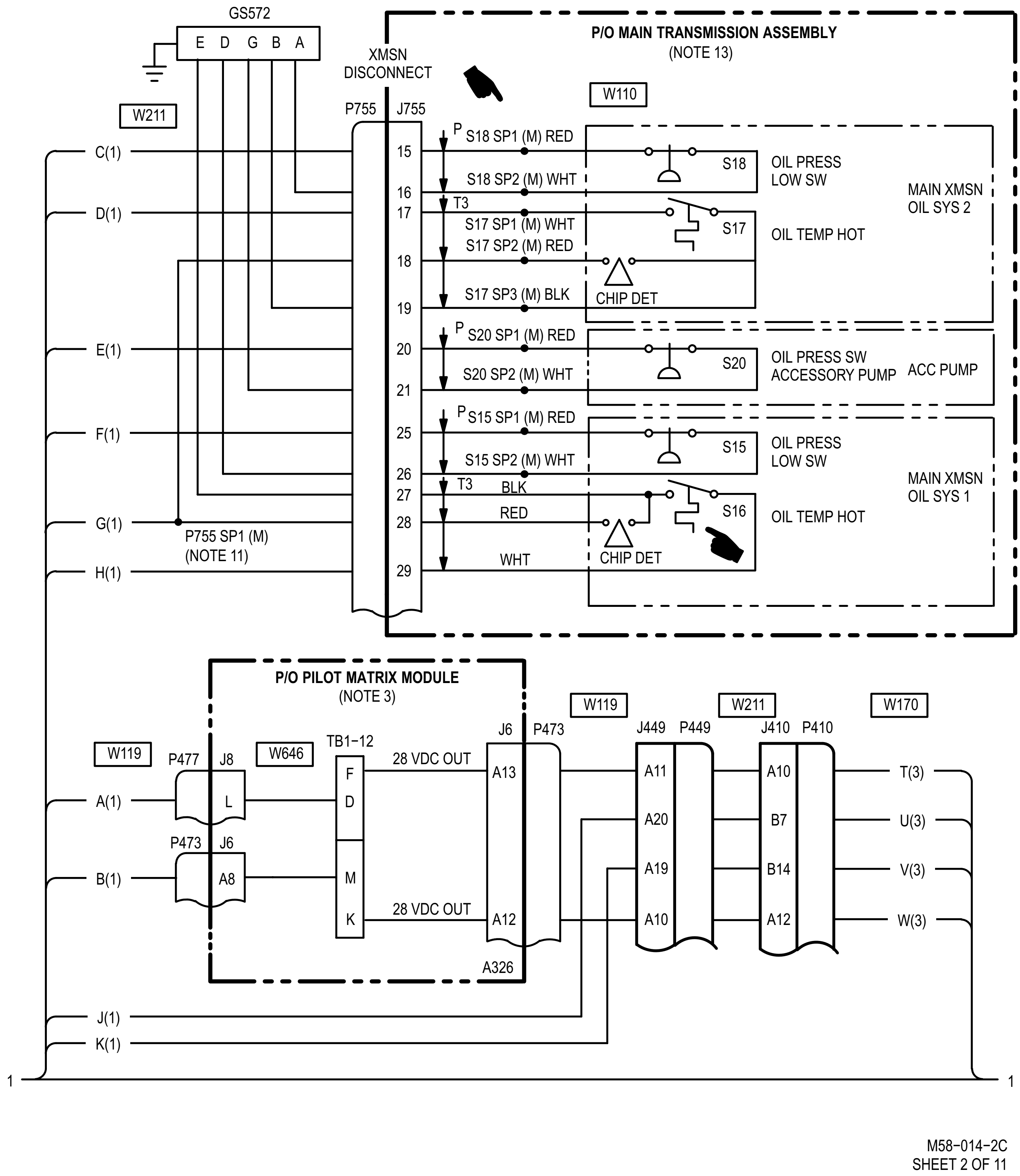
END OF TASK

6–14. DRIVE SYSTEM – WIRING INTERCONNECT DIAGRAM 6–14

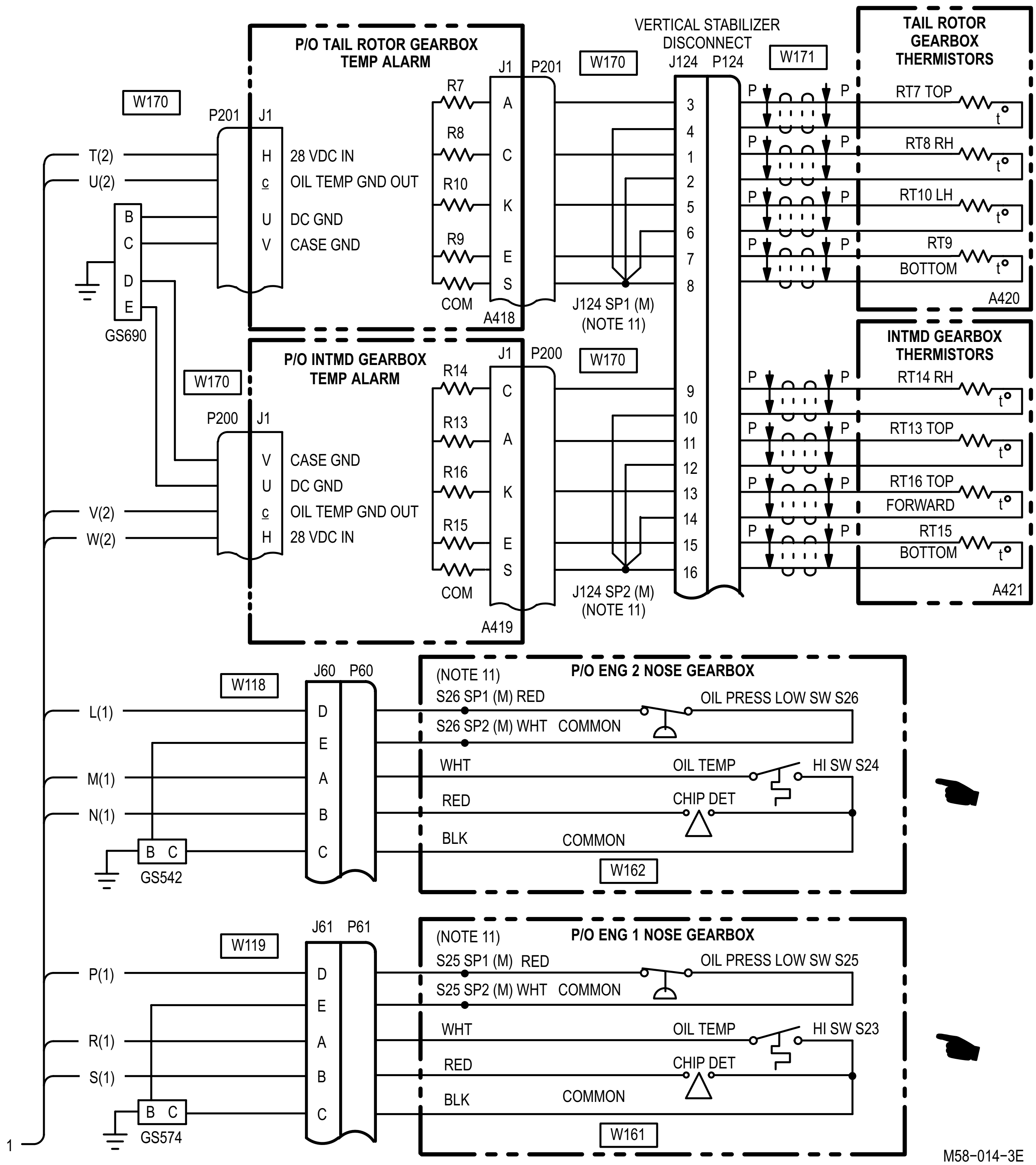


M58–014–1C
SHEET 1 OF 11

6–14. DRIVE SYSTEM – WIRING INTERCONNECT DIAGRAM (cont) 6–14

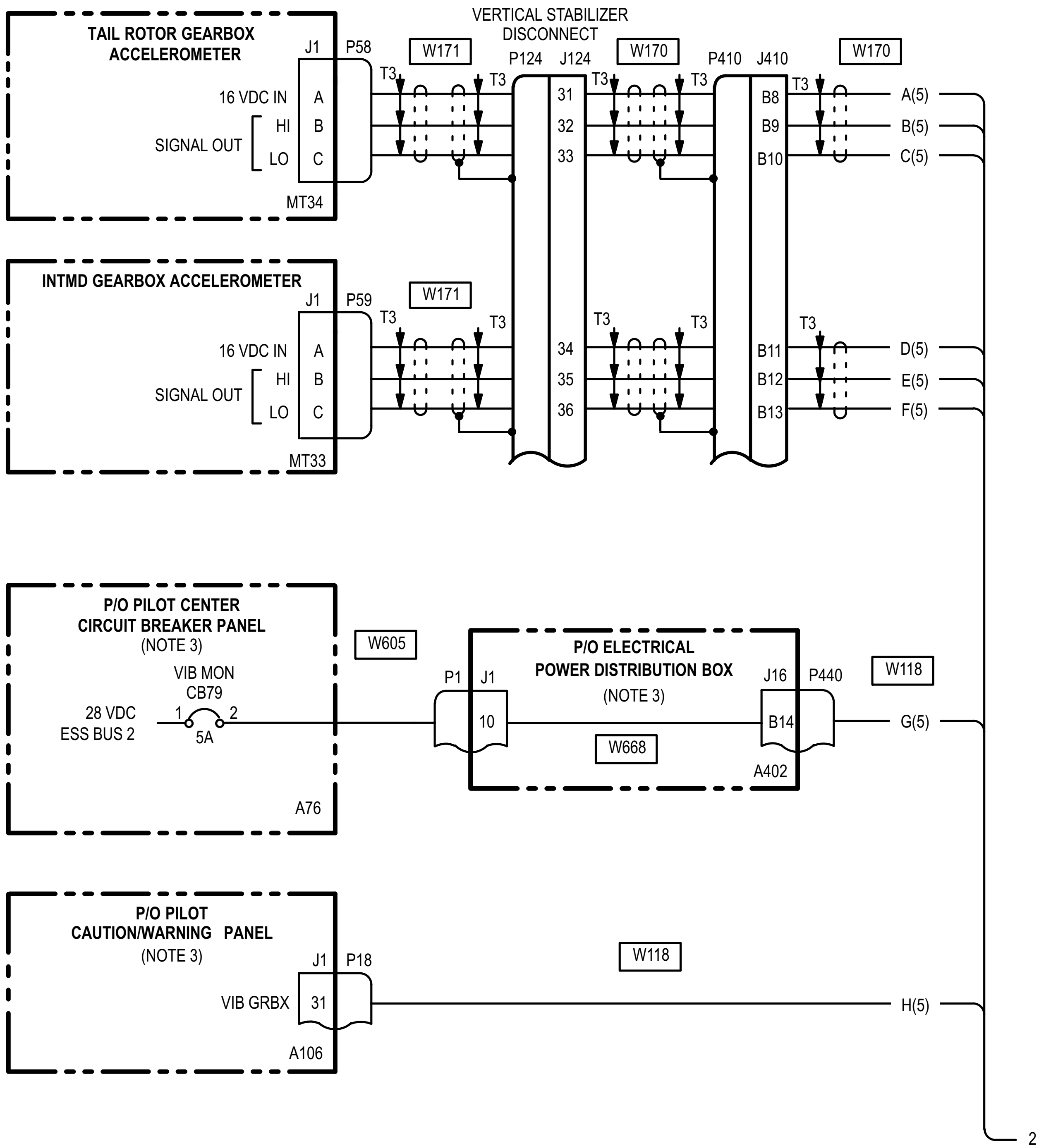


6–14. DRIVE SYSTEM – WIRING INTERCONNECT DIAGRAM (cont) 6–14



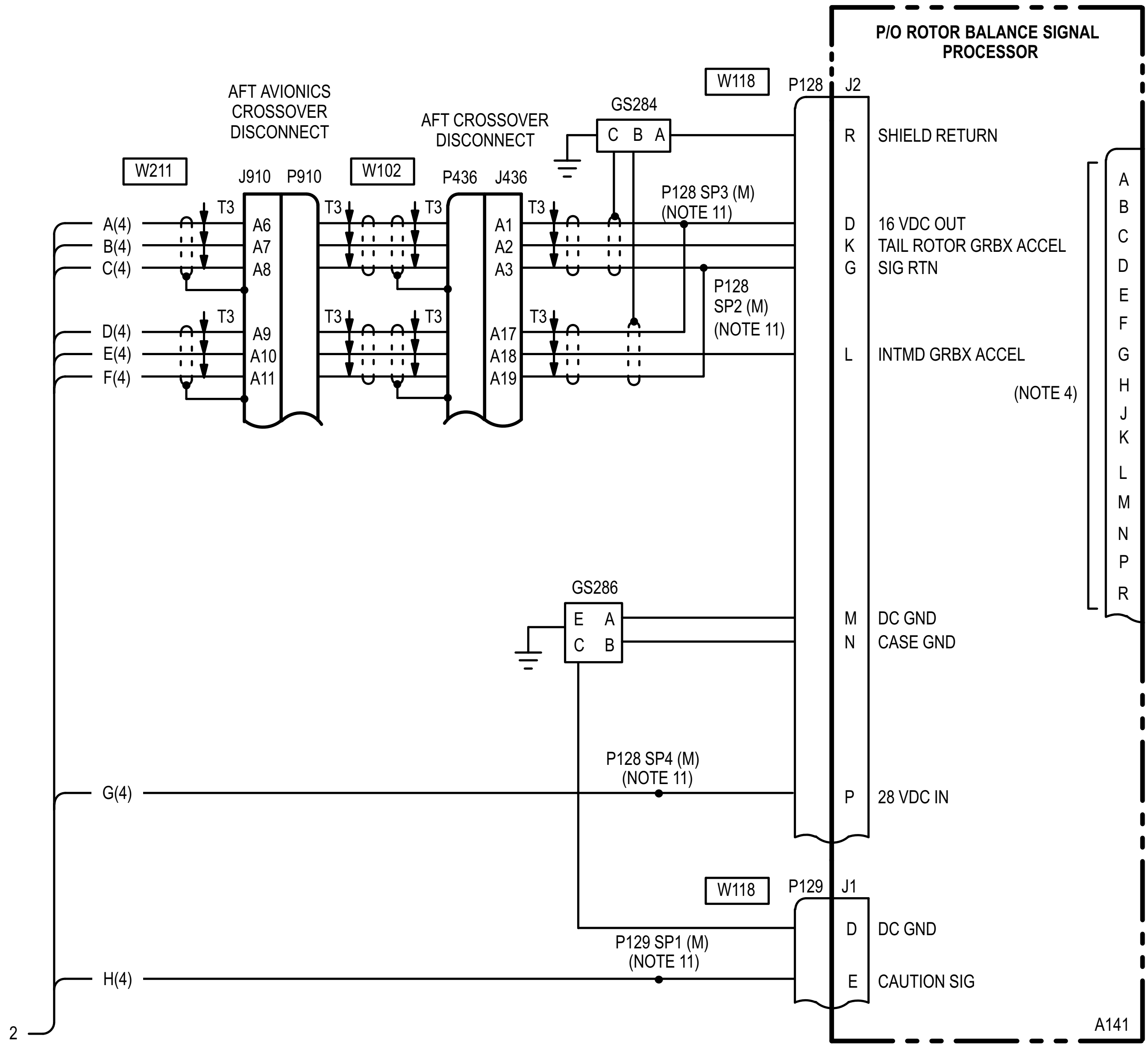
M58–014–3E
SHEET 3 OF 11

6–14. DRIVE SYSTEM – WIRING INTERCONNECT DIAGRAM (cont) 6–14



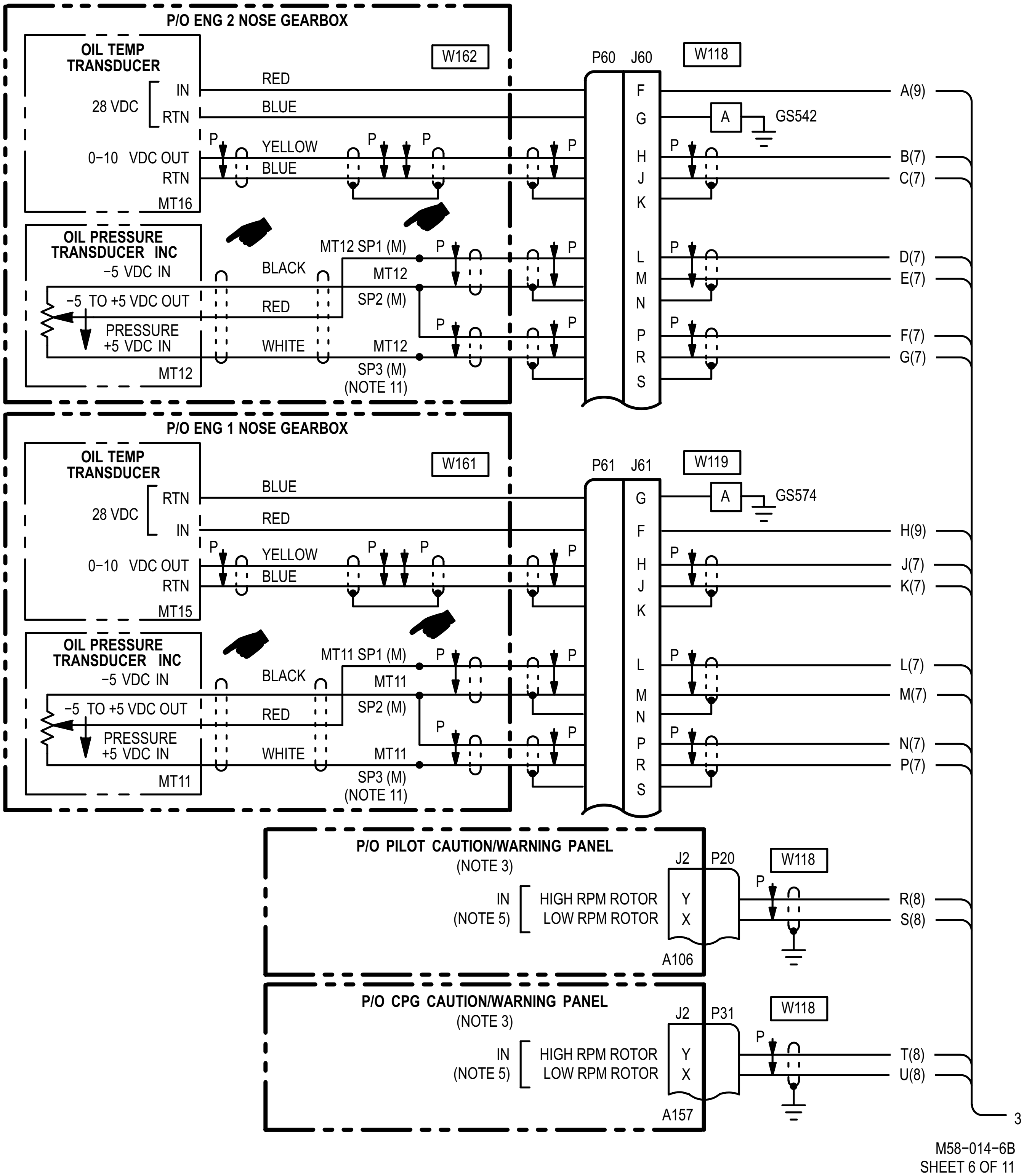
M58–014–4B
SHEET 4 OF 11

6–14. DRIVE SYSTEM – WIRING INTERCONNECT DIAGRAM (cont) 6–14

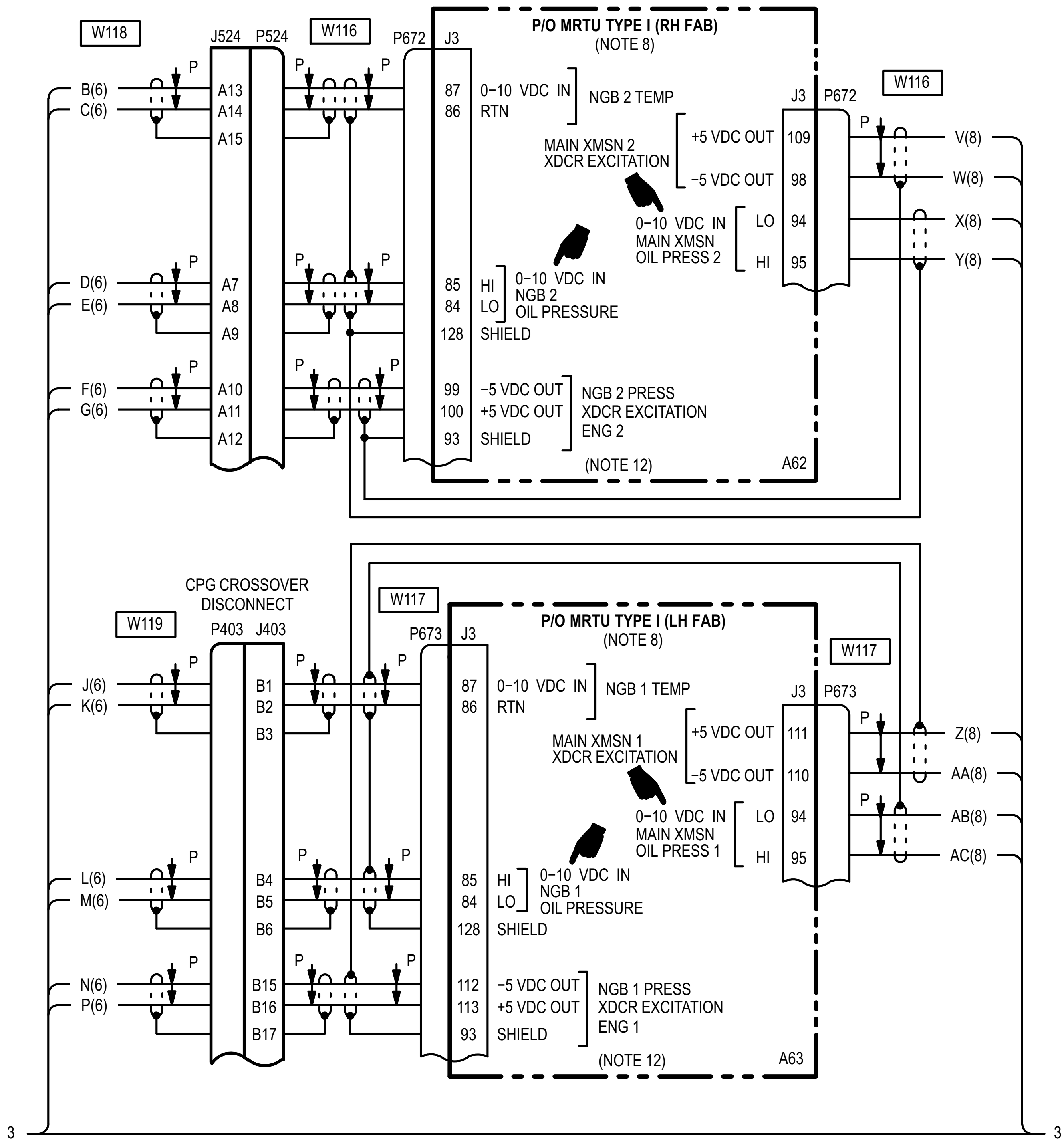


M58–014–5C
SHEET 5 OF 11

6–14. DRIVE SYSTEM – WIRING INTERCONNECT DIAGRAM (cont) 6–14

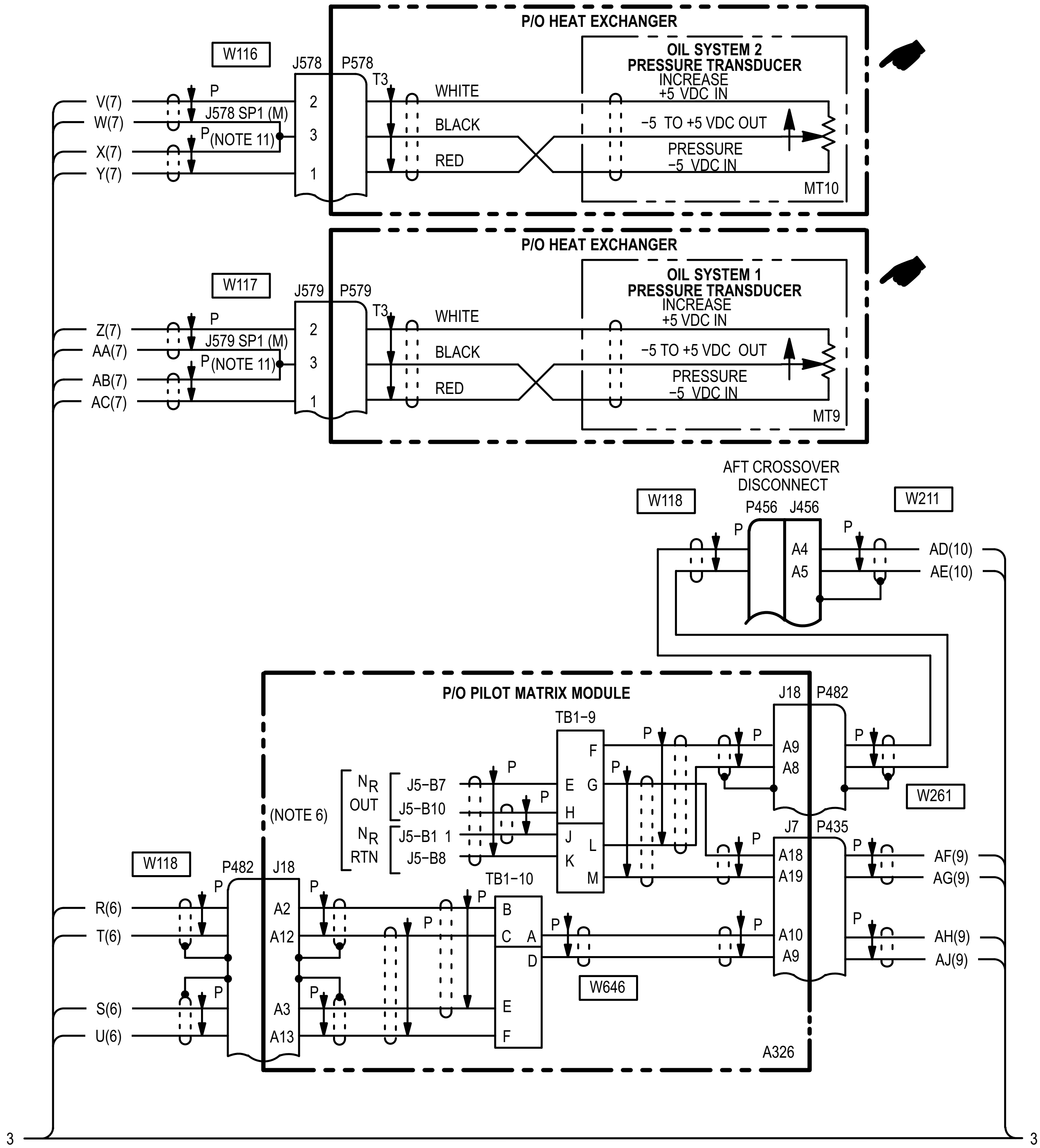


6–14. DRIVE SYSTEM – WIRING INTERCONNECT DIAGRAM (cont) 6–14



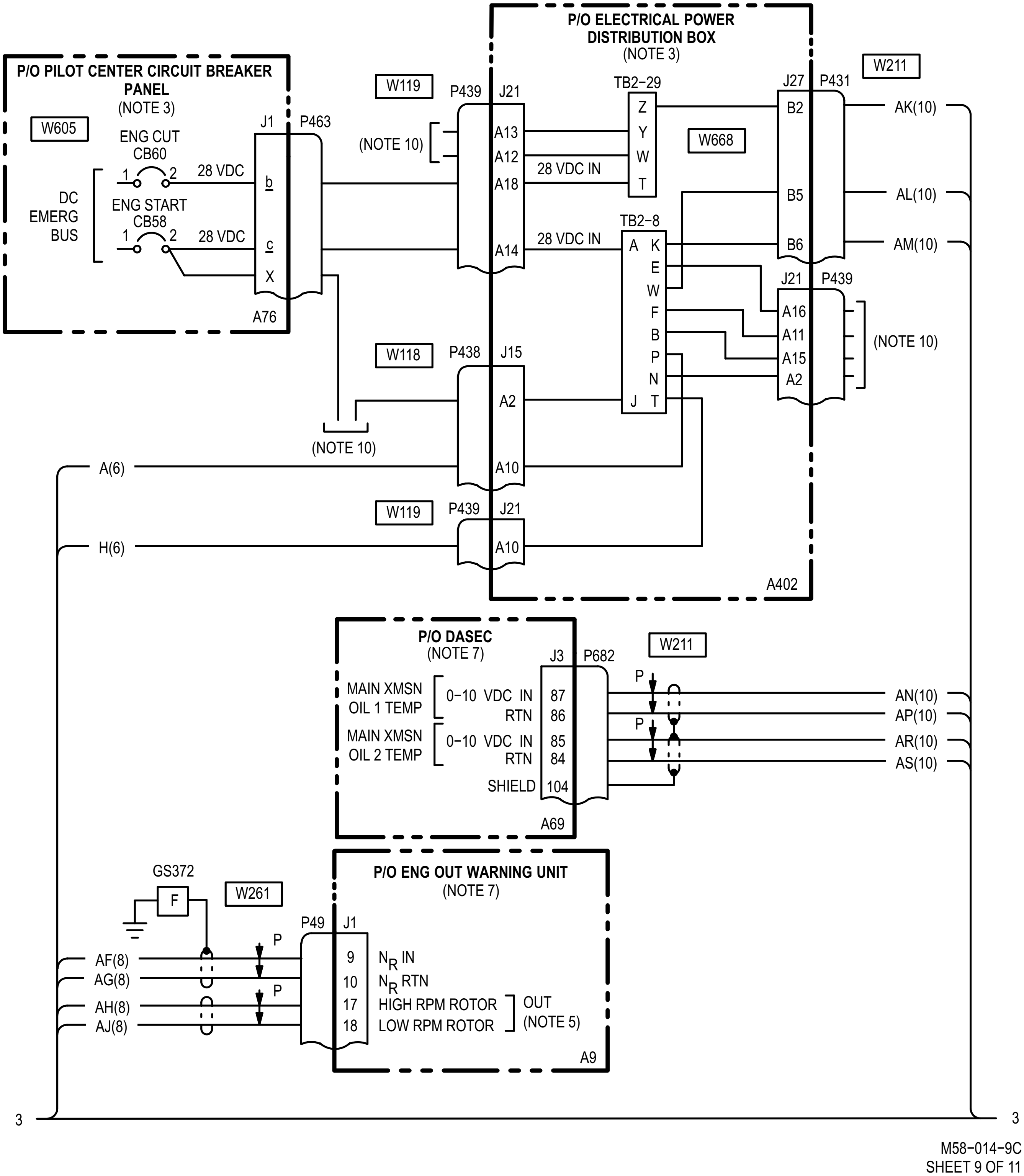
M58−014−7E
SHEET 7 OF 11

6–14. DRIVE SYSTEM – WIRING INTERCONNECT DIAGRAM (cont) 6–14

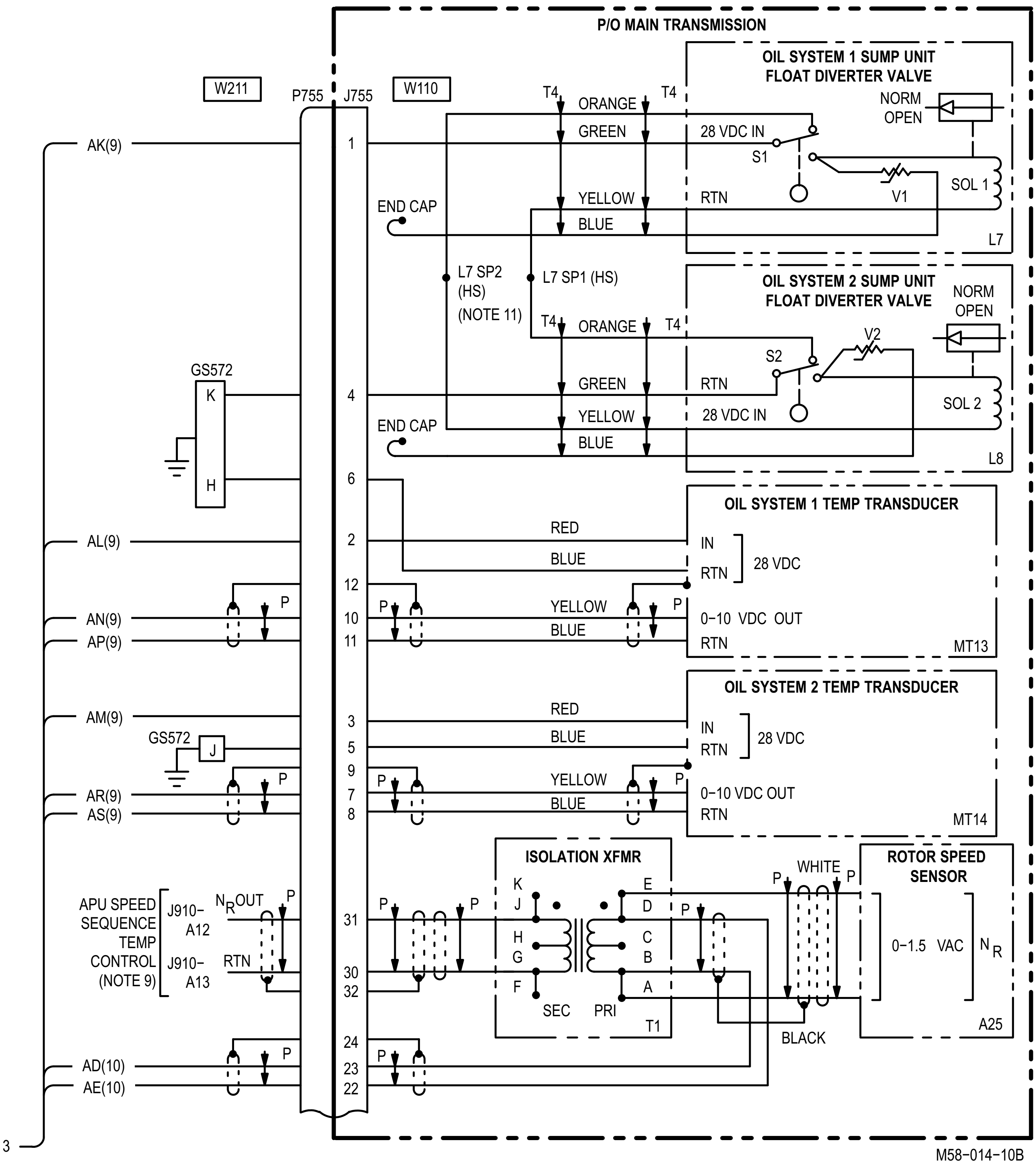


M58−014−8D
SHEET 8 OF 11

6–14. DRIVE SYSTEM – WIRING INTERCONNECT DIAGRAM (cont) 6–14



6–14. DRIVE SYSTEM – WIRING INTERCONNECT DIAGRAM (cont) 6–14



M58–014–10B
SHEET 10 OF 11

6–14. DRIVE SYSTEM – WIRING INTERCONNECT DIAGRAM (cont) 6–14

NOTES:

HIGHWAY USE: THE ALPHA CHARACTER IDENTIFIES A SPECIFIC LINE, AND THE NUMBER IN PARENTHESIS IDENTIFIES THE SHEET NUMBER WHERE THE SIGNAL TERMINATES.

1. ALL SIGNALS SHOWN ARE INPUTS FOR PILOT AND CPG CAUTION/WARNING INDICATORS. ALL SIGNALS ARE GROUNDED FAULT INPUTS.
2. INTERCONNECTIONS TO CPG CAUTION/WARNING PANEL NOT SHOWN (SEE NOTE 3).
3. ELECTRICAL SYSTEM (TM 1−1520−238−T−6).
4. CONNECTION FOR TRACKING AND BALANCING EQUIPMENT.
5. GROUND AT FAULT INPUT.
6. INSTRUMENTS (TM 1−1520−238−T−5).
7. FLIGHT CONTROLS (TM 1−1520−238−T−7).
8. FIRE CONTROL SYSTEM (TM 9−1230−476−20−2).
9. APU (TM 1−1520−238−T−8).
10. POWER PLANTS (CHAPTER 4).
11. HS DESIGNATES A HARD SPLICE WHICH CANNOT BE DISCONNECTED. M DESIGNATES A SOFT SPLICE WHICH CAN BE DISCONNECTED FOR A WIRING CHECK.
12. ☛ HI = +5 VDC (>99 LB), LO = −5 VDC (0 LB) MIN, DEFAULT = OVDC (50 LB).

M58−014−11A
SHEET 11 OF 11

6–15. HOD NGB 1 READING – DISPLAYS 0 LB OIL PRESSURE 6–15

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel and LN6, L60 fairings open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

If OIL PSI NOSE GRBX 1 indicator is also illuminated, troubleshoot Task 6–15.3 before proceeding.

1. Detach P61. Check for open between:
   P61–L and P61–M,
   P61–L and P61–P,
   P61–L and P61–R.
   Does open exist?

   YES Go to step 3.

   NO Go to step 2.

2. Check for short between:
   P61–L and ground,
   P61–M and ground,
   P61–P and ground,
   P61–R and ground.
   Does short exist?

   YES Go to step 3.

   NO Go to step 4.

3. Locate open or short in wire harness between P61 and MT11.
   Can wire harness be repaired?

   YES Repair wiring harness (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Replace MT11. Go to paragraph 6–13.

4. Reconnect P61. Detach P673. Check for open between:
   P673–85 and P673–84,
   P673–85 and P673–112,
   P673–85 and P673–113.
   Does open exist?

   YES Repair open wire between:
   P673–85 and J403–B4,
   P673–84 and J403–B5,
   P673–112 and J403–B15,
   P673–113 and J403–B16,
   P403–B4 and J61–L,
   P403–B5 and J61–M,
   P403–B15 and J61–P,
   P403–B16 and J61–R.
   Go to paragraph 6–13.

   NO Go to step 5.

6–15. HOD NGB 1 READING – DISPLAYS 0 LB OIL PRESSURE (cont) 6–15

5. Detach P61. Check for short between:
P673–85 and ground,
P673–84 and ground,
P673–112 and ground,
P673–113 and ground.
Does short exist?

YES	Repair shorted wire between: P673–85 and J403–B4, P673–84 and J403–B5, P673–112 and J403–B15, P673–113 and J403–B16, P403–B4 and J61–L, P403–B5 and J61–M, P403–B15 and J61–P, P403–B16 and J61–R.
NO	Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–15.1. HOD NGB READING – DISPLAYS 50 LB OIL PRESSURE 6–15.1

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel and LN6, L60 fairings open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Inspect splice SP1 on red wire from NGB 1 oil pressure transducer (MT11).
   Does open exist?

   YES Repair splice (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Go to step 2.

2. Depin splices SP1 (red wire) and SP2 (black wire) on MT11 wire harness. Check for open between red and black wire to MT11.
   Does open exist?

   YES Replace NGB 1 oil pressure transducer (TM 1-1520-238-23). Go to paragraph 6–13.

   NO Go to step 3.

3. Detach P61. Check for open between P61–L and SP1 (red wire).
   Does open exist?

   YES Repair open wire (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Go to srep 4.

4. Detach P673. Check for open between P673–85 and J61–L.
   Does open exist?

   YES Repair open wire between: P673–85 and J403–B4, P403–B4 and J61–L (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–15.2. HOD NGB 1 READING – DISPLAYS >99 LB OIL PRESSURE 6–15.2

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel and LN6 fairing open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Inspect splice SP2 on black wire from NGB 1 oil pressure transducer (MT11).
   Does open exist?

   YES Repair splice (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Go to step 2.

2. Depin splices SP1 (red wire) and SP2 (black wire) on MT11 wire harness. Check for open between red and black wire to MT11.
   Does open exist?

   YES Replace NGB 1 oil pressure transducer (TM 1-1520-238-23). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–15.3. HOD NGB 1 READING – DISPLAYS 54 LB OIL PRESSURE OR LESS 6–15.3

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Tester, MP-1	6685-00-693-5009
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel and LN6 fairing open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

A reading of 50 LB on the HOD is generally a wiring problem. Troubleshoot in accordance with Task 6–15.1 before proceeding.

1. Check pilot caution/warning panel **OIL PSI NOSE GRBX 1** indicator.
   Is indicator lighted?

   YES Go to step 3.

   NO Go to step 2.

2. Remove NGB 1 oil pressure transducer (MT11) (TM 1-1520-238-23). Connect MT11 to Tester, MP–1. Observe HOD while applying pressure to transducer with tester.
   Does HOD reflect applied pressure within +/– 5 PSI from 0 to 100 PSI?

   YES Go to step 3.

   NO Replace NGB 1 oil pressure transducer (TM 1-1520-238-23). Go to paragraph 6–13.

3. Install pressure gage GGG76 in NGB 1. Start engine 1 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Is NGB 1 oil pressure 35 – 54 LB?

   YES Replace NGB 1 lube pump. Remove gage GGG76 and reinstall oil pressure transducer (TM 1-1520-238-CL). Go to paragraph 6–13.

   NO Replace NGB 1 (TM 1-1520-238-23). Go to paragraph 6–13.

NOTE

If NGB 1 operating pressure was 28 PSI or less and OIL PSI NOSE GRBX 1 indicator was not illuminated, troubleshoot NGB 1 oil pressure switch.

END OF TASK

6–16. HOD XMN 1 READING – DISPLAYS 0 LB OIL PRESSURE 6–16

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L60 fairing open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

If OIL PSI MAIN XMSN 1 indicator is also illuminated, troubleshoot Task 6–16.3 before proceeding.

1. Detach P579. Check for open between:
   P579–1 and P579–2,
   P579–1 and P579–3.
   Does open exist?

   YES Go to step 3.

   NO Go to step 2.

2. Check for short between:
   J579–1 and ground,
   J579–2 and ground,
   J579–3 and ground.
   Does short exist?

   YES Go to step 3.

   NO Go to step 4.

3. Locate open or short in wire harness between P579 and MT9.
   Can wire harness be repaired?

   YES Repair wiring (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Replace MT9. Go to paragraph 6–13.

4. Reconnect P579. Detach P673.
   Check for open between:
   P673–95 and P673–94,
   P673–95 and P673–110,
   P673–95 and P673–111.
   Does open exist?

   YES Repair open wire between:
   P673–95 and J579–1,
   P673–94 and J579–3,
   P673–110 and J579–3,
   P673–111 and J579–2.
   Go to paragraph 6–13.

   NO Go to step 5.

5. Detach P579. Check for short between:
   P673–95 and ground,
   P673–94 and ground,
   P673–110 and ground,
   P673–111 and ground.
   Does short exist?

   YES Repair shorted wire between:
   P673–95 and J579–1,
   P673–94 and J579–3,
   P673–110 and J579–3,
   P673–111 and J579–2.
   Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–16.1. HOD XMN 1 READING – DISPLAYS 50 LB OIL PRESSURE 6–16.1

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L60 fairing open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P579. Check for open between: P579–1 and P579–3.
   Does open exist?

   YES Go to step 2.

   NO Go to step 3.

2. Inspect wire harness between oil system 1 heat exchanger pressure transducer (MT9) and P579.
   Can wire harness be repaired?

   YES Repair wire harness (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Replace oil system 1 heat exchanger pressure transducer (MT9) (TM 1-1520-238-23). Go to paragraph 6–13.

3. Detach P673. Check for open between P673–95 and J579–1.
   Does open exist?

   YES Repair open wire (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–16.2. HOD XMN 1 READING – DISPLAYS >99 LB OIL PRESSURE 6–16.2

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – none.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P579. Check for open between: P579–1 and P579–3.
   Does open exist?

   YES Go to step 2.

   NO Go to step 3.

2. Inspect wire harness between oil system 1 heat exchanger pressure transducer (MT9) and P579.
   Can wire harness be repaired?

   YES Repair wire harness (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Replace oil system 1 heat exchanger pressure transducer (MT9) (TM 1-1520-238-23). Go to paragraph 6–13.

3. Check for open between J579–3 and J579 SP1.
   Does open exist?

   YES Repair open wire (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–16.3. HOD XMN 1 READING – DISPLAYS 49 LB OIL PRESSURE OR LESS 6–16.3

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Tester, MP-1	6685-00-693-5009
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine operating.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

A reading of 50 LB on the HOD is generally a wiring problem. Troubleshoot in accordance with Task 6–16.1 before proceeding.

1. Visually inspect transmission for low oil level and damage (TM 1-1520-238-23).
Is damage present?

   YES Replace transmission (TM 1-1520-238-23). Go to paragraph 6–13.

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL PSI MAIN XMSN 1** indicator.
Was indicator lighted during normal operation?

   YES Go to step 4.

   NO Go to step 3.

3. Remove oil system 1 heat exchanger pressure transducer (MT9) (TM 1-1520-238-23). Connect MT9 to Testor, MP–1. Observe HOD while applying pressure to transducer with tester.
Does HOD reflect applied pressure within +/–5 PSI from 0 to 100PSI?

   YES Reinstall MT9 (TM 1-1520-238-23). Go to step 4.

   NO Replace oil system 1 heat exchanger pressure transducer (TM 1-1520-238-23). Go to paragraph 6–13.

6–16.3. HOD XMN 1 READING – DISPLAYS 49 LB OIL PRESSURE OR LESS (cont) 6–16.3

4. Remove transmission 1 oil pressure switch (TM 1-1520-238-23). Install pressure gage GGG76 in oil pressure switch port. Start engine 1 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Is XMSN 2 oil pressure 35 – 49 PSI on gage?

   YES Replace transmission 1 lube pump. Remove gage GGG76 and reinstall transmission 1 oil pressure switch (TM 1-1520-238-CL). Go to paragraph 6–13.

   NO <35 PSI – Replace transmission (TM 1-1520-238-23). Go to paragraph 6–13. >49 PSI – Refer to Task 6–17.

NOTE

If XMSN 1 operating pressure was 28 PSI or less and OIL PSI MAIN XMSN 1 indicator was not illuminated during normal operation, troubleshoot transmission 1 oil pressure switch.

END OF TASK

6–17. HOD XMN 2 READING – DISPLAYS 0 LB OIL PRESSURE 6–17

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – R60 fairing open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

If OIL PSI MAIN XMSN 2 indicator is also illuminated, troubleshoot Task 6–17.3 before proceeding.

1. Detach P578. Check for open between:
P578–1 and P578–2,
P578–1 and P578–3.
Does open exist?

YES Go to step 3.

NO Go to step 2.

2. Check for short between:
J578–1 and ground,
J578–2 and ground,
J578–3 and ground.
Does short exist?

YES Go to step 3.

NO Go to step 4.

3. Locate open or short in wire harness between P578 and MT10.
Can wire harness be repaired?

YES Repair wiring (TM 55-1500-323-24). Go to paragraph 6–13.

NO Replace MT10. Go to paragraph 6–13.

4. Reconnect P578. Detach P672.
Check for open between:
P672–95 and P672–94,
P672–95 and P672–98,
P672–95 and P672–109.
Does open exist?

YES Repair open wire between:
P672–95 and J578–1,
P672–94 and J578–3,
P672–98 and J578–3,
P672–109 and J578–2.
Go to paragraph 6–13.

NO Go to step 5.

5. Detach P578. Check for short between:
P672–95 and ground,
P672–94 and ground,
P672–98 and ground,
P672–109 and ground.
Does short exist?

YES Repair shorted wire between:
P672–95 and J578–1,
P672–94 and J578–3,
P672–98 and J578–3,
P672–109 and J578–2.
Go to paragraph 6–13.

NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–17.1. HOD XMN 2 READING – DISPLAYS 50 LB OIL PRESSURE 6–17.1

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – R60 fairing open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P578. Check for open between P578–1 and P578–3.
   Does open exist?

   YES Go to step 2.

   NO Go to step 3.

2. Inspect wire harness between oil system 2 heat exchanger pressure transducer (MT10) and P578.
   Can wire harness be repaired?

   YES Repair wire harness (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Replace oil system 2 heat exchanger pressure transducer (MT10) (TM 1-1520-238-23). Go to paragraph 6–13.

3. Detach P672. Check for open between P672–95 and J578–1.
   Does open exist?

   YES Repair open wire (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–17.2. HOD XMN 2 READING – DISPLAYS >99 LB OIL PRESSURE 6–17.2

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – none.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P578. Check for open between: P578–1 and P578–3.
   Does open exist?

   YES Go to step 2.

   NO Go to step 3.

2. Inspect wire harness between oil system 1 heat exchanger pressure transducer (MT10) and P578.
   Can wire harness be repaired?

   YES Repair wire harness (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Replace oil system 2 heat exchanger pressure transducer (MT10) (TM 1-1520-238-23). Go to paragraph 6–13.

3. Check for open between J578–3 and J578 SP1.
   Does open exist?

   YES Repair open wire (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–17.3. HOD XMN 2 READING – DISPLAYS 49 LB OIL PRESSURE OR LESS 6–17.3

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Tester, MP-1	6685-00-693-5009
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine operating.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

A reading of 50 LB on the HOD is generally a wiring problem. Troubleshoot in accordance with Task 6–17.1 before proceeding.

1. Visually inspect transmission for low oil level and damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace transmission (TM 1-1520-238-23). Go to paragraph 6–13.

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL PSI MAIN XMSN 2** indicator.
   Was indicator lighted during normal operation?

   YES Go to step 4.

   NO Go to step 3.

3. Remove oil system 1 heat exchanger pressure transducer (MT10) (TM 1-1520-238-23). Connect MT10 to Testor, MP–1. Observe HOD while applying pressure to transducer with tester.
   Does HOD reflect applied pressure within +/–5 PSI from 0 to 100PSI?

   YES Reinstall MT10 (TM 1-1520-238-23). Go to step 4.

   NO Replace oil system 2 heat exchanger pressure transducer (TM 1-1520-238-23). Go to paragraph 6–13.

6–17.3. HOD XMN 2 READING – DISPLAYS 49 LB OIL PRESSURE OR LESS (cont) 6–17.3

4. Remove transmission 2 oil pressure switch (TM 1-1520-238-23). Install pressure gage GGG76 in oil pressure switch port. Start engine 2 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Is XMSN 2 oil pressure 35 – 49 PSI on gage?

   YES — Replace transmission 2 lube pump. Remove gage GGG76 and reinstall transmission 2 oil pressure switch (TM 1-1520-238-CL).
   Go to paragraph 6–13.

   NO — <35 PSI – Replace transmission (TM 1-1520-238-23).
   Go to paragraph 6–13.
   >49 PSI – Refer to Task 6–18.

NOTE

If XMSN 2 operating pressure was 28 PSI or less and OIL PSI MAIN XMSN 2 indicator was not illuminated during normal operation, troubleshoot transmission 2 oil pressure switch.

END OF TASK

6–18. HOD NGB 2 READING – DISPLAYS 0 LB OIL PRESSURE 6–18

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – R200 access panel and RN6, R60 fairings open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

If OIL PSI NOSE GRBX 2 indicator is also illuminated, troubleshoot Task 6–18.3 before proceeding.

1. Detach P60. Check for open between:
   P60–L and P60–M,
   P60–L and P60–P,
   P60–L and P60–R.
   Does open exist?

   YES Go to step 3.

   NO Go to step 2.

2. Check for short between:
   P60–L and ground,
   P60–M and ground,
   P60–P and ground,
   P60–R and ground.
   Does short exist?

   YES Go to step 3.

   NO Go to step 4.

3. Locate open or short in wire harness between P60 and MT12.
   Can wire harness be repaired?

   YES Repair wiring harness (TM 55-1500-323-24. Go to paragraph 6–13.

   NO Replace MT12. Go to paragraph 6–13.

4. Reconnect P60. Detach P672. Check for open between:
   P672–85 and P672–84,
   P672–85 and P672–99,
   P672–85 and P672–100.
   Does open exist?

   YES Repair open wire between:
   P672–85 and J524–A7,
   P672–84 and J524–A8,
   P672–99 and J524–A10,
   P672–100 and J524–A11,
   P524–A7 and J60–L,
   P524–A8 and J60–M,
   P524–A10 and J60–P,
   P524–A11 and J60–R.
   Go to paragraph 6–13.

   NO Go to step 5.

6–18. HOD NGB 2 READING – DISPLAYS 0 LB OIL PRESSURE (cont) 6–18

5. Detach P60. Check for short between:
P672–85 and ground,
P672–84 and ground,
P672–99 and ground,
P672–100 and ground.
Does short exist?

YES	Repair shorted wire between: P672–85 and J524–A7, P672–84 and J524–A8, P672–99 and J524–A10, P672–100 and J524–A11, P524–A7 and J60–L, P524–A8 and J60–M, P524–A10 and J60–P, P524–A11 and J60–R. Go to paragraph 6–13.
NO	Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–18.1. HOD NGB 2 READING – DISPLAYS 50 LB OIL PRESSURE 6–18.1

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – R200 access panel and RN6, R60 fairings open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Inspect splice SP1 on red wire from NGB 2 oil pressure transducer (MT12).
   Does open exist?

   YES Repair splice (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Go to step 2.

2. Depin splices SP1 (red wire) and SP2 (black wire) on MT12 wire harness. Check for open between red and black wire to MT12.
   Does open exist?

   YES Replace NGB 2 oil pressure transducer (TM 1-1520-238-23). Go to paragraph 6–13.

   NO Go to step 3.

3. Detach P60. Check for open between P60–L and SP1 (red wire).
   Does open exist?

   YES Repair open wire (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Go to srep 4.

4. Detach P672. Check for open between P672–85 and J60–L.
   Does open exist?

   YES Repair open wire between: P672–85 and J524–A7, P524–A7 and J60–L (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–18.2. HOD NGB 2 READING – DISPLAYS >99 LB OIL PRESSURE 6–18.2

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – R200 access panel and RN6 fairing open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Inspect splice SP2 on black wire from NGB 2 oil pressure transducer (MT12).
   Does open exist?

   YES Repair splice (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Go to step 2.

2. Depin splices SP1 (red wire) and SP2 (black wire) on MT12 wire harness. Check for open between red and black wire to MT12.
   Does open exist?

   YES Replace NGB 2 oil pressure transducer (TM 1-1520-238-23). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–18.3. HOD NGB 2 READING – DISPLAYS 54 LB OIL PRESSURE OR LESS 6–18.3

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Tester, MP-1	6685-00-693-5009
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – R200 access panel and RN6 fairing open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

A reading of 50 LB on the HOD is generally a wiring problem. Troubleshoot in accordance with Task 6–18.1 before proceeding.

1. Check pilot caution/warning panel **OIL PSI NOSE GRBX 2** indicator.
   Is indicator lighted?

   YES Go to step 3.

   NO Go to step 2.

2. Remove NGB 2 oil pressure transducer (MT12) (TM 1-1520-238-23). Connect MT12 to Tester, MP–1. Observe HOD while applying pressure to transducer with tester.
   Does HOD reflect applied pressure within +/– 5 PSI from 0 to 100 PSI?

   YES Go to step 3.

   NO Replace NGB 2 oil pressure transducer (TM 1-1520-238-23). Go to paragraph 6–13.

3. Install pressure gage GGG76 in NGB 2. Start engine 2 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Is NGB 2 oil pressure 35 – 54 LB?

   YES Replace NGB 2 lube pump. Remove gage GGG76 and reinstall oil pressure transducer (TM 1-1520-238-CL). Go to paragraph 6–13.

   NO Replace NGB 2 (TM 1-1520-238-CL). Go to paragraph 6–13.

NOTE

If NGB 2 operating pressure was 28 PSI or less and OIL PSI NOSE GRBX 2 indicator was not illuminated, troubleshoot NGB 2 oil pressure switch.

END OF TASK

6–19. HOD NGB 1 READING – DOES NOT DISPLAY AMBIENT TEMPERATURE 6–19

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel and LN6, L60 fairings open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

- **Nose Gearbox will display higher than ambient temperature if recently operated.**
- **Entry in ( ) following pin locations is multimeter lead orientation.**

1. Detach P61. Check for open between:
P61–F and P61–G (red/blk),
P61–J and P61–H (blk/red).
Does open exist?

   YES Go to step 3.

   NO Go to step 2.

2. Check for short between:
P61–F and ground,
P61–G and ground,
P61–H and ground,
P61–J and ground.
Does short exist?

   YES Go to step 3.

   NO Go to step 4.

3. Locate open or short in wire harness between P61 and MT15.
Can wire harness be repaired?

   YES Repair wiring (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Replace MT15 (TM 1-1520-238-23). Go to paragraph 6–13.

4. Detach P673. Check for short between:
P673–86 and ground,
P673–87 and ground.
Does short exist?

   YES Repair shorted wire between: P673–86 and ground, P673–87 and ground (TM 55-1500-323-24)

   NO Go to step 5.

5. Reconnect P61. Check for open between:
P673–86 and P673–87 (blk/red).
Does open exist?

   YES Repair open wire (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Refer to (TM 9-1230-476-20-2) to troubleshoot multiplex subsystem.

END OF TASK

6–19.1. HOD NGB 1 READING – DISPLAYS –31 °C TEMPERATURE 6–19.1

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-23
TM 1-1520-238-T-6
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel and LN6, L60 fairings open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

- **A –32 °C reading is caused by no power to the transducer (MT15) or no signal from the transducer to the MRTU TYPE 1 (A63).**
- **If all HOD temperatures are –32 °C and ENG START circuit breaker is open, troubleshoot with Task 6–22.2 before proceeding.**
- **Entry in ( ) following pin locations is multimeter lead orientation.**

1. Detach P61. Check for open between:
   P61–F and P61–G (red/blk),
   P61–J and P61–H (blk/red).
   Does open exist?

   YES Go to step 3.

   NO Go to step 2.

2. Check for short between:
   P61–F and ground,
   P61–H and ground.
   Does short exist?

   YES Go to step 3.

   NO Go to step 4.

3. Locate open or short in the wire harness between P61 and MT15.
   Can wire harness be repaired?

   YES Repair wiring (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Replace MT15 (TM 1-1520-238-23). Go to paragraph 6–13.

4. Detach P673. Check for short between:
   P673–87 and ground.
   Does short exist?

   YES Repair shorted wire between: P673–87 and ground (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Go to step 5.

5. Reconnect P61. Check for open between:
   P673–86 and P673–87 (blk/red).
   Does open exist?

   YES Repair open wire (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–19.2. HOD NGB 1 READING – DISPLAYS HIGH OIL TEMPERATURE 6–19.2

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06

Personnel Required:

67R Attack Helicopter Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel and LN6 fairing open.

WARNING

Components may be hot enough to cause burns. If injury occurs, seek medical aid immediately.

1. Check other HOD oil temperature readings.
Are all readings relatively the same with none >130 °C?

YES Readings are normal for operating environment. Go to paragraph 6–13.

NO Go to step 2.

2. Check HOD NGB 1 oil pressure display.
Is pressure in normal range (55 – 85 LB)?

YES Go to step 3.

NO Go to Task 6–15.3.

3. Visually inspect NGB 1 oil system for low oil level and damage (TM 1-1520-238-23).
Is damage present?

YES Replace NGB 1 (TM 1-1520-238-23). Go to paragraph 6–13.

NO Go to step 4.

4. Inspect NGB 1 cooling fins and driveshaft shrouds for dirt or blockage.
Is dirt or blockage present?

YES Clean cooling fins and driveshaft shrouds (TM 1-1520-238-23). Go to paragraph 6–13.

NO Replace NGB 1 oil temperature transducer (MT15) (TM 1-1520-238-23). Go to paragraph 6–13.

END OF TASK

6–20. HOD XMN 1 READING – DOES NOT DISPLAY AMBIENT TEMPERATURE 6–20

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel and aft avionics door open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

- **Transmission will display higher than ambient temperature if recently operated.**
- **Entry in ( ) following pin locations is multimeter lead orientation.**

1. Detach P755. Check for open between:
   P755–2 and P755–6 (red/blk),
   P755–10 and P755–11 (red/blk).
   Does open exist?

   YES Go to step 3.

   NO Go to step 2.

2. Check for short between:
   P755–2 and ground,
   P755–6 and ground,
   P755–10 and ground,
   P755–11 and ground.
   Does short exist?

   YES Go to step 3.

   NO Go to step 4.

3. Locate open or short in wire harness between P755 and MT13.
   Can wire harness be repaired?

   YES Repair wiring (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Replace MT13 (TM 1-1520-238-23). Go to paragraph 6–13.

4. Detach P682. Check for short between:
   P682–86 and ground,
   P682–87 and ground.
   Does short exist?

   YES Repair shorted wire between: P682–86 and ground, P682–87 and ground (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Go to step 5.

5. Reconnect P755. Check for open between:
   P682–86 and P682–87 (blk/red).
   Does open exist?

   YES Repair open wire (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–20.1. HOD XMN 1 READING – DISPLAYS –31 °C TEMPERATURE 6–20.1

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel and aft avionics bay door open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

- **A –32 °C reading is caused by no power to the transducer (MT13) or no signal from the transducer to the DASEC (A69).**
- **If all HOD temperatures are –32 °C and ENG START circuit breaker is open, troubleshoot with paragraph 6–22.2 before proceeding.**
- **Entry in ( ) following pin locations is multimeter lead orientation.**

1. Detach P755. Check for open between:
   P755–2 and P755–6 (red/blk),
   P755–10 and P755–11 (red/blk).
   Does open exist?

   YES Go to step 3.

   NO Go to step 2.

2. Check for short between:
   P755–2 and ground,
   P755–10 and ground.
   Does short exist?

   YES Go to step 3.

   NO Go to step 4.

3. Locate open or short in wire harness between P755 and MT13.
   Can wire harness be repaired?

   YES Repair wiring (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Replace MT13 (TM 1-1520-238-23). Go to paragraph 6–13.

4. Detach P682. Check for short between:
   P682–87 and ground.
   Does short exist?

   YES Repair shorted wire between: P682–87 and ground (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Go to step 5.

5. Reconnect P755. Check for open between:
   P682–86 and P682–87 (blk/red).
   Does open exist?

   YES Repair open wire (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–20.2. HOD XMN 1 READING – DISPLAYS HIGH OIL TEMPERATURE 6–20.2

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06

Personnel Required:

67R Attack Helicopter Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel open.

WARNING

Components may be hot enough to cause burns. If injury occurs, seek medical aid immediately.

1. Check other HOD oil temperature readings.
   Are all readings relatively the same with none >130 °C?

   YES — Readings are normal for operating environment. Go to paragraph 6–13.

   NO — Go to step 2.

2. Check HOD XMN 1 oil pressure display.
   Is pressure in normal range (55 – 85 LB)?

   YES — Go to step 3.

   NO — Go to Task 6–16.3.

3. Visually inspect XMN 1 oil system for low oil level and damage (TM 1-1520-238-23).
   Is damage present?

   YES — Repair or replace damaged component (TM 1-1520-238-23). Go to paragraph 6–13.

   NO — Go to step 4.

4. Inspect XMN 1 oil heat exchanger for dirt or blockage.
   Is dirt or blockage present?

   YES — Clean cooling fins (TM 1-1520-238-23). Go to paragraph 6–13.

   NO — Replace XMN 1 oil temperature transducer (MT13) (TM 1-1520-238-23). Go to paragraph 6–13.

END OF TASK

6–21. HOD XMN 2 READING – DOES NOT DISPLAY AMBIENT TEMPERATURE 6–21

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-23
TM 1-1520-238-T-6
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 and R200 access panels and aft avionics bay door open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

- **Transmission will display higher than ambient temperature if recently operated.**
- **Entry in ( ) following pin locations is multimeter lead orientation.**

1. Detach P755. Check for open between:
   P755–3 and P755–5 (red/blk),
   P755–7 and P755–8 (red/blk).
   Does open exist?

   YES Go to step 3.

   NO Go to step 2.

2. Check for short between:
   P755–3 and ground,
   P755–5 and ground,
   P755–7 and ground,
   P755–8 and ground.
   Does short exist?

   YES Go to step 3.

   NO Go to step 4.

3. Locate open or short in wire harness between P755 and MT14.
   Can wire harness be repaired?

   YES Repair wiring (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Replace MT14 (TM 1-1520-238-23). Go to paragraph 6–13.

4. Detach P682. Check for short between:
   P682–84 and ground,
   P682–85 and ground.
   Does short exist?

   YES Repair shorted wire between: P682–84 and ground, P682–85 and ground (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Go to step 5.

5. Reconnect P755. Check for open between:
   P682–84 and P682–85 (blk/red).
   Does open exist?

   YES Repair open wire (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–21.1. HOD XMN 2 READING – DISPLAYS –31 °C TEMPERATURE 6–21.1

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-23
TM 1-1520-238-T-6
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 and R200 access panels and aft avionics bay door open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

- **A –32 °C reading is caused by no power to the transducer (MT13) or no signal from the transducer to the DASEC (A69).**
- **If all HOD temperatures are –32 °C and ENG START circuit breaker is open, troubleshoot with Task 6–22.2 before proceeding.**
- **Entry in ( ) following pin locations is multimeter lead orientation.**

1. Detach P755. Check for open between:
P755–3 and P755–5 (red/blk),
P755–7 and P755–8 (red/blk).
Does open exist?

   YES Go to step 3.

   NO Go to step 2.

2. Check for short between:
P755–3 and ground,
P755–7 and ground.
Does short exist?

   YES Go to step 3.

   NO Go to step 4.

3. Locate open or short in wire harness between P755 and MT14.
Can wire harness be repaired?

   YES Repair wiring (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Replace MT14 (TM 1-1520-238-23). Go to paragraph 6–13.

4. Detach P682. Check for short between:
P682–85 and ground.
Does short exist?

   YES Repair shorted wire between: P682–85 and ground (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Go to step 5.

5. Reconnect P755. Check for open between:
P682–84 and P682–85 (blk/red).
Does open exist?

   YES Repair open wire (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–21.2. HOD XMN 2 READING – DISPLAYS HIGH OIL TEMPERATURE 6–21.2

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06

Personnel Required:

67R Attack Helicopter Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – R200 access panel open.

WARNING

Components may be hot enough to cause burns. If injury occurs, seek medical aid immediately.

1. Check other HOD oil temperature readings.
Are all readings relatively the same with none >130 °C?

YES Readings are normal for operating environment. Go to paragraph 6–13.

NO Go to step 2.

2. Check HOD XMN 2 oil pressure display.
Is pressure in normal range (55 – 85 LB)?

YES Go to step 3.

NO Go to paragraph 6–17.3.

3. Visually inspect XMN 2 oil system for low oil level and damage (TM 1-1520-238-23).
Is damage present?

YES Repair or replace damaged component (TM 1-1520-238-23). Go to paragraph 6–13.

NO Go to step 4.

4. Inspect XMN 2 oil heat exchanger for dirt or blockage.
Is dirt or blockage present?

YES Clean cooling fins (TM 1-1520-238-23). Go to paragraph 6–13.

NO Replace XMN 2 oil temperature transducer (MT13) (TM 1-1520-238-23). Go to paragraph 6–13.

END OF TASK

6–22. HOD NGB 2 READING – DOES NOT DISPLAY AMBIENT TEMPERATURE 6–22

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – R200 access panel and RN6, R60 fairings open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

- **Nose gearbox will display higher than ambient temperature if recently operated.**
- **Entry in ( ) following pin locations is multimeter lead orientation.**

1. Detach P60. Check for open between:
   P60–F and P60–G (red/blk),
   P60–J and P60–H (blk/red).
   Does open exist?

   YES Go to step 3.

   NO Go to step 2.

2. Check for short between:
   P60–F and ground,
   P60–G and ground,
   P60–H and ground,
   P60–J and ground.
   Does short exist?

   YES Go to step 3.

   NO Go to step 4.

3. Locate open or short in wire harness between P60 and MT16.
   Can wire harness be repaired?

   YES Repair wiring (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Replace MT16 (TM 1-1520-238-23). Go to paragraph 6–13.

4. Detach P672. Check for short between:
   P672–86 and ground,
   P672–87 and ground.
   Does short exist?

   YES Repair shorted wire between: P672–86 and ground, P672–87 and ground (TM 55-1500-323-24).

   NO Go to step 5.

5. Reconnect P60. Check for open between:
   P672–86 and P672–87 (blk/red).
   Does open exist?

   YES Repair open wire (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–22.1. HOD NGB 2 READING – DISPLAYS –31 °C TEMPERATURE 6–22.1

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-23
TM 55-1500-323-24
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – R200 access panel and RN6, R60 fairings open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

- **A –32 °C reading is caused by no power to the transducer (MT16) or no signal from the transducer to the MRTU TYPE 1 (A62).**
- **If all HOD temperatures are –32 °C and ENG START circuit breaker is open, troubleshoot with paragraph 6–22.2 before proceeding.**
- **Entry in ( ) following pin locations is multimeter lead orientation.**

1. Detach P60. Check for open between:
P60–F and P60–G (red/blk),
P60–J and P60–H (blk/red).

   YES Go to step 3.

   NO Go to step 2.

2. Check for short between:
P60–F and ground,
P60–H and ground.
Does short exist?

   YES Go to step 3.

   NO Go to step 4.

3. Locate open or short in the wire harness between P60 and MT16.
Can wire harness be repaired?

   YES Repair wiring (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Replace MT16 (TM 1-1520-238-23). Go to paragraph 6–13.

4. Detach P672. Check for short between:
P672–87 and ground.
Does short exist?

   YES Repair shorted wire between: P672–87 and ground (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Go to step 5.

5. Reconnect P60. Check for open between:
P672–86 and P672–87 (blk/red).
Does open exist?

   YES Repair open wire (TM 55-1500-323-24). Go to paragraph 6–13.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–22.2. HOD NGB 2 READING – DISPLAYS HIGH OIL TEMPERATURE 6–22.2

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06

Personnel Required:

67R Attack Helicopter Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – R200 access panel and RN6 fairing open.

WARNING

Components may be hot enough to cause burns. If injury occurs, seek medical aid immediately.

1. Check other HOD oil temperature readings.
Are all readings relatively the same with none >130 °C?

YES Readings are normal for operating environment. Go to paragraph 6–13.

NO Go to step 2.

2. Check HOD NGB 2 oil pressure display.
Is pressure in normal range (55 – 85 LB)?

YES Go to step 3.

NO Go to Task 6–18.3.

3. Visually inspect NGB 2 oil system for low oil level and damage (TM 1-1520-238-23).
Is damage present?

YES Replace NGB 2 (TM 1-1520-238-23). Go to paragraph 6–13.

NO Go to step 4.

4. Inspect NGB 2 cooling fins and driveshaft shrouds for dirt or blockage.
Is dirt or blockage present?

YES Clean cooling fins and driveshaft shrouds (TM 1-1520-238-23). Go to paragraph 6–13.

NO Replace NGB 2 oil temperature transducer (MT16) (TM 1-1520-238-23). Go to paragraph 6–13.

END OF TASK

6–22.3. HOD DISPLAY – READS –32 °C FOR ALL GEARBOXES 6–22.3

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-23
TM 1-1520-238-T-6
TM 55-1500-323-24

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 and R200 access panels and electrical power distribution panel (A402) open.

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P61. Check for short between:
   P61–F and ground.
   Does short exist?

   YES Go to step 4.

   NO Reconnect P61. Go to step 2.

2. Detach P60. Check for short between:
   P60–F and ground.
   Does short exist?

   YES Go to step 4.

   NO Reconnect P60. Go to step 3.

3. Detach P755. Check for short between:
   J755–2 and ground,
   J755–3 and ground.
   Does short exist?

   YES Go to step 4.

   NO Reconnect P755. Go to step 5.

4. Locate short in wire harness.
   Can wire harness be repaired?

   YES Repair shorted wire between:
   P61–F and ground,
   P60–F and ground,
   P755–2 and ground,
   P755–3 and ground
   (TM 55-1500-323-24).
   Go to step 6–13.

   NO Replace the shorted temperature transducer (MT13, MT14, MT15, or MT16)
   (TM 1-1520-238-23).
   Go to paragraph 6–13.

5. Open **ENG START** circuit breaker (CB58). Gain access to Electrical Power Distribution Box (A402). Depin wires, one at a time, and check for short between:
   TB2–8 Pin T and ground (NGB 1),
   TB2–8 Pin W and ground (XMN 1),
   TB2–8 Pin K and ground (XMN 2),
   TB2–8 Pin P and ground (NGB 2),
   TB2–8 Pin A and ground (CB58).
   Does short exist?

   YES Repair shorted wire
   (TM 55-1500-323-24).
   Go to paragraph 6–13.

   NO Go to step 6.

6–22.3. HOD DISPLAY – READS –32 °C FOR ALL GEARBOXES (cont) 6–22.3

6. Detach P463. Check for short between (A76)J1–c and ground.
Does short exist?

YES	Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station).
NO	Replace **ENG START** breaker (CB58) (TM 1-1520-238-23). Go to paragraph 6–13.

END OF TASK

6–23. OIL PSI ACC PUMP INDICATOR – DOES NOT LIGHT WITH ELECTRICAL POWER APPLIED AND ALL POWER PLANTS OFF 6–23

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 panel removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between J755–20 and J755–21.
   Does open exist?

   YES Go to step 3.

   NO Go to step 2.

2. Check for open between:
   J755–20 and P18–4,
   J755–21 and ground.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 6–12

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

3. Detach S20 SP1 and S20 SP2.
   Check for open between:
   J755–20 and S20 SP1,
   J755–21 and S20 SP2.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 6–12.

   NO Replace main transmission accessory pump oil pressure switch (TM 1-1520-238-23).

END OF TASK

6–24. CHIPS MAIN XMSN INDICATOR – LIGHTS 6–24

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 and R200 panels removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Remove both oil system chip detectors. Inspect for chips (TM 1-1520-238-23).
   Are chips present?

   YES Perform main transmission chip detector inspection (TM 1-1520-238-23).

   NO Go to step 2.

2. On pilot and CPG caution/warning panels. Check **CHIPS MAIN XMSN** indicators.
   Are indicators lighted?

   YES Go to step 3.

   NO Reinstall each chip detector singly. Replace chip detector that causes indicators to light (TM 1-1520-238-23).

3. Detach P18.
   Are indicators lighted?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

   NO Repair shorted wire between:
   P18–3 and P456–A9,
   P456–A9 and P755–28,
   P755–28 and P755–18.
   Go to paragraph 6–12.

END OF TASK

6–25. OIL HOT MAIN XMSN 1 INDICATOR – LIGHTS 6–25

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 panel removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between J755–29 and J755–27.
   Does open exist?

   YES Go to step 2.

   NO Replace main transmission oil system 1 chip detector (TM 1-1520-238-23).

2. Check for short between:
   P18–65 and ground,
   P456–A8 and ground,
   J456–A8 and ground,
   P755–29 and ground.
   Does short exist?

   YES Repair shorted wire.
   Go to paragraph 6–12.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

END OF TASK

6–26. OIL HOT MAIN XMSN 2 INDICATOR – LIGHTS 6–26

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 panel removedd

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between J755–17 and J755–19.
   Does open exist?

   YES Go to step 2.

   NO Replace main transmission oil system 2 chip detector (TM 1-1520-238-23).

2. Check for short between:
   P18–66 and ground,
   P456–A2 and ground,
   J456–A2 and ground,
   P755–17 and ground.
   Does short exist?

   YES Repair shorted wire. Go to paragraph 6–13.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

END OF TASK

6–27. OIL PSI MAIN XMSN 1 INDICATOR – DOES NOT LIGHT WITH ELECTRICAL POWER APPLIED AND ALL POWER PLANTS OFF 6–27

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 panel removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between J755–25 and J755–26.
   Does open exist?

   YES Replace main transmission oil system 1 low oil pressure switch (TM 1-1520-238-23).

   NO Go to step 2.

2. Check for open between:
   P18–9 and P456–A7,
   J456–A7 and P755–25,
   P755–26 and ground.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 6–12.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

END OF TASK

6–28. OIL PSI MAIN XMSN 2 INDICATOR – DOES NOT LIGHT WITH ELECTRICAL POWER APPLIED AND ALL POWER PLANTS OFF 6–28

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – R200 panel removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between J755–15 and J755–16.
   Does open exist?

   YES Replace main transmission oil system 2 low oil pressure switch (TM 1-1520-238-23).

   NO Go to step 2.

2. Check for open between:
   P18–10 and J456–A1,
   J456–A1 and P755–15,
   P755–16 and ground.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 6–12.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

END OF TASK

6–29. TEMP INT INDICATOR – LIGHTS 6–29

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200, R295, L510, R510, L545, and R545 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P200.
   Does TEMP INT indicator remain lighted?

   YES Go to step 3.

   NO Go to step 2.

2. Check resistance between P200–U and P200–c.
   Is resistance greater than 1 megohm?

   YES Go to step 4.

   NO Replace IGB temperature alarm.

3. Check for short between P18–26 and ground.
   Does short exist?

   YES Repair shorted wire between:
   P914–A9 and ground,
   J449–A19 and ground,
   J410–B14 and ground,
   P200–c and ground.
   Go to paragraph 6–12.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

4. Remove IGB thermistor probe RT14 (TM 1-1520-238-23). Check resistance between P200–C and P200–S.
   Is resistance greater than 32k ohms?

   YES Go to step 6.

   NO Go to step 5.

5. Check resistance between P124–9 and P124–10.
   Is resistance greater than 32k ohms?

   YES Repair wire to wire short between:
   P200–C and J124–9,
   P200–A and J124–11,
   P200–K and J124–13,
   P200–E and J124–15.
   Go to paragraph 6–12.

   NO Replace IGB thermistor probe RT14 (TM 1-1520-238-23).

6. Remove IGB thermistor probe RT13 (TM 1-1520-238-23). Check resistance between P200–A and P200–S.
   Is resistance greater than 32k ohms?

   YES Go to step 8.

   NO Go to step 7.

7. Check resistance between P124–11 and P124–12.
   Is resistance greater than 32k ohms?

   YES Repair shorted wire between:
   P200–C and J124–9,
   P200–A and J124–11,
   P200–K and J124–13,
   P200–E and J124–15.
   Go to paragraph 6–12.

   NO Replace IGB thermistor probe RT13 (TM 1-1520-238-23).

8. Remove IGB thermistor probe RT16 (TM 1-1520-238-23). Check resistance between P200–K and P200–S.
   Is resistance greater than 32k ohms?

   YES Go to step 10.

   NO Go to step 9.

9. Check resistance between P124–13 and P124–14.
   Is resistance greater than 32k ohms?

   YES Repair shorted wire between:
   P200–C and J124–9,
   P200–A and J124–11,
   P200–K and J124–13,
   P200–E and J124–15.
   Go to paragraph 6–12.

   NO Replace IGB thermistor probe RT16 (TM 1-1520-238-23).

10. Remove IGB thermistor probe RT15 (TM 1-1520-238-23). Check resistance between P200–E and P200–S.
    Is resistance greater than 32k ohms?

    YES Repair shorted wire between:
    P200–C and J124–9,
    P200–A and J124–11,
    P200–K and J124–13,
    P200–E and J124–15.
    Go to paragraph 6–12.

    NO Replace IGB thermistor probe RT15 (TM 1-1520-238-23).

END OF TASK

6–30. TEMP TR INDICATOR – LIGHTS 6–30

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200, R295, L510, R510, L530, and R540 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Visually inspect T/R gearbox for low oil level and damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace T/R gearbox. (TM 1-1520-238-23).

   NO Go to step 2.

2. Detach P201.
   Does TEMP TR indicator remain lighted?

   YES Go to step 4.

   NO Go to step 3.

3. Check resistance between P201–S and P201–A.
   Is resistance greater than 2.45 megohms?

   YES Go to step 6.

   NO Go to step 5.

4. Check for short between P18–25 and ground.
   Does short exist?

   YES Check for short between; P18–25 and P914–A10, J914–A10 and J449–A20, P449–A20 and J410–B7, P410–B7 and P201–c. Repair shorted wire segment. Go to paragraph 6–12.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

5. Remove TGB thermistor probe RT7 (TM 1-1520-238-23). Check for short between P201–K and ground.
   Does short exist?

   YES Repair shorted wire between P201–K and thermistor RT7. Go to paragraph 6–12.

   NO Replace TGB thermistor probe RT7 (TM 1-1520-238-23).

6. Check resistance between P201–S and P201–C.
   Is resistance greater than 2.45 megohms?

   YES Go to step 8.

   NO Go to step 7.

7. Remove TGB thermistor probe RT8 (TM 1-1520-238-23). Check for short between P201–C and ground.
   Does short exist?

   YES Repair shorted wire between P201–C and thermistor RT8 (TM 1-1520-238-23). Go to paragraph 6–13.

   NO Replace TGB thermistor probe RT8 (TM 1-1520-238-23).

6–30. TEMP TR INDICATOR – LIGHTS (cont) 6–30

8. Check resistance between P201–S and P201–K.
   Is resistance greater than 2.45 megohms?

   YES Go to step 10.

   NO Go to step 9.

9. Remove TGB thermistor probe R10 (TM 1-1520-238-23). Check for short between P201–A and ground.
   Does short exist?

   YES Repair shorted wire between P201–A and thermistor RT10 (TM 1-1520-238-23). Go to paragraph 6–13.

   NO Install IGB thermistor probe RT10 (TM 1-1520-238-23).

10. Check resistance between P201–S and P201–E.
    Is resistance greater than 2.45 megohms?

    YES TGB temperature alarm (TM 1-1520-238-23).

    NO Go to step 11.

11. Remove TGB thermistor probe RT9 (TM 1-1520-238-23). Check for short between P201–E and ground.
    Does short exist?

    YES Repair shorted wire between P201–E and thermistor RT9 (TM 1-1520-238-23). Go to paragraph 6–12.

    NO Replace TGB thermistor probe RT15 (TM 1-1520-238-23).

END OF TASK

6–31. OIL HOT NOSE GRBX 1 INDICATOR – LIGHTS 6–31

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P18.
   Does indicator remain lighted?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

   NO Go to step 2.

2. Check for short between J61–A and ground.
   Does short exist?

   YES Repair shorted wire between P18–52 and J61–A. Go to paragraph 6–12.

   NO Replace NGB 1 oil temperature probe (TM 1-1520-238-23).

END OF TASK

6–32. OIL HOT NOSE GRBX 2 INDICATOR – LIGHTS 6–32

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P18.
   Does indicator remain lighted?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

   NO Go to step 2.

2. Check for short between J60–A and ground.
   Does short exist?

   YES Repair shorted wire between P18–53 and J60–A. Go to paragraph 6–12.

   NO Replace NGB 2 oil temperature probe (TM 1-1520-238-23).

END OF TASK

6–33. OIL PSI NOSE GRBX 1 INDICATOR – DOES NOT LIGHT WITH ELECTRICAL POWER APPLIED AND ALL POWER PLANTS OFF 6–33

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between P61–D and P61–E.
   Does open exist?

   YES Replace NGB 1 low oil pressure switch (TM 1-1520-238-23).

   NO Go to step 2.

2. Check for open between:
   J61–D and P18–44,
   J61–E and ground.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–12.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

END OF TASK

6–34. OIL PSI NOSE GRBX 2 INDICATOR – DOES NOT LIGHT WITH ELECTRICAL POWER APPLIED AND ALL POWER PLANTS OFF 6–34

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – R200 access panel open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between P60–D and P60–E.
Does open exist?

YES Replace NGB 2 low oil pressure switch (TM 1-1520-238-23).

NO Go to step 2.

2. Check for open between:
J60–D and P18–45,
J60–E and ground.
Does open exist?

YES Repair open wire.
Go to paragraph 6–12.

NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

END OF TASK

6–35. CHIPS NOSE GRBX 1 INDICATOR – LIGHTS 6–35

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Remove NGB 1 chip detector. Inspect for chips (TM 1-1520-238-23).
   Do chips exist on chip detector?

   YES Perform NGB1 chip detector inspection (TM 1-1520-238-23).

   NO Go to step 2.

2. Check **CHIPS NOSE GRBX 1** indicator with chip detector removed.
   Does indicator remain lighted?

   YES Replace NGB1 chip detector (TM 1-1520-238-23).

   NO Go to step 3.

3. Check for short between P18–36 and ground.
   Does short exist?

   YES Repair shorted wire between P18–36 and J61–B. Go to paragraph 6–12.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

END OF TASK

6–36. CHIPS NOSE GRBX 2 INDICATOR – LIGHTS 6–36

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68F Aircraft Electrician

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Remove NGB 2 chip detector. Inspect for chips (TM 1-1520-238-23).
   Do chips exist on chip detector?

   YES Perform NGB 2 chip detector inspection (TM 1-1520-238-23).

   NO Go to step 2.

2. Check **CHIPS NOSE GRBX 2** indicator with chip detector removed.
   Does indicator remain lighted?

   YES Replace NGB 2 chip detector (TM 1-1520-238-23).

   NO Go to step 3.

3. Check for short between P18–37 and ground.
   Does short exist?

   YES Repair shorted wire between P18–37 and J60–B. Go to paragraph 6–12.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

END OF TASK

6–37. PILOT LOW RPM ROTOR INDICATOR – DOES NOT LIGHT WITH ELECTRICAL POWER APPLIED AND ALL POWER PLANTS OFF 6–37

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between P20–X and ground.
   Does open exist?

   YES Go to step 2.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

2. Check for open between P20–X and P49–18.
   Does open exist?

   YES Repair open wire between:
   P49–18 and P435–A9,
   P482–A3 and P20–X.
   (A326):
   J7–A9 and TB1–10–D,
   TB1–10–E and J18–A3.
   Go to paragraph 6–13.

   NO Replace engine out warning unit (TM 1-1520-238-23).

END OF TASK

6–38. CPG LOW RPM ROTOR INDICATOR – DOES NOT LIGHT WITH ELECTRICAL POWER APPLIED AND ALL POWER PLANTS OFF 6–38

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between P31–X and P49–18.
Does open exist?

YES Repair open wire between:
P49–18 and P435–A9,
P482–A13 and P31–X.
(A326)J7–A9 and
(A326)TB1–10–D,
(A326)TB1–10–F and
(A326)J18–A13.
Go to paragraph 6–12.

NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

END OF TASK

6–39. HIGH RPM ROTOR INDICATOR – LIGHTS 6–39

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L140 access fairing open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P20.
   Does pilot HIGH RPM ROTOR indicator remain lighted?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

   NO Go to step 2.

2. Detach P31.
   Does CPG HIGH RPM ROTOR indicator remain lighted?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot the CPG caution/warning system.

   NO Go to step 3.

3. Detach P49 and check short between:
   P20–Y and ground,
   P49–17 and ground.
   Does short exist?

   YES Repair shorted wire between:
   P20–Y and P482–A2,
   P435–A10 and P49–17.
   (A326):
   J18–A2 and TB1–10–B,
   TB1–10–B and J7–A10.
   Go to paragraph 6–12.

   NO Go to step 4.

4. Check for short between P31–Y and ground.
   Does short exist?

   YES Repair shorted wire between:
   P31–Y and P482–A12,
   P435–A10 and P49–17.
   (A326):
   J18–A12 and TB1–10–C,
   TB1–10–A and J7–A10.
   Go to paragraph 6–12.

   NO Replace engine out warning unit (TM 1-1520-238-23).

END OF TASK

6–40. ENG CUT CIRCUIT BREAKER – DOES NOT STAY CLOSED 6–40

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-T-6

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for short between (A76)J1–b and ground.
   Does short exist?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station)

   NO Go to step 2.

2. Identify and detach wires from (A402):
   TB2–29–T and TB2–29–Z. Check for short between (A402):
   J21–A18 and ground,
   J27–B2 and ground.
   Does short exist?

   YES Repair shorted wire between (A402):
   J21–A18 and TB2–29–T,
   J27–B2 and TB2–29–Z.
   Go to paragraph 6–12.

   NO Go to step 3.

3. Detach P755. Check for short between P431–B2 and ground.
   Does short exist?

   YES Repair shorted wire between P431–B2 and P755–1.
   Go to paragraph 6–12.

   NO Refer to chapter 4 to troubleshoot power plants.

END OF TASK

6–41. VIB GRBX INDICATOR – LIGHTS WITH ELECTRICAL POWER APPLIED AND ALL POWER PLANTS OFF 6–41

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Detach P129.
   Does VIB GRBX indicator remain lighted?

   YES Go to step 3.

   NO Go to step 2.

2. Attach P129. Detach P128.
   Does VIB GRBX indicator remain lighted?

   YES Replace rotor balance signal processor (TM 1-1520-238-23).

   NO Go to step 4.

3. Check for short between P18–31 and ground.
   Does short exist?

   YES Repair shorted wire.
   Go to paragraph 6–12.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

4. Attach P128. Detach P58.
   Does VIB GRBX indicator remain lighted?

   YES Go to step 5.

   NO Replace TGB accelerometer (TM 1-1520-238-23).

5. Detach P59.
   Does VIB GRBX indicator remain lighted?

   YES Detach P128 and P56. Check for shorted wire between:
   P58–A and ground,
   P58–B and ground,
   P59–A and ground,
   P59–B and ground.
   Repair shorted wire.
   Go to paragraph 6–12.

   NO Replace IGB accelerometer (TM 1-1520-238-23).

END OF TASK

6–42. OIL PSI ACC PUMP INDICATOR – LIGHTS 6–42

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68D Aircraft Powertrain Repairer/NDI
68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-T-8
TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 panel removed, T250L, T250R, T290R, and L325 access doors open
TM 1-1520-238-CL	APU operating

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check accessory drive lube pump oil bypass screen for contamination.
Is contamination present?

   YES Clean accessory drive lube pump oil bypass screen and replace main transmission accessory pump pressure switch (TM 1-1520-238-23).

   NO Go to step 2.

2. Check pilot caution/warning panel.
Is GEN 2 indicator also lighted?

   YES Go to step 4.

   NO Go to step 3.

3. Shut down APU (TM 1-1520-238-23) and (TM 1-1520-238-CL). Detach P755.
Does OIL PSI ACC PUMP indicator remain lighted?

   YES Go to step 6.

   NO Go to step 5.

4. Check APU drive shaft (7).
Is shaft turning?

   YES Replace transmission (TM 1-1520-238-23).

   NO Refer to TM 1-1520-238-T-8 to troubleshoot APU.

5. Detach S20 SP1. Check for short between J755–20 and ground.
Does short exist?

   YES Repair shorted wire. Go to paragraph 6–12.

   NO Go to step 7.

6–42. OIL PSI ACC PUMP INDICATOR – LIGHTS (cont) 6–42

6. Check for short between P18–4 and P755–20.
   Does short exist?

   YES — Repair shorted wire. Go to paragraph 6–12.

   NO — Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

7. Remove accessory oil pump pressure switch.
   Install pressure gage (TM 1-1520-238-23).
   Restart and run APU (TM 1-1520-238-23).
   Is minimum 26 psi oil pressure present?

   YES — Replace main transmission accessory pump pressure switch (TM 1-1520-238-23).

   NO — Replace main transmission accessory drive lube pump (TM 1-1520-238-23).

END OF TASK

6–43. VIB MON CIRCUIT BREAKER (CB79) – DOES NOT STAY CLOSED 6–43

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. With **VIB MON** circuit breaker open. Check for short between P128–P and ground.
Does short exist?

   YES Go to step 2.

   NO Replace rotor balance signal processor (TM 1-1520-238-23).

2. Detach P1. Check for short between P128–P and ground.
Does short exist?

   YES Repair shorted wire between:
P440–B14 and P128–P.
(A402):
J1–10 and J16–B14.
Go to paragraph 6–12.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc essential bus 2 – pilot station).

END OF TASK

6–45. HOD NGB 1 READING – DISPLAYS 28 LB OR LESS OIL PRESSURE 6–45

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68F Aircraft Electrician
152FG Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel and LN6, L60 fairings open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Visually inspect NGB 1 for low oil level and damage (TM 1-1520-238-23).
Is damage present?

YES Replace NGB 1 (TM 1-1520-238-23).

NO Go to step 2.

2. Remove NGB 1 oil pressure transducer (TM 1-1520-238-23). Install pressure gage. Start engine 1 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
Is oil pressure above 28 LB on pressure gage?

YES Go to step 3.

NO Replace NGB 1 (TM 1-1520-238-23).

3. Check for open between:
P673–85 and P673–84,
P673–85 and P673–112
P673–85 and P673–113.
Does open exist?

YES Go to step 4.

NO Go to step 5.

4. Check for open between:
P61–L and P61–M,
P61–L and P61–P,
P61–L and P61–R.
Does open exist?

YES Replace NGB 1 oil pressure transducer (TM 1-1520-238-23).

NO Repair open wire between:
J61–L and P673–85,
J61–M and P673–84,
J61–P and P673–112,
J61–R and P673–113.
Go to paragraph 6–13.

All data on pages 6–107 and 6–108 (paragraph 6–44) deleted

6–45. HOD NGB 1 READING – DISPLAYS 28 LB OR LESS OIL PRESSURE (cont) 6–45

5. Detach P673. Check for short between:
   J61–L and J61–M,
   J61–P and J61–R.
   Does short exist?

   YES Repair shorted wire.
   Go to paragraph 6–13.

   NO Go to step 6.

6. Check for short between:
   P61–L and P61–M,
   P61–L and P61–P,
   P61–L and P61–R.
   Does short exist?

   YES Replace NGB 1 oil pressure transducer (TM 1-1520-238-23).

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–46. HOD NGB 1 READING – DISPLAYS LOW OIL PRESSURE 6–46

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 1 operating

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **NGB 1** oil temperature reading.
   Is reading 140° C or higher?

   YES Go to paragraph 6–45 to troubleshoot HOD NGB 1 display.

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL PSI NOSE GRBX 1** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–48 to troubleshoot NGB 1 OIL PSI indicator.

   NO Go to step 3.

3. Check pilot caution/warning panel **OIL HOT NOSE GRBX 1** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–62 to troubleshoot OIL HOT NOSE GRBX 1 indicator.

   NO Go to step 4.

4. Check HOD display for **NGB 1** oil pressure reading.
   Is oil pressure 35 LB or higher?

   YES Replace NGB 1 lube pump (TM 1-1520-238-23).

   NO NGB 1 oil pressure not critically low. Go to paragraph 6–13.

END OF TASK

6–47. OIL PSI NOSE GRBX 1 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL NGB 1 OIL PRESSURE 6–47

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 55–1230–476–20–2
TM 1-1520-238-23
TM 9-1230-476-20-2

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display **NGB 1** oil temperature reading.
   Was NGB 1 oil temperature 140° C or higher on HOD during flight?

   YES Go to step 3.

   NO Go to step 2.

2. Detach P18. Check **OIL PSI NOSE GRBX 1** indicator.
   Does indicator remain lighted?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

   NO Go to step 4.

3. Visually inspect NGB 1 for low oil level (TM 1-1520-238-23).
   Is damage present?

   YES Replace NGB 1 (TM 1-1520-238-23).

   NO Go to step 6.

4. Check for short between P61–D and P61–E.
   Does short exist?

   YES Replace NGB 1 low oil pressure switch (TM 1-1520-238-23).

   NO Go to step 5.

5. Detach P18 and P61. Check for short between J61–D and ground.
   Does short exist?

   YES Repair shorted wire between J61–D and P18–44. Go to paragraph 6–13.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

6. Remove NGB 1 oil pressure transducer (TM 1-1520-238-23). Install pressure gage. Start engine 1 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Is oil pressure above 28 LB on pressure gage?

   YES Go to step 7.

   NO Replace NGB 1 (TM 1-1520-238-23).

6–47. OIL PSI NOSE GRBX 1 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL NGB 1 OIL PRESSURE (cont) 6–47

7. Check for open between:
P673–85 and P673–84,
P673–85 and P673–112,
P673–85 and P673–113.
Does open exist?

YES	Go to step 8.
NO	Go to step 9.

8. Check for open between:
P61–L and P61–M,
P61–L and P61–P,
P61–L and P61–R.
Does open exist?

YES	Replace NGB 1 oil pressure transducer (TM 1-1520-238-23).
NO	Repair open wire between: P61–L and P673–85, P61–M and P673–84, P61–P and P673–112, P61–R and P673–113. Go to paragraph 6–13.

9. Check for short between:
P673–84 and ground,
P673–85 and ground,
P673–112 and ground,
P673–113 and ground.
Does short exist?

YES	Go to step 10.
NO	Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

10. Check for short between:
P61–L and ground,
P61–M and ground,
P61–P and ground,
P61–R and ground.
Does short exist?

YES	Replace NGB 1 oil pressure transducer (TM 1-1520-238-23).
NO	Repair shorted wire between: P61–L and P673–85, P61–M and P673–84, P61–P and P673–112, P61–R and P673–113. Go to paragraph 6–13.

END OF TASK

6–48. OIL PSI NOSE GRBX 1 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS LOW NGB 1 OIL PRESSURE 6–48

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 1 operating

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **NGB 1** oil temperature reading.
   Is oil temperature 121° C or higher?

   YES Replace NGB 1 lube pump (TM 1-1520-238-23).

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL HOT NOSE GRBX 1** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–45 to troubleshoot HOD NGB 1 display.

   NO Go to step 3.

3. Check HOD display for **NGB 1** oil pressure reading.
   Is reading 35 LB or lower?

   YES Go to step 4.

   NO Go to paragraph 6–47 to troubleshoot OIL PSI NOSE GRBX 1 indicator.

4. Check HOD display for **NGB 1** oil pressure reading.
   Is reading 28 LB or lower?

   YES Replace NGB 1 (TM 1-1520-238-23).

   NO Go to step 5.

5. Visually inspect NGB 1 for low oil level and damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace NGB 1 (TM 1-1520-238-23).

   NO Replace NGB 1 lube pump (TM 1-1520-238-23).

END OF TASK

6–49. HOD XMN 1 READING – DISPLAYS 28 LB OR LESS OIL PRESSURE 6–49

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68F Aircraft Electrician
152FG Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L60 fairings and L325, T250L, T250R, T290L, T290R and T325 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Visually inspect oil system 1 for low oil level and physical damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace main transmission (TM 1-1520-238-23).

   NO Go to step 2.

2. Remove oil system 1 heat exchanger pressure transducer (TM 1-1520-238-23). Install pressure gage. Start engine 1 and place **PWR** lever to **FLY**. (TM 1-1520-238-CL). Operate until readings stabilize.
   Is oil pressure above 28 LB on pressure gage?

   YES Go to step 3.

   NO Go to step 4.

3. Check for open between:
   P673–95 and P673–94,
   P673–95 and P673–110,
   P673–95 and P673–111.
   Does open exist?

   YES Go to step 4.

   NO Go to step 5.

4. Check for open between:
   P579–1and P579–2,
   P579–1 and P579–3.
   Does open exist?

   YES Replace oil system 1 heat exchanger pressure transducer (TM 1-1520-238-23).

   NO Repair open wire between:
   P673–111 and J579–2,
   P673–95 and J579–1,
   P673–110 and J579–3,
   P673–94 and J579–3.
   Go to paragraph 6–13.

6–49. HOD XMN 1 READING – DISPLAYS 28 LB OR LESS OIL PRESSURE (cont) 6–49

5. Detach P673. Check for short between:
J579–1 and J579–3,
J579–2 and J579–3.
Does short exist?

YES	Repair shorted wire. Go to paragraph 6–13.
NO	Go to step 6.

6. Check for short between:
P579–1and P579–3,
P579–2 and P579–3.
Does short exist?

YES	Replace oil system 1 heat exchanger pressure transducer (TM 1-1520-238-23).
NO	Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–50. HOD XMN 1 READING – DISPLAYS LOW OIL PRESSURE 6–50

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 1 operating

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **XMN 1** oil temperature reading.
   Is reading 140° C or higher?

   YES Go to paragraph 6–49 to troubleshoot HOD XMN 1 display.

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL PSI MAIN XMSN 1** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–52 to troubleshoot OIL PSI MAIN XMSN 1 indicator.

   NO Go to step 3.

3. Check pilot caution/warning panel **OIL HOT MAIN XMSN 1** indicator.
   Is indicator lighted?

   YES Go to step 4.

   NO Go to paragraph 6–51 to troubleshoot OIL HOT MAIN XMSN 1 indicator.

4. Check HOD display for **XMN 1** oil pressure reading.
   Is reading oil pressure 35 LB or lower?

   YES Replace main transmission 1 primary pump (TM 1-1520-238-23).

   NO Main transmission 1 oil pressure is not critically low. Go to paragraph 6–13.

END OF TASK

6–51. OIL PSI MAIN XMSN 1 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL XMN 1 OIL PRESSURE 6–51

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68D Aircraft Powertrain Repairer/NDI
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 1-1520-238-CL
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238–23	Access provisions – L60 fairing and L325, T250L, T250R, T290L, T290R and T325 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

Verify transmission system operating temperature is normal during flight. Low oil pressure may have resulted from high NGB 1 oil temperature.

1. Detach P18.
   Is OIL MAIN XMSN 1 indicator lighted?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

   NO Go to step 2.

2. Detach P755. Check for short between P18–9 and ground.
   Does short exist?

   YES Repair shorted wire between P18–9 and P755–25. Go to paragraph 6–13.

   NO Go to step 3.

3. Check for open between:
   P18–9 and P456–A7,
   P755–26 and ground.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 6–13.

   NO Go to step 4.

4. Attach P18 and P755. Check for open between J456–A7 and ground.
   Does open exist?

   YES Replace main transmission oil system 1 oil pressure switch (TM 1-1520-238-23).

   NO Go to step 5.

6–51. OIL PSI MAIN XMSN 1 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL XMN 1 OIL PRESSURE (cont) 6–51

5. Remove oil system 1 heat exchanger pressure transducer. (TM 1-1520-238-23). Install pressure gage. Start engine 1 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Does oil pressure gage read above 28 LBS?

   YES Go to step 6.

   NO Replace system 1 main transmission pump (TM 1-1520-238-23).

6. Check for open between:
   P673–95 and P673–94,
   P673–95 and P673–110,
   P673–95 and P673 111.
   Does open exist?

   YES Go to step 8.

   NO Go to step 7.

7. Check for short between:
   P673–94 and ground,
   P673–95 and ground,
   P673–110 and ground,
   P673–111 and ground.
   Does open exist?

   YES Go to step 9.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

8. Check for open between:
   P579–1 and P579–2,
   P579–1 and P579–3.
   Does open exist?

   YES Replace oil system 1 heat exchanger pressure transducer (TM 1-1520-238-23).

   NO Repair open wire between:
   P673–95 and J579–1,
   P673–111 and J579–2,
   P673–110 and J579–3,
   P673–94 and J579–3.
   Go to paragraph 6–13.

9. Check for short between:
   P579–1 and ground,
   P579–2 and ground,
   P579–3 and ground.
   Does short exist?

   YES Replace oil system 1 heat exchanger pressure transducer (TM 1-1520-238-23).

   NO Repair shorted wire between:
   P673–94 and J579–3,
   P673–95 and J579–1,
   P673–110 and J579–3,
   P673–111 and J579–2.
   Go to paragraph 6–13.

END OF TASK

6–52. OIL PSI MAIN XMSN 1 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS LOW XMN 1 OIL PRESSURE 6–52

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 1 operating

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **XMN 1** oil temperature reading.
   Is oil temperature 121° C or higher?

   YES Replace main transmission 1 primary lube pump (TM 1-1520-238-23).

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL HOT MAIN XMSN1** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–49 to troubleshoot HOD XMN1 display.

   NO Go to step 3.

3. Check HOD display for **XMN 1** oil pressure.
   Is reading 35 LB or lower?

   YES Go to step 4.

   NO Go to paragraph 6–51 to troubleshoot OIL PSI MAIN XMSN indicator.

4. Check HOD display for **XMN 1** oil pressure reading.
   Is reading 28 LB or lower?

   YES Replace main transmission (TM 1-1520-238-23).

   NO Go to step 5.

5. Visually inspect oil system 1 for low oil level and physical damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace main transmission (TM 1-1520-238-23).

   NO Go to step 6.

6. Replace main transmission primary lube pump (TM 1-1520-238-23).
   Is HOD display still 28 LB or lower?

   YES Replace main transmission 1 float diverter valve (TM 1-1520-238-23). Go to paragraph 6–13.

   NO Go to paragraph 6–13.

END OF TASK

6–53. HOD XMN 2 READING – DISPLAYS 28 LB OR LESS OIL PRESSURE 6–53

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68F Aircraft Electrician
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L60 fairing and L325, T250L, T250R, T290L, T290R and T325 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Visually inspect oil system 2 for low oil level and physical damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace main transmission (TM 1-1520-238-23).

   NO Go to step 2.

2. Remove oil system 2 heat exchanger pressure transducer (TM 1-1520-238-23). Install pressure gage. Start engine 1 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Is oil pressure above 28 LB on pressure gage?

   YES Go to step 3.

   NO Go to step 4.

3. Check for open between:
   P672–95 and P672–94,
   P672–95 and P672–98,
   P672–95 and P672–109.
   Does open exist?

   YES Go to step 4.

   NO Go to step 5.

4. Check for open between:
   P578–1 and P578–2,
   P578–1 and P578–3.
   Does open exist?

   YES Replace oil system 2 heat exchanger pressure transducer (TM 1-1520-238-23).

   NO Repair open wire between:
   P578–2 and P672–109,
   P578–3 and P672–98,
   P578–3 and P672–94,
   P578–1 and P674–95.
   Go to paragraph 6–13.

6–53. HOD XMN 2 READING – DISPLAYS 28 LB OR LESS OIL PRESSURE (cont) 6–53

5. Detach P672. Check for short between:
   J578–1 and J578–3,
   J578–2 and J578–3.
   Does short exist?

   YES Repair shorted wire.
   Go to paragraph 6–13.

   NO Go to step 6.

6. Check for short between:
   P578–1and P578–2,
   P578–1 and P578–3.
   Does short exist?

   YES Replace oil system 2 heat exchanger pressure transducer (TM 1-1520-238-23).

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–54. HOD XMN 2 READING – DISPLAYS LOW OIL PRESSURE 6–54

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 2 operating

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **XMN 2** oil temperature reading.
   Is reading 140° C or higher?

   YES Go to paragraph 6–53 to troubleshoot HOD XMN 2 display.

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL PSI MAIN XMSN 2** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–56 to troubleshoot OIL PSI MAIN XMSN 2 indicator.

   NO Go to step 3.

3. Check pilot caution/warning panel **OIL HOT MAIN XMSN 2** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–70 to troubleshoot OIL HOT MAIN XMSN 2 indicator.

   NO Go to step 4.

4. Check HOD display for **XMN 2** oil pressure reading.
   Is reading oil pressure 35 LB or lower?

   YES Replace main transmission 2 primary lube pump (TM 1-1520-238-23).

   NO Main transmission 2 oil pressure is not critically low. Go to paragraph 6–13.

END OF TASK

6–55. OIL PSI MAIN XMSN 2 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL XMN 2 OIL PRESSURE 6–55

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68D Aircraft Powertrain Repairer/NDI
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 1-1520-238-CL
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L60 fairing and L200, L325, T250L, T250R, T290L, T290R and T325 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

Verify transmission system operating temperature is normal during flight. Low oil pressure may may have resulted from high NGB 1 oil temperature.

1. Detach P18.
Is OIL PSI MAIN XMSN 2 indicator lighted(see note)?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

   NO Go to step 2.

2. Detach P755. Check for short between P18–10 and ground.
Does short exist?

   YES Repair shorted wire between P18–10 and P755–15. Go to paragraph 6–13.

   NO Go to step 3.

3. Check for open between:
P18–10 and P456–A1,
J456–A1 and P755–15,
P755–16 and ground.
Does open exist?

   YES Repair open wire.
   Go to paragraph 6–13.

   NO Go to step 4.

4. Attach P18 and P755. Check for open between J456–A1 and ground.
Does open exist?

   YES Replace main transmission oil system 2 oil pressure switch (TM 1-1520-238-23).

   NO Go to step 5.

6–55. OIL PSI MAIN XMSN 2 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL XMN 2 OIL PRESSURE (cont) 6–55

5. Remove oil system 2 heat exchanger pressure transducer (TM 1-1520-238-23). Install pressure gage. Start engine 1 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Does oil pressure gage read above 28 LBS on pressure gage?

   YES Go to step 6.

   NO Replace system 2 main transmission pump (TM 1-1520-238-23).

6. Check for open between:
   P672–95 and P672–94,
   P672–95 and P672–98,
   P672–95 and P672–109.
   Does open exist?

   YES Go to step 8.

   NO Go to step 7.

7. Check for short between:
   P673–94 and ground,
   P673–95 and ground,
   P673–98 and ground,
   P673–109 and ground.
   Does short exist?

   YES Go to step 9.

   NO Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

8. Check for open between:
   P578–1 and P578–2,
   P578–1 and P578–3.
   Does open exist?

   YES Replace oil system 2 heat exchanger pressure transducer (TM 1-1520-238-23).

   NO Repair open wire between:
   P672–95 and J578–1,
   P672–109 and J578–2,
   P672–98 and J578–3,
   P672–94 and J578–3.
   Go to paragraph 6–13.

9. Check for short between:
   P578–1 and ground,
   P578–2 and ground,
   P578–3 and ground.
   Does short exist?

   YES Replace oil system 2 heat exchanger pressure transducer (TM 1-1520-238-23).

   NO Repair shorted wire between:
   P672–94 and J578–3,
   P672–95 and J578–1,
   P672–98 and J578–3,
   P672–109 and J578–2.
   Go to paragraph 6–13.

END OF TASK

6–56. OIL PSI MAIN XMSN 2 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS LOW XMN 2 OIL PRESSURE 6–56

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 2 operating

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **XMN 2** oil temperature reading.
   Is oil temperature 121° C or higher?

   YES Replace main transmission 2 primary lube pump (TM 1-1520-238-23).

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL HOT MAIN XMSN 2** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–53 to troubleshoot HOD XMN2 display.

   NO Go to step 3.

3. Check HOD display for **XMN 2** oil pressure.
   Is reading 35 LB or lower?

   YES Go to step 4.

   NO Go to paragraph 6–55 to troubleshoot OIL PSI MAIN XMSN 2 indicator.

4. Check HOD display for **XMN 2** oil pressure reading.
   Is reading 28 LB or lower?

   YES Replace main transmission (TM 1-1520-238-23).

   NO Go to step 5.

5. Visually inspect oil system 2 for low oil level and physical damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace main transmission (TM 1-1520-238-23).

   NO Go to step 6.

6. Replace main transmission primary lube pump (TM 1-1520-238-23).
   Is HOD display still 28 LB or lower?

   YES Replace main transmission 2 float diverter valve (TM 1-1520-238-23).

   NO Go to paragraph 6–13.

END OF TASK

6–57. HOD NGB 2 READING – DISPLAYS 28 LB OR LESS OIL PRESSURE 6–57

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68F Aircraft Electrician
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – R200 access panel and RN6, R60 fairings open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Visually inspect **NGB 2** for low oil level and damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace NGB 2 (TM 1-1520-238-23).

   NO Go to step 2.

2. Remove **NGB 2** oil pressure transducer (TM 1-1520-238-23). Install pressure gage. Start engine 2 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Is oil pressure above 28 LB on pressure gage?

   YES Go to step 3.

   NO Replace NGB 2 (TM 1-1520-238-23).

3. Check for open between:
   P672–85 and P673–84,
   P672–85 and P673–99,
   P672–85 and P673–100.
   Does open exist?

   YES Go to step 4.

   NO Go to step 5.

4. Check for open between:
   P60–L and P60–M,
   P60–L and P60–P,
   P60–L and P60–R.
   Does open exist?

   YES Replace NGB 2 oil pressure transducer (TM 1-1520-238-23).

   NO Repair open wire between:
   J60–L and P672–85,
   J60–M and P672–84,
   J60–P and P672–99,
   J60–R and P672–100.
   Go to paragraph 6–13.

5. Detach P672. Check for short between:
   J60–L and P60–M,
   J60–P and P60–R.
   Does short exist?

   YES Repair shorted wire. Go to paragraph 6–13.

   NO Go to step 6.

6–57. HOD NGB 2 READING – DISPLAYS 28 LB OR LESS OIL PRESSURE (cont) 6–57

6. Check for short between:
   P60–L and P60–M,
   P60–L and P60–P,
   P60–L and P60–R.
   Does short exist?

YES	Replace NGB 2 oil pressure transducer (TM 1-1520-238-23).
NO	Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–58. HOD NGB 2 READING – DISPLAYS LOW OIL PRESSURE 6–58

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 2 operating

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **NGB 2** oil temperature reading.
   Is reading 140° C or higher?

   YES Go to paragraph 6–57 to troubleshoot HOD NGB 2 display.

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL PSI NOSE GRBX 2** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–60 totroubleshoot OIL PSI NOSE GRBX 2 indicator.

   NO Go to step 3.

3. Check pilot caution/warning panel **OIL HOT NOSE GRBX 2** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–74 to troubleshoot OIL HOT NOSE GRBX 2 indicator.

   NO Go to step 4.

4. Check HOD display for **NGB 2** oil pressure reading.
   Is oil pressure 35 LB or lower?

   YES Replace NGB 2 lube pump (TM 1-1520-238-23).

   NO NGB 2 oil pressure not critically low. Go to paragraph 6–13.

END OF TASK

6–59. OIL PSI NOSE GRBX 2 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL NGB 2 OIL PRESSURE 6–59

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 1-1520-238-CL
TM 9-1230-476-20-2

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display **NGB 2** oil temperature reading.
   Is reading 140° C or higher?

   YES Go to step 3.

   NO Go to step 2.

2. Detach P18. Check **OIL PSI NOSE GRBX 2** indicator.
   Does indicator remain lighted?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

   NO Go to step 4.

3. Visually inspect NGB 2 for low oil level and damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace NGB 2 (TM 1-1520-238-23).

   NO Go to step 6.

4. Check for short between P60–D and P60–E.
   Does short exist?

   YES Replace NGB 2 low oil pressure switch (TM 1-1520-238-23).

   NO Go to step 5.

5. Detach P18 and check for short between J60–D and ground.
   Does short exist?

   YES Repair shorted wire between J60–D and P18–45. Go to paragraph 6–13.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

6. Remove NGB 2 oil pressure transducer (TM 1-1520-238-23). Install pressure gage. Start engine 2 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Does open exist?

   YES Go to step 7.

   NO Replace NGB 2 (TM 1-1520-238-23).

6–59. OIL PSI NOSE GRBX 2 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL NGB 2 OIL PRESSURE (cont) 6–59

7. Check for open between:
P672–85 and P672–84,
P672–85 and P672–99,
P672–85 and P672–100.
Does open exist?

YES	Go to step 8.
NO	Go to step 9.

8. Check for open between:
P60–L and P60–M,
P60–L and P60–P,
P60–L and P60–R.
Does open exist?

YES	Replace NGB 2 oil pressure transducer (TM 1-1520-238-23).
NO	Repair open wire between: P60–L and P672–85, P60–M and P672–84, P60–P and P672–99, P60–R and P672–100. Go to paragraph 6–13.

9. Detach P672. Check for short between:
J60–L and ground,
J60–M and ground,
J60–L and ground,
J60–R and ground.
Does short exist?

YES	Repair shorted wire. Go to paragraph 6–13.
NO	Go to step 10.

10. Check for short between:
P60–L and P60–M,
P60–M and P60–P,
P60–M and P60–R.
Does short exist?

YES	Replace NGB 2 oil pressure transducer (TM 1-1520-238-23).
NO	Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

END OF TASK

6–60. OIL PSI NOSE GRBX 2 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS LOW NGB 2 OIL PRESSURE 6–60

Tools:

Nomenclature	Part Number
Tool Kit, Powertrain Repairer's	SC518099CLA013

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 2 operating

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **NGB 2** oil temperature reading.
   Is oil temperature 121° C or higher?

   YES Replace NGB 2 lube pump (TM 1-1520-238-23).

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL HOT NOSE GRBX 2** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–57 to troubleshoot HOD NGB 2 display.

   NO Go to step 3.

3. Check HOD display for **NGB 1** oil pressure reading.
   Is reading 35 LB or lower?

   YES Go to step 4.

   NO Go to paragraph 6–59 to troubleshoot OIL PSI NOSE GRBX 2 indicator.

4. Check HOD display for **NGB 2** oil pressure reading.
   Is reading 28 LB or lower?

   YES Replace NGB 2 (TM 1-1520-238-23).

   NO Go to step 5.

5. Visually inspect NGB 2 for low oil level and damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace NGB 2 (TM 1-1520-238-23).

   NO Replace NGB 2 lube pump (TM 1-1520-238-23).

END OF TASK

6–60.1. HOD NGB 1 READING – DISPLAYS 140° C OR HIGHER OIL TEMPERATURE 6–60.1

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 1-1520-238-CL
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 panel and LN6, L60 fairings access open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Visually inspect oil system 1 for low oil level and damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace NGB1 (TM 1-1520-238-23).

   NO Go to step 2.

2. Remove NGB 1 oil pressure transducer (TM 1-1520-238-23). Install pressure gage. Start engine 1 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Is oil pressure above 28 LB on pressure gage?

   YES Go to step 3.

   NO Replace NGB1 (TM 1-1520-238-23).

3. Check for 28 VDC between J61–F and J61–G.
   Is voltage present?

   YES Go to step 4.

   NO Go to step 5.

4. Check for 10 VDC between P673–87 and P673–86.
   Is voltage present?

   YES Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

   NO Go to step 6.

5. Check for 28 VDC at J61–F.
   Is voltage present?

   YES Repair open wire between J61–G and GS574–A. Go to paragraph 6–13.

   NO Go to step 7.

6. Check for open between P61–H and P61–J.
   Does open exist?

   YES Replace NGB 1 oil temperature probe (TM 1-1520-238-23).

   NO Go to step 8.

6–60.1. HOD NGB 1 READING – DISPLAYS 140° C OR HIGHER OIL TEMPERATURE (cont) 6–60.1

7. Check for open between:
J61–F and P439–A10,
P439–A14 and P463–c.
(A402):
J21–A10 and J21–A14.
Does open exist?

YES Repair open wire.
Go to paragraph 6–13.

NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station)

8. Check for short between P61–H and P61–J.
Does short exist?

YES Replace NGB 2 oil temperature probe (TM 1-1520-238-23).

NO Repair shorted wire between:
J61–H and P403 –B1,
J61–J and P403 –B2,
J403–B1 and P673–87,
J403–B2 and P673–86.
Go to paragraph 6–13.

END OF TASK

6–61. HOD NGB 1 READING – DISPLAYS HIGH OIL TEMPERATURE 6–61

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Powertrain Repairer's	SC518099CLA013

Personnel Required:

67R Attack Helicopter Repairer
68D Aircraft Powertrain Repairer/NDI
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 1 operating

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **NGB 1** oil pressure reading.
   Is reading 28 LB or lower?

   YES Go to paragraph 6–45 to troubleshoot HOD NGB 1 display.

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL HOT NOSE GRBX 1** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–63 to troubleshoot OIL HOT NOSE GRBX 1 indicator.

   NO Go to step 3.

3. Check pilot caution/warning panel **OIL PSI NOSE GRBX 1** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–47 to troubleshoot OIL PSI NOSE GRBX 1 indicator.

   NO Go to step 4.

4. Check HOD display for **NGB 1** oil temperature reading.
   Is oil temperature 121° C or higher?

   YES Go to step 5.

   NO NGB 1 oil temperature is not critically high. Go to paragraph 6–13.

5. Inspect NGB 1 for cooling fin blockage (TM 1-1520-238-23).
   Is there blockage?

   YES Clear cooling fin blockage and correct damage (TM 1-1520-238-23).

   NO Replace NGB 1 lube pump (TM 1-1520-238-23).

END OF TASK

6–62. OIL HOT NOSE GRBX 1 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL NGB 1 OIL TEMPERATURE 6–62

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68D Aircraft Powertrain Repairer/NDI
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 1-1520-238-CL
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel and LN6, L60 fairings open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display **NGB 1** oil pressure reading.
   Is reading 28 LB or lower?

   YES Go to step 3.

   NO Go to step 2.

2. Detach P18.
   Does indicator remain lighted?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

   NO Go to step 4.

3. Visually inspect NGB 1 for low oil level and damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace NGB1 (TM 1-1520-238-23).

   NO Go to step 5.

4. Detach P18 and check for short between J61–A and ground.
   Does short exist?

   YES Repair shorted wire between J61–A and P18–52. Go to paragraph 6–13.

   NO Replace NGB 1 metallic chip detector (TM 1-1520-238-23).

5. Remove NGB 1 oil pressure transducer (TM 1-1520-238-23). Install pressure gage. Start engine 1 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Is oil pressure above 28 LB on pressure gage?

   YES Go to step 6.

   NO Replace NGB 1 (TM 1-1520-238-23).

6. Check for 28 VDC between J61–F and J61–G.
   Is voltage present?

   YES Go to step 7.

   NO Go to step 9.

6–62. OIL HOT NOSE GRBX 1 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL NGB 1 OIL TEMPERATURE (cont) 6–62

7. Check for 10 VDC between P673–87 and P673–86.
   Is voltage present?

   YES Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

   NO Go to step 8.

8. Check for open between P61–H and P61–J.
   Does open exist?

   YES Replace NGB 1 oil temperature probe (TM 1-1520-238-23).

   NO Go to step 11.

9. Check for 28 VDC at J61–F.
   Is voltage present?

   YES Repair open wire between J61–G and GS574–A.
   Go to paragraph 6–13.

   NO Go to step 10.

10. Check for open between:
    P61–F and P439–A10,
    P439–A14 and P463–c.
    (A402):
    J21–A10 and J21–A14.
    Does open exist?

    YES Repair open wire.
    Go to paragraph 6–13.

    NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station)

11. Check for short between P61–H and P61–J.
    Does short exist?

    YES Replace NGB 1 oil temperature probe (TM 1-1520-238-23).

    NO Repair shorted wire between:
    J61–H and P403–B1,
    J61–J and P403–B2,
    J403–B2 and P673–86,
    J403–B1 and P673–87.
    Go to paragraph 6–13.

END OF TASK

6–63. OIL HOT NOSE GRBX 1 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS HIGH NGB 1 OIL TEMPERATURE 6–63

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Multimeter, Digital	AN/PSM-45

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel and LN6 fairing open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **NGB 1** oil pressure reading.
Is oil reading 28 LB or lower?

YES Go to paragraph 6–62 to troubleshoot OIL HOT NOSE GRBX 1 indicator.

NO Go to step 2.

2. Check pilot caution/warning panel **OIL PSI NOSE GRBX 1** indicator.
Is indicator lighted?

YES Go to paragraph 6–60.1 to troubleshoot HOD NGB 1 display.

NO Go to step 3.

3. Check HOD display for **NGB 1** oil temperature reading.
Is oil temperature 121° C or higher?

YES Go to step 6.

NO Go to step 4.

4. Detach P18.
Does indicator remain lighted?

YES Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

NO Go to step 5.

5. Check for short between J61–A and P18–52.
Does short exist?

YES Repair shorted wire. Go to paragraph 6–13.

NO Replace NGB 1 metallic chip detector (TM 1-1520-238-23).

6. Inspect NGB 1 for cooling fin blockage (TM 1-1520-238-23).
Is there blockage?

YES Clear fin blockage and correct damage (TM 1-1520-238-23).

NO Go to step 7.

7. Check NGB 1 flexible coupling shaft and fan (TM 1-1520-238-23).
Is fan blocked or damaged?

YES Clear fan blockage and correct damage (TM 1-1520-238-23).

NO Replace NGB 1 lube pump (TM 1-1520-238-23).

END OF TASK

6–64. HOD XMN 1 READING – DISPLAYS 140° C OR HIGHER OIL TEMPERATURE 6–64

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Multimeter, Digital	AN/PSM-45

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68F Aircraft Electrician

References:

TM 1-1520-238-23
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L325, T250L, T250R, T290L, T290R and T325 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

NOTE

If HOD is indicating 140° C or higher for main transmission oil temperature, either OIL HOT MAIN XMSN 1 or 2 indicator may be lighted or both, depending upon temperature difference readings at temperature transducers. Transmission temperature transducer 2 may be considerably cooler than 1 due to hot oil being pumped into transmission 1 sump first. Therefore, if OIL HOT MAIN XMSN 1 indicator is on and 2 off, the 2 circuitry may not necessarily require troubleshooting.

1. Check caution/warning panels **OIL HOT MAIN XMSN 1** and **2** indicators.
   Is either OIL HOT MAIN XMSN 1 or 2 indicator light lighted?

   YES Go to step 3.

   NO Go to step 2.

2. Check for 28 VDC between P755–2 and P755–6.
   Is voltage present?

   YES Go to step 4.

   NO Go to step 5.

3. Check transmission oil heat exchangers (TM 1-1520-238-23).
   Are heat exchangers operating properly?

   YES Replace main transmission (TM 1-1520-238-23).

   NO Replace transmission heat exchanger (TM 1-1520-238-23).

4. Check for 10 VDC between P682–87 and P682–86.
   Is voltage present?

   YES Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

   NO Go to step 6.

5. Check for 28 VDC between P755–2 and ground.
   Is voltage present?

   YES Repair wire between: P755–6 and GS572–H. Go to paragraph 6–13.

   NO Refer to chapter 4 to troubleshoot power plants.

6–64. HOD XMN 1 READING – DISPLAYS 140° C OR HIGHER OIL TEMPERATURE (cont) 6–64

6. Check for open between:
   P755–10 and P682–87,
   P755–11 and P682–86.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 6–13.

   NO Go to step 7.

7. Check for short between:
   P755–10 and ground,
   P755–11 and ground,
   P682–86 and ground,
   P682–87 and ground.
   Does short exist?

   YES Repair shorted wire.
   Go to paragraph 6–13.

   NO Replace main transmission oil
   system 1 temperature
   transducer (TM 1-1520-238-23).

END OF TASK

6–65. HOD XMN 1 READING – DISPLAYS HIGH OIL TEMPERATURE 6–65

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06

Personnel Required:

67R Attack Helicopter Repairer
68D Aircraft Powertrain Repairer/NDI
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 1 operating

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **XMN 1** oil pressure reading.
   Is reading 28 LB or lower?

   YES Go to paragraph 6–49 to troubleshoot HOD XMN 1 display.

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL HOT XMSN 1** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–67 to troubleshoot OIL HOT MAIN XMSN 1 indicator.

   NO Go to step 3.

3. Check pilot caution/warning panel **OIL PSI MAIN XMSN 1** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–51 to troubleshoot OIL PSI MAIN XMSN 1 indicator.

   NO Go to step 4.

4. Check HOD display for **XMN 1** oil temperature reading.
   Is oil temperature 121° C or higher?

   YES Go to step 5.

   NO Main transmission 1 oil temperature is not critically high. Go to paragraph 6–13.

5. Check heat exchanger 1 for obstruction and damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace main transmission 1 heat exchanger (TM 1-1520-238-23).

   NO Replace NGB 1 lube pump (TM 1-1520-238-23).

END OF TASK

6–66. OIL HOT MAIN XMSN 1 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL XMN 1 OIL TEMPERATURE 6–66

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 1-1520-238-CL
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200, L325, R290R, R295, T250L, T250R, T290L and T325 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display **XMN 1** oil pressure reading.
Is reading 28 LB or lower?

    YES Go to step 3.

    NO Go to step 2.

2. Check for short between J755–29 and J755–27.
Does short exist?

    YES Replace main transmission oil system 1 chip detector (TM 1-1520-238-23).

    NO Go to step 4.

3. Visually inspect oil system 1 for low oil level and physical damage (TM 1-1520-238-23).
Is damage present?

    YES Replace main transmission (TM 1-1520-238-23).

    NO Go to step 5.

4. Check for short between P755–29 and P18–65.
Does short exist?

    YES Repair shorted wire. Go to paragraph 6–13.

    NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

5. Remove engine system 1 heat exchanger pressure transducer (TM 1-1520-238-23). Install pressure gage. Start engine 1 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
Is oil pressure above 28 LB on pressure gage?

    YES Go to step 6.

    NO Replace main transmission (TM 1-1520-238-23).

6. Check for 28 VDC between P755–2 and P755–6.
Is voltage present?

    YES Go to step 7.

    NO Go to step 8.

6–66. OIL HOT MAIN XMSN 1 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL XMN 1 OIL TEMPERATURE (cont) 6–66

7. Check for 10 VDC between P682–87 and P682–86.
   Is voltage present?

   YES Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

   NO Go to step 9.

8. Check for 28 VDC at P755–2.
   Is voltage present?

   YES Repair open wire between P755–6 and GS572–H. Go to paragraph 6–13.

   NO Refer to chapter 4 to troubleshoot power plants.

9. Check for open between J755–10 and J755–11.
   Does open exist?

   YES Replace main transmission oil system 1 temperature probe (TM 1-1520-238-23).

   NO Go to step 10.

10. Check for short between J755–10 and J755–11.
    Does short exist?

    YES Replace main transmission oil system 1 temperature probe (TM 1-1520-238-23).

    NO Repair shorted wire between: P755–10 and P682–87, P755–11 and P682–86. Go to paragraph 6–13.

END OF TASK

6–67. OIL HOT MAIN XMSN 1 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS HIGH XMN 1 OIL TEMPERATURE 6–67

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Multimeter, Digital	AN/PSM-45

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 1 operating
TM 1-1520-238-23	Access provisions – L200, L325, R290R, T250L, T250R, T290L and T325 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **XMN 1** oil pressure reading.
Is oil reading 28 LB or lower?

YES Go to paragraph 6–66 to troubleshoot OIL HOT MAIN XMSN 1 indicator.

NO Go to step 2.

2. Check pilot caution/warning panel **OIL PSI MAIN XMSN 1** indicator.
Is indicator lighted?

YES Go to paragraph 6–64 to troubleshoot HOD XMN 1 display.

NO Go to step 3.

3. Check HOD display for **XMN 1** oil temperature reading.
Is oil temperature 121° C or higher?

YES Go to step 5.

NO Go to step 4.

4. Check for short between J755–29 and J755–27.
Does short exist?

YES Replace main transmission oil system 1 chip detector (TM 1-1520-238-23).

NO Go to step 6.

5. Check heat exchanger 1 for obstruction and damage (TM 1-1520-238-23).
Is damage present?

YES Replace main transmission 1 heat exchanger (TM 1-1520-238-23).

NO Replace main transmission 1 primary lube pump (TM 1-1520-238-23).

6. Check for short between P755–29 and P18–65.
Does short exist?

YES Repair shorted wire. Go to paragraph 6–15.

NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

END OF TASK

6–68. HOD XMN 2 READING – DISPLAYS 140° C OR HIGHER OIL TEMPERATURE 6–68

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68F Aircraft Electrician
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – T250L, T250R, T290L, R290R, R295, L325 and T325 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Visually inspect oil system 1 for low oil level and physical damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace main transmission (TM 1-1520-238-23).

   NO Go to step 2.

2. Remove oil system 1 heat exchanger pressure transducer (TM 1-1520-238-23). Install pressure gage. Start engine 1 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Is oil pressure above 28 LB on pressure gage?

   YES Go to step 3.

   NO Replace main transmission (TM 1-1520-238-23).

3. Check for 28 VDC between P755–3 and P755–5.
   Is voltage present?

   YES Go to step 4.

   NO Go to step 5.

4. Check for 10 VDC between P682–84 and P682–85.
   Is voltage present?

   YES Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

   NO Go to step 6.

5. Check for 28 VDC at P755–3.
   Is voltage present?

   YES Repair open wire between P755–5 and GS572–J. Go to paragraph 6–15.

   NO Refer to chapter 4 to troubleshoot power plants.

6–68. HOD XMN 2 READING – DISPLAYS 140° C OR HIGHER OIL TEMPERATURE (cont) 6–68

6. Check for open between J755–7 and J755–8.
Does open exist?

YES	Replace main transmission oil system 2 temperature probe (TM 1-1520-238-23).
NO	Go to step 7.

7. Check for short between P755–7 and J755–8.
Does short exist?

YES	Replace main transmission oil system 2 temperature probe (TM 1-1520-238-23).
NO	Repair shorted wire between: P755–7 and P682–85, P755–8 and P682–84. Go to paragraph 6–13.

END OF TASK

6–69. HOD XMN2 READING – DISPLAYS HIGH OIL TEMPERATURE 6–69

Tools:

Nomenclature	Part Number
Tool Kit, Powertrain Repairer's	SC518099CLA013

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 2 operating

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **XMN 2** oil pressure reading.
   Is reading 28 LB or lower?

   YES Go to paragraph 6–53 to troubleshoot HOD XMN 2 display.

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL HOT MAIN XMSN 2** indicator.
   Is indicator lighted?

   YES Go to paragraph6–71 to troubleshoot OIL HOT MAIN XMSN 2 indicator.

   NO Go to step 3.

3. Check pilot caution/warning panel **OIL PSI MAIN XMSN 2** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–55 to troubleshoot OIL PSI MAIN XMSN 2 indicator.

   NO Go to step 4.

4. Check HOD display for **XMN 2** oil temperature reading.
   Is oil temperature 121° C or higher?

   YES Go to step 5.

   NO Main transmission 2 oil temperature is not critically high. Go to paragraph 6–13.

5. Check heat exchanger 2 for obstruction and damage (TM 1-1520-238-23).
   Is damage present?

   YES Remove any obstructions or replace main transmission 2 heat exchanger if damaged (TM 1-1520-238-23).

   NO Replace main transmission 2 primary lube pump (TM 1-1520-238-23).

END OF TASK

6–70. OIL HOT MAIN XMSN 2 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL XMN 2 OIL TEMPERATURE 6–70

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 1-1520-238-CL
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L325, R200, R290R, R295, T250L, T250R, T290L and T325 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display **XMN 2** oil pressure reading. **Is reading 28 LB or lower?**

   YES Go to step 3.

   NO Go to step 2.

2. Check for short between J755–17 and J755–19. **Does short exist?**

   YES Replace main transmission oil system 2 chip detector (TM 1-1520-238-23).

   NO Go to step 4.

3. Visually inspect soil system 1 for low oil level and physical damage (TM 1-1520-238-23). **Is damage present?**

   YES Replace main transmission (TM 1-1520-238-23).

   NO Go to step 5.

4. Check for short between P755–17 and P18–66. **Does short exist?**

   YES Repair shorted wire. Go to paragraph 6–13.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

5. Remove engine system 1 heat exchanger pressure transducer (TM 1-1520-238-23). Install pressure gage. Start engine 1 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize. **Is oil pressure above 28 LB on pressure gage?**

   YES Go to step 6.

   NO Replace main transmission (TM 1-1520-238-23).

6–70. OIL HOT MAIN XMSN 2 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL XMN 2 OIL TEMPERATURE (cont) 6–70

6. Check for 28 VDC between P755–3 and P755–5.
   Is voltage present?

YES	Go to step 7.
NO	Go to step 8.

7. Check for 10 VDC between P682–84 and P682–85.
   Is voltage present?

YES	Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.
NO	Go to step 9.

8. Check for 28 VDC at P755–3.
   Is voltage present?

YES	Repair open wire between P755–5 and GS572–J. Go to paragraph 6–13.
NO	Refer to chapter 4 to troubleshoot power plants.

9. Check for open between J755–7 and J755–8.
   Does open exist?

YES	Replace main transmission oil system 2 temperature probe (TM 1-1520-238-23).
NO	Go to step 10.

10. Check for short between J755–7 and J755–8.
    Does short exist?

YES	Replace main transmission oil system 2 temperature probe (TM 1-1520-238-23).
NO	Repair shorted wire between: P755–7 and P682–85, P755–8 and P682–84. Go to paragraph 6–13.

END OF TASK

6–71. OIL HOT MAIN XMSN 2 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS HIGH XMN 2 OIL TEMPERATURE 6–71

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Multimeter, Digital	AN/PSM-45

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 2 operating

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **XMN 2** oil pressure reading.
   Is oil reading 28 LB or lower?

   YES Go to paragraph 6–70 to troubleshoot OIL HOT MAIN XMSN 2 indicator.

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL PSI MAIN XMSN 2** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–68 to troubleshoot HOD XMN 2 display.

   NO Go to step 3.

3. Check HOD display for **XMN 2** oil temperature reading.
   Is oil temperature 121° C or higher?

   YES Go to step 5.

   NO Go to step 4.

4. Check for short between J755–17 and J755–19.
   Does short exist?

   YES Replace main transmission oil system 2 chip detector (TM 1-1520-238-23).

   NO Go to step 6.

5. Check heat exchanger 2 for obstruction and damage (TM 1-1520-238-23).
   Is there obstruction or damage?

   YES Remove obstruction or replace main transmission 2 heat exchanger if it has damage (TM 1-1520-238-23).

   NO Replace main transmission 2 primary lube pump (TM 1-1520-238-23).

6. Check for short between P755–17 and P18–66.
   Does short exist?

   YES Repair shorted wire. Go to paragraph 6–13.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

END OF TASK

6–72. HOD NGB 2 READING – DISPLAYS 140° C OR HIGHER OIL TEMPERATURE 6–72

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68F Aircraft Electrician
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 1-1520-238-CL
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – R200 panel and RN6, R60 fairings access open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Visually inspect oil system 2 for low oil level and damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace NGB2 (TM 1-1520-238-23).

   NO Go to step 2.

2. Remove NGB 2 oil pressure transducer (TM 1-1520-238-23). Install pressure gage. Start engine 2 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Is oil pressure above 28 LB on pressure gage?

   YES Go to step 3.

   NO Replace NGB2 (TM 1-1520-238-23).

3. Check for 28 VDC between J60–F and J60–G.
   Is voltage present?

   YES Go to step 4.

   NO Go to step 5.

4. Check for 10 VDC between P672–87 and P672–86.
   Is voltage present?

   YES Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

   NO Go to step 6.

5. Check for 28 VDC at J60–F.
   Is voltage present?

   YES Repair open wire between J60–G and GS542–A. Go to paragraph 6–13.

   NO Go to step 7.

6. Check for open between P60–H and P60–J.
   Does open exist?

   YES Replace NGB 2 oil temperature probe (TM 1-1520-238-23).

   NO Go to step 8.

6–72. HOD NGB 2 READING – DISPLAYS 140° C OR HIGHER OIL TEMPERATURE (cont) 6–72

7. Check for open between:
   J60–F and P438–A10,
   P439–A14 and P463–c.
   (A402):
   J15–A10 and J21–A14.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 6–13.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station)

8. Check for short between P60–H and P60–J.
   Does short exist?

   YES Replace NGB 2 oil temperature probe (TM 1-1520-238-23).

   NO Repair shorted wire between:
   J60–H and J524 –A13,
   J60–J and J524 –A14,
   P524 –A13 and P672–87,
   P524–A14 and P672–86.
   Go to paragraph 6–13.

END OF TASK

6–73. HOD NGB 2 READING – DISPLAYS HIGH OIL TEMPERATURE 6–73

Tools:

Nomenclature	Part Number
Tool Kit, Powertrain Repairer's	SC518099CLA013

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
152FG Maintenance Test Pilot

References:

TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 2 operating

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **NGB 2** oil pressure reading.
   Is reading 28 LB or lower?

   YES Go to paragraph 6–57 to troubleshoot HOD NGB 2 display.

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL HOT NOSE GRBX 2** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–75 to troubleshoot OIL HOT NOSE GRBX 2 indicator.

   NO Go to step 3.

3. Check pilot caution/warning panel **OIL PSI NOSE GRBX 2** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–59 to troubleshoot OIL PSI NOSE GRBX 2 indicator.

   NO Go to step 4.

4. Check HOD display for **NGB 2** oil temperature reading.
   Is oil temperature 121° C or higher?

   YES Go to step 5.

   NO NGB 2 oil temperature is not critically high. Go to paragraph 6–13.

5. Inspect NGB 2 for cooling fin damage or blockage (TM 1-1520-238-23).
   Is there fin damage or blockage?

   YES Clear cooling fin blockage and correct damage (TM 1-1520-238-23).

   NO Go to step 6.

6. Check NGB 2 flexible coupling shaft and fan.
   Is fan blocked or damaged?

   YES Clear fan blockage or replace coupling and fan (TM 1-1520-238-23).

   NO Replace NGB 2 lube pump (TM 1-1520-238-23).

END OF TASK

6–74. OIL HOT NOSE GRBX 2 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL NGB 2 OIL TEMPERATURE 6–74

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Adapter, Straight Pipe to Tube, Female Pipe End, 37° Flared	A1100-4-4
Gage Pressure, Dial Indicating (0-200 PSI)	GGG76
Multimeter, Digital	AN/PSM-45

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 1-1520-238-CL
TM 9-1230-476-20-2

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 access panel and LN6, L60 fairings open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display **NGB 2** oil pressure reading.
   Is reading 28 LB or lower?

   YES Go to step 3.

   NO Go to step 2.

2. Detach P18.
   Does indicator remain lighted?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

   NO Go to step 4.

3. Visually inspect NGB 2 for low oil level and damage (TM 1-1520-238-23).
   Is damage present?

   YES Replace NGB 2 (TM 1-1520-238-23).

   NO Go to step 5.

4. Check for short between J60–A and P18–53.
   Does short exist?

   YES Repair shorted wire. Go to paragraph 6–13.

   NO Replace NGB 2 metallic chip detector (TM 1-1520-238-23).

5. Remove NGB 2 oil pressure transducer (TM 1-1520-238-23). Install pressure gage. Start engine 2 and place **PWR** lever to **FLY** (TM 1-1520-238-CL). Operate until readings stabilize.
   Is oil pressure above 28 LB on pressure gage?

   YES Go to step 6.

   NO Replace NGB 2 (TM 1-1520-238-23).

6. Check for 28 VDC between J60–F and J60–G.
   Is voltage present?

   YES Go to step 7.

   NO Go to step 9.

6–74. OIL HOT NOSE GRBX 2 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS NORMAL NGB 2 OIL TEMPERATURE (cont) 6–74

7. Check for 10 VDC between P672–87 and P672–86.
   Is voltage present?

   YES Refer to TM 9-1230-476-20-2 to troubleshoot multiplex subsystem.

   NO Go to step 9.

8. Check for 28 VDC at J60–F.
   Is voltage present?

   YES Repair open wire between J60–G and GS542–A.
   Go to paragraph 6–13.

   NO Go to step 10.

9. Check for open between P60–H and P60–J.
   Does open exist?

   YES Replace NGB 2 oil temperature probe (TM 1-1520-238-23).

   NO Go to step 11.

10. Check for open between:
    P60–F and P438–A10,
    P439–A14 and P463–c.
    (A402):
    J15–A10 and J21–A14.
    Does open exist?

    YES Repair open wire.
    Go to paragraph 6–13.

    NO Refer to TM 1-1520-238-T-6 to troubleshoot circuit protection system (dc emergency bus – pilot station)

11. Check for short between P60–H and P60–J.
    Does short exist?

    YES Replace NGB 2 oil temperature probe (TM 1-1520-238-23).

    NO Repair shorted wire between:
    J60–H and J524–A13,
    J60–J and J524–A14,
    J524–A13 and P672–87,
    J524–A14 and P672–86.
    Go to paragraph 6–13.

END OF TASK

6–75. OIL HOT NOSE GRBX 2 INDICATOR – IS LIGHTED WHEN HOD DISPLAYS HIGH NGB 2 OIL TEMPERATURE 6–75

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Tool Kit, Powertrain Repairer's	SC518099CLA013
Multimeter, Digital	AN/PSM-45

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
68X Armament/Electrical Systems Repairer
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 2 operating
TM 1-1520-238-23	Access provisions – R200 access panel and RN6 fairing open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check HOD display for **NGB 2** oil pressure reading.
   Is oil reading 28 LB or lower?

   YES Go to paragraph 6–74 to troubleshoot HOD NGB 2 display.

   NO Go to step 2.

2. Check pilot caution/warning panel **OIL PSI NOSE GRBX 2** indicator.
   Is indicator lighted?

   YES Go to paragraph 6–72 to troubleshoot HOD NGB 2 display.

   NO Go to step 3.

3. Check HOD display for **NGB 2** oil temperature reading.
   Is oil temperature 121° C or higher?

   YES Go to step 6.

   NO Go to step 4.

4. Detach P18.
   Does indicator remain lighted?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

   NO Go to step 5.

5. Check for short between J60–A and P18–53.
   Does short exist?

   YES Repair shorted wire. Go to paragraph 6–13.

   NO Replace NGB 2 metallic chip detector (TM 1-1520-238-23).

6. Inspect NGB 2 for cooling fin blockage (TM 1-1520-238-23).
   Is there blockage?

   YES Clear fin blockage and correct damage (TM 1-1520-238-23).

   NO Go to step 7.

7. Check NGB 2 flexible coupling shaft and fan (TM 1-1520-238-23).
   Is fan blocked or damaged?

   YES Clear fan blockage or correct damage (TM 1-1520-238-23).

   NO Replace NGB 2 lube pump (TM 1-1520-238-23).

END OF TASK

6–76. CHIPS NOSE GRBX 1 INDICATOR – LIGHTS 6–76

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 panel removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Remove NGB 1 chip detector. Inspect for chips (TM 1-1520-238-23).
Are chips present?

    YES Perform NGB inspection chip detector inspection (TM 1-1520-238-23).

    NO Go to step 2.

2. Replace NGB chip detector (TM 1-1520-238-23).
Does indicator remain lighted?

    YES Go to step 3.

    NO Go to paragraph 6–13.

3. Check for short between J61–B and P18–36.
Does short exist?

    YES Repair shorted wire. Go to paragraph 6–13.

    NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

END OF TASK

6–77. CHIPS NOSE GRBX 2 INDICATOR – LIGHTS 6–77

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L200 panel removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Remove NGB 2 chip detector. Inspect for chips (TM 1-1520-238-23).
   Are chips present?

   YES Perform NGB inspection chip detector inspection (TM 1-1520-238-23).

   NO Go to step 2.

2. Replace NGB chip detector (TM 1-1520-238-23).
   Does indicator remain lighted?

   YES Go to step 3.

   NO Go to paragraph 6–13.

3. Check for short between J60–B and P18–37.
   Does short exist?

   YES Repair shorted wire. Go to paragraph 6–13.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

END OF TASK

6–78. TEMP INT INDICATOR – LIGHTS 6–78

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45
Tester, Pyrometer and Thermocouple	TH–299

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 1 operating
TM 1-1520-238-23	Access provisions – L510, R510 fairings removed After engine shutdown, L545, R545 covers and L200, R295 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Place **PWR** lever to **FLY.** Operate until **TEMP INT** indicator lights. Shut down engine (TM 1-1520-238-CL). Immediately hold tester wand against each of four IGB thermistor bosses in turn and record temperature readings.
   Is any reading above 140° C?

   YES Replace IGB (TM 1-1520-238-23)

   NO Go to step 2.

2. Check intermediate gearbox grease level (TM 1-1520-238-23).
   Is grease level within limits?

   YES Go to step 3.

   NO Service gearbox (TM 1-1520-238-23).

3. Detach P200.
   Does TEMP INT indicator remain lighted?

   YES Go to step 5.

   NO Go to step 4.

4. Check resistance between P200–S and P200–C.
   Is resistance greater than 1 megohm?

   YES Go to step 7.

   NO Go to step 6.

5. Check for short between P200–S and P18–26.
   Does short exist?

   YES Repair shorted wire. Go to paragraph 6–13.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

6–78. TEMP INT INDICATOR – LIGHTS (cont) 6–78

6. Remove IGB thermistor probe RT14 (TM 1-1520-238-23). Check for short between P200–C and ground.
   Does short exist?

   YES Repair shorted wire between P200–C and thermistor RT14. Reinstall thermistor (TM 1-1520-238-23).

   NO Replace IGB thermistor probe (TM 1-1520-238-23).

7. Check resistance between P200–S and P200–A.
   Is resistance greater than 1 megohm?

   YES Go to step 9.

   NO Go to step 8.

8. Remove IGB thermistor probe (TM 1-1520-238-23). Check for short between P200–A and ground.
   Does short exist?

   YES Repair shorted wire between P200–A and thermistor RT13. Reinstall thermistor (TM 1-1520-238-23).

   NO Replace IGB thermistor probe (TM 1-1520-238-23).

9. Check resistance between P200–S and P200–K.
   Is resistance greater than 1 megohm?

   YES Go to step 11.

   NO Go to step 10.

10. Remove IGB thermistor probe (TM 1-1520-238-23). Check for short between P200–K and ground.
    Does short exist?

    YES Repair shorted wire between: P200–K and thermistor RT16. Reinstall thermistor (TM 1-1520-238-23).

    NO Replace IGB thermistor probe (TM 1-1520-238-23).

11. Check resistance between P200–S and P200–E.
    Is resistance greater than 1 megohm?

    YES Replace IGB temperature alarm (TM 1-1520-238-23).

    NO Go to step 12.

12. Remove IGB thermistor probe (TM 1-1520-238-23). Check for short between P200–E and ground.
    Does short exist?

    YES Repair shorted wire between P200–E and thermistor RT15. Reinstall thermistor (TM 1-1520-238-23).

    NO Replace IGB thermistor probe (TM 1-1520-238-23).

END OF TASK

6–79. TEMP TR INDICATOR – LIGHTS 6–79

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45
Tester, Pyrometer and Thermocouple	TH–299

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-23
TM 1-1520-238-CL

Equipment Conditions:

Ref	Condition
TM 1-1520-238-CL	Engine 1 operating
TM 1-1520-238-23	Access provisions – L510, R510, L530, and R540 fairings removed After engine shutdown L545, R545 covers and L200, R295 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Place **PWR** lever to **FLY.** Operate until **TEMP TR** indicator lights. Shut down engine (TM 1-1520-238-CL). Immediately hold tester wand against each of four TGB thermistor bosses in turn and record temperature readings.
   Is any reading above 140° C?

   YES Replace TGB (TM 1-1520-238-23).

   NO Go to step 2.

2. Check intermediate gearbox grease level (TM 1-1520-238-23).
   Is grease level within limits?

   YES Go to step 3.

   NO Service gearbox (TM 1-1520-238-23).

3. Detach P201.
   Does TEMP TR indicator remain lighted?

   YES Go to step 5.

   NO Go to step 4.

4. Check resistance between P201–S and P201–A.
   Is resistance greater than 1 megohm?

   YES Go to step 7.

   NO Go to step 6.

5. Check for short between P201–c and P18–25.
   Does short exist?

   YES Repair shorted wire. Go to paragraph 6–13.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

6–79. TEMP TR INDICATOR – LIGHTS (cont) 6–79

6. Remove TGB thermistor probe RT7 (TM 1-1520-238-23). Check for short between P201–A and ground.
   Does short exist?

   YES Repair shorted wire between P201–A and thermistor RT7. Reinstall thermistor (TM 1-1520-238-23).

   NO Replace TGB thermistor probe (TM 1-1520-238-23).

7. Check resistance between P201–S and P201–C.
   Is resistance greater than 1 megohm?

   YES Go to step 9.

   NO Go to step 8.

8. Remove TGB thermistor probe RT8 RH (TM 1-1520-238-23). Check for short between P201–C and ground.
   Does short exist?

   YES Repair shorted wire between P201–C and thermistor RT8. Reinstall thermistor (TM 1-1520-238-23).

   NO Replace TGB thermistor probe (TM 1-1520-238-23).

9. Check resistance between P201–S and P201–K.
   Is resistance greater than 1 megohm?

   YES Go to step 11.

   NO Go to step 10.

10. Remove TGB thermistor probe (TM 1-1520-238-23). Check for short between P201–K and ground.
    Does short exist?

    YES Repair shorted wire between P201–K and thermistor RT10. Reinstall thermistor (TM 1-1520-238-23).

    NO Replace TGB thermistor probe (TM 1-1520-238-23).

11. Check resistance between P201–S and P201–E.
    Is resistance greater than 1 megohm?

    YES Replace TGB temperature alarm (TM 1-1520-238-23).

    NO Go to step 12.

12. Remove TGB thermistor probe (TM 1-1520-238-23). Check for short between P201–E and ground.
    Does short exist?

    YES Repair shorted wire between P201–E and thermistor RT9. Reinstall thermistor (TM 1-1520-238-23).

    NO Replace TGB thermistor probe (TM 1-1520-238-23).

END OF TASK

6–80. NGB OIL LOSS IS INDICATED 6–80

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01

Personnel Required:

67R Attack Helicopter Repairer

References:

TM 1-1520-238-23

1. Visually inspect area around NGB expansion plugs for leakage.
   Is leakage present?

   YES Replace gearbox (TM 1-1520-238-23).

   NO Go to step 2.

2. Inspect NGB for visible damage.
   Is damage present?

   YES Replace NGB (TM 1-1520-238-23).

   NO Go to step 3.

3. Visually inspect for oil being forced out NGB breather.
   Is oil leakage present at breather?

   YES Replace NGB filler plug packing (TM 1-1520-238-23).

   NO Go to step 4.

4. Visually inspect area around NGB seals and packing for leakage.
   Is leakage present?

   YES Replace seal or packing (TM 1-1520-238-23).

   NO Refer to special inspection number 26 (NGB oil loss) (TM 1-1520-238-23).

END OF TASK

6–81. DRIVE SYSTEM – VIBRATION MAINTENANCE OPERATIONAL CHECK 6–81

Tools:

Nomenclature	Part Number
Tool Kit, Powertrain Repairer's	SC518099CLA013

Personnel Required:

68D Aircraft Powertrain Repairer/NDI
152FG Maintenance Test Pilot

References:

TM 1-1520-238-T-6
TM 1-1520-238-CL
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
Paragraph 6–12	DRIVE SYSTEM – INDICATORS MAINTENANCE OPERATIONAL CHECK completed

WARNING

Make sure that helicopter safing procedures are accomplished. Observe all safety precautions during troubleshooting and maintenance procedures. Failure to do so could result in death or serious injury.

NOTE

- **Refer to pilot station (fig. 6–12) and CPG station (fig. 6–13) for cockpit configuration and equipment.**
- **If referenced out of one paragraph or volume and into another for additional troubleshooting, upon completion of the task return to the maintenance operational check for the original paragraph or volume.**

1. Complete the maintenance operational check as follows:

Task	Result
a. Start and run helicopter (TM 1-1520-238-CL). On pilot master caution/warning panel (fig. 6–17), check that **LOW RPM ROTOR** indicator goes out when **N_r RPM%** on pilot **ENG–RTR RPM%** indicator (fig. 6–22) reaches or is above 93%.	If main rotor or tail rotor do not rotate, refer to TM 1-1520-238-23 to visually inspect drive system. If **LOW RPM ROTOR** indicator remains lighted above **93% N_r** on pilot and CPG master caution/warning panels, go to paragraph 6–82.
b. Increase power on one engine to 100%, and then retard throttle slowly until **N_p** vertical scale reads **80%** to **85% N_p**.	

6–81. DRIVE SYSTEM – VIBRATION MAINTENANCE OPERATIONAL CHECK (cont) 6–81

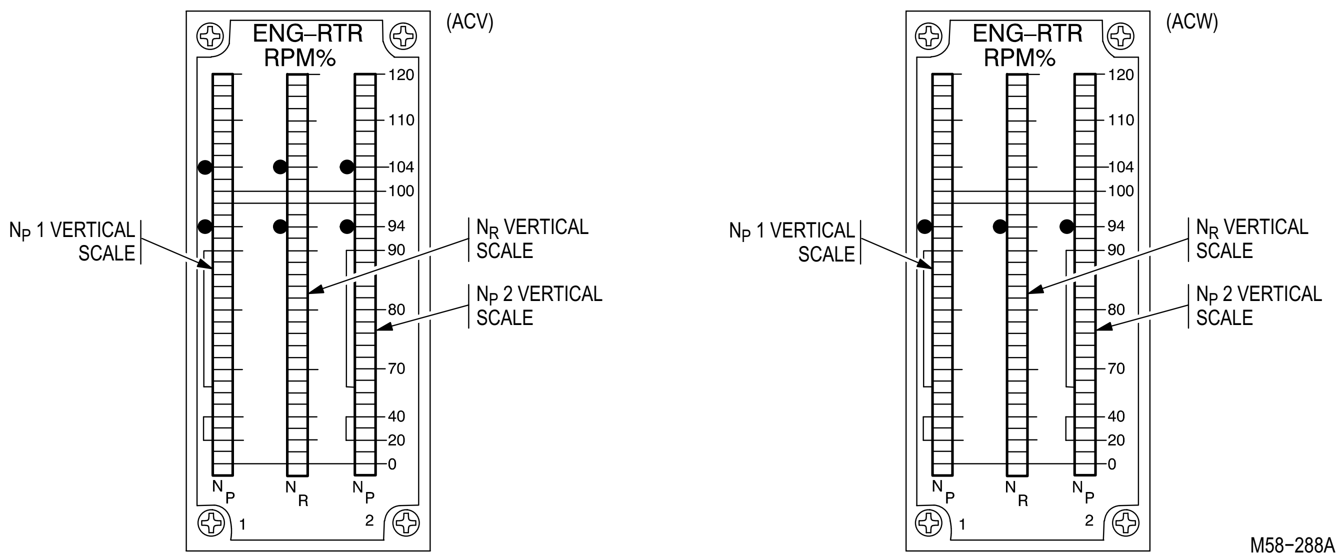


Figure 6–22. Pilot ENG–RTR RPM% Indicator

Task	Result
c. On pilot and CPG master caution/warning panels (fig. 6–18), check **LOW RPM ROTOR** indicators. Listen for low rotor audible warning in pilot and CPG headsets.	If pilot **LOW RPM ROTOR** indicator does not light at 93% or less, go to paragraph 6–83. If CPG **LOW RPM ROTOR** indicator does not light at 93% or less, go to paragraph 6–84. If low rotor audio warning is not heard in both headsets, refer to TM 1-1520-238-T-6 to troubleshoot low rotor audio warning.

CAUTION

Delaying decrease of PWR lever may result in an engine/rotor overspeed.

Task	Result
d. Set **ENG 1 PWR** lever to **LOCKOUT**. Note **N_p/N_r/N_G** increase. Then immediately retard **ENG 1 PWR** lever to a position midway between **FLY** and **IDLE**.	

6–81. DRIVE SYSTEM – VIBRATION MAINTENANCE OPERATIONAL CHECK (cont) 6–81

Task	Result

CAUTION

To avoid engine damage, do not operate engine steady–state between 24%–38% N_p or in the 57%–72% N_p range.

Task	Result
e. Advance **ENG 1 PWR** lever to a position where both engine torques are matched at **101% N_p.** Continue advancing until **ENG 1** torque is approximately 10% greater than **ENG 2** and an increase in **ENG 1 N_p** is noted.	
f. Slowly advance **ENG 1 PWR** lever above **101% N_p** until **HIGH RPM ROTOR** indicator is lighted.	**(ACV)** If pilot **HIGH RPM ROTOR** indicator does not light at **104% N_r**, go to paragraph 6–85. **(ACW)** If pilot **HIGH RPM ROTOR** indicator does not light at **108% N_r**, go to paragraph 6–85.1. **(ACW)** If CPG **HIGH RPM ROTOR** indicator does not light at **108% N_r**, go to paragraph 6–85.2. **(ACV)** If CPG **HIGH RPM ROTOR** indicator does not light at **104% N_r**, go to paragraph 6–86.
g. Set **ENG 1 PWR** lever to **IDLE**. Verify **N_G** is at idle speed.	
h. Set **ENG 1 PWR** lever to **FLY**. Verify ECU is reset.	
i. Raise collective to 20% torque. Note any rotor instability or unusual control positioning.	
j. Check **VIB GRBX** indicator on pilot and CPG caution/warning panels (figs. 6–17 and 6–18).	If **VIB GRBX** indicators light, go to paragraph 6–87.

2. Shut down helicopter (TM 1-1520-238-CL).

END OF TASK

6–82. LOW RPM ROTOR INDICATORS – REMAIN LIGHTED ABOVE 93% N_R 6–82

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68F Aircraft Electrician

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L140 fairing and L325, T250L, T250R, T290L, T290R and T325 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check rotor N_R indicator for rpm indication.
   Does N_R indicator continue to operate correctly?

   YES Go to step 2.

   NO Go to step 3.

2. Detach P49.
   Does LOW RPM ROTOR indicators remain lit?

   YES Go to step 4.

   NO Go to step 5.

3. Check for open between J755–23 and J755–22.
   Does open exist?

   YES Replace magnetic pickup and isolation transformer (TM 1-1520-238-23).

   NO Repair open wire between: P755–22 and (A326)TB1–9–F, P755–23 and (A326)TB1–9–L.

4. Detach P20 and P31.
   Does LOW RPM ROTOR indicators remain lit?

   YES Refer to TM 1-1520-238-T-6 to troubleshoot the pilot and CPG caution/warning system.

   NO Go to step 6.

5. Check for open between: (A326)TB1–9–G and P49–9, (A326)TB1–9–M and P49–10.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Replace engine out warning unit (TM 1-1520-238-23).

6. Attach P31 and detach (A326)TB1–10–F. Check for short between P20–X and ground.
   Does short exist?

   YES Repair shorted wire between P20–X and P49–18. Go to paragraph 6–81.

   NO Repair shorted wire between P31–X and P49–18. Go to paragraph 6–81.

END OF TASK

6–83. PILOT LOW RPM ROTOR INDICATOR – DOES NOT LIGHT AT 93% OR LESS 6–83

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68F Aircraft Electrician

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L140 fairing and L325, T250L, T250R, T290L, T290R and T325 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for audio in headset.
   Is low RPM audio warning present?

   YES Go to step 3.

   NO Go to step 2.

2. Check for open between:
   P755–22 and P49–9,
   P755–23 and P49–10.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Go to step 4.

3. Detach P49–18. Short P49–18 to ground.
   Does indicator light?

   YES Replace engine out warning unit (TM 1-1520-238-23).

   NO Go to step 5.

4. Check for 6 to 8 VAC between P49–9 and P49–10.
   Is voltage present?

   YES Replace engine out warning unit (TM 1-1520-238-23).

   NO Replace rotor speed sensor A25 and isolation transformer T1 (TM 1-1520-238-23).

5. Check for open between P49–18 and P20–x.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot caution/warning system.

END OF TASK

6–84. CPG LOW RPM ROTOR INDICATOR – DOES NOT LIGHT AT 93% OR LESS 6–84

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L140 fairing and T250L, T250R, T290L, T290R, L325, and T325 access doors open

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for audio in headset.
   Does low rpm audio warning exist?

   YES Go to step 2.

   NO Go to paragraph 6–83 to troubleshoot pilot LOW RPM ROTOR indicator.

2. CPG **LOW RPM ROTOR** indicator does not light.
   Is pilot LOW RPM ROTOR indicator lighted?

   YES Go to step 3.

   NO Go to paragraph 6–83 to troubleshoot pilot LOW RPM ROTOR indicator.

3. Check for open wire between P31–X and (A326)TB1–10F.
   Does open exist?

   YES Repair open wire.
   Go to paragraph 6–81.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the CPG caution/warning system.

END OF TASK

6–85. PILOT HIGH RPM ROTOR INDICATOR – DOES NOT LIGHT AT 104% N_R (ACV) 6–85

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L140 fairing open Non–transparant barrier removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between (A326)TB1–9–G and P49–9.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Go to step 2.

2. Check for open between (A326)TB1–9–M and P49–10.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Go to step 3.

3. Detach (A326)TB1–10–C. Check for open between P49–17 and P20–Y.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Go to step 4.

4. Replace engine out warning unit (TM 1-1520-238-23). Repeat paragraph 6–81, step d.
   Does pilot HIGH RPM ROTOR indicator light at 104% N_R?

   YES Go to paragraph 6–81.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot and CPG caution/warning system.

END OF TASK

6–85.1. PILOT HIGH RPM ROTOR INDICATOR – DOES NOT LIGHT AT 108% N_R (ACW) 6–85.1

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L140 fairing open Non–transparant barrier removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between (A326)TB1–9–G and P49–9.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Go to step 2.

2. Check for open between (A326)TB1–9–M and P49–10.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Go to step 3.

3. Detach (A326)TB1–10–C. Check for open between P49–17 and P20–Y.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Go to step 4.

4. Replace engine out warning unit (TM 1-1520-238-23). Repeat paragraph 6–81, step d.
   Does pilot HIGH RPM ROTOR indicator light at 108% N_R?

   YES Go to paragraph 6–81.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot and CPG caution/warning system.

END OF TASK

6–85.2. CPG HIGH RPM ROTOR INDICATOR – DOES NOT LIGHT AT 108% N_R (ACW) 6–85.2

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L140 fairing open Non–transparant barrier removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between (A326)TB1–9–G and P49–9.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Go to step 2.

2. Check for open between (A326)TB1–9–M and P49–10.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Go to step 3.

3. Detach (A326)TB1–10–B. Check for open between P49–17 and P31–Y.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Go to step 4.

4. Replace engine out warning unit (TM 1-1520-238-23). Repeat paragraph 6–81, drive system–vibration maintenance operational check, step d.
   Does CPG HIGH RPM ROTOR indicator light at 108% N_R?

   YES Go to paragraph 6–81.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot and CPG caution/warning system.

END OF TASK

6–86. CPG HIGH RPM ROTOR INDICATOR – DOES NOT LIGHT AT 104% N_R (ACV) 6–86

Tools:

Nomenclature	Part Number
Tool Kit, Aircraft Mechanic's	SC518099CLA01
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

67R Attack Helicopter Repairer
68X Armament/Electrical Systems Repairer
One person to assist

References:

TM 1-1520-238-T-6
TM 1-1520-238-23

Equipment Conditions:

Ref	Condition
TM 1-1520-238-23	Access provisions – L140 fairing open Non–transparent barrier removed

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check for open between (A326)TB1–9–G and P49–9.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Go to step 2.

2. Check for open between (A326)TB1–9–M and P49–10.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Go to step 3.

3. Detach (A326)TB1–10–B. Check for open between P49–17 and P31–Y.
   Does open exist?

   YES Repair open wire. Go to paragraph 6–81.

   NO Go to step 4.

4. Replace engine out warning unit (TM 1-1520-238-23). Repeat paragraph 6–81, drive system–vibration maintenance operational check, step d.
   Does CPG HIGH RPM ROTOR indicator light at 104% N_R?

   YES Go to paragraph 6–81.

   NO Refer to TM 1-1520-238-T-6 to troubleshoot the pilot and CPG caution/warning system.

END OF TASK

6–87. VIB GRBX INDICATOR – LIGHTS 6–87

Tools:

Nomenclature	Part Number
Tool Kit, Electrical Repairer's	SC518099CLA06
Multimeter, Digital	AN/PSM-45

Personnel Required:

68X Armament/Electrical Systems Repairer

References:

TM 1-1520-238-23

WARNING

Turn off power before detaching or attaching wires and connectors. High current 28 VDC or 115 VAC is present. Failure to do so could result in death or serious injury.

1. Check pilot caution/warning panel **VIB GRBX** indicator.
   Is indicator lighted?

   YES Go to step 2.

   NO Replace rotor balance signal processor (TM 1-1520-238-23). If problem persists, replace intermediate gearbox (TM 1-1520-238-23). If problem persists, replace tail rotor gearbox (TM 1-1520-238-23).

2. Detach P129.
   Does VIB GRBX indicator remain lighted?

   YES Go to step 3.

   NO Replace rotor balance signal processor (TM 1-1520-238-23).

3. Detach P18. Check for short between P129–E and ground.
   Does short exist?

   YES Repair shorted wire. Go to paragraph 6–81.

   NO Replace pilot caution/warning panel (TM 1-1520-238-23).

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

MILTON H. HAMILTON
Administrative Assistant to the
Secretary of the Army
01683

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To be distributed in accordance with DA Form 12-31-E, block no. 3138, AVUM and AVIM maintenance requirements for TM 1-1520-238-T-4.

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To: 2028@redstone.army.mil
Subject DA Form 2028

1. ***From:*** Joe Smith
2. *Unit:* home
3. ***Address:*** 4300 Park
4. ***City:*** Hometown
5. ***St:*** MO
6. ***Zip:*** 77777
7. ***Date Sent:*** 19-OCT-93
8. ***Pub no:*** 55-2840-229-23
9. ***Pub Title:*** TM
10. ***Publication Date:*** 04-JUL-85
11. *Change Number:* 7
12. *Submitter Rank:* MSG
13. ***Submitter FName:*** Joe
14. *Submitter MName:* T
15. ***Submitter LName:*** Smith
16. ***Submitter Phone:*** 123-123-1234
17. ***Problem:* 1**
18. *Page:* 2
19. *Paragraph:* 3
20. *Line:* 4
21. *NSN:* 5
22. *Reference:* 6
23. *Figure:* 7
24. *Table:* 8
25. *Item:* 9
26. *Total:* 123
27. ***Text:***

This is the text for the problem below line 27.

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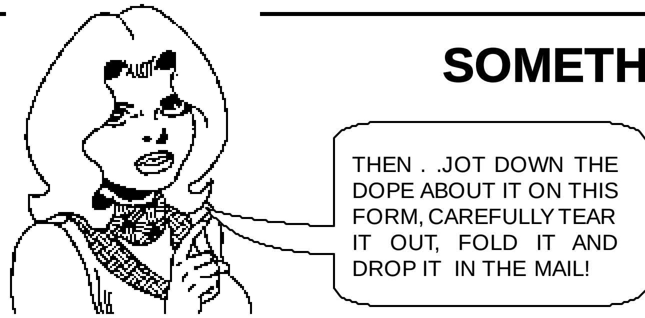

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FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

PFC John DOE
CO A 3rd Engineer Bn
Ft. Leonardwood, MO 63108

DATE SENT

10 January 1999

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE
TM 1–1520–238-T-4	30 December 1998	Troubleshooting Manual for AH-64

BE EXACT PIN–POINT WHERE IT IS

PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO	IN THIS SPACE, TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
6	2-1 a			In line 6 of paragraph 2–1a the manual states the engine has 6 cylinders. The engine on my set only has 4 cylinders. Change the manual to show 4 cylinders.
81		4-3		Callout 16 on figure 4–3 is pointed at a bolt. In key to figure 4–3, item 16 is called a shim. Please correct one or the other

EXAMPLE

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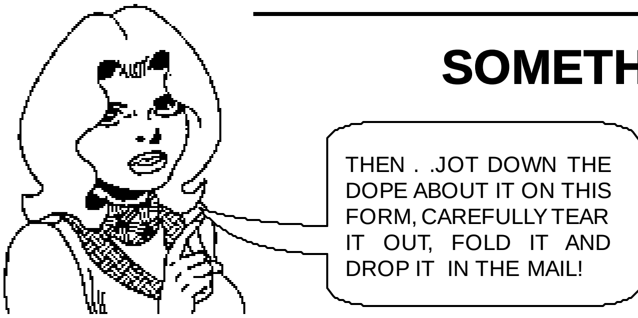

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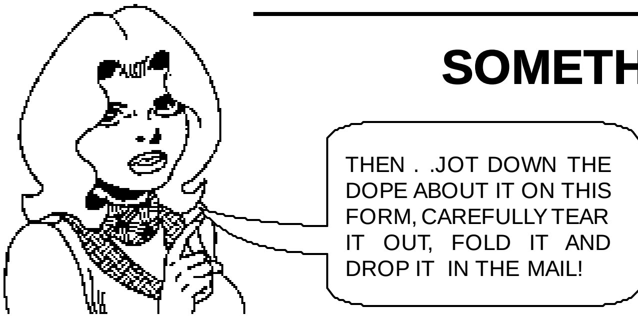

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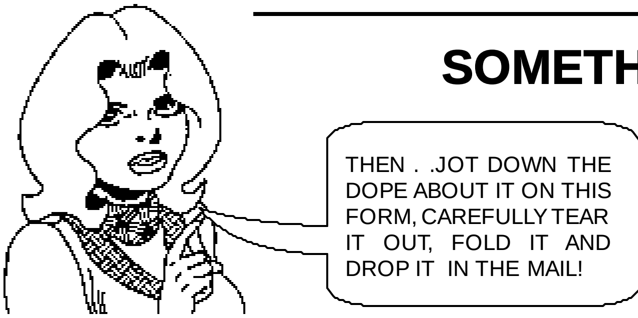

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

PIN: 069968-10