TECHNICAL MANUAL

OPERATOR'S, AVIATION UNIT, AND INTERMEDIATE MAINTENANCE MANUAL INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST

FOR
TEST SET, AVIATION VIBRATION ANALYZER (AVA)

WITH VERSION 7.01

PN 29313107
NSN 6625-01-282-3746

*This Manual supercedes TM 1-6625-724-13&P, dated 31 August 1994, including all changes.

HEADQUARTERS, DEPARTMENT OF THE ARMY

7 MARCH 2002

Warnings and Cautions that appear in the text of this publication and relate to specific procedures are repeated here for emphasis:

WARNING

Failure to correctly connect the dc power cable can result in personnel injury. Observe polarities when connecting the dc power cable. (WP0006 00-3)

WARNING

Installation of the UTD assembly on the nose mount (tracker mount) will cause the wirestrike protection system to be ineffective. All flights with the UTD installed are limited to areas where wirestrikes are not likely. (WP0006 00-4)

WARNING

When routing cables, ensure cables are not routed through areas containing moving parts or heat sources. Cabling can become entangled in moving parts and cause injury to personnel or destruction of equipment. (WP0006 00-6)

WARNING

Failure to observe all safety precautions when connecting external power to the AVA equipment can result in injury to personnel. Observe all safety precautions when connecting external power. (WP0006 00-7)

WARNING

Use extreme care when flying with UTD mounted. UTD interferes with wirestrike capabilities. (WP0069 00-1, WP0070 00-1, WP0071 00-1, WP0072 00-1, WP0073 00-1 and WP0074 00-1)

WARNING

If main rotor 1/REV vibration becomes objectionable, acquire data normally through the highest airspeed at which vibration can be tolerated. Do not skip test conditions, data should be taken from ground to the highest airspeed possible. After data is taken at the highest speed achieved, press QUIT then highlight "Save and Exit" and then press DO. Land the aircraft and perform corrections suggested by the CADU prior to further flight. (WP0069 00-17, WP0070 00-13, WP0071 00-19 and WP0072 00-14)

WARNING

CRITICAL SAFETY ITEM

Only 70361-08700-101, Titanium and PL565A428H4, Steel Setscrews are used as balance weight. Verification of proper vibration weight hardware is a critical characteristic. (WP0069 00-51)

WARNING

Total blade balance weight is not to exceed 1017 grams, nine –3 weights, on a single blade. (WP0071 00-14 and WP0071 00-21)

WARNING

Vibration levels (vertical or lateral) of 1.2 ips and above may cause aircraft damage. Avoid flying the aircraft with these levels. (WP0071 00-18)

WARNING

Avoid flying the aircraft with track spreads (high to low blade) of 3 inches or more. (WP0071 00-18)

WARNING

Total blade trim tab bends are not to exceed +/- 5 degrees in any pocket. Tabs should be bent uniformly at all locations suggested by the AVA diagnostics. (WP0071 00-21)

WARNING

Ensure proper blade weight retaining hardware is installed in the tail rotor blades. (WP0071 00-35)

WARNING

NEVER remove ALL of the weight from the tail rotor blade tips in an attempt to "zero out" the balance for a new starting point, doing so may cause severe tail rotor vibration and result in aircraft damage. In addition to being used for dynamic rotor balance, tail rotor tip weights serve the important purpose of maintaining the design static spanwise mass moment of the blade and are initially installed by the manufacturer. Efforts should be made to make the minimum disturbance to those weights over the course of tail rotor dynamic balance maintenance exercises. (WP0071 00-33)

WARNING

Ensure UTD cable does not interfere with the CPO pedal travel [during OH-58D tracker installation]. (WP0073 00-8)

WARNING

If Main Rotor RPM cannot be maintained in the green, terminate test flight [during OH-58 track Main Rotor in flight]. (WP0073 00-12)

CHANGE
NO. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C.,28 July 2008

TECHNICAL MANUAL

OPERATOR'S AVIATION UNIT AND INTERMEDIATE MAINTENANCE MANUAL
INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST
FOR
TEST SET
AVIATION VIBRATION ANALYZER (AVA)
WITH VERSION 7.01
P/N 29313107
NSN 6625-01-282-3746

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

TM 1-6625-724-13&P, 7 March 2002, is updated as follows:

1. File this sheet in front of the manual for reference.

2. New or updated text is indicated by a vertical bar in the outer margin of the page.

3. Added illustrations are indicated by a vertical bar adjacent to the figure number. Changed illustrations are indicated by a miniature pointing hand adjacent to the updated area.

4. Remove old pages and insert new pages as indicated below.

Remove Pages	Insert Pages
A and B	A and B
i thru x	i thru x
INDEX-1 and INDEX-2	INDEX-1 and INDEX-2

5. Replace the following work packages with their revised version.

<u>Work Package Number</u>

WP 0002 00
WP 0009 00 thru WP 0011 00
WP 0058 00
WP 0061 00
WP 0063 00 thru WP 0065 00
WP 0069 00
WP 0071 00
WP 0073 00 thru WP 0074 00

6. Add the following new work package.

<u>Work Package Number</u>

WP 0075 01

CHANGE
NO. 3

By Order of the Secretary of the Army

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army
0819002

CHANGE
NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 22 February 2006

TECHNICAL MANUAL

**OPERATOR'S AVIATION UNIT AND INTERMEDIATE MAINTENANCE MANUAL
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4. Remove old pages and insert new pages as indicated below.

Remove Pages	Insert Pages
a through c/(d blank)	a through c/(d blank)
A and B	A and B
i thru x	i thru x
INDEX-1 thru INDEX-3/(4blank)	INDEX-1 thru INDEX-3/(4blank)

5. Replace the following work packages with their revised version.

Work Package Number

WP 0063 00 and WP 0064 00
WP 0069 00
WP 0071 00 and WP 0072 00
WP 0075 00

By Order of the Secretary of the Army:

PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

Official:

Sandra R. Riley
SANDRA R. RILEY
Administrative Assistant to the
Secretary of the Army
0603905

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., 22 December 2003

TECHNICAL MANUAL

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4. Remove old pages and insert new pages as indicated below:

Remove Pages	Insert Pages
A and B	A and B
i thru vi	i thru vi
INDEX Pages 1 thru 3/(4blank)	INDEX Pages 1 thru 3/(4 blank)

5. Replace the following work packages with their revised version.

<u>Work Package Number</u>
WP 0001 00 thru WP 0002 00
WP 0004 00 thru WP 0007 00
WP 0012 00 and WP 0013 00
WP 0025 00
WP 0029 and WP 0030 00
WP 0061 00
WP 0063 00 thru WP 0065 00
WP 0069 00
WP 0071 00 thru WP 0073 00
WP 0075 00

7. Add the following new work packages.

<u>Work Package Number</u>
WP 0005 01

By Order of the Secretary of the Army:

Official:

PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

Joel B. Hudson

JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army
0331610

LIST OF EFFECTIVE PAGES/WORK PACKAGES

NOTE: A vertical line in the outer margins of the page indicates the portion of text affected by the changes. A miniature pointing hands indicates changes to illustrations. A shaded area indicates changes to wiring diagrams.

Date of issue for the original manual is:

Original ………7 March 2002
Change 1…….. 22 December 2003
Change 2…….. 22 February 2006
Change 3…….. 28 July 2008

TOTAL NUMBER OF PAGES FOR FRONT AND REAR MATTER IS 12 AND TOTAL NUMBER OF WORK PACKAGES IS 12 CONSISTING OF THE FOLLOWING:

Page/WP No.	*Change No.
Cover	1
a	0
b and c	2
d blank	0
A and B	3
i thru x	3
Chapter 1 Title Page	0
WP 0001 00	1
WP 0002 00	3
WP 0003 00	0
Chapter 2 Title Page	0
WP 0004 00	1
WP 0005 00	0
WP 0005 01	1
WP 0006 00	1
WP 0007 00	1
WP 0008 00	0
WP 0009 00	3
WP 0010 00	3
WP 0011 00	3
WP 0012 00	1
WP 0013 00	1
WP 0014 00	0
WP 0015 00	0
Chapter 3 Title Page	0
WP 0016 00	0
WP 0017 00	0
WP 0018 00	0
WP 0019 00	0
Chapter 4 Title Page	0
WP 0020 00	0
WP 0021 00	0
WP 0022 00	0
WP 0023 00	0
WP 0024 00	0
WP 0025 00	1
WP 0026 00	0
WP 0027 00	0
WP 0028 00	0
WP 0029 00	1
WP 0030 00	1
WP 0031 00	0
WP 0032 00	0
WP 0033 00	0
WP 0034 00	0
WP 0035 00	0
WP 0036 00	0
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WP 0069 00	3
WP 0070 00	0
WP 0071 00	3
WP 0072 00	2

Page/WP No.		*Change No.
WP 0073 00	………………	3
WP 0074 00	………………	3
WP 0075 00	………………	2
WP 0075 01	………………	3
INDEX-1 thru INDEX-2	……	3
INDEX-3	……….……..	2
INDEX-4 blank	………………	0

OPERATOR'S, AVIATION UNIT, AND INTERMEDIATE MAINTENANCE MANUAL INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST FOR TEST SET, AVIATION VIBRATION ANALYZER (AVA) PN 29313107 NSN 6625-01-282-3746

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manual. If you find mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) located at the back of this manual, directly to: Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also provide DA Form 2028 information to AMCOM via e-mail, fax or the World Wide Web. Our fax number is: DSN 788-6546 or Commercial (256) 842-6546. Our e-mail address is 2028@redstone.army.mil. Instructions for sending an electronic 2028 may be found at the back of this manual immediately preceding the hard copy 2028. For the World Wide Web use: https://amcom2028.redstone.army.mil.

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TABLE OF CONTENTS

*This TM supersedes copy dated 31 August 1994

TITLE	WP No./Page

LIST OF ILLUSTRATIONS

TITLE	WP No./Page

CHAPTER 4 (Continued)

CHAPTER 5

Not Applicable

REPAIR PARTS AND SPECIAL TOOLS LIST

TITLE **WP No./Page**

REPAIR PARTS AND SPECIAL TOOLS LIST (Continued)

H-60 SERIES

AH-1S

TITLE **WP No./Page**

TITLE **WP No./Page**

UH-1H/M (Continued)

H-47

LIST OF TABLES

HOW TO USE THIS MANUAL

PURPOSE AND SCOPE

This technical manual provides Aviation Unit (AVUM) and Field level (AVIM) maintenance information for the Aviation Vibration Analyzer Test Set. The information includes equipment description and operator instructions, trouble shooting procedures, maintenance and testing procedures, and supporting data including a Repair Parts and Special Tools List (RPSTL) for identifying and ordering repair parts.

ARRANGEMENT, IDENTIFICATION AND LOCATION OF FRONT MATTER, REAR MATTER, CHAPTERS AND WORK PACKAGES.

This manual is composed of front matter, chapters containing work packages (WP's), and rear matter.

Front Matter

The front matter includes such items as the Warning Summary, List of Effective Pages/WPs, Table of Contents, and How to Use This Manual.

Chapters and Work Packages

The WPs contain information pertinent to the performance of specific tasks. Each WP is maintained as a separate entity. The WPs are grouped into Chapters based on overall content. WPs are arranged in numerical sequence regardless of chapter division. The chapter divisions and the WPs contained within the chapters are listed in the Table of Contents.

Chapter 1 – Introductory Information with Technical Principals of Operation. This chapter provides general and descriptive information concerning the equipment.

Chapter 2 – Operating Instructions. This chapter provides a description of the operator controls and indicators, and provides instructions for operating the equipment in detail.

Chapter 3 – Troubleshooting Instructions. This chapter provides troubleshooting/fault isolation information appropriate to the maintenance level covered. The troubleshooting procedures are presented according toe the fault symptoms observed during the operational check procedures in Chapter 4.

Chapter 4 – Maintenance Instructions. This chapter provides information on performing preventive and corrective maintenance actions. Included are instructions concerning inspection, preventive maintenance checks and services, operational check, and repair actions including subassembly/component removal installation procedures.

Chapter 5 – Supporting Information. This chapter provides information to support the maintenance actions in Chapter 4. Included are a list of reference material, the Maintenance Allocation Chart, which identifies maintenance actions and their maintenance levels, the RPSTL and AVA application procedures for every aircraft the Aviation Vibrations Analyzer is used with.

Rear Matter

The rear matter includes such items as an alphabetical index to the manual, and copies of DA From 2028-2 for recommending improvements to the manual.

Identifying Work Packages

Each WP is identified by a six digit number. The first digits are assigned sequentially.

Locating Work Packages

There are two ways to locate a WP when the number is not known, using the Table of Contents in the manual's front matter and using the Index in the manual's rear matter.

Locating a Work Package in the Table of Contents

First determine the category of the WP subject, then find the appropriate chapter in the Table of Contents. Scan the WP titles in that chapter until you find the WP subject matter. In the example below, it is desired to locate the inspection and fault isolation for the Universal Tracking Device (yellow highlight). The procedures fall into the category of Troubleshooting. Go to the Table of Contents and find the chapter titled "Troubleshooting Instructions". Scan the WP titles within that chapter until you find "Universal Tracking Device (UTD) Inspection and Fault Isolation" and follow the leader line to find the WP number.

TABLE OF CONTENTS

Locating a Work Package in the Index

Look up the subject matter alphabetically in the Index. The Index lists the applicable WP number and the page number within the WP on which the subject matter starts. In the example below, it is desired to locate the Control and Display Unit (CADU) (yellow highlight). Go to the index, find "Control and Display Unit" and follow the leader line to find the page number.

ALPHABETICAL INDEX

WORK PACKAGE CONTENT AND PRESENTATION

The content and the presentation techniques used in the WP's vary according to the material covered.

The TM number and WP number are placed at the top of the page and are set off by horizontal line as show below

TM 1-6625-724-13&P	0002 00

The page number is placed at the bottom of the page and consists of the WP number and a sequential number denoting the page within the WP as shown below.

0002 00-1

Secondary and lower-level paragraphs are denoted by headings set in Upper and Lower Case type. These paragraphs always relate to and are subordinate to the most recent primary paragraph heading.

Figures are titled and numbered and listed in the table of contents under the chapter and WP they appear and if you follow the leader line the last digit is the page number of the WP where the figure is shown.

Descriptive Narrative

For WP's consisting primarily of descriptive narrative (equipment data, operaton, etc.), text begins immediately below the WP title and number.

Procedures

For WPs consisting primarily of procedures (maintenance tasks, operating instructions, etc.), the WP includes a statement of the scope of the WP and an initial setup section with index and figures if any immediately following the WP title and number. The Index lists what tasks are covered in the WP. Procedural steps are numbered (See example below).

AUTOMATIC SYSTEM TEST
AVIATION VIBRATION ANALYZER

1. A self-test is automatically performed every time the DAU is powered up. This power-up test takes approximately two seconds to complete. This tests the unit's basic operation and ability to make measurements. If a test fails, a failure error message appears on the CADU screen.
2. A self-test is automatically performed at 24-hour intervals. This test takes approximately ten seconds to complete. Results are stored in memory and are used to correct measured data.
3. The following procedures will verify basic operation of the AVA system.

Initial Setup:

Personnel Required: **Aircraft Technician**

Parts:

Equipment Condition: **Connected for normal operation**

CHAPTER 1

INTRODUCTION

GENERAL INFORMATION
AVIATION VIBRATION ANALYZER

Index

Figures

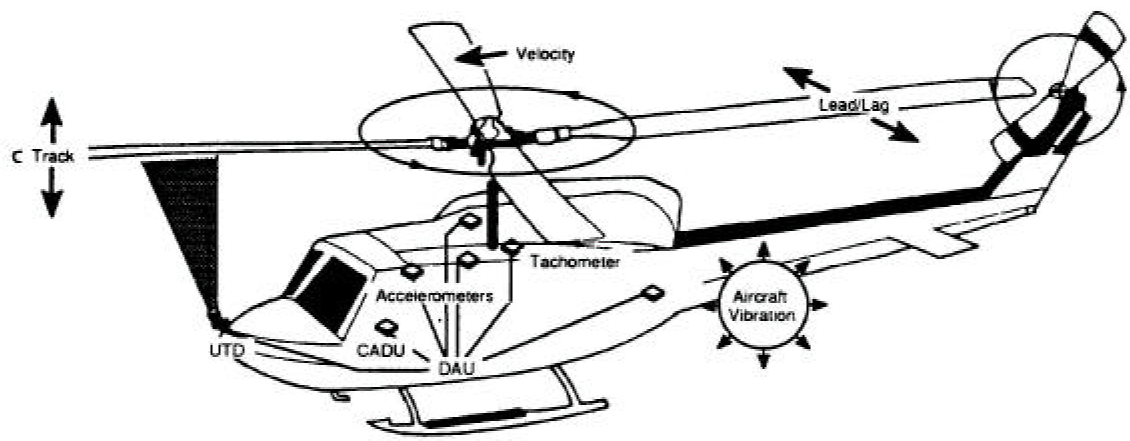
1. SCOPE

NOTE

Version 7.01 will not operate with previous CADU or DAU versions (i.e. 3.1 or 6.01/6.03).

a. This manual contains operation, maintenance, illustrated parts breakdown, and repair parts list for the Test Set, Aviation Vibration Analyzer (AVA), Part Number 29313107 (NSN 6625-01-282-3746), version 7.01.

b. The AVA is a portable field instrument for checking performance of helicopter rotor systems. A typical system setup is shown below in figure 1.



AVA	
UTD	Universal Tracking Device
CADU	Control and Display Unit
DAU	Data Acquisition Unit

Sensor	DAU Channels	Measurement
Accelerometer	14	Vibration
Tachometer	2	Shaft Speed
Tracker	2	Track/Lag

Figure 1. Typical System Setup

c. The AVA is capable of testing helicopter rotor blade vibrations to detect vibration faults and make recommended maintenance actions to correct any faults.

d. The AVA, coupled with an engine adapter kit, can perform engine vibration analysis.

2. MAINTENANCE FORMS, RECORDS AND REPORTS.

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA PAM 738-751, The Army Maintenance Management System - Aviation (TAMMS-A).

3. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR).

If your AVA needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Put it on an SF368 (Quality Deficiency Report). Mail it to us at:

Commander
U.S. Army Aviation and Missile Command
ATTN: AMSAM-MMC-MA-NM
Redstone Arsenal, AL 35898-5230

We'll send you a reply.

4. DESTRUCTION OF ARMY MATERIAL TO PREVENT ENEMY USE.

Procedures for destroying Army Material to prevent enemy use are listed in TM 750-244-1-4

5. PREPARATION FOR STORAGE OR SHIPMENT.

Instructions are provided in Chapter 4.

6. LIST OF ACRONYMS.

See list immediately following.

ACRONYM LIST

A	Amperes
A/D	Analog-To-Digital
AAT	Active Automatic Tracker
AC or ac	Alternating Current
ACC	Accelerometer
AGC	Automatic Gain Control
ASPA	Asynchronous Power Averaged Spectrum
AVA	Aviation Vibration Analyzer
BIT	Built in test
BSY	Busy
C	Centigrade
CADU	Control And Display Unit
CAGE	Commercial and Government Entity
C-BOX	Combiner Gearbox
CCA	Circuit Card Assembly
CCM	Credit Card Memory
CD	Carrier Detect
CH	Channel
CPG	Co-pilot Gunner
CPR	Cardiopulmonary Resuscitation
CR	Carriage Return
CTRST	Contrast

ACRONYM LIST

CTS	Clear To Send
D/A	digital-to-analog
DAC	digital-to-analog converter
DAU	Data Acquisition Unit
dB	decibel
Deg	degrees
DIAG	Diagnostic
DIAGS	diagnostics
DOS	Disk Operating System
DPL	Diagnostic Programming Language
DRAM	Dynamic Random-Access-Memory
DSIMM	dynamic single in-line memory module
DSP	Digital Signal Processing
DSR	Data Set Ready
DTR	Data Transfer Ready
DVM	digital voltmeter
ECU	Engine Control Unit
EIR	Equipment Improvement Recommendation
EMI	electro-magnetic interference
EPROM	Electronic Programmable Read-Only-Memory
EPT	Enhanced Passive Tracker
ESD	Electrostatic Discharge
EUTD	Enhanced Universal Tracking Device
EXT	external
F	Fahrenheit
FAB	Forward Avionics Bay
FFT	Fast Fourier Transform
FIFO	First In-First Out
ft.	feet
Gbytes	Giga bytes
Hz	Hertz
I/O	Input/Output
IBM	International Business Machines
ID	Identify
IEFAB	Improved Extended Forward Avionics Bay
IETM	Integrated Electronic Technical Manual
IPS	Inches Per Second
ips	inches per second
IR	Infrared
kHz	kilo Hertz
lb.	Pound
LED	Light Emitting Diode
LF	Line Feed
LMT	Limits
LMP	Lamp
MB	Megabyte
MHz	Megahertz
mm	millimeter

ACRONYM LIST

MMI	Man Machine Interface
MMS	Mast Mounted Sight
MPD	Multi-Parameter Display
mV	millivolt
mV/g	millivolt per Gravity
N/A	Not Applicable
No.	Number
Nr	Main Rotor Speed
NSN	National Stock Number
N2	Power Turbine Speed
OMI	Operator Machine Interface
OS	Operating System
OUTBD	Outboard
PAM	Process Analysis Mode
PC	Personal Computer
PCB	printed circuit board
PCL	Pitch Change Link
PHV	Pilot Heel Vertical
P/L	Pitch Link
PMCS	Preventive Maintenance Checks and Services
PROM	Programmable Read Only Memory
P/N	Part Number
PWA	Printed Wiring Assembly
PWR	Power
RADS-AT	Rotor Analysis Diagnostic System-Advanced Technology
RADSCOM	RADS-AT Communication Program (DOS Version)
RAM	Random Access Memory
RDG	Rapid Deployment Gear
RDY	Ready
RPM	Revolutions per Minute
RTN	Return
1/REV, 2/REV, 3/REV, etc.	Once per revolution, Twice per revolution, etc.
RX	Receive
SG	Standard Landing Gear
SI	Smiths Industries
SPS	Signal Processing Systems, a division of Smiths Industries
SPU	Signal Processing Unit
SSPA	Synchronous Sampled Power Averaged Spectrum
SSTA/SSTAR	Synchronous Sampled Time Averaged Spectrum
SW	Switch
T&B	Track and Balance
Tach	Tachometer
TACHO	Tachometer
TGT	Target
TRK	Tracker
UTD	Universal Tracking Device

ACRONYM LIST

Vac	Volts alternating current
Vdc	Volts direct current
Vib	Vibration
VRTN	Volts Return
WinRADSCOM	Windows RADSCOM
WP	Work Package

END OF WORK PACKAGE

EQUIPMENT DESCRIPTION
AVIATION VIBRATION ANALYZER

Index

Tables

1. EQUIPMENT CHARACTERISTICS, CAPABILITIES AND FEATURES

FUNCTION

a. General. The AVA is a test set that is designed to measure, record, and process vibration and blade position information in order to diagnose and correct rotor and vibration related faults. The system combines a measurement capability with a programmable analysis and display capability that presents measurement, diagnostic, and corrective information to maintenance personnel for action.

b. Electrical System: The AVA contains two power cables to permit operation from the following power sources:

1. 28 Vdc aircraft power

2. 12 Vdc for charging CADU battery

2. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

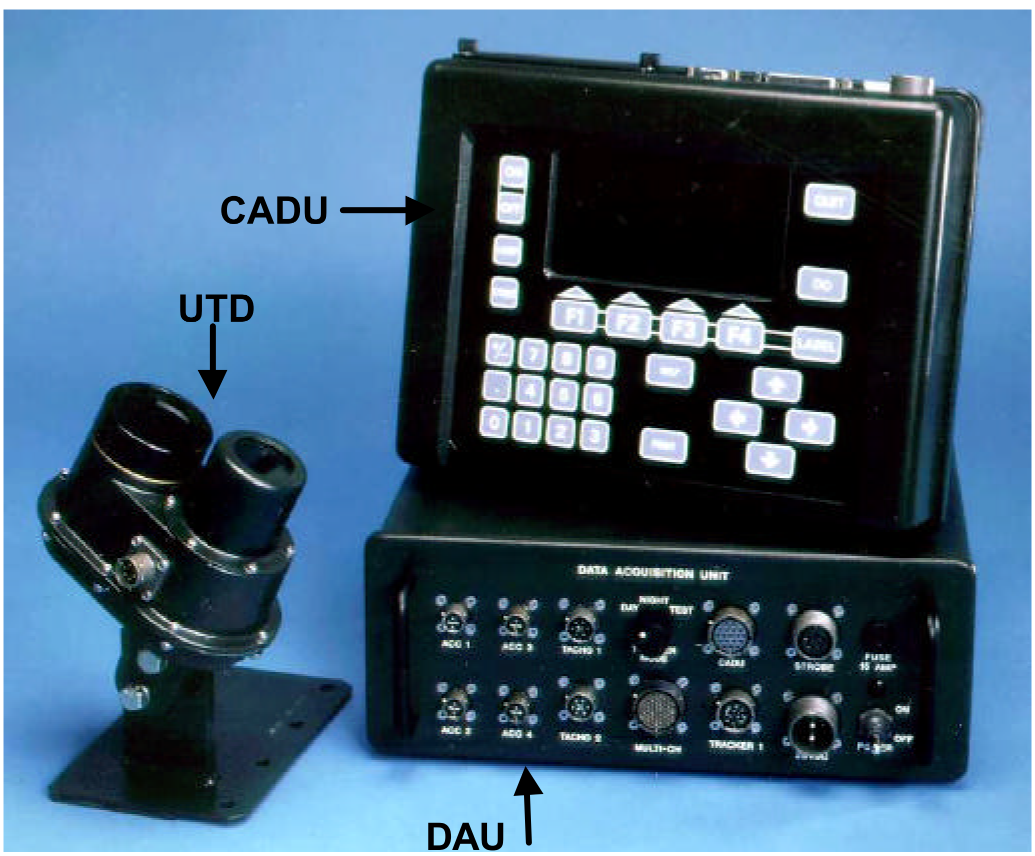


Figure 1. AVA Major Components

a. General: The major components furnished with the AVA are shown in figure 1. All items included in the basic kit are listed in table 1.

b. Control and Display Unit (CADU): To control data acquisition, display measurement and analysis results, print reports, and transfer data to or receive data from an off-line computer.

c. Data Acquisition Unit (DAU): Processes tracker and vibration signals.

d. Universal Tracking Device (UTD): Projects light source for blade rotation during night/active. Receives intensity changes to obtain blade height information during day/passive.

e. Accessories: An accessory storage case is provided for individual helicopter types. The accessories supplied with the AVA are listed in tables 2 and 3.

Table 1. Inventory List for AVA Basic Kit P/N 29313107 (NSN 6625-01-282-3746)

Description	Part Number	NSN	Qty
Control and Display Unit (CADU) (with serial and parallel printer ports)	29314106	6625-01-325-3390	1
Data Acquisition Unit (DAU)	29328203	6695-01-325-3391	1
10-ft Aircraft Power Cable	29104700	6150-01-327-6827	1
10-ft DAU to CADU Cable	29325601	6150-01-327-4177	1
Universal Tracking Device (UTD)	29310700	6210-01-348-8252	1
25-ft UTD Cable	29325701	6150-01-327-4178	1
Optical RPM Sensor with 50-ft Cable	29314700	6625-01-327-5323	1
Optical RPM Sensor Bracket	29198700	5340-01-379-2647	1
Magnetic RPM Sensor	27288400	6625-01-327-5359	1
20-ft Magnetic RPM Sensor Cable	29105403	6450-01-327-6828	1
54 mV/g Accelerometer	28110900	6680-01-328-1913	2
Accelerometer Mounting Bracket	29313000	5340-01-331-5884	2
25-ft 54 mV/g Accelerometer Cable	29105605	6150-01-347-0052	1
50-ft 54 mV/g Accelerometer Cable	29105600	6150-01-328-1872	1
Shipping/Storage Case Assembly	29320800		1
12V Battery Charger	29315000	6130-01-329-6494	1
256KB Credit Card Memory	28131220	5895-01-329-4862	1
6-ft RS-232 CABLE (DB9F to DB25M)	28130802	6150–01–365–398	1
Gender Changer (DB25F to DB25F)	28130800	6625–01–426–0666	1
RS-232 Adapter (DB25M to DB9F)	28130801	4940-01-366-5274	1
Electronic Gram/Ounce Scale	29323700	6670-01-325-3162	1
Electronic Gram/Ounce Scale	*29323703	6670-01-325-3162	1
Electronic Gram/Ounce Scale	*CS2000	6670-01-407-4073	1
Canvas Carrying Case	29086000	5895-01-324-9712	1
Reflective Tape (3M-7610)	10605000	9390-01-334-4357	1
Inventory List Card	29321207		1
Identification Plate	29327200	9905–01–469–0497	1
RADSCOM Disk (Superceded by WinRADSCOM CDROM)	29788700		1
WinRADSCOM CDROM	553959-03-01		1
Technical Manual-Army Document	TM 1-6625-724-13&P		1

*** This is an alternate part.**

Table 2. AVA Specific Aircraft Accessories

Description	Part Number	NSN	Qty
Inventory List for AH-1S Aircraft Adapter Set P/N 29315500 (NSN 6625-01-324-9820)			
Adapter Set Case	29320100		1
AH-1 UTD Bracket	29197900		1
AH-1 Magnetic RPM Sensor Mounting Bracket	29315600		1
AH-1 Magnetic RPM Sensor Striking Plate	29315700		1
AH-1 DC Power Cable	29317100	6150-01-327-4182	1
Inventory Card	29321600		1
Inventory List for AH-64A Aircraft Adapter Set P/N 29315300 (NSN 6625-01-324-9818)			
Adapter Set Case	29320100		1
AH-64A UTD Bracket	29240100		1
6-ft AH-64A/D to DAU Cable	29304600	6150-01-327-6830	1
Inventory Card	29321400		1
Inventory List for AH-64D Aircraft Adapter Set P/N 29315301			
Adapter Set Case	29320100		1
AH-64D UTD Bracket	29771400		1
6-ft AH-64A/D to DAU Cable	29304600	6150–01–327–6830	1
Inventory Card	29321401		1
Inventory List for EH/UH-60 Aircraft Adapter Set P/N 29315400 (NSN 6625-01-324-9819)			
Adapter Set Case	29320100		1
EH/UH-60 UTD Bracket	29328100		1
25-ft 54 mV/g Accelerometer Cable	29105605	6150-01-347-0052	2
54 mV/g Accelerometer	28110900	6680-01-329-1913	1
Accelerometer Mounting Bracket	29313000	5340-01-331-5884	1
High Speed Shaft RPM Sensor Bracket	29754500		1
Accelerometer Mounting Plate	29317300		1
Plug	20114-109		1
Inventory Card	29321500		1
Inventory List for OH-58A/C/D Aircraft Adapter Set P/N 29316000 (NSN 6625-01–325-8536)			
Adapter Set Case	29320100		1
OH-58A/C/D UTD Bracket	29328000		1
OH-58A/C/D Optical RPM Sensor Bracket	29198600		1
OH-58A/C/D Magnetic RPM Sensor Mounting Bracket	29316100		1
OH-58A/C/D Magnetic RPM Sensor Striker Plate	29316300		1
OH-58A DC Power Cable	29317100	6150-01-327-4182	1
Inventory Card	29321700		1
Inventory List for UH-1H/M Aircraft Adapter Set P/N 29316900 (NSN 6625-01–324-9822)			
Adapter Set Case	29320100		1
UH-1 UTD Bracket	29328001		1
UH-1 Magnetic RPM Sensor Mounting Bracket	29312600		1
UH-1 Magnetic RPM Sensor Striker Plate	29312700		1
UH-1 DC Power Cable	29312800	6150-01-327-6829	1
Inventory Card	29321900		1
Inventory List for CH-47D Aircraft Adapter Set P/N 29315200 (NSN 6625-01-364-4477)			
Adapter Set Case	29726900		1
UTD	29310700	6210-01-348-8252	1
Sunshield, UTD	29722100		2
50-ft. UTD Cable	29725500		1
CH-47D Forward UTD Bracket	29141700		1

Table 2. AVA Specific Aircraft Accessories (Cont.)

Inventory List for CH-47D Aircraft Adapter Set P/N 29315200 (NSN 6625-01-364-4477) (Cont)			
CH-47D Aft UTD Bracket	29724300		1
15-ft. CH-47D to DAU Cable	29085700		1
50-ft. 54 mV/g Accelerometer Cable	29105600	6150-01-328-1872	4
CH-47D Accelerometer Mounting Bracket	29339500		3
Inventory Card	29321300		1

Table 3. AVA Common Replacement Parts

Description	Part Number	NSN	Qty
Bulb, UTD	28127400	6240-01-333-5703	1
Credit Card Memory (CCM), 256 Kilobyte	28131210	5895-01-329-4862	1
Cable, AVA Test Set	29283200	6150-01-356-5825	1
Fuse, DAU, 15A, 125 Volt	28107801	5920-01-111-5535	1
Tape, Reflective, 150 Feet	10605000	9390-01-334-4357	1
Accelerometer, 54 mV/g	28110900	6680-01-329-1913	1
Cable, Accelerometer, 54 mV/g, 25 Feet	29105605	6150-01-347-0052	1
Cable, Accelerometer, 54 mV/g, 50 Feet	29105600	6150-01-328-1872	1

3. EQUIPMENT DATA

Table 4. Reference Data

UNIT DIMENSIONS	
Data Acquisition Unit (DAU)	Height inches (mm): 4 ¾ (120) Width inches (mm): 12 ⅛ (308) Depth inches (mm): 12 ½ (317) Weight pounds (kg): 11 ½ (5.1)
Control and Display Unit (CADU)	Height inches (mm): 8 ½ (216) Width inches (mm): 11 (279) Depth inches (mm): 2 ⅛ (54) Weight pounds (kg): 5 ½ (2.5)
Universal Tracking Device (UTD)	Height inches (mm): 6 ½ (160) Width inches (mm): 3 ½ (87) Depth inches (mm): 5 ¾ (145) Weight pounds (Kg): 1 ½ (0.6)
MEMORY CAPACITY	
Data Acquisition Unit (DAU)	2.0 Mb (Standard Release)
Control and Display Unit (CADU)	2.0 Mb (Non-volatile static RAM)
POWER REQUIREMENTS	
Data Acquisition Unit (DAU)	Input dc power: 24-36 Vdc (Reverse polarity protected and fused)
Control and Display Unit (CADU)	Input dc power: 12 Vdc Internal battery power: 8 hours (Non-volatile memory retained 2 years)
POWER DRAW	
Data Acquisition Unit (DAU)	28 watts
Control and Display Unit (CADU)	11 watts
Total Both Units	39 watts
ENVIRONMENTAL REQUIREMENTS	
Data Acquisition Unit (DAU)	Operating: -40 to +131°F (-40 to +55ºC) Storage: -60 to +160°F (-51 to +71ºC)
Control and Display Unit (CADU)	Operating: -40 to +131°F (-40 to +55ºC) (Ext. Power) Storage: -51 to +160°F (-51 to +71ºC) Operating: -4 to +131°F (-20 to +55ºC) (Int. Power) Storage: -40 to +70°F (-40 to +70ºC)
Universal Tracking Device (UTD)	Operating: -40 to +158°F (-40 to +70ºC) Storage: -60 to +158°F (-51 to +70ºC)

END OF WORK PACKAGE

TECHNICAL PRINCIPLES OF OPERATION
AVIATION VIBRATION ANALYZER

Figures

PRINCIPLES OF OPERATION

The AVA system maintains a database of measured data, diagnostic outputs, and aircraft history. The system will generate printed reports from this database to support historical review and trending of data. All or part of the database may be deleted, transferred to an external computer, or restored from a computer. Transfer is accomplished by means of an RS-232 link using KERMIT protocol, or a solid-state memory unit the size of a credit card. Diagnostic programs and replacement software modules are transferable by the same means.

The primary mission of the AVA is to collect helicopter blade track height, blade lead/lag, vertical/lateral vibration measurements, shaft vibration, and to calculate the recommended maintenance correction to the rotor system that will result in reduced vibration levels. This system may also be used for engine vibration analysis.

The actual measurements are carried out automatically and simultaneously by a single operator keystroke. The AVA executes configured, internally stored software programs limited to the established aircraft maintenance procedures that reduce vibration levels. User interface is needed for entry of aircraft identification, single key commands for data collection, results display, and computed maintenance corrections.

Each of the AVA functions provides an overview style of direction to the operator in the form of a main diagram. The diagram contains all of the elements and options that the operator can invoke along with a general description of what to do in making the desired selections.

Figure 1 shows the four main functions performed by the AVA and the basic elements associated within each function.

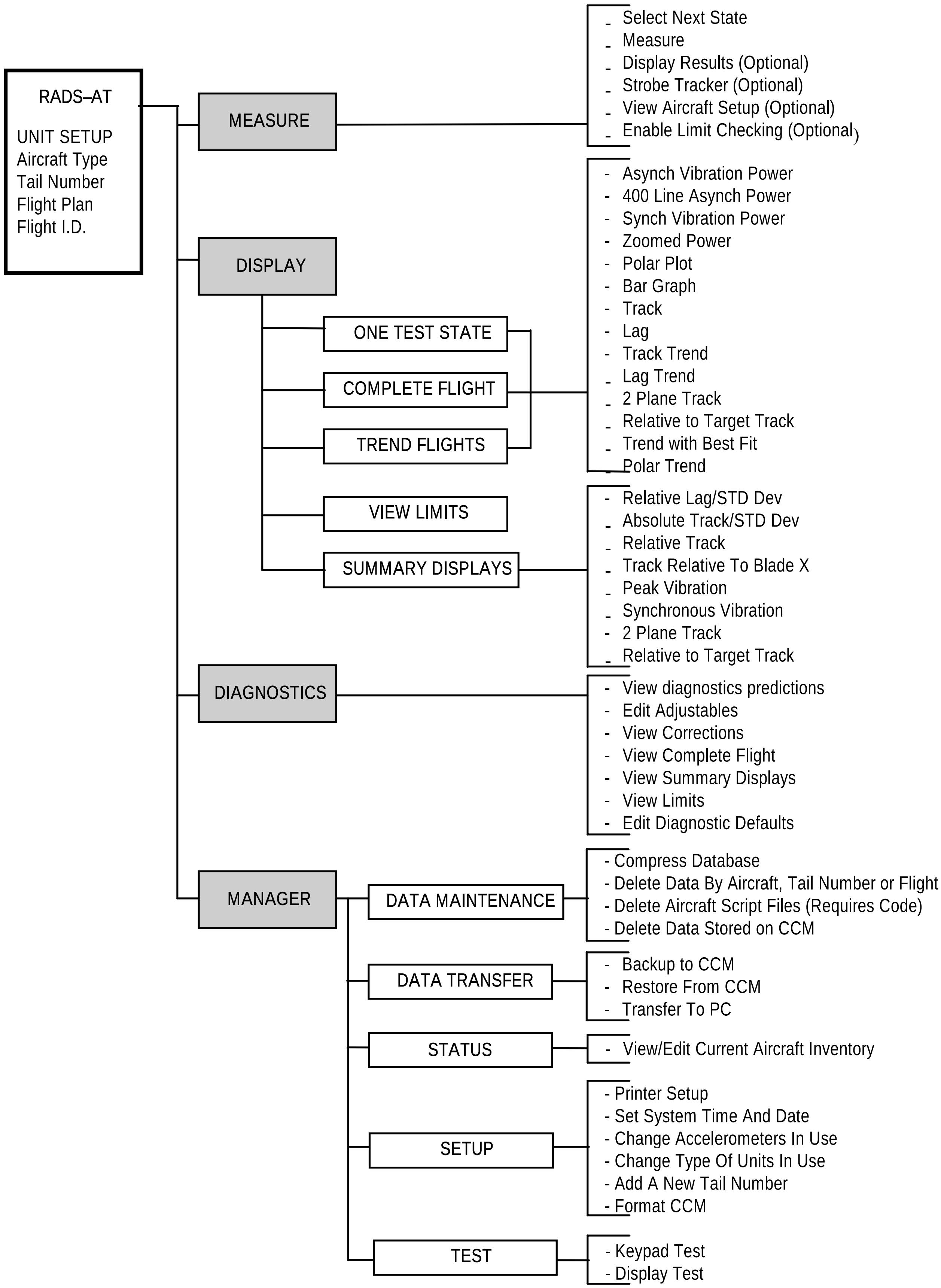


Figure 1. AVA Overall Menu Structure

CHAPTER 2

OPERATING INSTRUCTIONS

DESCRIPTION AND USE OF OPERATOR CONTROLS AND INDICATORS AVIATION VIBRATION ANALYZER

CAUTION

Handle the test set with care as the electronic circuitry it incorporates can be damaged by shock from improper handling.

Index

Figures

1. GENERAL

This chapter contains instructions for unpacking and installing AVA assemblies for assigned aircraft. Preventive maintenance checks and services are included. Also included are descriptions of operator's controls and indicators plus operating procedures.

2. PRE-OPERATION PROCEDURES

CAUTION

Handle the test set with care as the electronic circuitry it incorporates can be damaged by shock from improper handling.

NOTE

The Control and Display Unit (CADU) contains rechargeable batteries. This unit must be recharged prior to use in accordance with the following:

Open credit card memory door (located on the top side of the CADU) by loosening the two hold down screws. The 12 Vdc power jack input is located next to the exposed credit card memory drive. Plug the 12 Vdc Battery Charger (supplied with the AVA) into the CADU first, then plug the charger into a 110 Vac wall outlet.

For a full charge that will give approximately eight hours of use, charge the CADU for at least eight hours.

3. CONTROLS AND INSTRUMENTS

a. General. This section describes the various instruments and controls and furnishes the operator with sufficient information pertaining to the various instruments to operate the equipment.

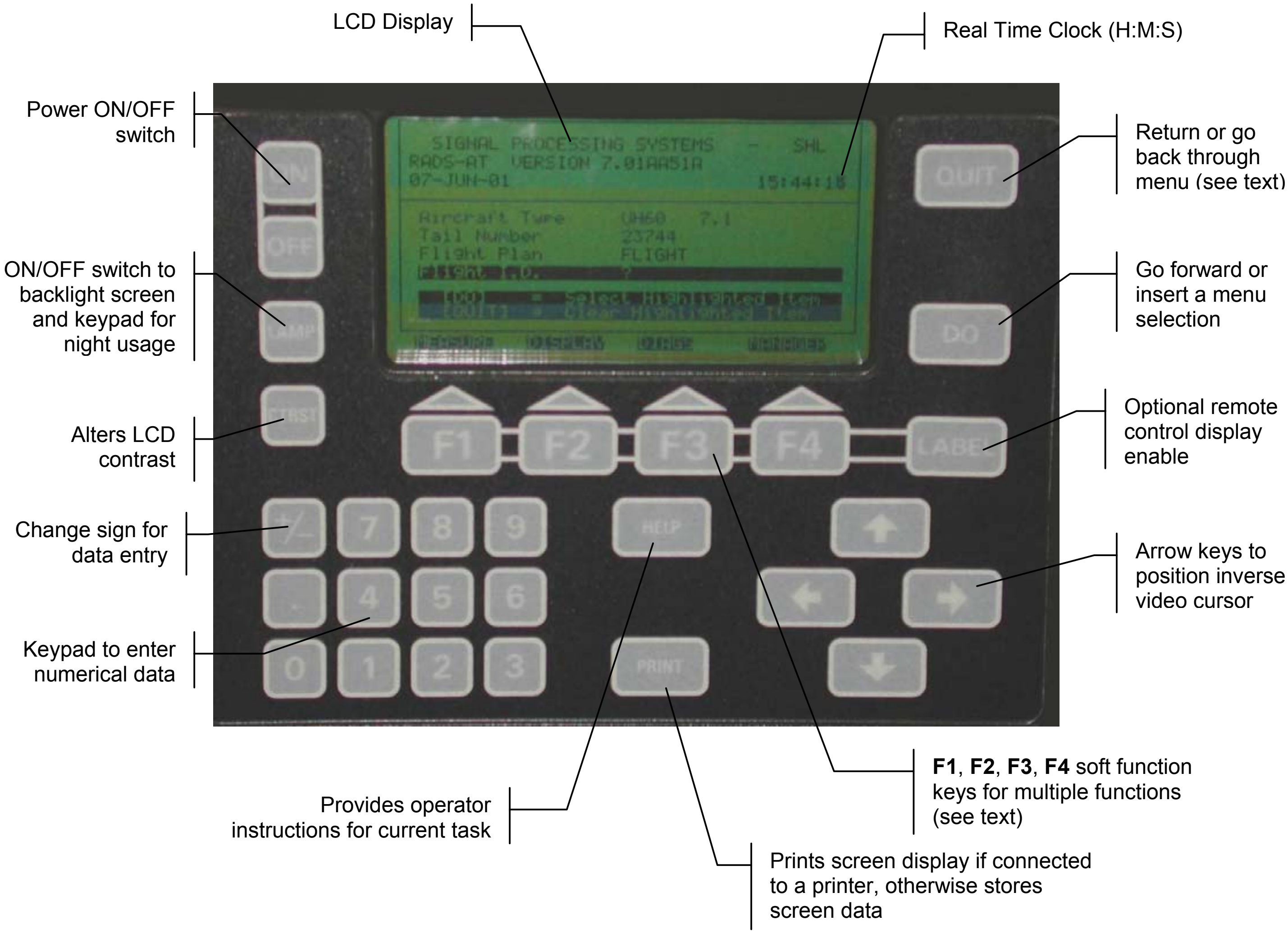


Figure 1. CADU Display and Keypad

b. The Control and Display Unit, see figure 1.

1. Power **ON/OFF**. The **OFF** position opens the circuit and shuts off the electrical power supply to the unit. The **ON** position provides electrical current to the unit when the power source is connected.
2. Function Keys. The four function keys (**F1**, **F2**, **F3**, and **F4**) provide the operator with the ability to select functions from within each menu. Functional keys are also used to enter alphanumerics in tail number menus.
3. Arrow Keys. Four arrow keys (UP, RIGHT, DOWN, and LEFT) on the lower right corner of the CADU move an inverse video cursor to highlight the various selections that the user will be making. Execution of the highlighted menu selection is accomplished by pressing the **DO** key.
4. **DO** Key. The **DO** key, located on the right-hand side of the CADU front panel, executes the operator selected menu item.
5. **QUIT** Key. In the DISPLAY mode, pressing the **QUIT** key will step the user back through previously displayed screens to return to the beginning of the selections. In the MEASURE mode, the **QUIT** key is used to abort or cancel whatever operation is being conducted.
6. **LAMP** Key. The **LAMP** key controls the backlighting of the CADU display. When externally powered, pressing the **LAMP** key will toggle the lamp OFF or ON, which will provide display lighting in darkened environments. When the CADU is operating on battery power the **LAMP** key must be pressed and held for display lighting.

7. **CTRST** Key. The Contrast key controls the readability of the CADU display. Pressing and holding the **CTRST** key will cause the display to change in contrast gradually. Release the **CTRST** key when the desired contrast is obtained.
8. Numeric Keypad. In the lower left corner are ten numeric keys (**0-9**), plus one key for the decimal and one key for the +/- that toggles numeric key entries to either positive or negative values.
9. **HELP** Key. The **HELP** key provides additional information in certain restricted cases.
10. **PRINT** Key. Pressing the **PRINT** key will print out the screen currently displayed on the CADU. If there is no printer currently attached, the CADU will store or "spool" the screen into memory for output when a printer is attached. The CADU will spool up to twenty screens. If more than twenty displays are spooled, the first display spooled will be discarded to make room for the next.
11. **LABEL** Key. Optional remote control display enable.

c. Data Acquisition Unit (DAU), see figure 2.

1. **ON/OFF** Switch. The **ON/OFF** switch provides power to the DAU and external power to the CADU.
2. **TRACKER MODE** Switch. The **TRACKER MODE** switch selects three modes of operation: **DAY**, **NIGHT**, or **TEST**.

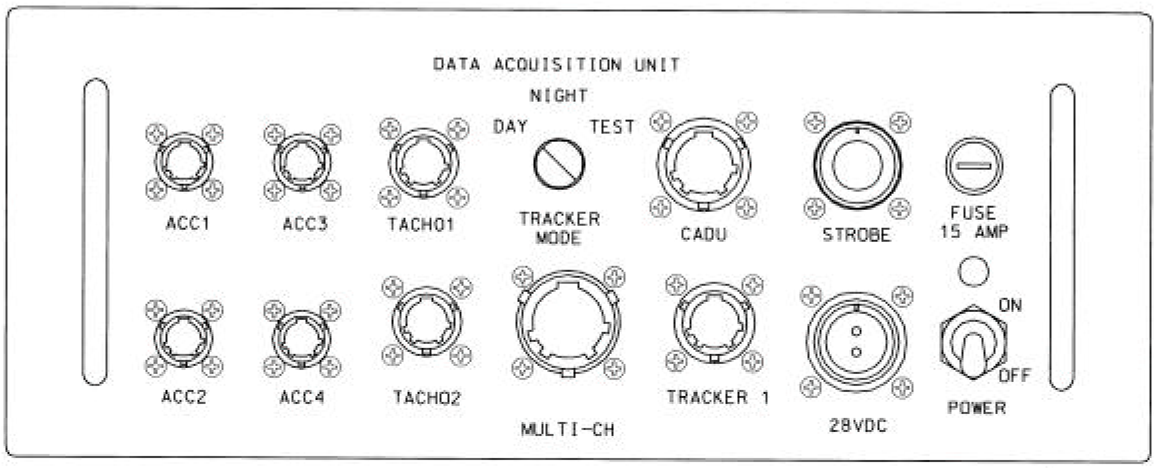


Figure 2. DAU Front Panel

29323700

29323703

Figure 3. Scale

d. Scale part number 29323700, see figure 3.

1. **OFF** Switch. The **OFF** switch removes voltage from internal circuits.
2. **ON/TARE** Switch. The **ON/TARE** switch is a momentary contact switch that applies internal power to the scale.
3. **GRAM/OUNCE** Selector Switch. The **GRAM/OUNCE** selector switch is a slide switch that selects a weighting of either gram or ounce.

NOTE

Ensure scale is turned off prior to changing gram/ounce switch.

e. Scale part number 29323703, see figure 3.

1. **On/Off/Zero Switch**. Pressing once applies internal power to the scale. Press and holding for three seconds removes voltage from internal circuits. Once on; after adding mass; pressing this switch will zero scale.
2. **Cal/Unit switch.** Press this key briefly to change weighing unit. The units available are grams (g), or pound-ounces (lb-oz). Press and hold this key to begin the calibration procedure.

END OF WORK PACKAGE

RADSCOM OPERATION
AVIATION VIBRATION ANALYZER

Figures

1. **Introduction**
The RADSCOM software is a Disk Operating System (DOS) based program supplied with the AVA. RADSCOM is designed to provide support functions for proper and effective operation of the AVA system, including two principle roles of loading and unloading aircraft data or setup files to and from the AVA CADU. A windows-based version of RADSCOM, referred to as WinRADSCOM, is also available for use with the AVA. Refer to WP 005 01 for operation and use of WinRADSCOM.

   a. **Loading Aircraft Setup Files (scripts) or Historical (backup) Data from a Personal Computer (PC)**
   These operations are performed when new or updated aircraft script files become available, or after the CADU database has been rebuilt. The aircraft specific script file is required to be resident in the AVA CADU prior to any measurement on the intended aircraft. For detailed instructions on this procedure, refer to sections 4 and 6.

   b. **Backup Aircraft Data from the CADU to the PC**
   The backup operation is usually performed when the CADU internal memory space is filled and the user wants to make new measurements, or when measured data needs to be transferred to another system or aviation facility. Using these instructions, the user can store data from the CADU onto the PC. Then the data can be deleted from the CADU to obtain more memory space for subsequent measurements, if desired. For detailed instructions on this procedure, refer to section 5.

2. **Installing or Updating RADSCOM on the PC**
The following paragraphs provide instructions on configuring the IBM PC/AT (or IBM compatible) for using the RADSCOM program.

   a. **Hardware Requirements**
   The RADSCOM package assumes the operater is using an IBM PC or AT compatible computer and Microsoft Windows? 95/98.. The computer must have an available RS-232 serial port. The communication package assumes that the serial port is configured as COM1 and will automatically set the baud rate, stop bits and parity to be compatible with the AVA. If the computer's RS-232 port is configured as COM2, use the RADSCOM selection menu "Set Serial Port To Use (default=1)" to set the serial port to the correct COM number, by entering the number "2", when prompted.

   b. **Installing RADSCOM Program on a Hard Drive from Floppy Disk**

NOTE
The following steps are required for initial installation of RADSCOM onto the hard drive of the PC, or if the version of RADSCOM on the hard drive is being replaced.

(1) To install or update the RADSCOM or aircraft configuration disks on a PC, insert the RADSCOM program disk into the disk drive.

(2) On the PC, select "Start", "Programs", and then click on "MS-DOS Prompt".

(3) On the PC, change the current directory to the letter of the disk drive (A:, B:, etc.), type "RCOM", and press the <RETURN> key. The RADSCOM Initial Menu, figure 1, will appear on the PC display screen.

(4) On the PC, press the down arrow to move the highlight bar over the selection "Maintenance Utilities" and press the <RETURN> key. The Maintenance Utilities menu will appear, see figure 2.

(5) On the PC, ensure the highlight bar is over the selection "Install RADSCOM on a Disk" and press the <RETURN> key. An old RADSCOM directory on hard disk may be deleted prior to installing a new one. This is accomplished by responding with a "Y" to the question on the display. This is the recommended method, unless the old directory contains stored data or custom files.

NOTE

Once the installation of the RADSCOM program is complete, it is recommended to keep the RADSCOM floppy disk in a safe location as a backup source for the program.

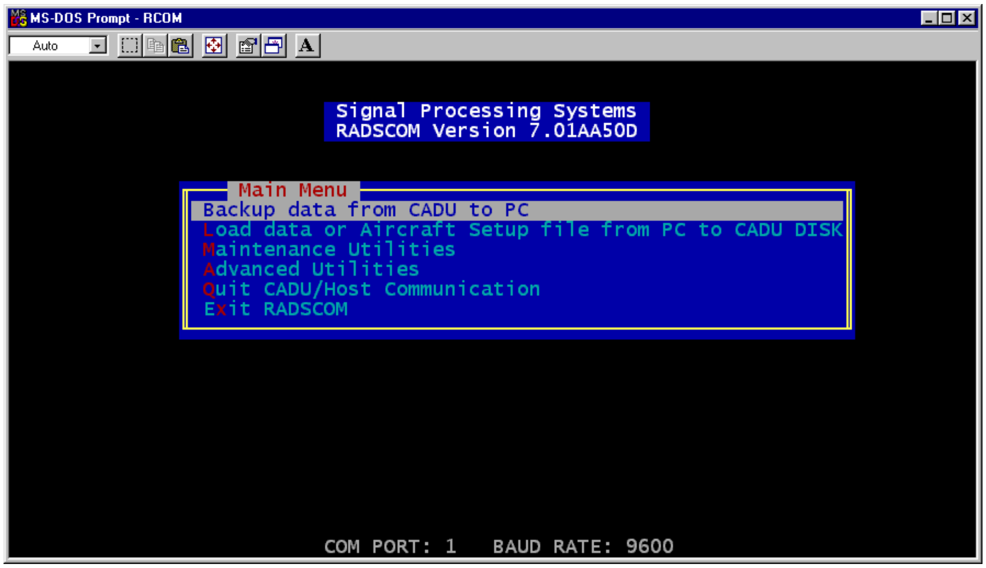


Figure 1. RADSCOM Initial Menu

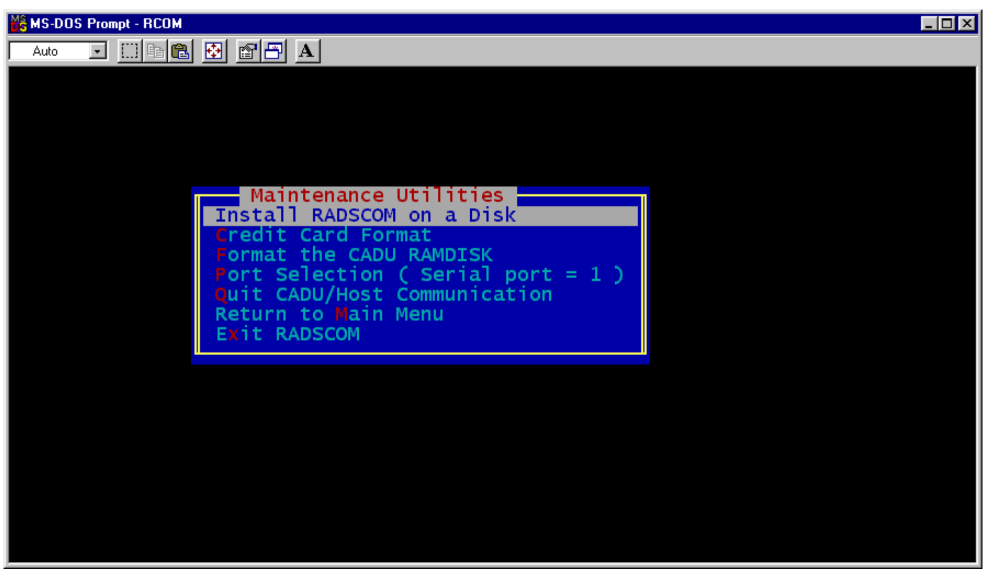


Figure 2. RADSCOM Maintenance Utilities Menu

3. **Using The RADSCOM Program**

To use the RADSCOM program the first time, create an icon on the Windows desktop by performing the following steps:

(1) Right-click on the open desktop, then select New and click on Shortcut. When the shortcut menu appears, select browse, then using the mouse, double-click the folder C:\RADSCOM.

(2) Double-click the file ‘Rcom”, then select Next.

(3) In the dialog box, Type RADSCOM 7.01, then click next.

(4) Choose a desired icon to represent RADSCOM on the Windows desktop, then click on “Finish”.

(5) Double-click the RADSCOM icon on the Windows Desktop to start the RADSCOM program.

RADSCOM Commands

The RADSCOM package is a menu driven program containing functions that enable communications between the CADU and an IBM or IBM compatible computer. These functions allow the user to initialize the CADU RAM disk, create the CADU file structure, transfer data from the CADU to the PC, transfer data from the PC to the CADU, and create the Credit Card file structure.

The following notations are used in this section:

file name: name of a file residing on the PC

<path>: path to the file to be referenced on the disk (e.g. C:\RADSCOM\AC_Types \uh60_r.cmd, etc.)

Listed below are the most commonly used RADSCOM single-letter selections and a short description of each. They are sorted according to the RADSCOM menu in which they appear. Some commands appear more than once in the program and will therefore appear more than once in the description:

Main Menu (see figure 1)

B Allows CADU backup data to be transferred to the PC when using “Backup to PC” option on the CADU.

L Load a data or aircraft setup file into the CADU from the IBM (or compatible) PC.

M Enter the RADSCOM Maintenance Utilities section of the program.

A Enter the RADSCOM Advanced Utilities section of the program.

Q Send a command the CADU to exit the CADU Host Communications mode.

X Exit the RADSCOM program.

Maintenance Utilities (see figure 2)

I Copies the RADSCOM diskette to the specified hard disk where the new directories are created. If the directories exist, errors are reported, but the files will be copied correctly. The created directory will be RADSCOM. The old RADSCOM directory and all of its contents can be removed by executing the proper selection in the displayed menu.

C Formats the CADU Credit Card Memory device (if installed in the CADU). All files contained on the Credit Card Memory are erased.

F This command is used to format the CADU RAM Disk and configure the system. All files and aircraft data contained in the CADU RAM Disk are erased.

P Set the serial port to a new port setting, 1-4. (Default setting is COM1.)

Q Send a command to the CADU to exit the CADU Host Communications mode.

M Return to the RADSCOM Main Menu

X Exit the RADSCOM program.

4. **Loading Aircraft Script Files to CADU**

The following is the procedure for installing the individual aircraft script files for AVA system operations:

NOTE

It is not required to install all aircraft script files from the PC to the CADU. It is recommended that only the required aircraft files needed by the user be installed.

a. Connect CADU RS232 port (9-pin connector) to PC RS232 port.

b. Reboot CADU as described in Section 8 of this procedure..

c. When the boot menu appears on the CADU, select Option 2, set up for host communications.

d. Double-click the RADSCOM icon, then on the RADSCOM Main Menu, select option L (Load Aircraft Data or Setup File from PC to CADU DISK).

e. Follow instructions: Type file name C:\RADSCOM\AC_Types\<file name> as found in the file list below (if script file is on floppy drive, an example might be A:\<file name>)

f. An example of the transfer progress screen will appear, see figure 3.

g. At the completion of the load, a confirmation message will appear on the CADU.

h. On the PC, press any key to return the RADSCOM menu. Return to step e to load another script file, or select option **Q** (Quit CADU/Host Communications).

i. After quitting CADU/Host communication select option 1 on the CADU, Proceed with normal operation, and disconnect RS232 cable.

Script File Names

AH1S_R.CMD	AH64_R.CMD	CH47_R.CMD	OH58D_R.CMD
AH1SM_R.CMD	AH64D_R.CMD	MH47_R.CMD	OH58DM_R.CMD
AH1SS_R.CMD	AH64D2_R.CMD	UH60_R.CMD	UH1_R.CMD
AH1SSM_R.CMD	AH64NB_R.CMD	OH58AC_R.CMD	UH1CRB_R.CMD

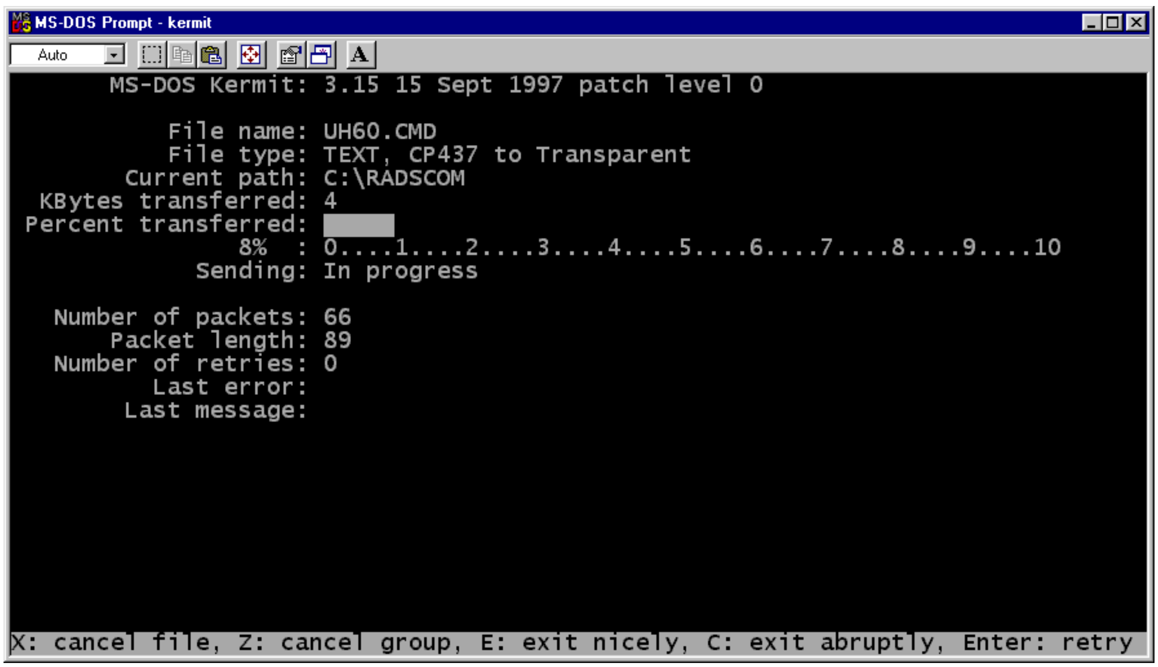


Figure 3. MS-Kermit Transfer Display (Typical)

5. **Backing up Data From CADU to PC**

The following is the procedure for transferring data from the CADU database to the PC.

a. Connect CADU RS232 port (9-pin connector) to PC RS232 port.

b. From the CADU Main Menu, Select **F4** (Manager).

c. Using the CADU arrow keys, select Data Transfer and press **DO**.

d. Using the CADU arrow keys, select Transfer to PC and press **DO**.

e. Using the CADU arrow keys, select which data will be backed up and press **DO**.

f. Using the CADU arrow keys, toggle the backup confirmation to YES and press **DO**.

g. On the PC, create a directory for storage of the backup data (see Windows manual for instructions on making a new folder). For example: C:\AVADATA\AC_Type\Tail#\Today's Date\

h. Double-click the RADSCOM icon to start program.

i. On the RADSCOM Main Menu, select option B (Backup data from CADU to PC).

j. Type in desired location (as performed in step g) for backup data to be stored to the PC and press enter.

k. Press **DO** on the CADU to begin the transfer. An example of the transfer progress screen will appear, see figure 4.

l. CADU database. Using the LEFT or RIGHT arrow key, toggle to the desired selection and press **DO**.

m. Repeat steps e through k until all desired data is stored to the PC.

n. On the PC, press any key to return the RADSCOM menu.

o. On the PC, select option **X** (Exit RADSCOM)

p. On the CADU, press **QUIT** to return to the Main Menu and disconnect RS232 cable.

NOTE

After deleting files from the CADU always perform the Compress option from the Manager Menu, under the Data Maintenance selection. This will free up space in the CADU database memory.

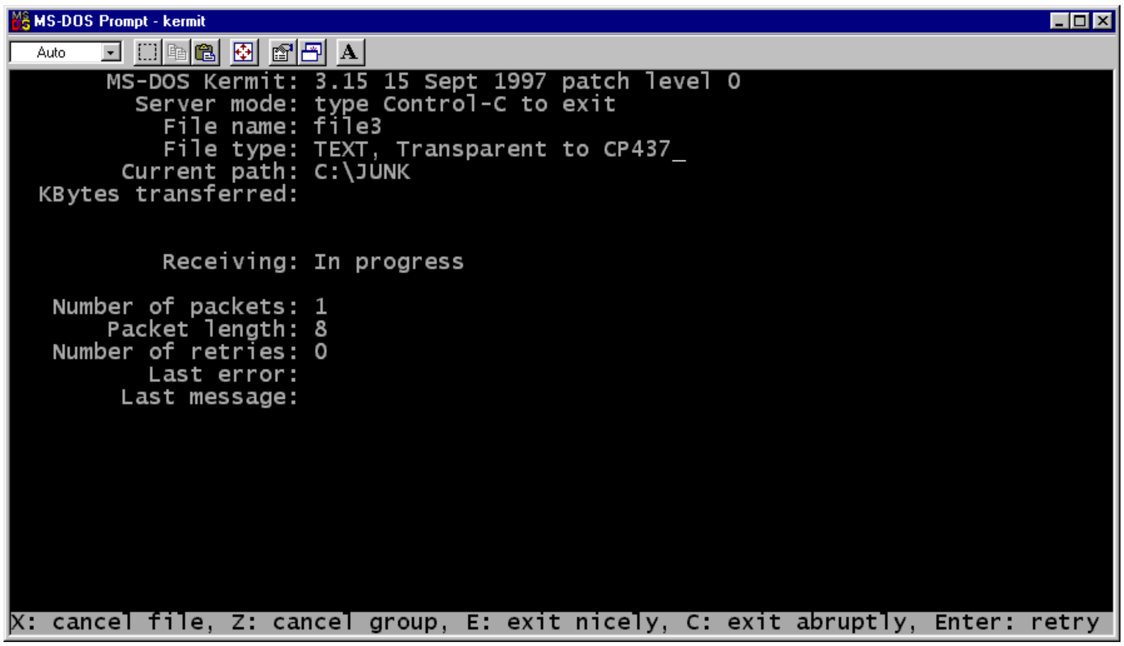


Figure 4. MS-KERMIT Transfer Process Screen

Unloaded data is written in text format in the form of separate text files. The following is a brief description of the data contained within each file:

file1	Tail number definitions
file2	Flight ID records
file3	Tracker data
file4	Synchronously-sampled time averaged data
file5	Synchronously-sampled power averaged data
file6	Asynchronously-sampled power averaged data
file7	Asynchronously-sampled zoom spectral data
file8	Synchronously-sampled time averaged data (first 12 harmonics only)
file16	Engine vibration data
file17	Adjustments setting

NOTE

The file names are not unique, so it is possible to confuse information in file1 through file8 when using KERMIT. To avoid renaming new files, create different directories to store the files. KERMIT will rename the incoming files to prevent overwriting data.

These data files are backed up in DPL script format. It is recommended to archive collected data to keep a historical database of vibration levels and diagnostic problems. Future products will allow this data to be viewed and trended using an IBM PC/AT or compatible computer.

6. **Loading Data Files Into The CADU**

Archived data files are data files which have been transferred from the CADU to the IBM compatible PC for storage. Perform the following steps to load data files from the PC into the CADU:

a. On the CADU, place the CADU in the Host Communications mode of operation. (see steps 4b and 4c).

b. On the PC, double-click the RADSCOM icon to execute the RADSCOM program.

c. Select the "Load data or aircraft setup file from the PC to CADU" menu option.

d. Type in the path (e.g., C:\AVADATA\AC_Type\Tail#\Today’s Date\file1) of the file to be loaded and press the <RETURN> key. (When loading "file1" through "file17" the user only has to specify the first file [e.g., file 1]. The RADSCOM program automatically loads the other files [“file2" through "file17"].)

e. Follow the instructions displayed on the PC screen. The Kermit program will begin. (If the transfer of data stops prior to the transfer of all data files, return to the RADSCOM Menu.)

f. At the completion of the transfer of the last file, press any key on the PC keyboard when prompted to do so.

g. Repeat steps c through f to load additional data, or proceed to step h.

h. Press Q to QUIT the CADU to Host Communications

i. On the CADU, selection option 1, Continue with Normal Operations.

j. On the PC, select X to exit RADSCOM.

k. Disconnect the serial cable from the CADU and from the PC

7. **Initializing the CADU RAM Disk**

It will not normally be necessary to format the system RAM disk unless something serious has failed or a battery replacement is not performed properly. However, the procedure is provided in case of a system failure. During a reformat, all data and aircraft files are deleted, and the required AVA system files are reloaded into the CADU. The following is the procedure for initializing the CADU RAMDISK using an IBM PC/AT or compatible:

CAUTION

All data files contained on the RAM Disk will be erased and will have to be reloaded if the following procedure [initializing the CADU RAM Disk] is performed.

a. On the CADU

(1) Connect an external power source to the CADU (to prevent an inadvertent auto shutdown due to a low battery).

(2) Connect the serial cable between the PC and CADU.

(3) Place the CADU in the Host Communications mode. (see step 4b and 4c).

b. On the PC

(1) Start the RADSCOM program.

(2) Select "Maintenance Utilities" by typing **M**, or press the down arrow on the PC to highlight “Maintenance Utilities" and then press **ENTER**.

(3) Select the menu option "Format CADU RAMDISK" by typing the letter **F** that appears directly to the left of the menu selection.

(4) Follow the instructions that are displayed on the PC display.

(5) When the initialization is complete, select the menu option "Exit RADSCOM" to exit the program.

(6) Follow the instructions displayed on the CADU screen.

8. **Rebooting the CADU**

There are two methods that can be used to reboot the CADU, a “soft” reboot and a “hard” reboot.”

a. For a “soft” reboot perform the following:

(1) Turn CADU on.

(2) Press the **DO** and **QUIT** keys simultaneously. Allow 15 seconds for CADU to complete task.

b. For a “hard” reboot perform the following only when a “soft” reboot does not work:

(1) Turn CADU off.

(2) While holding pressing the HELP key, turn the CADU on.

END OF WORK PACKAGE

WinRADSCOM OPERATION
AVIATION VIBRATION ANALYZER

Figures

1. **Introduction**
WinRADSCOM is used to load aircraft script files or data from a Personal Computer (PC) to the CADU or to backup data from the CADU to a PC. The WinRADSCOM software operates on Windows 95, 98, ME, XP, 2000, and NT 5.0.

The WinRADSCOM program is a 32 bit windows-based application that provides all the functionality of the DOS RADSCOM program. The RADSCOM software operates on the Disk Operating System (DOS) version 2.2 or higher. Refer to WP 0005 00 for RADSCOM operation. Some of this functionality includes the configuration of the communication port, initialization of the CADU RAM disk, and the formatting of the CADU's Credit Card Memory (CCM). Aircraft script files can be loaded into the CADU for RADS-AT system diagnostics. The collected data files in the CADU can be backed up to a PC and saved to a specified file location with the desired folder structure and the predefined file names. The data files can then be transferred back to the CADU from the PC. Binary or text files can be transferred from the PC to the CADU or vice versa, and the CADU terminal can be emulated in WinRADSCOM.

In addition to the DOS RADSCOM functionality, WinRADSCOM includes data display capabilities. Previously, the data could only be viewed using the CADU's small monochrome display. In WinRADSCOM, the user has the ability to select files on the PC that have been transferred from the CADU. The data from the selected files is available for viewing on a synchronous vibration polar chart, track/lag display or asynchronous spectrum plot.

2. **Installing or Updating WinRADSCOM on the IBM PC/AT**
The following paragraphs provide instructions on configuring the IBM PC/AT (or IBM compatible) for using the WinRADSCOM program.

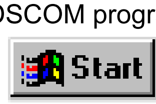
   a. **Hardware Requirements**
   The WinRADSCOM package operates on, as a minimum, a Pentium 100 class PC with 16 Megabytes of RAM and a 4X CDROM drive. The PC's operating system must be one of the following: Microsoft Windows 95, 98, ME, XP, 2000, or NT 5.0. The PC must have an available external RS-232 serial port. The communication package assumes that the serial port is configured as COM1. If the PC's RS-232 port is configured as COM2, use the WinRADSCOM menu selection "Comm → Select Serial Port" to set the serial port to the correct COM number. WinRADSCOM will automatically set the baud rate, stop bits and parity to be compatible with the AVA.

   b. **Installing WinRADSCOM Program on a hard drive from CDROM Disk.**

NOTE

The following steps are required for initial installation of WinRADSCOM onto the hard drive of the PC, or if the version of WinRADSCOM on the hard drive is being replaced. WinRADSCOM is only loaded on the PC.

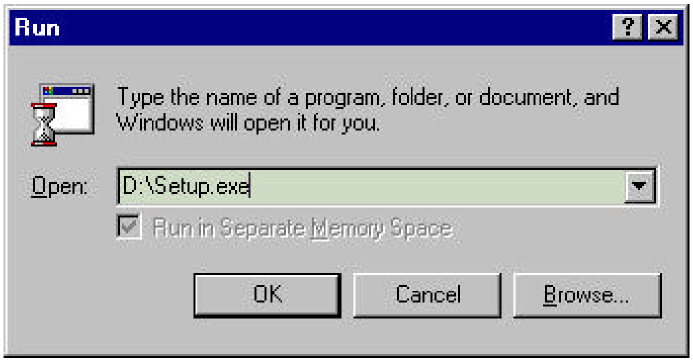
(1) Insert the WinRADSCOM program disk into the CDROM drive.

(2) On the PC, select 

"Start", then 

"Run".

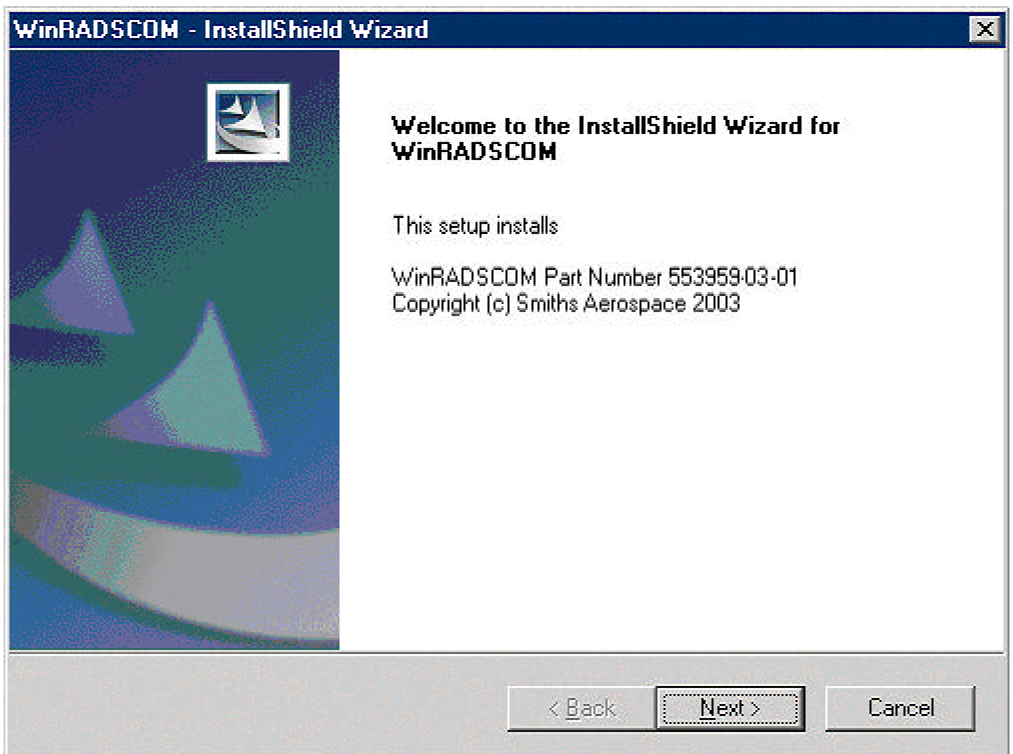
(3) Windows "Run" dialog box is displayed as follows:



(4) On the PC, use the Browse button to change the current directory to the CDROM drive (D:, E:, etc.), and then select the "setup.exe" file.

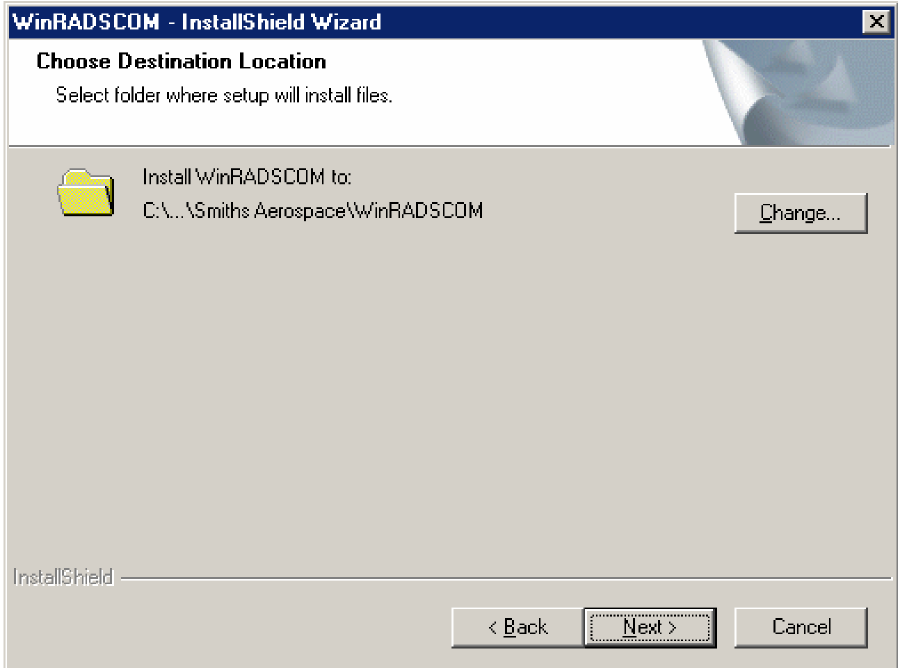
(5) Click the "OK" command button.

(6) The WinRADSCOM initial setup dialog box is displayed as follows:



(7) Click the "Next>" command button.

(8) The WinRADSCOM "Choose Destination Location" dialog box is displayed as follows:



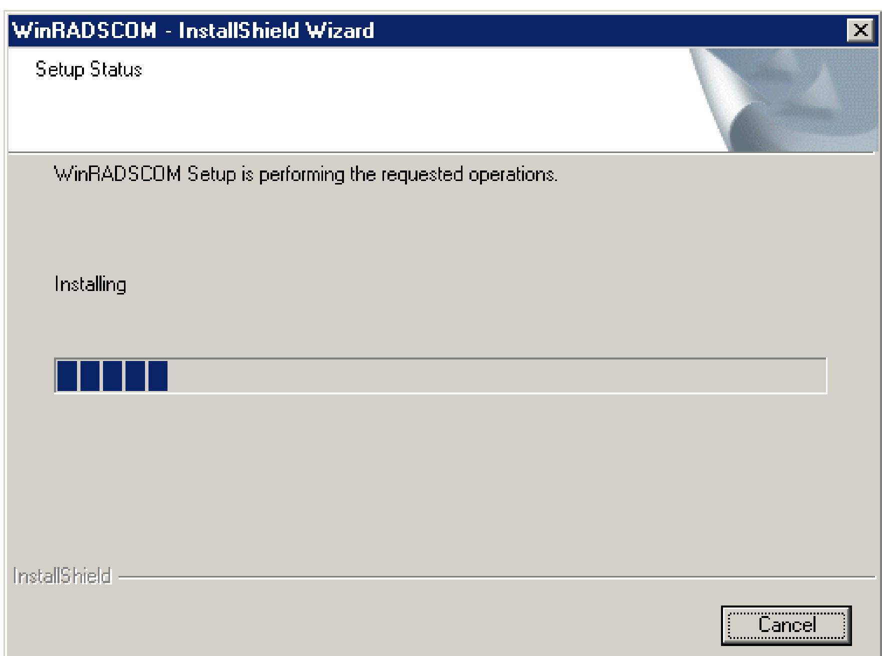
NOTE

It is strongly recommended you install the WinRADSCOM software in the default directory. This will ensure trouble free updates in the future.

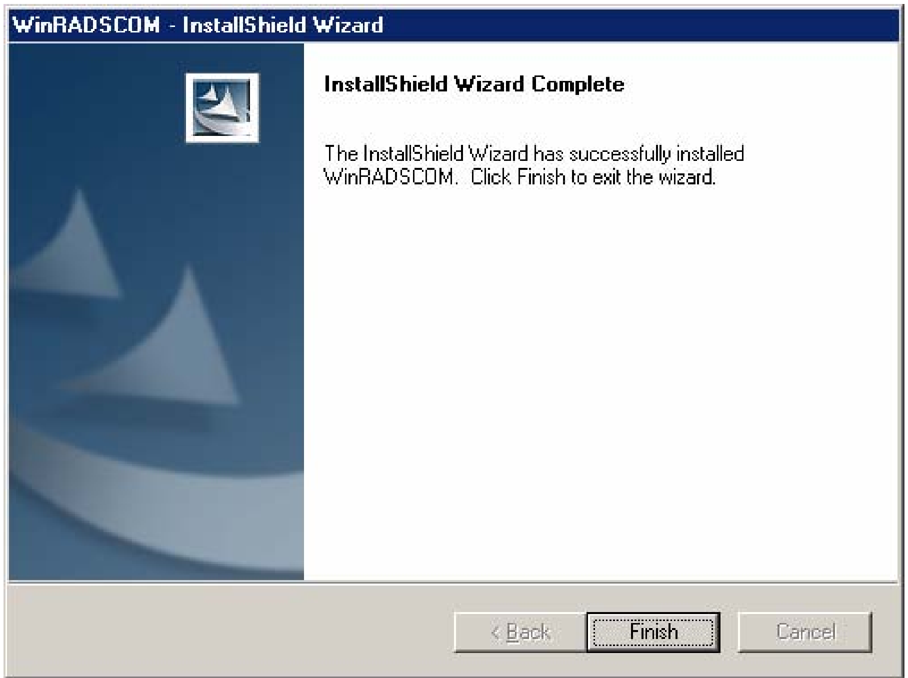
(9) If you choose to change the Destination Folder; use the Browse command button to select the directory and folder where setup will install the WinRADSCOM application files.

(10) Click the "Next>" command button.

(11) The WinRADSCOM "Setup Status" is displayed as follows:



(12) The WinRADSCOM "Install Shield Wizard Complete" is displayed as follows:



(13) Click "Finish" command button.

NOTE

Once the installation of the WinRADSCOM program is complete, it is recommended to keep the WinRADSCOM CDROM disk in a safe location as a backup source for the program.

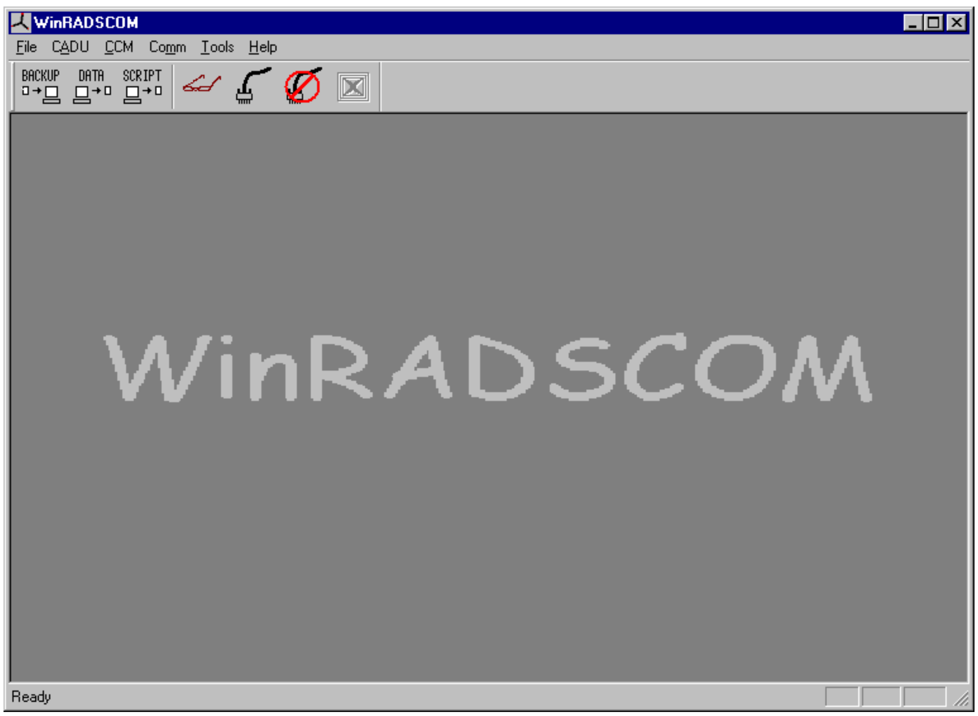


Figure 1. WinRADSCOM Main Window

3. Using The WinRADSCOM Program

NOTE

When reformatting the CADU RAMDISK or performing data or script file transfers, it is strongly recommended that the 12 Vdc battery charger be connected and supplying power to the CADU.

By default, WinRADSCOM execution (operation) is done in the directory in which the WinRADSCOM program resides.

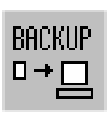
To use the WinRADSCOM program, select "Start" => "Programs" => "WinRADSCOM" => WinRADSCOM.

The WinRADSCOM main window, figure 1, will appear displaying the various functions available. Select the desired function by using the toolbar or main menu bar. Then follow any instructions that appear on the screen.

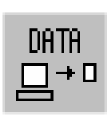
a. WinRADSCOM Functions

The WinRADSCOM software is a 32-bit Windows driven program containing functions that enable communications between the CADU and an IBM or IBM compatible computer. These functions allow the user to initialize the CADU RAM disk, create the CADU file structure, transfer data from the CADU to the PC, transfer data from the PC to the CADU, and create the Credit Card file structure. The WinRADSCOM communication package contains commands that allow the creation of the AVA CADU file structure, unload data from the CADU's database and load aircraft setup files from the PC to the CADU.

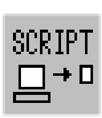
Listed below are the available WinRADSCOM single button selections and a short description of each:



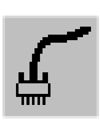
Allows CADU backup data to be transferred to the PC when using "Backup to PC" option on the CADU.



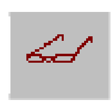
Allows PC to transmit backup data into a CADU



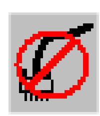
Allows PC to transmit aircraft setup (script) files into a CADU prior to measurement



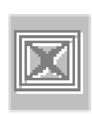
Set the serial port to a new port setting, 1-4. (Default setting is COM1).



View data in Polar, Track, or Spectrum plot formats.



Quit the CADU Host Communications setup.



Close terminal window. Red and active only when the terminal emulation window is active.

4. WinRADSCOM Functions

Listed below are the available WinRADSCOM functions and a short description of each:

a. **CADU Menu Selection**

Backup CADU data to a PC

This option is used to set the PC up to receive information from the CADU and subsequently store the data into a file for archival or later use. This option requires the PC to be connected to the CADU 9-pin connector using a null-modem serial cable. Communications is initiated via the CADU when at the "Main Menu" by pressing (F4) "Manager Menu" then selecting "Data Transfer-Transfer Data to PC".

Load aircraft data to CADU

This option is used to transmit backup data into a CADU for review or trending. This option requires the PC to be connected to the CADU 9-pin connector using a null-modem serial cable. The CADU must be in the host communications mode. This is accomplished by rebooting the CADU and selecting option 2.

Load aircraft scripts to CADU

This option is used to transmit aircraft setup (script) files into a CADU prior to measurement. This option requires the PC to be connected to the CADU 9-pin connector using a null-modem serial cable. The CADU must be in the host communications mode. This is done by rebooting the CADU and selecting option 2.

NOTE

Selecting Format CADU RAMDISK will completely and permanently delete any data and script files currently in the CADU. Backup any desired data to a PC or CCM and ensure any desired aircraft script files are available for reload prior to using this option.

Format CADU RAMDISK

NOTE

The CADU operating system software is referred to as the PROM.

This option is used to completely erase and rebuild the CADU database. When completed, the CADU will need to be rebooted and any needed script files reloaded prior to use. This option requires the PC to be connected to the CADU 9-pin connector using a null-modem serial cable. The CADU must be in the host communications mode. This is accomplished by rebooting the CADU and selecting option 2.

The user must select a proper CADU PROM version by viewing the "Main Menu", or by looking at the data tag on back of the CADU. The PROM version is currently at 7.01. Do not try to format a CADU with an incorrect PROM version as it may make it unserviceable. Both the CADU and CCM formatting require the selection of the proper PROM version. Any of the other WinRADSCOM options may be performed regardless of PROM version.

CADU Advanced Utilities

These options are designed for individuals with an advanced working knowledge of the CADU. These options should not be used if the operator is unfamiliar with the CADU database structure and operation.

Receive a file from CADU
Send a file to CADU

These options are used to copy files directly to and from a CADU RAMDISK. These are not to be used in place of the LOAD and BACKUP routines.

Terminal Emulation Mode

This option configures the PC to act as a terminal window in order to interact directly with the CADU RAMDISK. To exit the terminal window press the "Close Terminal Button". This button only becomes active when in the "Terminal Window", and is grayed out at all other times.

Change Data Directory

This option is used to change the directory on the PC to store the backup data from the CADU.

b. **CCM Menu Selection**

Format Credit Card Memory (CCM)

This option is used to prepare a new CCM for data storage, or after an old CCM battery has been replaced. This option requires the PC to be connected to the CADU 9-pin connector using a null-modem serial cable. The CADU must be in the host communications mode. This is done by rebooting the CADU and selecting option 2. The user must select a proper CADU PROM version prior to clicking on the "Format" button.

Load Aircraft Scripts to CCM

This option is used to transmit aircraft setup (script) files into a CCM. This option requires the PC to be connected to the CADU 9-pin connector using a null-modem serial cable. A CCM must be inserted into the card slot on the CADU. The CADU must be in host communications mode. This is accomplished by rebooting the CADU and selecting option 2. The script file will be transmitted to a designated location on the CCM. Once complete this CCM can now be used to load the aircraft script file(s) to a CADU by selecting option 3 on the CADU boot-up menu.

c. **Comm Menu Selection**

Select Serial Port

This option is used to select which of the PC serial ports will be used by WinRADSCOM to communicate with the CADU. It also allows the user to scan for additional communication ports and to test the connection to the CADU.

Quit CADU/Host Communication

This option sends a command to the CADU to exit the host communication mode and returns the CADU to the boot-up menu. This can be used any time CADU is in Host Mode.

d. **Tools Menu Selection**

NOTE

A concatenated file is one that contains all the AVA measured data and is labeled by the aircraft type and the date and time that it was stored.

View Data

This option is used to view recorded data in Polar, Track or Spectrum displays. Synchronous vibration data is displayed in a polar plot. Track/lag data is displayed in line chart and tabular format. Asynchronously sampled power spectrum data is displayed in the spectrum line chart.

Import Data

This option allows the user to select a concatenated file from a user-specified location and import/unpack the data to the archival structure.

Export Data

This option allows the user to select a concatenated file from an archival structure and to store the selected file in a user specified location.

5. Rebooting the CADU

There are two methods that can be used to reboot the CADU, a “soft” reboot and a “hard” reboot.

a. For a “soft” reboot perform the following:

(1) Turn the CADU on.

(2) Press the **DO** and **QUIT** keys simultaneously. Allow 15 seconds for CADU to complete task.

b. For a “hard” reboot perform the following only when a “soft” reboot does not work:

(1) Turn CADU off.

(2) While holding/pressing the **HELP** key, turn the CADU on.

6. Data Storage Space

The AVA system provides two types of data file storage space for data collected during normal operation. The RAM Disk, contained within the CADU, allows for the storage of 1.25 MB of data, and the Credit Card Memory, inserted into the CADU, provides from 256 KB to 2 MB (depending on which CCM is in use) of data storage space.

If insufficient space is available for the storage of the data being collected (or transferred) into the RAM Disk or Credit Card Memory, an error message (32468: Insufficient Space to Store Results) will be displayed on the CADU display screen.

Due to the limited amount of data storage space available, the following is a list of procedures that will allow for more effective use of the allotted data storage space.

NOTE

After deleting data from the CADU (not from the CCM), always perform the Compress option from the Manager menu, under the Data Maintenance selection. This will "free up" space in the CADU database memory, providing room for new data.

(a) Delete data from the CADU database after it has been successfully transferred to the PC for backup.

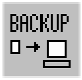
(b) Only load the aircraft setup files (script files) necessary to perform work on the intended aircraft. Loading aircraft script files of aircraft types that are seldom used take up unnecessary memory space.

(c) Delete data from the CCM database when it has been successfully transferred to the CADU.

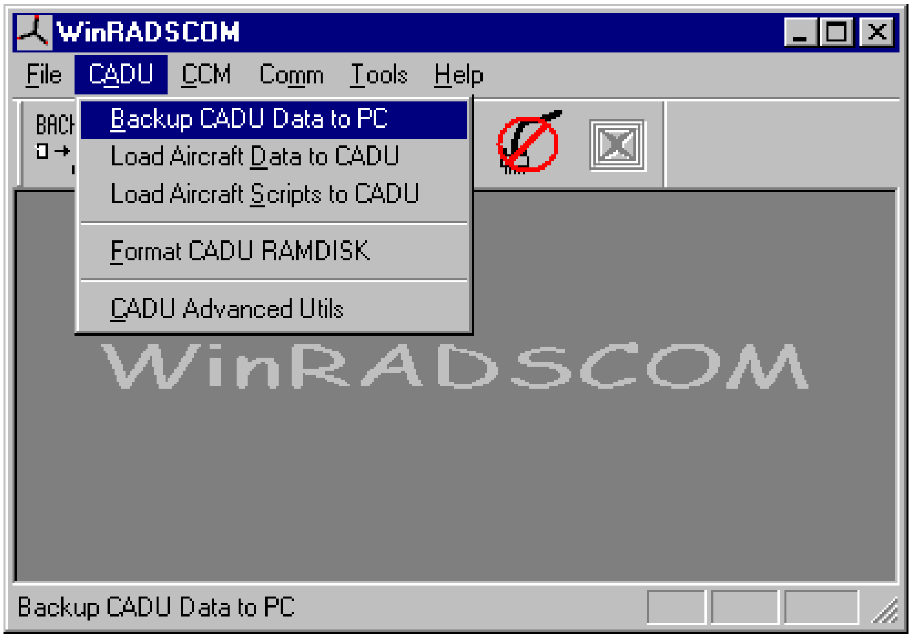
7. **CADU Functions**

a. **BACKUP CADU Data to PC**

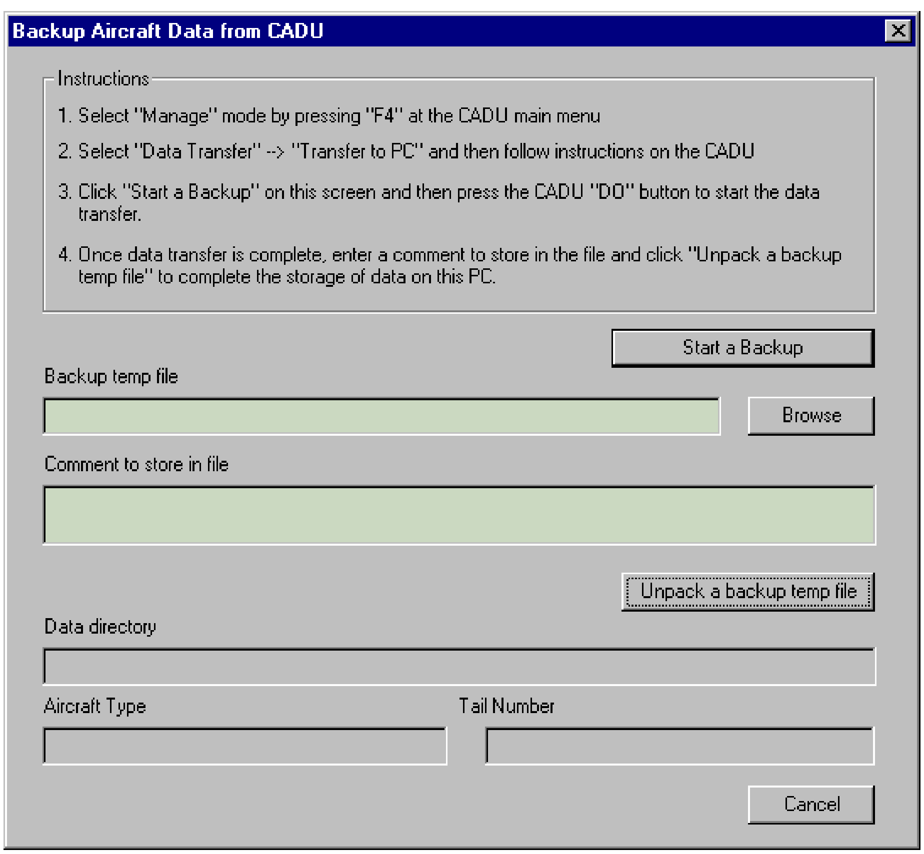
(1) Start the WinRADSCOM program.

(2) Select "Backup CADU Data to PC" from the "CADU" dropdown on the main menu or select 

button on the toolbar.



(3) "Backup Aircraft Data from CADU" dialog box is displayed as follows:

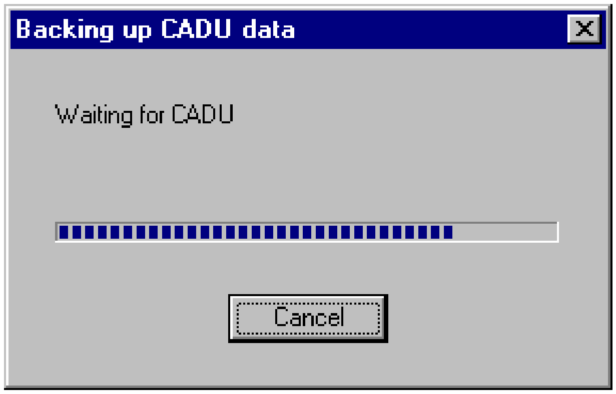


(4) On the CADU, select "Manager" mode (press F4 at the CADU main menu).

(5) On the CADU, select "Data Transfer" → "Transfer to PC", follow instructions displayed on CADU.

(6) Click the "Start a Backup" command button, then on the CADU press the CADU "DO" button.

(7) During the backup, the following dialog will be displayed:



(8) Once the data transfer is complete, enter comments to store with the file.

(9) Click "Unpack a backup temp file" to complete storage of data on this PC.

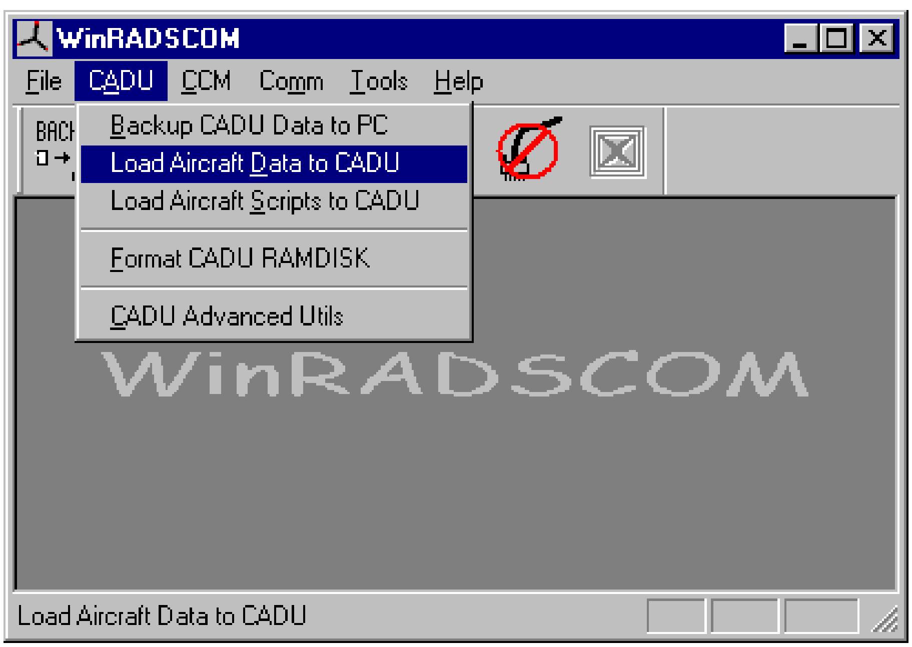
(10) During the data unpacking process, the data will be automatically stored by the aircraft type, followed by tail number, and then the date the data was stored. This data will be stored in this format under the "Data" directory of WinRADSCOM unless commanded differently by the "Change Directory" option in the "CADU Advanced Utils" menu (Refer to paragraph 7).

b. Load Aircraft Data to CADU

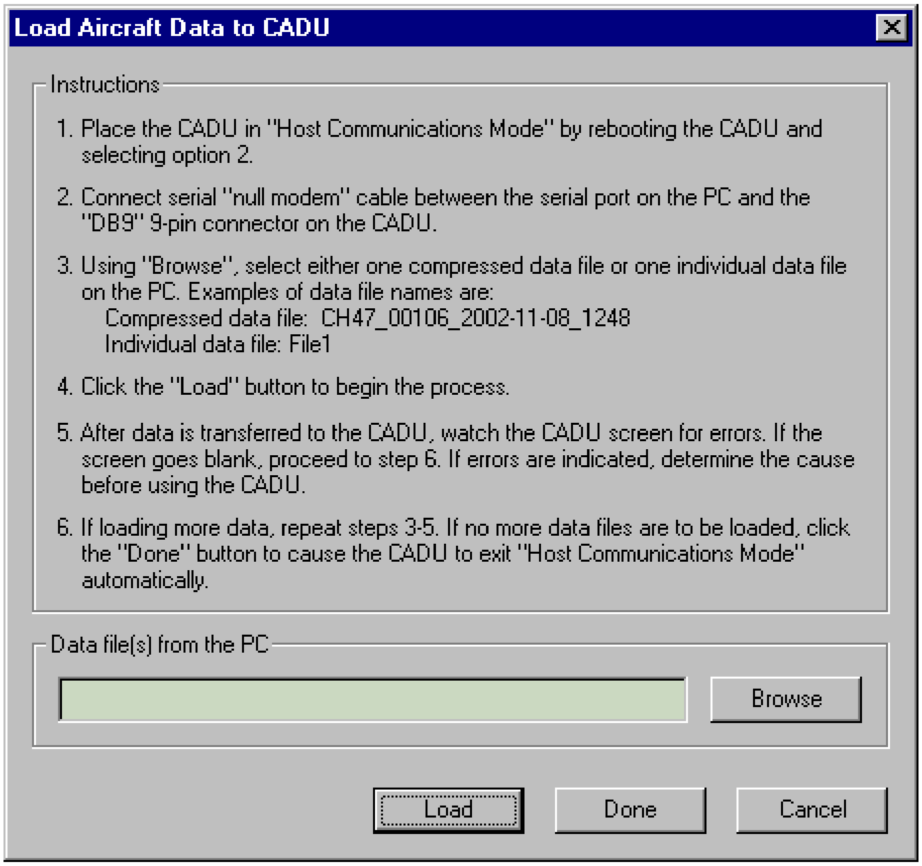
(1) Start the WinRADSCOM program.

(2) Select "Load Aircraft Data to CADU" from the "CADU" dropdown on the main menu or select 

button on the toolbar.



(3) "Load Aircraft Data to CADU" dialog box is displayed as follows:



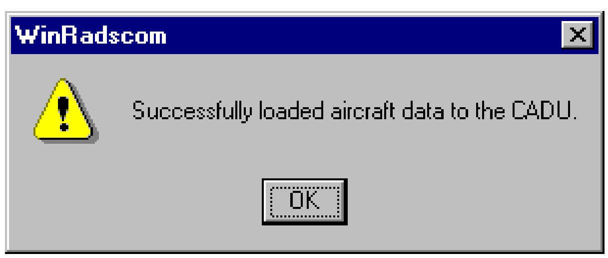
(4) Place CADU in "Host Communications Mode" by rebooting and then selecting option 2.

(5) Connect the serial null modem cable between the PC and the CADU.

(6) Use the "Browse" command button to find the correct file to load, select either one compressed data file or one individual data file from the PC.

(7) Click the "Load" command button.

(8) When file loading is complete, the following dialog will be displayed:



(9) Click the "OK" command button.

(10) "Load Aircraft Data to CADU" dialog box is displayed on the PC.

(11) On the CADU:

(a) Follow any instructions that may appear on the CADU. If the file loading was successful, a message will appear on the CADU screen to inform the operator.

(b) Upon completion of the transfer of data from the PC to the CADU, the CADU screen should become dark and blank.

(12) If loading additional data files then repeat steps 6 – 9. Click the "Done" command button on the PC if no more data files are to be loaded.

(13) "Quit CADU/Host Comm" dialog box is displayed as follows:

(14) Click the "OK" command button and the CADU will exit Host Mode. When CADU screen returns to the five option boot menu, press **1** on the keypad, “Return to normal operation”.

c. Load Aircraft Scripts to CADU

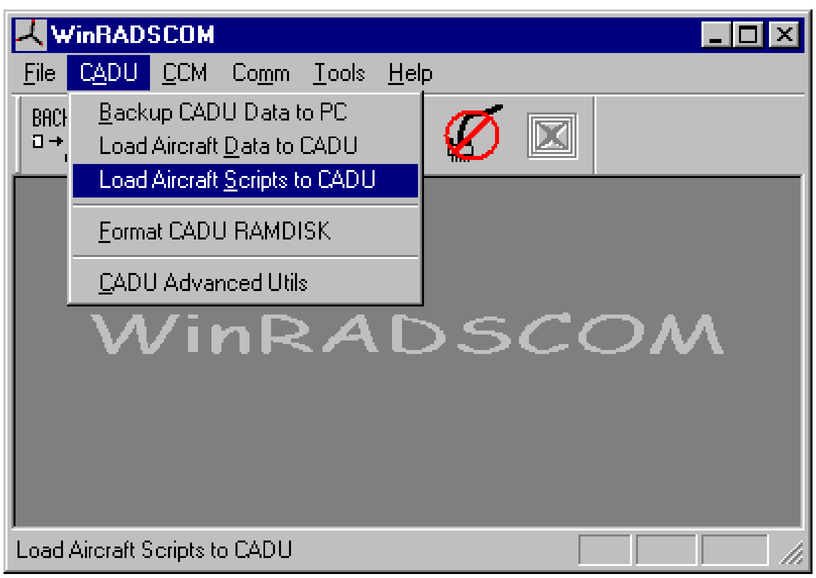
NOTE

It is not required to install all aircraft script files from the PC to the CADU. It is recommended that only the required aircraft files needed by the user be installed.

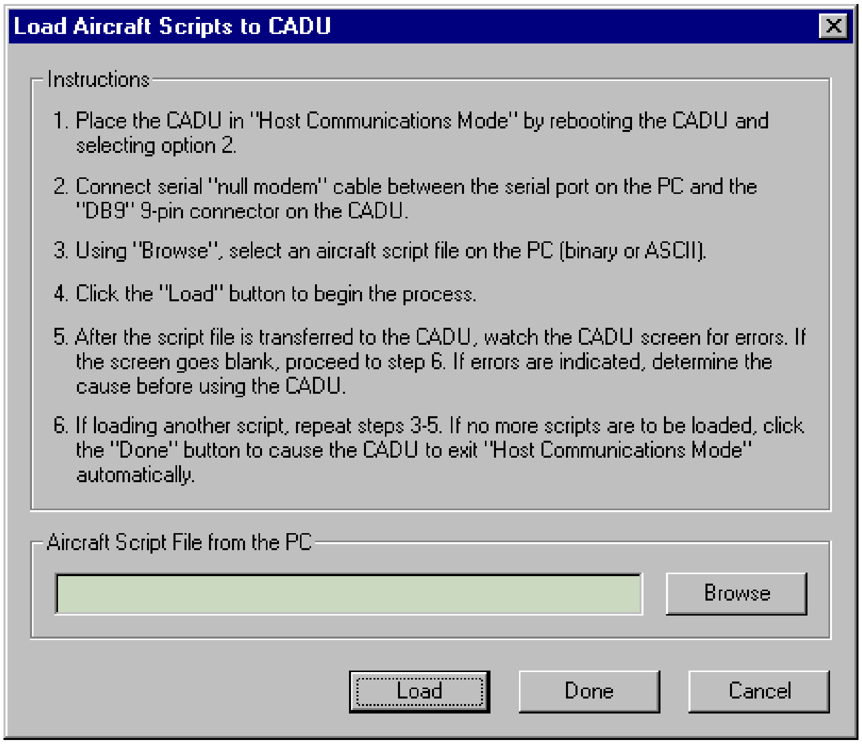
(1) Start the WinRADSCOM program.

(2) Select "Load Aircraft Scripts to CADU" from the "CADU" dropdown on the main menu or select

button on the toolbar.



(3) "Load Aircraft Scripts to CADU" dialog box is displayed as follows:



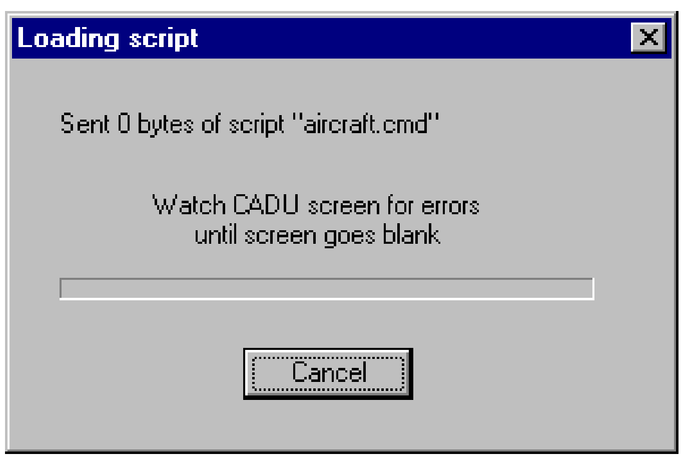
(4) Place CADU in "Host Communications Mode" by rebooting and then selecting option 2.

(5) Connect the serial null modem cable between the PC and the CADU.

(6) Select an aircraft script file from the PC (binary or ASCII). Type in the "Aircraft Script File from the PC" text box or use the "Browse" command button to find the correct file to load.

(7) Click the "Load" command button.

(8) During the loading process, the following dialog will be displayed:



(9) On the CADU

(a) Follow any instructions that may appear on the CADU. If the file loading was successful, a message will appear on the CADU screen to inform the operator.

(b) Upon completion of the transfer of data from the PC to the CADU the screen should become dark and unreadable.

(10) On the PC click the "Done" command button.

(11) The "Quit CADU/Host Comm" dialog box is displayed as follows:

(12) Click the "OK" command button. When the CADU screen returns to the five option boot menu, press **1** on the keypad, “Return to normal operation.”

d. Format CADU RAMDISK

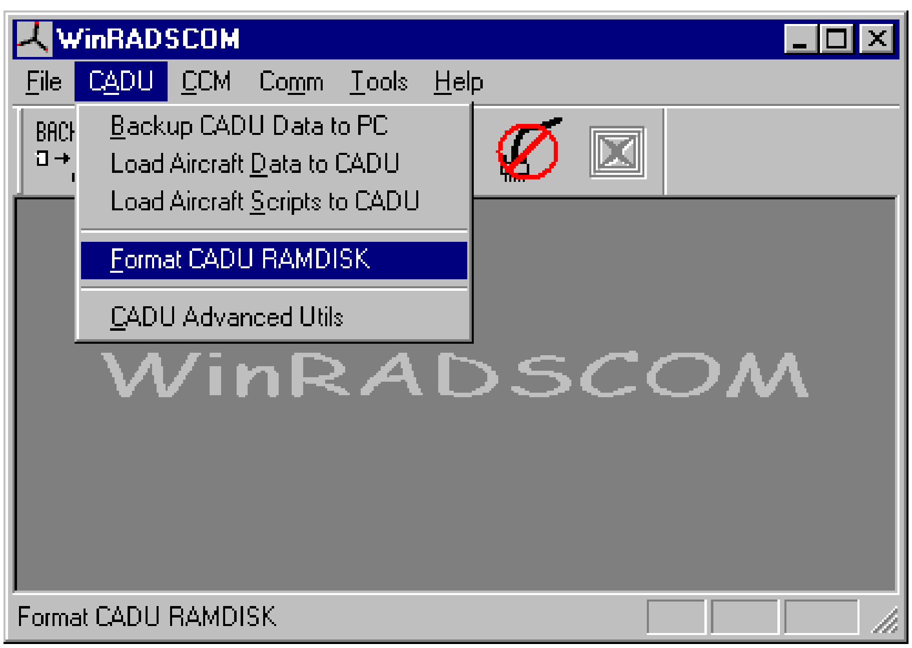
It will not normally be necessary to format the system RAM disk unless something serious has failed or a battery replacement is not performed properly. However, the procedure is provided in case of a system failure. During a reformat, all data and aircraft files are deleted, and the required AVA system files are reloaded into the CADU. The following is the procedure for initializing the CADU RAMDISK using an IBM PC/AT or compatible computer:

CAUTION

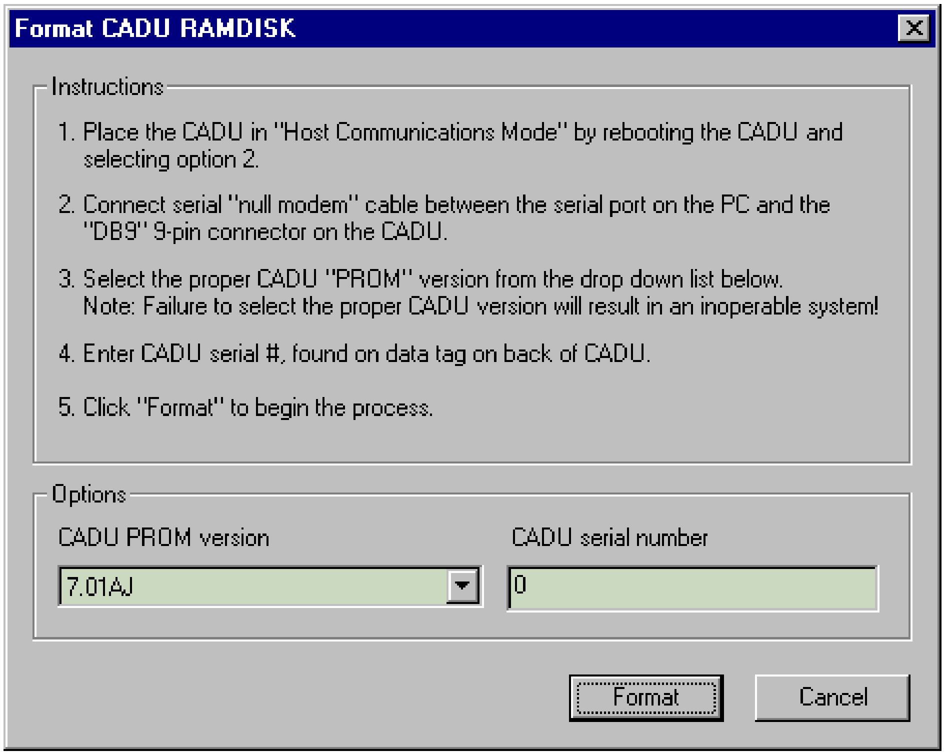
All data files contained on the RAM Disk will be erased and will have to be reloaded if the following procedure [Format CADU RAMDISK] is performed.

(1) Start the WinRADSCOM program.

(2) Select "Format CADU RAMDISK" from the "CADU" dropdown on the main menu.



(3) "Format CADU RAMDISK" dialog box is displayed as follows:



(4) Place CADU in "Host Communications Mode" by rebooting and then selecting option 2.

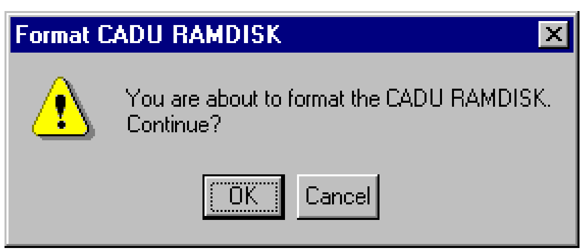
(5) Connect the serial null modem cable between the PC and the CADU.

(6) Select the appropriate CADU PROM version from the "CADU PROM version" drop down list if more than one is available.

(7) Enter the CADU serial number in the "CADU serial number" text box.

(8) Click the "Format" command button.

(9) The "Format CADU RAMDISK" dialog box is displayed as follows:



(10) Click the "OK" command button.

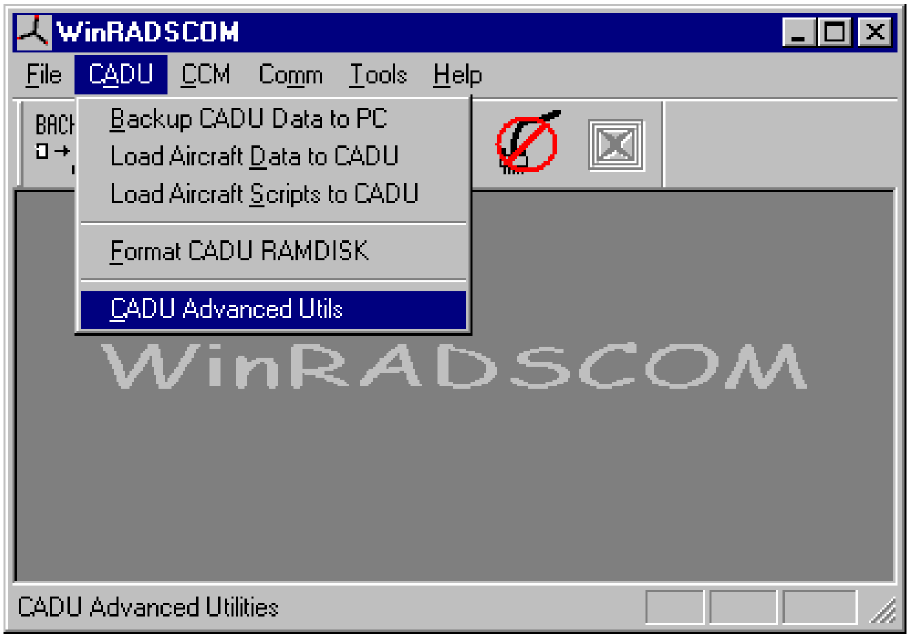
(11) Watch the CADU screen for any errors and, when commanded by the CADU, reboot the CADU by "Pressing the Off button" and then while holding down the "Help button" press the "On Button". The CADU is now ready for script file loading, see Para 7. C. for details.

e. CADU Advanced Utilities

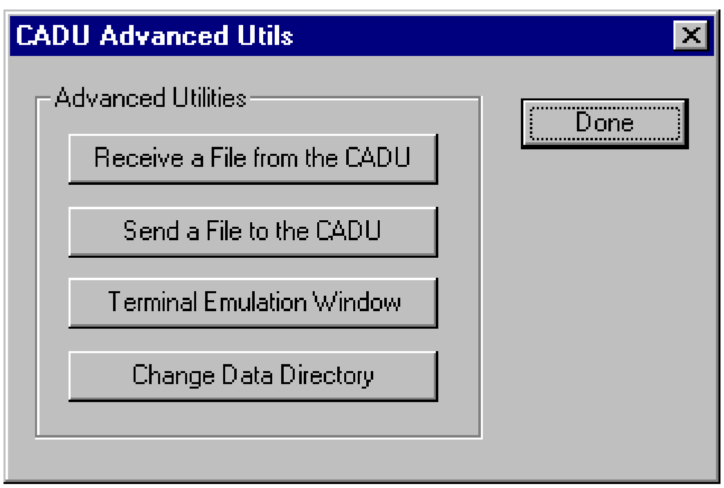
The only advanced utilities that should be used as part of normal operation in the field is the "Change Data Directory" function. Contact Smiths AVA Customer Support for assistance on the use of the remaining advanced utilities.

(1) Start the WinRADSCOM program.

(2) Select "CADU Advanced Utils" from the "CADU" dropdown on the main menu.

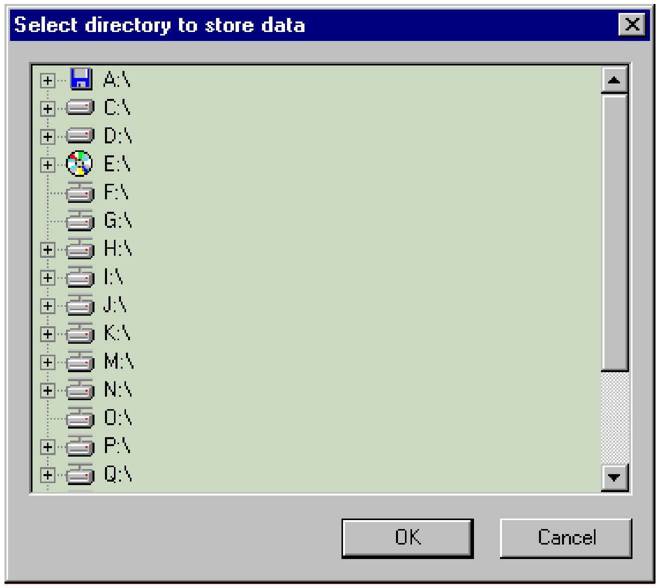


(3) "CADU Advanced Utils" dialog box is displayed as follows:



(4) Select "Change Data Directory" on the CADU Advanced Utilities dialog box.

(5) "Select directory to store data" dialog box is displayed as follows:



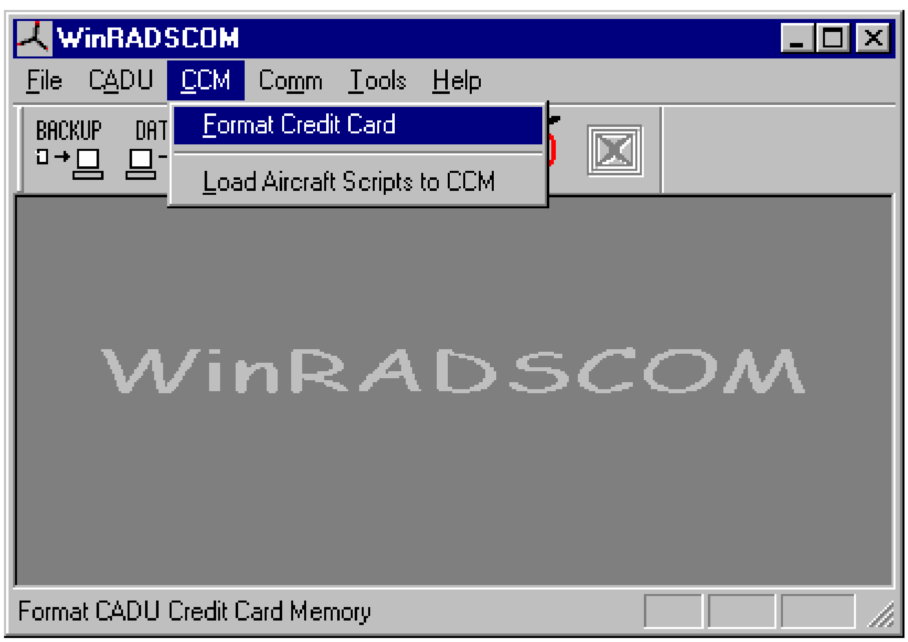
(6) Navigate to desired drive or directory, and then click the "OK" command button.

8. **CCM Functions**

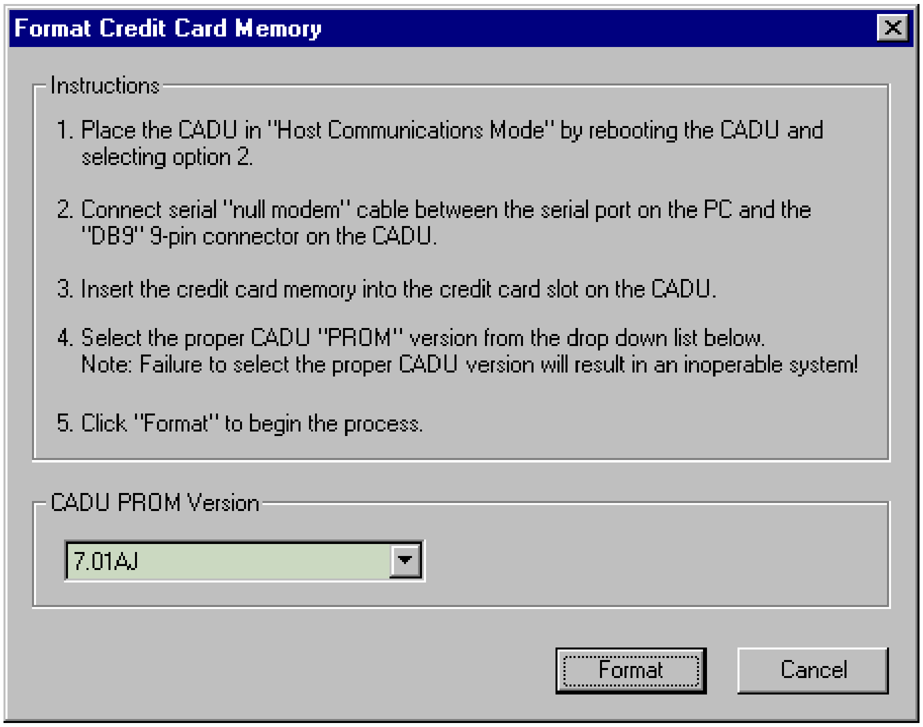
a. **Format Credit Card**

(1) Start the WinRADSCOM program.

(2) Select "Format Credit Card" from the "CCM" dropdown on the main menu.



(3) "Format Credit Card Memory" dialog box is displayed as follows:



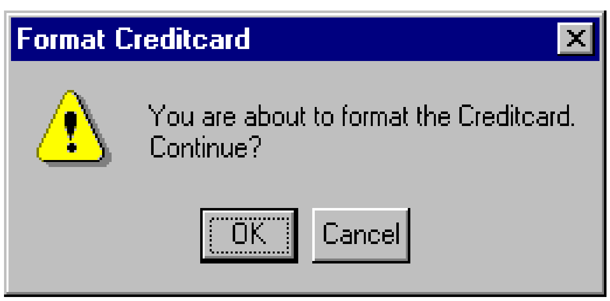
(4) Place CADU in "Host Communications Mode" by rebooting and then selecting option 2.

(5) Connect the serial null modem cable between the PC and the CADU.

(6) Insert the Credit Card Memory into the credit card slot on the CADU.

(7) Select the appropriate CADU PROM version from the "CADU PROM Version" drop down list if more than one is available.

(8) Click the "Format" command button. The "Format Credit card" dialog box is displayed as follows:



(9) Click the "OK" command button.

b. Load Aircraft Scripts to CCM

The following is the procedure for installing the individual aircraft script files for AVA system operations:

NOTE

When installing script files onto the CCM the user must keep track of the amount of file space used during loading. The typical CCM is only 256K and the number of script files that can be loaded onto this device is limited.

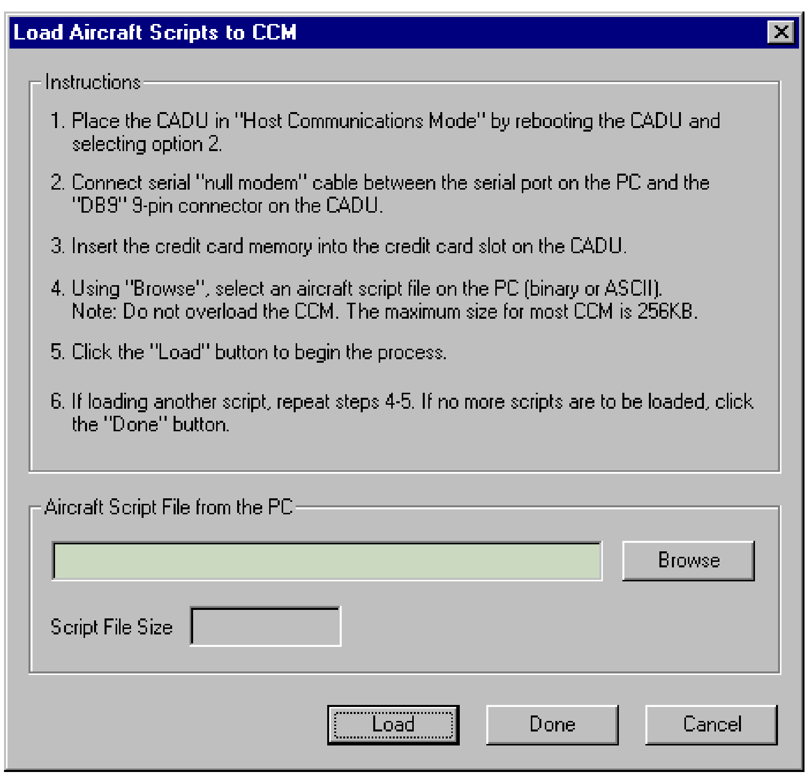
NOTE

During the load process the "Load Script to CCM" dialog box will display the amount of space needed to load the selected file. The user should add the total space used to ensure there will be enough room to load any additional scripts if desired.

(1) Start the WinRADSCOM program.

(2) Select "Load Aircraft Scripts to CCM" from the "CCM" dropdown on the main menu.

(3) "Load Aircraft Scripts to CCM" dialog box is displayed as follows:



(4) Place CADU in "Host Communications Mode" by rebooting and then selecting option 2.

(5) Connect the serial null modem cable between the PC and the CADU.

(6) Insert CCM into the slot on the CADU.

NOTE

If loading text type script files, the file name must not have an extension, i.e.: *.txt, *.700 etc. Text files with an extension will appear to load to the CCM without error; however, when loading onto the CADU they will not fully transfer.

(7) Select an aircraft script file from the PC (binary or ASCII). Type in the "Aircraft Script File from the PC" text box or use the "Browse" command button to find the correct file to load.

(8) Click the "Load" command button.

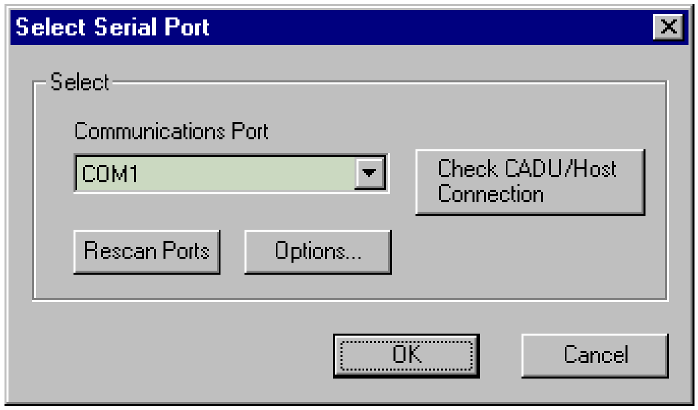
9. Communication Functions

a. Communication Setup

(1) Start the WinRADSCOM program.

(2) Select "Select Serial Port" from the "Comm" dropdown on the main menu.

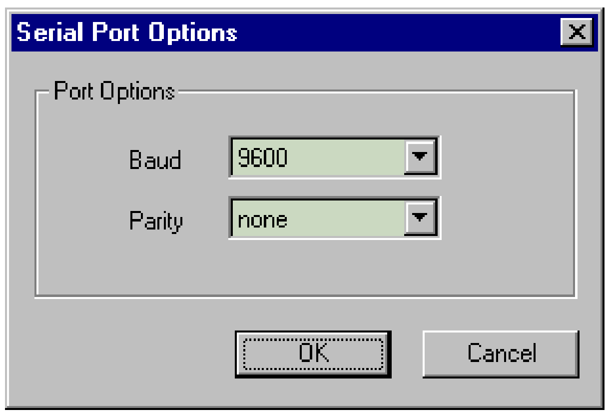
(3) "Select Serial Port" dialog box is displayed as follows:



(4) Select the appropriate serial port that your CADU to DAU cable is connected. It should be noted that all available serial ports on the PC will be shown. Only select the port that the CADU is connected to. It may be necessary to select "Rescan Ports" if the desired communications port is not shown.

(5) To set non-standard communication port parameters, click the "Options" command button.

(6) "Serial Port Options" dialog box is displayed as follows:



(7) Select desired Communications Port baud rate and parity from the pulldown menu(s).

(8) Ensure baud rate is set to "9600" and parity is set to "none".

(9) Click the "OK" command button to finish serial port setup.

b. Quit CADU/Host Communications

(1) Start the WinRADSCOM program.

(2) Select "Quit CADU/Host Comm" from the "Comm" dropdown on the main menu.

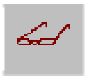
(3) "Quit CADU/Host Comm" dialog box is displayed as follows:

(4) Click the "OK" command button to end communication with the CADU.

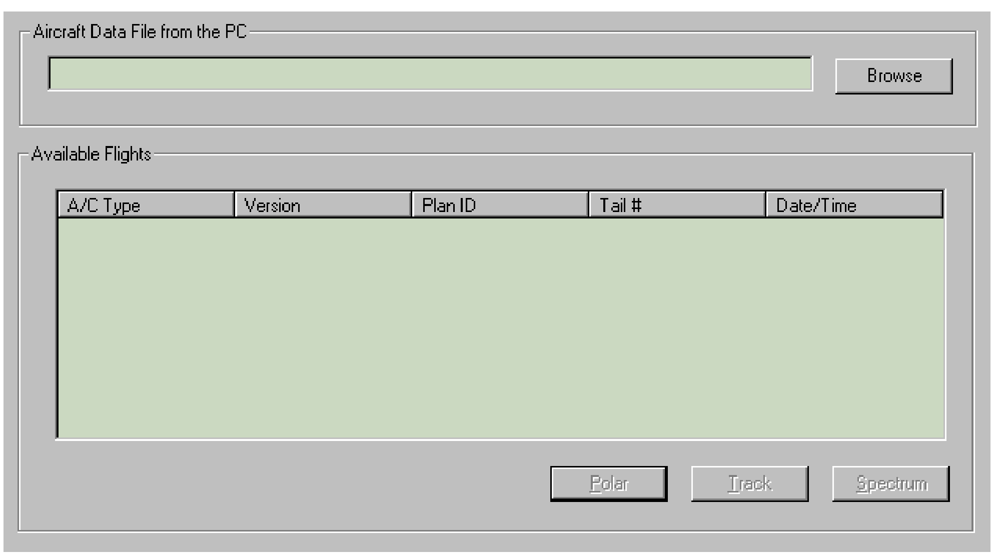
10. **Tools Functions**

a. View Data

(1) Start the WinRADSCOM program.

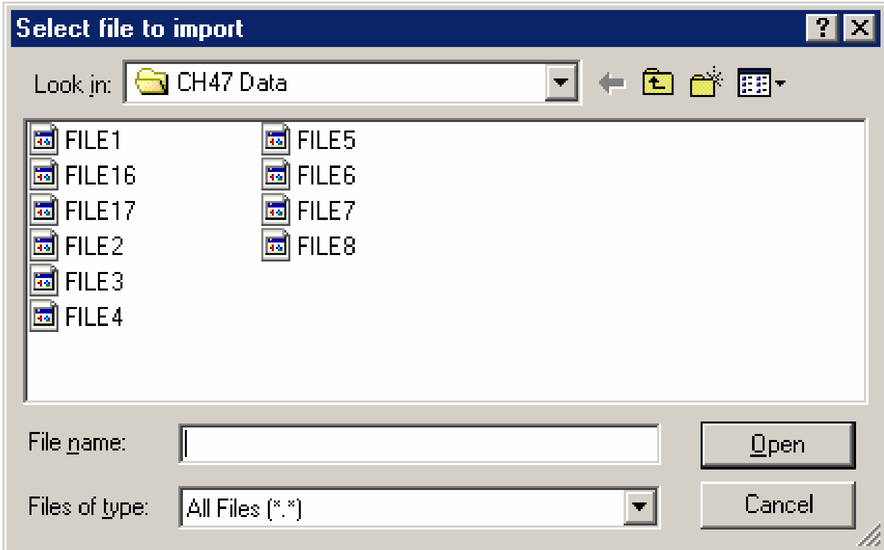
(2) Select "View Data" from the "Tools" dropdown on the main menu or select “the eyeglasses”  button on the toolbar.

(3) "Flight List" dialog box is displayed as follows:



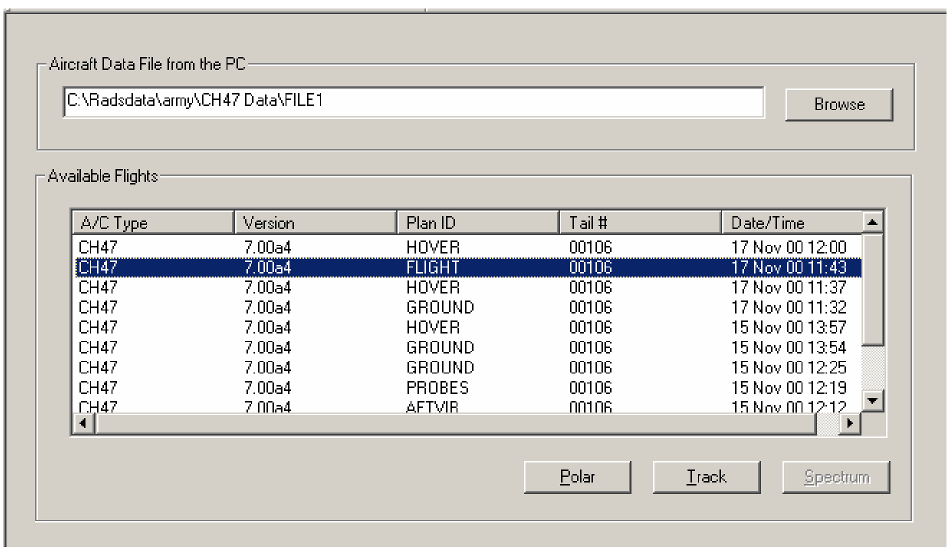
(4) Click the "Browse" command button.

(5) The "Select file to import" dialog box is displayed as follows:



(6) Locate and select the desired data file to import, then click the "Open" command button.

(7) Select the desired flight plan to view.



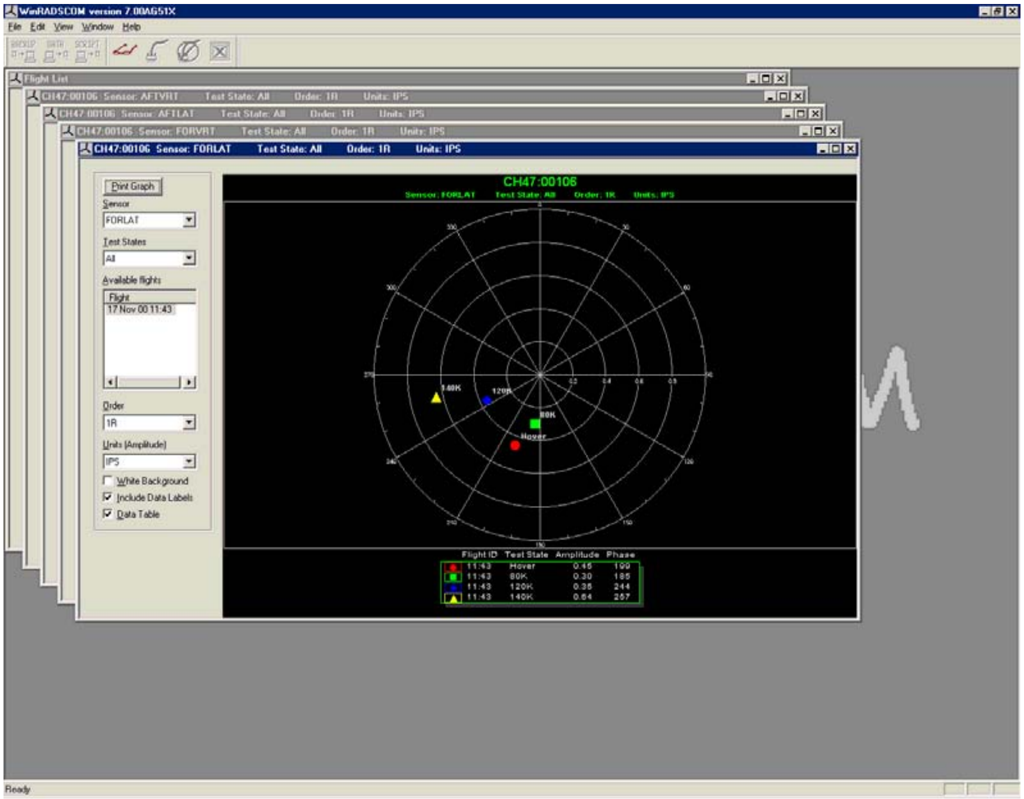
(8) Select the desired data display type (Polar, Track or Spectrum).

NOTE

Only those display types with available data will be highlighted.

(9) Click the "Polar" command button to view data in polar format.

(10) Polar data is displayed as follows (sample plot shown):



(11) All accelerometer data for the flight selected will be displayed. Select the sensor data you wish to look at in detail by mouse clicking the appropriate window header.

The user may manipulate the data as desired in the following ways:

(a) View data of an entire flight:
By selecting “all” in "Test States” box)

(b) View data of one test state over several flights:
Select a single test state in the “Test States” box and then select the desired multiple flights in the “Available Flights” box.

(c) Harmonics from 1r to 12r:
By selecting the desired order in the “Orders” box.

(d) Vibration “Units”:
The vibration amplitude may be changed from “IPS” to “Mils’ or “G’s” as desired in the “Units” box.

(e) White Background:
A white background display may be selected by putting a check in the box. This option is suggested for use when printing the graph.

(f) Data labels:
Data labels may be turned off on the polar plot by removing the check in the box.

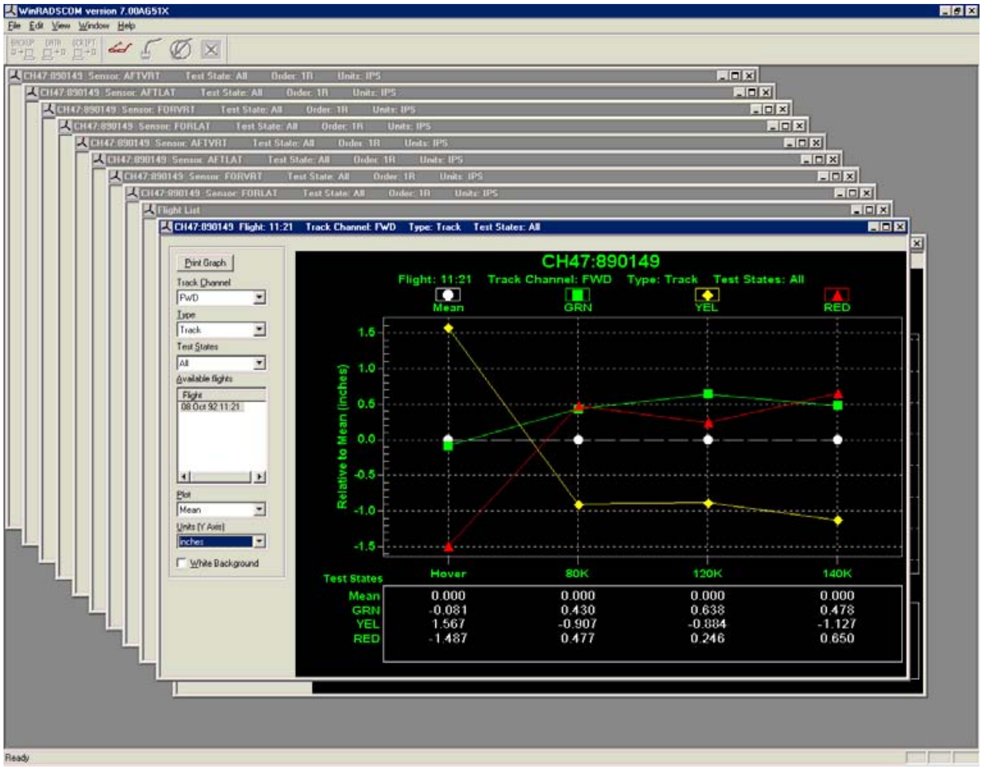
(g) Data table:
The data table at the bottom of the page may be hidden by removing the check in the box.

(h) Zoom:
If you desire more resolution of the plot around specific data points you can draw a box around the points by left clicking the mouse button and then dragging a rectangle around the points of interest. To return the display back to its default size, press the “Z” key.

(12) Click the Flight List window or the Eyeglasses icon to open the Flight List Window.

(13) Click the "Track" command button to view tracker 1 or 2 data in a line graph format.

(14) Track data is displayed as follows (sample plot shown):



The user may manipulate the data as desired in the following ways:

(a) View data of an entire flight:
By selecting “all” in "Test States” box)

(b) View data of one test state:
Select one test condition and the track data will be displayed for that single test state.

(c) View data of one test state over several flights:
Select a single test state in the “Test States” box and then select the desired multiple flights in the “Available Flights” box.

(d) Track/Lag:
To view Track or Lag, select the desired type in the “Type” box.

(e) To change the display for different plot styles:
Select either: Absolute, Mean, Standard of Deviation or Relative to a specific blade.

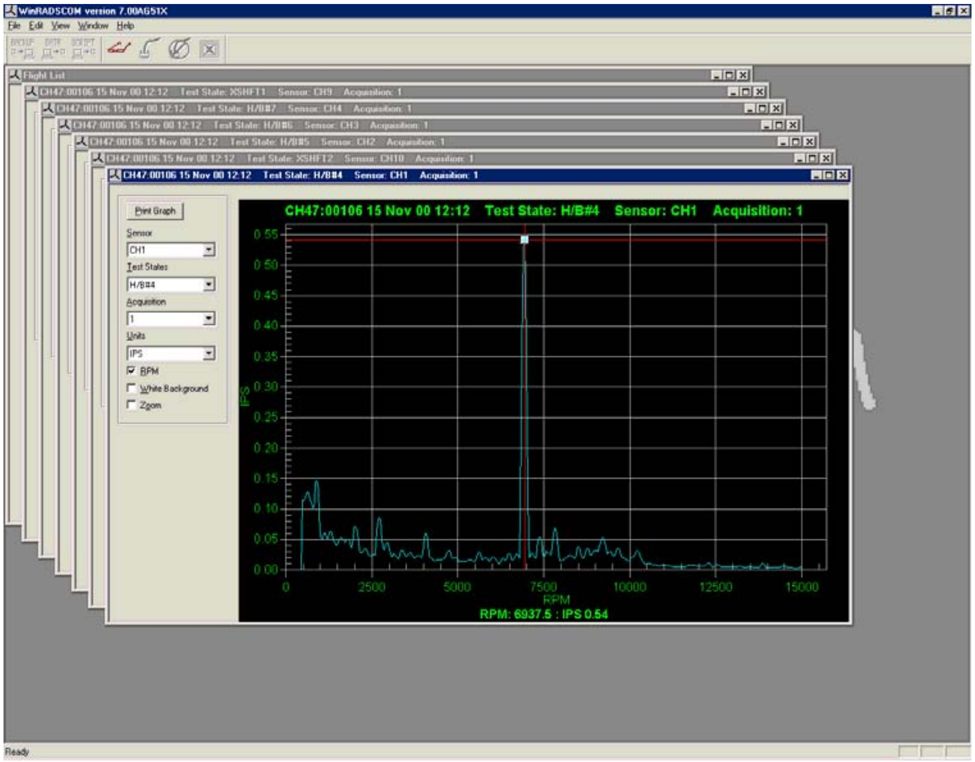
(f) Track Units:
The track units may be changed from “Inches, mm’s, feet, meter’s and mils by changing the desired unit in the “Units” box.

(g) White Background:
A white background display may be selected by putting a check in the box. This option is suggested for use when printing the graph.

(15) Click the Flight List window or the Eyeglasses icon to open the Flight List Window.

(16) Click the "Spectrum" command button to view asynchronous data in spectrum format.

(17) Spectrum data is displayed as follows (sample plot shown):



The user may manipulate the data as desired in the following ways:

(a) Sensor:
To change to a different sensor than the first one displayed simply select another senor from the list in the “Sensor” box.

(b) Acquisitions:
To view data from another acquisition of the same test state select the desired acquisition number from the list in the “Acquisitions” box.

(c) Units:
To change the vibration units to “G’s”, “IPS” or “Mils” select the desired type in the “Units” box.

(d) Change Frequency to Hz:
Remove the check from the “RPM” box.

(e) White Background:
A white background display may be selected by putting a check in the box. This option is suggested for use when printing the graph.

(f) Zoom:
To enable the Zoom function, place a check in the box. To obtain more resolution of the plot around specific data points you can draw a box around the points by left clicking the mouse button and then dragging a rectangle around the points of interest. To return the display back to its default size, press the “Z” key. To return the frequency cursor, remove the check in the Zoom check box.

(18) Click the Flight List window or the Eyeglasses icon to open the Flight List Window to select additional data. If no additional data is to be viewed then select “Close All” from the “Windows” drop down menu or the close window button on the Flight List Window

(19) Data viewing tips (all types):

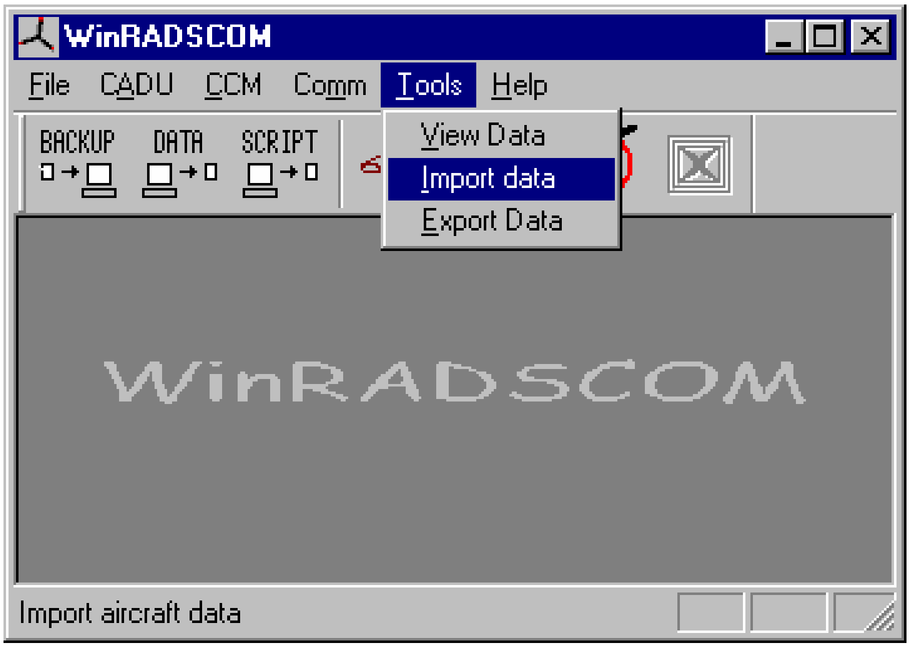
- Maximize Display:
  To make the display full screen, press the “M” key. To return the screen back to its default size press the “Esc” key.
- Printing a Display:
  Press the “P” key and the active window will be sent to the printer.

- Display Customization:
  To change the display defaults, export graphs etc., right click on the display and the Customization Dialog will be active. Use the built in help for additional description of available options.

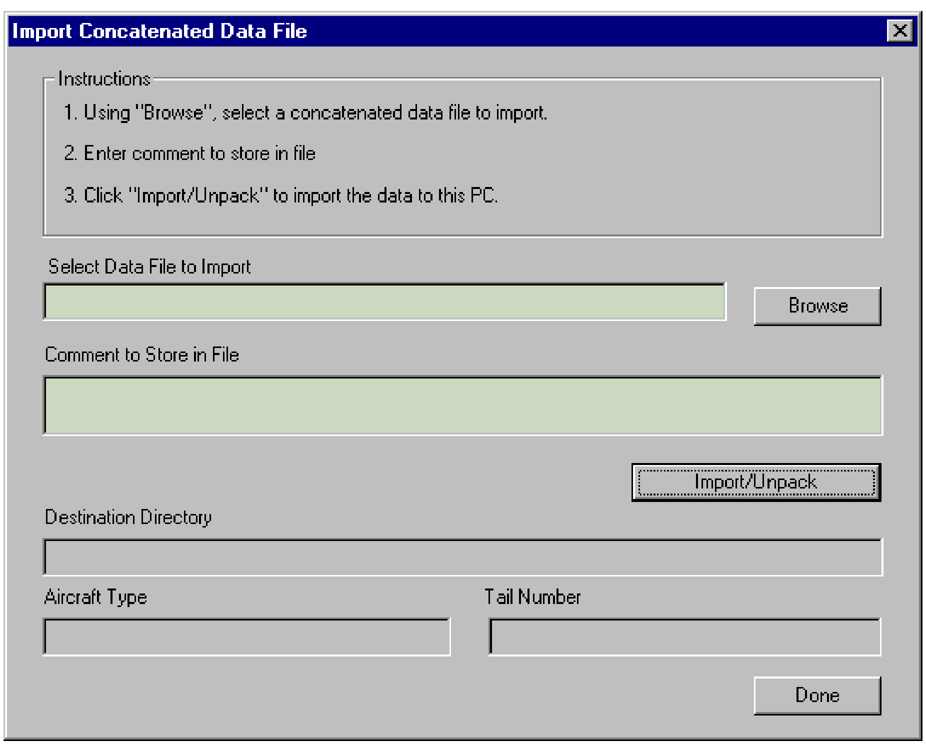
b. Import Data

(1) Start the WinRADSCOM program.

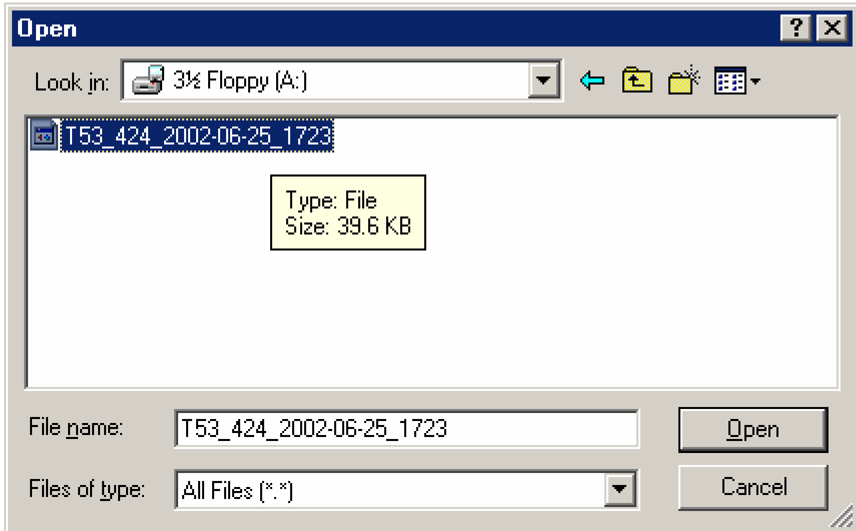
(2) Select "Import Data" from the "Tools" dropdown on the main menu.



(3) "Import Concatenated Data File" dialog box is displayed as follows:



(4) Click the "Browse" command button. The "Open" dialog box will be displayed as follows:



(5) Select the desired concatenated data file, and then click the "Open" command button.

NOTE

The import function is designed to receive concatenated data files. These compressed data files are files stored under their long file name and can be identified by the following format "aircraftype_tailnumber_date".

(6) Add any desired comment(s) to be stored with file in the "Comment to store in file" text box.

(7) Click the "Import" command button.

(8) Data will automatically be sent to the data directory and written to disk the same way as archived when transferring data from the CADU.

(9) Import Success dialog box is displayed as follows:

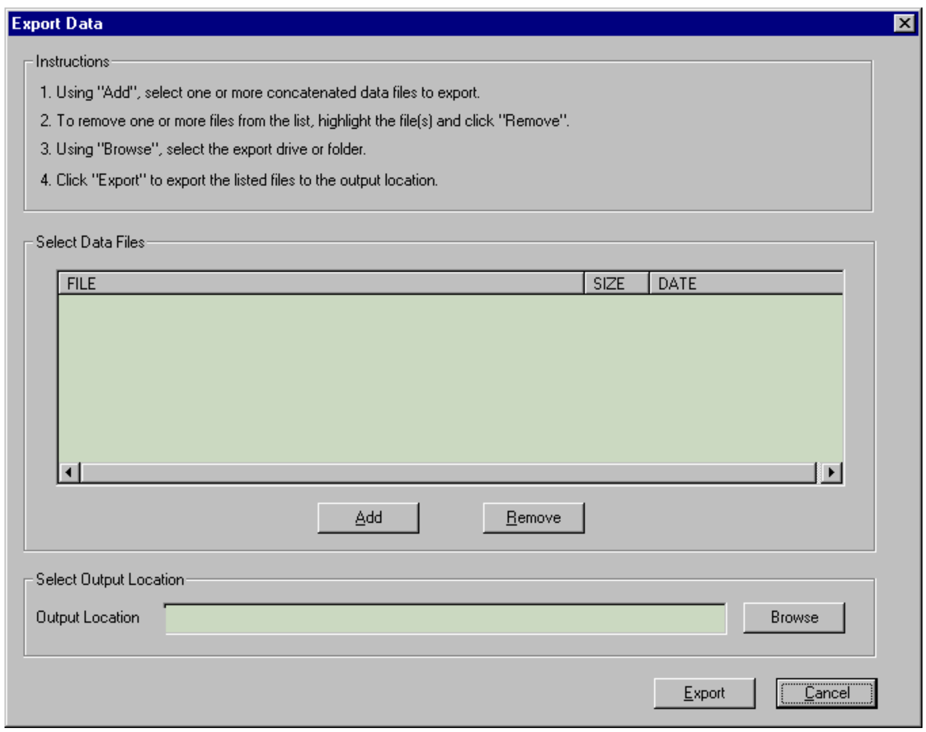
(10) Click the "OK" command button to finish Import Concatenated Data File.

c. Export Data

(1) Start the WinRADSCOM program.

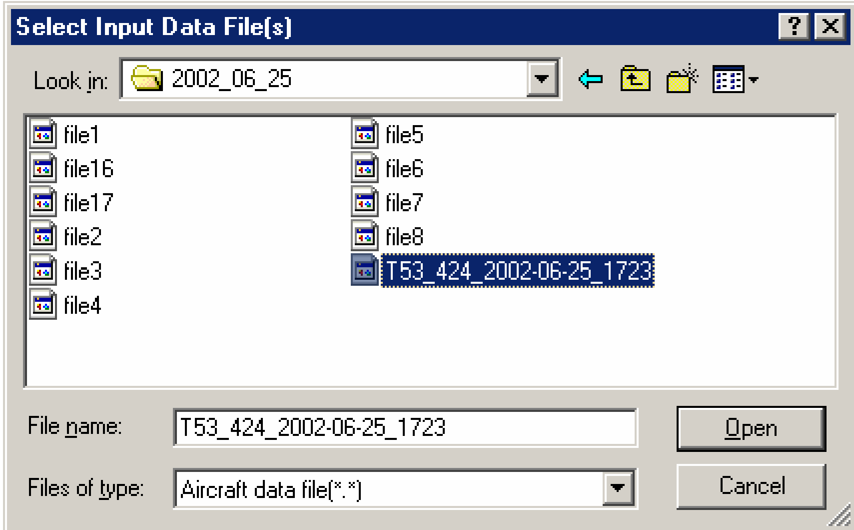
(2) Select "Export Data" from the "Tools" dropdown on the main menu.

(3) "Export Data" dialog box is displayed as follows:



(4) Click the "Add" command button to select a concatenated data file for export.

(5) "Select Input Data File(s)" dialog box is displayed as follows:



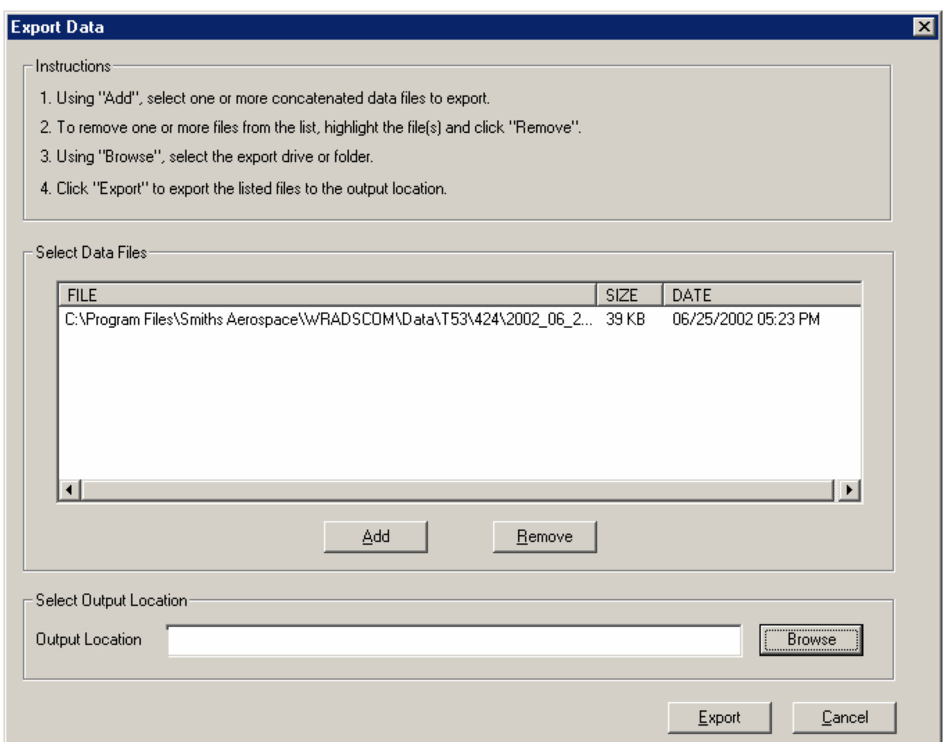
(6) Locate and select the desired file(s) to export.

NOTE

The export function is designed to send concatenated data files. These compressed data files are files stored under their long file name and can be identified by the following format "aircrafttype_tailnumber_date".

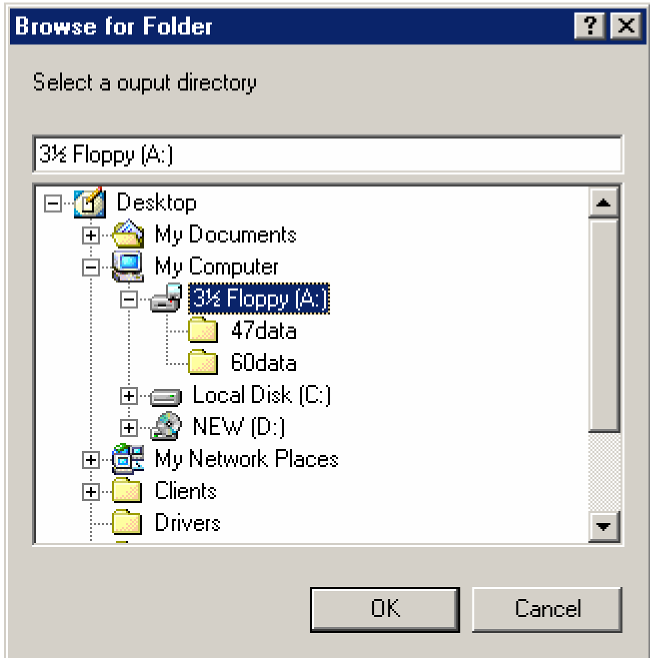
(7) Click the "Open" command button.

(8) Select data file(s) in the file list and click the "Remove" button to remove files mistakenly added to the list.



(9) Click the "Browse" command button to enter the Output Location.

(10) "Open" dialog box is displayed as follows:



(11) Locate and select the desired directory to export to.

(12) Click the "OK" command button.

(13) The export success dialog box is displayed as follows:

(14) Click the "OK" command button.

11. Troubleshooting

CADU cannot communicate with the PC during Format, Script, or Data File Loading:

- Ensure data transfer cable is a "serial null modem".
- Ensure CADU is turned on. It is recommended operator connect 12Vdc CADU battery charger to CADU prior to the start of data transfer.
- Ensure CADU is in "Host Mode". CADU is in host mode when at the five option menu and the screen has a blinking cursor at the very bottom left corner of the display.
- Ensure WinRADSCOM is set to use the proper serial port. After changing to the correct port, press "Check CADU/Host Operation" button to ensure communication with the CADU.

PC cannot communicate with the CADU during transfer of data from the CADU to the PC

- Ensure data transfer cable is a serial null modem.
- Ensure WinRADSOM software indicates that it is waiting for data to be sent from CADU.

PREPARATION FOR OPERATION
AVIATION VIBRATION ANALYZER

WARNING

Failure to correctly connect the dc power cable can result in personnel injury. Observe polarities when connecting the dc power cable.

WARNING

Installation of the UTD assembly on the nose mount (tracker mount) will cause the wirestrike protection system to be ineffective. All flights with the UTD installed are limited to areas where wire strikes are not likely.

WARNING

When routing cables, ensure cables are not routed through areas containing moving parts or heat sources. Cabling can become entangled in moving parts and cause injury to personnel or destruction of equipment.

WARNING

Failure to observe all safety precautions when connecting external power to the AVA equipment can result in injury to personnel. Observe all safety precautions when connecting external power.

CAUTION

If dc input power is reversed, allowing any portion of the AVA system to touch the airframe can cause damage to the AVA.

CAUTION

Install cable connecting the CADU to the DAU prior to connecting external power.

CAUTION

The Magnetic RPM Sensor must be installed in the prescribed position or an incorrect blade may be used as the reference blade. Blade color-coding must be determined to be correct prior to starting work on rotor.

CAUTION

Always install lockwire after tightening the jam nut. A loose jam nut could cause aircraft damage.

Index

Figures

Tables

1. GENERAL PROCEDURES

This section includes unpacking instructions, installation instructions, self-test procedures, and operating procedures.

2. UNPACKING

The following is a general procedure for unpacking and installing the AVA equipment on the aircraft to be tested. This procedure should be considered a guideline.

The AVA equipment is contained in two carrying cases. The component case, marked AVA Basic Kit, contains the Data Acquisition Unit (DAU), Control and Display Unit (CADU), and Universal Tracking Device (UTD). It also contains the Credit Card Memory (CCM) device and room for several accelerometers and their cables.

The accessory case, marked Adapter Kit, may contain the specific aircraft power cables, the UTD mounting brackets, a multi-pin connector cable, accelerometer mounting blocks, and various cables for the optical and magnetic RPM sensors. Each accessory case is aircraft specific and contains the items required for use with that aircraft.

3. INSTALLATION

Refer to WP0002 00 table 1 for a list of items included in the basic kit. WP0002 00 table 2 provides a list of items for each type of aircraft. WP0002 00 table 3 is a list of available accessories. Figure 1 shows a typical AVA system interconnect.

a. **AIRCRAFT CONFIGURATION.**
The aircraft equipment setup configuration will vary widely depending on the type of aircraft and operation being performed. This paragraph describes basic installation procedures and guidelines common to all installations. For aircraft specific details, consult the appropriate work package.

The number, type, and position of the required aircraft sensors are dependent upon the aircraft setup script. For simpler aircraft, generally two accelerometers, a Magnetic RPM Sensor, a UTD, a CADU, and a DAU must be installed. WP0001 00 figure 1 shows a typical system setup of an aircraft installation.

1. **Connecting Aircraft Power**

WARNING

Failure to correctly connect the dc power cable can result in personnel injury. Observe polarities when connecting the dc power cable.

CAUTION

If dc input power is reversed, allowing any portion of the AVA system to touch the airframe can cause damage to the AVA.

CAUTION

Install cable connecting the CADU to the DAU prior to connecting external power.

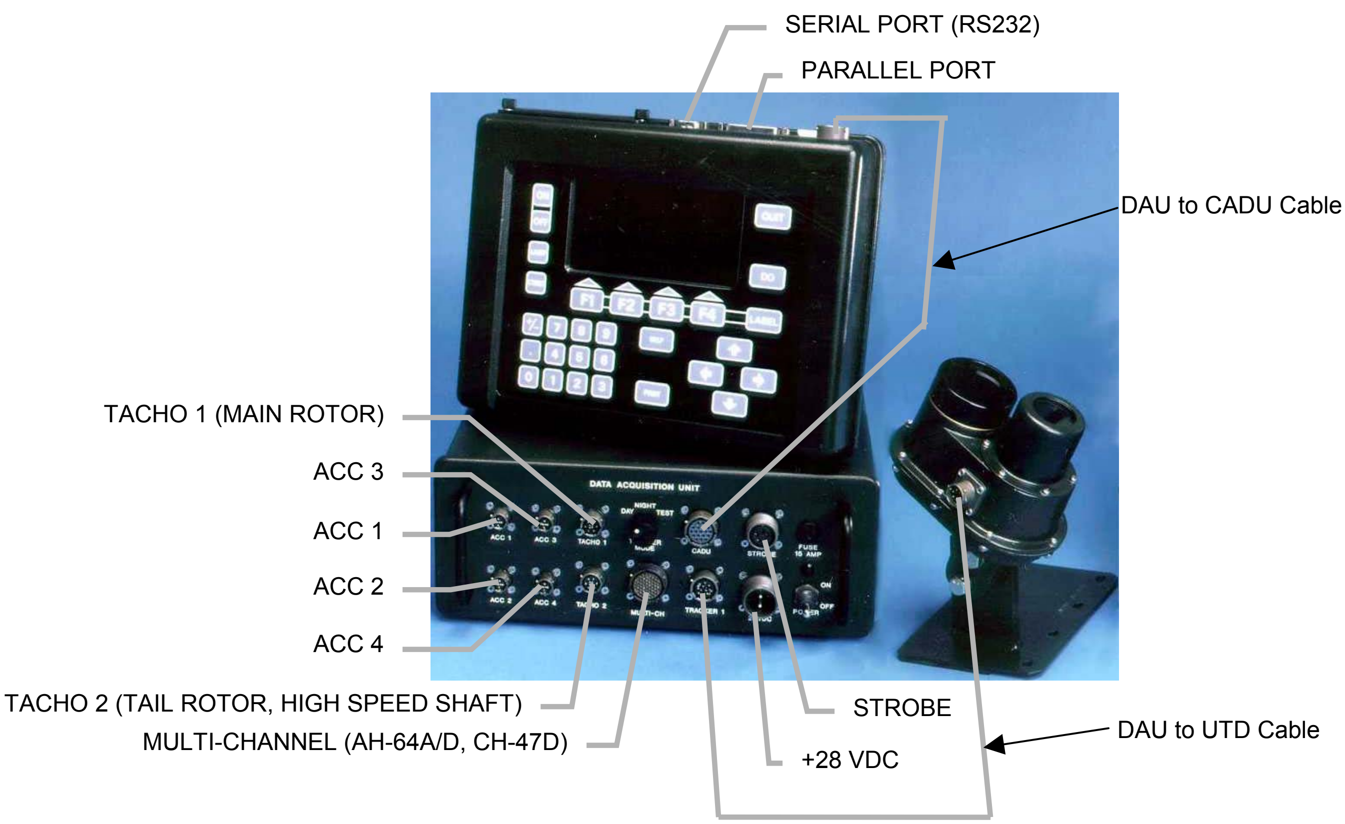


Figure 1. AVA System Interconnect

The AVA requires 18 to 36 Vdc power at about 1.5 amps to operate. The polarity of the input power is important. Connect the positive (+) supply rail to pin B on the DAU power input connector and connect ground to pin A. An aircraft power cable is provided in the AVA basic kit, and aircraft specific power cable adapters are in each accessory kit if a different connection is required.

For aircraft with compatible circular power connectors, simply install the cable between the DAU and the aircraft power receptacle. For some aircraft this is not available, and the small interface cable must be used. Typically a map light socket or other source of power can be found which is capable of powering the system. A green power indicator lamp will illuminate when external power is applied to the DAU and the DAU power switch is in the ON position. The green light is not an indication of correct connections, only that the switch is on and power is applied. The green light will also light if connected backwards.

2. **Installing Universal Tracking Device**

WARNING

Installation of the UTD assembly on the nose mount (tracker mount) will cause the wirestrike protection system to be ineffective. All flights with the UTD installed are limited to areas where wire strikes are not likely.

The installation of the UTD is critical to its proper operation and correct measurement. Figure 2 provides a diagram of the required aircraft mounting. The exact mounting position of the UTD and the installation angle are determined by the aircraft setup file, and the aircraft specific UTD bracket. To mount the UTD to the aircraft under test, attach the UTD bracket to the airframe at the required position. After the bracket is secured, attach the UTD to the bracket. There is a critical consideration to observe during installation for accurate measurements, the arrow on the body of the UTD must point in the direction of blade rotation.

NOTE

The UTD lens should be cleaned periodically with optical tissue or soft cloth for optimum performance.

3. **Installing Magnetic RPM Sensor**

CAUTION

The Magnetic RPM Sensor must be installed in the prescribed position or an incorrect blade may be used as the reference blade. Blade color-coding must be determined if correct prior to starting work on rotor.

The position and gap of the Magnetic RPM Sensor is critical to the operation of the AVA. The Magnetic RPM Sensor must be installed in the position prescribed by the appropriate aircraft work package or adjustments will be recommended for the wrong blade.

(a) Mount the Magnetic RPM Sensor from below the bracket with a jam nut on either side.

(b) Adjust the Magnetic RPM Sensor for a gap specified in the specific work package. Tighten jam nuts.

(c) Rotate the main rotor by hand and align the interrupter and the Magnetic RPM sensor. Check the clearance at the Magnetic RPM Sensor. Some aircraft will have a single interrupter at one position on the swashplate and other aircraft will have one double interrupter and a single interrupter for each other blade position. The aircraft setup file will prescribe either a single or double bladed interrupter. It is important to use the correct type of interrupter consistent with the aircraft setup file or tachometer frequency errors will occur. Consult the appropriate aircraft work package.

CAUTION

Always install lockwire after tightening the jam nut. A loose jam nut could cause aircraft damage.

(d) Install lockwire on jam nuts.

4. **Installing Accelerometers**
The specific position and orientation of the accelerometers is critical to the proper operation of the AVA. An accelerometer installed upside down or on the wrong axis will cause a 180° phase measurement error, causing adjustments to be recommended for the wrong blade or mass balance position. Consult the appropriate work package at the back of this manual for mounting details. It is essential that the accelerometer be in the proper position and orientation for the system to operate property. Verify the accelerometer is attached firmly to the mounting block or bracket.

5. **Installing Cables**
Refer to the appropriate work package for details on cable routing in specific aircraft. Work package 0060 00 provides detailed information on each of the cable assemblies. Cable assembly part numbers typically end in "XX" during discussion. These last two digits represent the fact that cables can be ordered in various lengths, but the functionality remains the same. Table 1 lists the five input signal types and their uses. Aircraft specific cables are listed in the aircraft work packages.

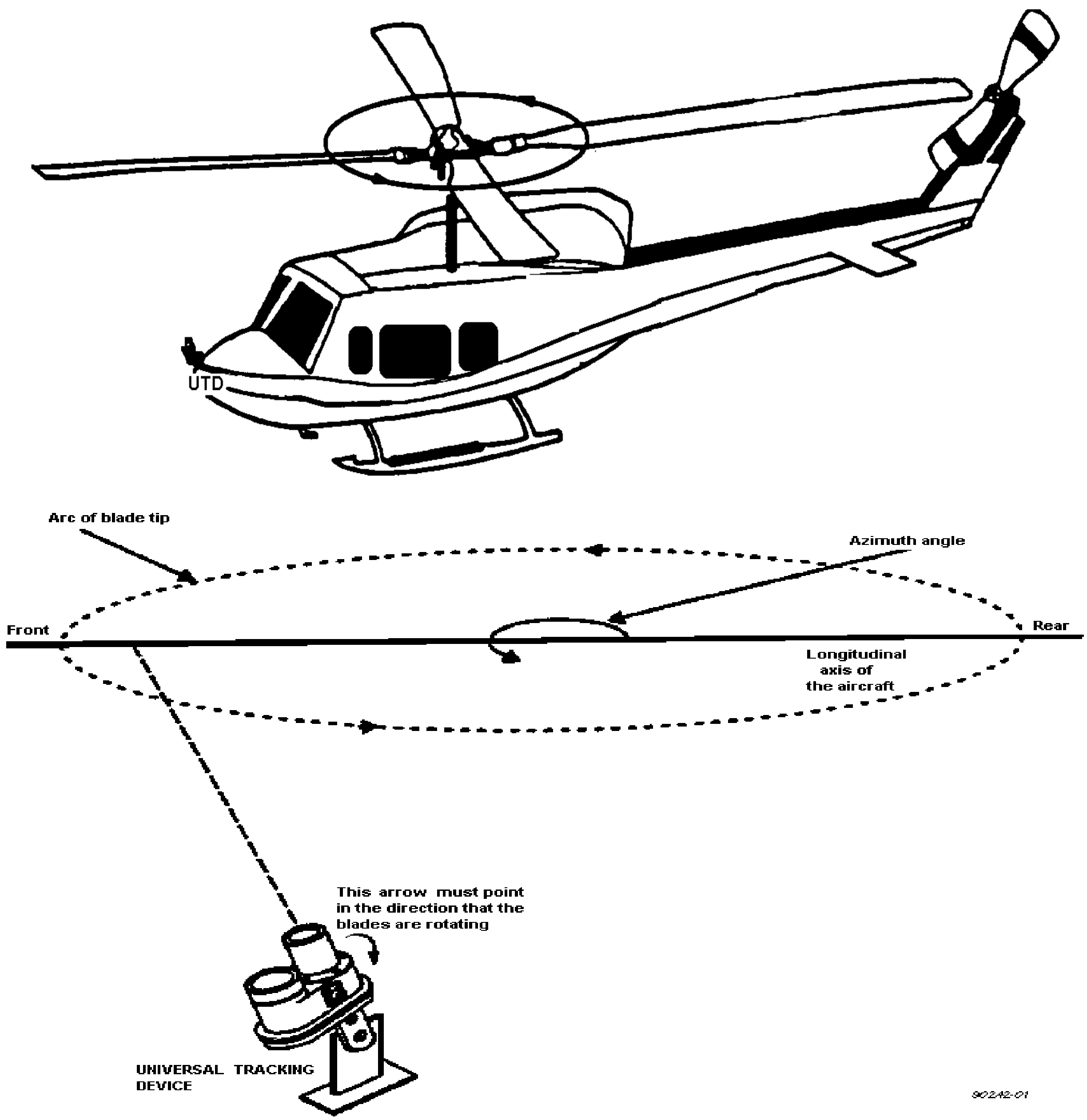


Figure 2. Universal Tracking Device (UTD) Mounting

WARNING

When routing cables, ensure cables are not routed through areas containing moving parts or heat sources. Cabling can become entangled in moving parts and cause injury to personnel or destruction of equipment.

(a) Route the cables to prevent safety mishaps as per the appropriate aircraft work package in this TM.

(b) Attach the UTD to the DAU Tracker connector with cable 29325701. Attach the magnetic RPM sensor to the DAU connector specified by the appropriate aircraft work package (e.g. Tracker 1, Tacho 2, etc.) with cable 291054XX.

(c) Attach the accelerometers to the proper DAU ACC channels using cable 291056XX.

5. **Installing Optical RPM Sensor**
The Optical RPM Sensor is intended to be used as a 1/REV tachometer input to determine frequency and phase of a rotating component. It is important to keep in mind that the operating characteristics depend somewhat on environmental conditions. Under adverse conditions (strong backlighting, high rotating speed, rain, or dense fog) the maximum operating range should be considered to be approximately 30 inches. Under more favorable conditions with a good reflector, it is possible to extend the range to 4 feet. As a general rule of thumb however, 6 inches would be the nominal distance.

Table 1. Individual Input Signal Cable Types

Cable	Use
UTD to DAU	Universal Tracking Device power from the DAU. Tracker processed signals back to the DAU (TRACKER 1).
Magnetic RPM Sensor	Main rotor RPM (Tacho) signal to the DAU (TACHO 1).
Optical RPM Sensor	Tail rotor RPM (Tacho) signal to the DAU (TACHO 2 [in most cases]).
Accelerometer to DAU	54 mV/g accelerometer signal to DAU (ACC1, ACC2, ACC3, ACC4)
Multiple Input to DAU	One additional UTD input to the DAU (MULTI-CH) One additional Tacho input to the DAU (MULTI-CH) Ten additional accelerometer inputs to the DAU (MULTI-CH).

6. **Installing Reflective Tape**
Tape Types. The type of reflective tape used is extremely important for proper system performance. 3M tape #7610 (NSN 9390-01-334-4357) is considered to be the standard target material because of its strong reflection, lightweight, low profile, and excellent adhesion. The tape will not seriously affect the balance of the rotor, and will not dislodge in flight. In wet conditions however, the 3M 7610 tape does not perform well. An overcoat of clear tape, or using 3M #38-70 (hex pattern tape) is recommended under wet conditions.

7. **Loading Aircraft Configuration Files (Script Files)**
Each aircraft type supported by the AVA has a unique aircraft configuration file. This aircraft configuration file contains setup information for the airframe, aircraft specific measurements, Flight Plans, airframe specific diagnostic coefficients, procedures, and displays. It is necessary to have the proper aircraft configuration file loaded into the CADU database in order to use the AVA on the desired aircraft. This is initially performed at the factory prior to shipment. If for any reason the desired aircraft is not already in the database (CADU ramdisk reformat, new aircraft release, etc), follow the procedure in work package 0005 00 or 0005 01 as applicable for loading data files into the CADU to load the aircraft setup file into the CADU. Once loaded, the file will remain in the CADU until the database is reformatted or the file is deleted via the MANAGER menu.

b. **OFFICE CONFIGURATION.**
Figure 1 depicts the system interconnection of the various AVA elements. The major elements of the system (including cables) are shown in the diagram for the purpose of displaying the extent of the capability of the AVA, although not all the inputs and units may be necessary for any particular test. The office configuration is a subset of the equipment shown in the figure. Generally the office configuration consists of a CADU, battery charger, a printer or host computer, and cables. There is no need for the DAU or associated cables and sensor for AVA operation in an office. The office configuration would primarily involve interaction between the AVA CADU and a host computer (transferring measurement data to the host computer and uploading setup data, programs, etc. from a host computer) or using the CADU to run diagnostics and view displays on measured data.

1. **Connecting External Power**

WARNING

Failure to observe all safety precautions when connecting external power to the AVA equipment can result in injury to personnel. Observe all safety precautions when connecting external power.

Connect external power to the CADU by connecting the 12 Vdc battery charger to the CADU and an AC power source.

(a) For the wall mounted supply: The 12 Vdc battery charger connects at the top of the CADU under the credit card slot cover and provides the required power to operate the CADU independent of the DAU and/or charge the internal battery. Keep the battery charger connected to the CADU whenever charging the NiCad battery or using the CADU. It is not recommended to be connected for long-term storage.

(b) To verify that external power has been applied: To verify that external power has been applied, turn on the CADU and press the LAMP key. The lamp will remain ON when the key is released if external power is available and extinguish if external power is not available.

2. **Connecting External Computer**
The AVA serial port is dual function. It can either be used to communicate with an external printer, as described below, or communicate with an external computer either directly or through an external modem. Typically this external computer will be an IBM PC compatible. Connect an external computer as follows:

(a) Connect the serial null modem cable, P/N 28130802, between the RS-232 port on the CADU (the 9-pin connector) and the RS-232 port on the host computer (usually a 9-pin connector). The Gender Changer, P/N 28130800, and RS-232 Adapter, P/N 28130801, may be required. Cable, gender changer and adapter are supplied with the basic AVA kit.

(b) The AVA Communication Package (RADSCOM or WinRADSCOM) is available for executing more sophisticated commands from an IBM compatible computer to the AVA. These commands are described in more detail throughout various sections of this manual.

3. **Connecting Printer**
To print out spooled pages (Displays), an external printer can be connected to the CADU printer port. The CADU provides a RS-232 serial port and a parallel printer port. Use the serial port (9-pin connector) for the AVA printer and Epson compatible serial printers. Use the parallel port (25-pin connector) for those printers that have a parallel interface. Connect the printer by attaching the CADU-to-printer cable between the CADU serial port and the printer RS-232 port. When viewing it from the top edge, the serial port connector (9 pins) is in the middle of the CADU.

4. **Configuring the Printer**
To configure the CADU for the printer, go into the MANAGER menu using the **F4** key from the main menu. Use the UP/DOWN arrow keys to highlight the Setup option and select by pressing the **DO** key. Then select the option Printer by highlighting it and press **DO**. Then set port type to either parallel or serial by highlighting the Change Port option and selecting the appropriate port, and press **DO**. Select

the driver from the installed drivers under the Change Type option. For each printer type there are often two drivers, a standard driver and one ending in "LF." If you experience data overprinting on one line, use the driver ending in "LF." Conversely, if you experience data printing on every other line, select the driver without the "LF."

5. **Setting Up Printer**
The AVA is designed to work with a wide variety of commercially available printers. Due to their low cost and wide availability, it is recommended that a commercial grade printer be used for office environment printing. The AVA can be used with either a serial or parallel printer. The Centronix parallel interface is supported by the AVA.

The CADU has been designed with an internal print spooler. Basically this means that as the **PRINT** key is pressed while DPL is executing, the graphics image that appears on the screen is stored in RAM disk awaiting printing.

If a printer is properly attached and configured, the image will be immediately printed. If no printer is attached, the print image is stored until a printer is attached. Up to 20 spooled screens can be stored without printing. If more than twenty displays are spooled, the first display spooled will be discarded to make room for the next.

6. **Setting Up Printer Switch Settings**
The printer must be set up to operate with the AVA. There are basically three areas of setup:

(a) Printer configuration switch setup (this is done on the printer)

(b) CADU printer type setup

(c) CADU printer port selection (serial or parallel)

Since there are a wide variety of acceptable printers, only a few printer specific switch settings will be given in this manual. The typical printer must be set up as follows:

Hardware Interface: ....Serial (RS-232) or Parallel Port
Parity: ....None
Stop Bits.....................................1
Data Bits:....................................8
Baud Rate: 9600
Data Protocol: ....ON/XOFF Disabled RDY/BSY Enabled (DTR hardware handshake)
Handshake:................................Carrier Detect (CD) Disabled
Clear To Send (CTS) Disabled
Data Set Ready (DSR) Disabled
Paper Length: ....11"
Emulation: ....Choose from list on CADU
LF Definition:..............................CR without LF
CR with LF
Character Set:............................USA Character Set

The AVA supports several compatible printers that associate a line feed with a carriage return. If this is the case with your printer, choose the printer type with _LF when in the DPL MANAGER Menu section, otherwise choose a printer type without _LF.

7. **Configuring the CADU for Printer Type**
After the switches have been set on the printer, the CADU must be configured for that particular printer. To select the AVA printer, or any other printer type, go into the DPL MANAGER section and select the Setup operation. Another screen will appear from which the printer operation should be selected.

8. **Testing Setup**
A majority of the time, the printer manuals do not accurately depict the switch locations and proper positions. A few simple checks can be made to test the printer configuration. If the setup is not working, review the printer switch settings and make corrections as necessary.

Establish if any communication can be made between the CADU and the printer. The following procedures will test areas like data bits, parity and baud rate:

(a) Test the graphics compatibility by pressing the **PRINT** key to print the Main Menu screen (The first screen that appears when normal AVA operation has started).

(b) Test the text mode by pressing the **PRINT** key in any help, error, or menu selection screen. The following is an example:

(1) Press the **PRINT** key to print out the text displayed on the screen at this time.

(2) If the printer fails to print the proper screen, flush the print spooler using the following sequence:

(a) Select the Manager menu by pressing **F4** at the main menu.

(b) Select setup option by using the UP/DOWN arrow keys and highlighting the Setup option and pressing the **DO** key.

(c) Select the Printer option and press the **DO** key.

(d) Select the Disable option and press the **DO** key.

(e) Select the Flush Queue option and press the **DO** key.

(f) Select the Enable option and press the **DO** key.

(c) If the screen does not print any characters or prints incorrectly, make corrections to the printer switch settings as necessary.

(1) If the printer prints random characters, verify that the correct print driver was selected, most likely the incorrect one was selected.

(2) If the printer prints on one line only and repeatedly overprints the line, select the print driver that ends in “LF” (e.g. Epson_LF).

(3) If the printer skips a line when printing, select the print driver without “LF”.

NOTE

Most printers will have to be powered off and on between switch setting changes to accept changes.

4. SELF-TEST PROCEDURE

The AVA has three methods of self-test and calibration. There are no adjustments required to guarantee the system is calibrated, because all measurements are based on a high accuracy, high stability voltage and frequency references. The accuracy of these references is constantly compared against secondary voltage and frequency references to insure measurement accuracy.

a. The first basic type of self-test is performed every time the DAU is powered up. This power-up test takes approximately two seconds to complete and tests the following areas:

1. DAU to CADU Communications
2. DAU System Memory
3. DAU High Accuracy Voltage Reference
4. DAU High Accuracy Frequency Reference
5. DAU A/D Converter Operation
6. DAU Sample Memory Store

This tests the machine's basic operation and ability to make measurements. If a test fails, a failure specific error message is returned to the CADU and reported on an error screen.

b. The second type of test is performed at 24-hour intervals and is used for system calibration. This test takes approximately ten seconds to complete. The results of the calibration are stored in a non-volatile memory and are used to correct the measured data. At 24 hour intervals, the following tests are performed:

1. DAU to CADU Communications

2. DAU System Memory
3. DAU High Accuracy Voltage Reference
4. DAU High Accuracy Frequency Reference
5. DAU A/D Converter Operation
6. DAU Sample Memory Store
7. DAU Analog Anti-Alias Filter Ripple
8. DAU Analog Anti-Alias Filter Cutoff Frequency
9. DAU Analog Filter Gain
10. DAU DAC Gain
11. DAU Accelerometer Input Circuitry
12. DAU Gain Range Circuitry

c. The third type of testing is performed before or during the measurement. These tests include accelerometer, interrupter and UTD fault tests. The accelerometer is checked for saturation and proper bias level. The tachometer frequency is monitored. The UTD is monitored for a series of faults including:

1. Correct number of pulses per blade.
2. Correct UTD setup.
3. Correct blade velocity.
4. Correct blade chord width (in DAY mode).

END OF WORK PACKAGE

TURN ON/OFF PROCEDURES
AVIATION VIBRATION ANALYZER

CAUTION

The operator must exit DPL prior to performing a system reboot of the AVA to prevent the possible loss or corruption of the internal database data.

Figures

a. **Power On Procedure**
The CADU is powered from the DAU, the 12 Vdc battery charger, or by its own internal rechargeable battery pack. The internal battery pack is charged anytime the CADU is connected to external power by the 12 Vdc battery charger or DAU. The CADU can be operated while charging. Power is distributed to the CADU when the DAU power switch is activated. To operate the CADU with or without external power, press the **ON** key. The CADU will operate eight hours with a fully charged battery, depending on lamp usage. If the CADU does not respond it may be necessary to reboot it, see step b.

b. Reboot and Start-Up Selection Menu

Note

The recommended procedure for rebooting the CADU is a soft reboot, see step 1. If the CADU is locked up a hard reboot is necessary, see step 2.

1. A soft reboot of the CADU is accomplished by simultaneously pressing the DO and QUIT keys.
2. A hard reboot of the CADU is accomplished by first pressing the OFF key. While pressing and holding the HELP key press the ON key.

For either case the following message will display after a few seconds:

CADU System Bootstrap V3.1
Please Wait...

When the above message goes away, the Start-Up Selection Menu will appear (refer to figure 1).

Note: Option 2 includes communication use with the WinRADSCOM program.

```
*******************************************
***            RADS-AT            ***
*******************************************
Please select an option:
1:  Proceed with normal operation
2:  Set up for host communication
    use this option with the
    RADSCOM diskette.
3.  Load aircraft setup flies from
    the credit card
4:  Modem setup
5:  Help menu

Select (1, 2, 3, 4, or 5):
```

Figure 1. Start-Up Selection Menu

This screen is prompting the user for input. The user must press **1** to proceed with normal operation , **2** to go into host communication to use the RADSCOM or WinRADSCOM interface, **3** to load aircraft setup files from the credit card memory, **4** to perform a modem setup, or **5** to select the Help menu. Because there is no default, this screen will wait for one of these five keys to be pressed.

(a) If the user selects option **1**, normal system operation will begin and the DPL Booting Window will appear as shown in figure 2.

Booting DPL

Please Wait

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Figure 2. DPL Booting Window

After booting is completed the first Main Menu will appear as shown in figure 3, except that RADS-AT VERSION 7.01 will always be followed by the most current software enhancement level code. For example: VERSION 7.01AA51D.

SIGNAL PROCESSING SYSTEMS - SHL
RADS-AT VERSION 7.01XXXXX
1-AUG-01 **00:01:01**

Aircraft Type	UH60	7.1
Tail Number	8243934	
Flight Plan	FLIGHT	
Flight I.D.	1-AUG-01 at 06:01	

[DO] = Select Highlighted item
[QUIT] = Clear Highlighted Item
MEASURE DISPLAY DIAGS MANAGER

Figure 3. Main Menu

(b) If the user selects option **2**, the following additional instructions will be displayed:

Connect the PC to HOST cable
between the RS232 ports of the
CADU and the HOST computer

(c) If the user selects option **3** and a CCM is installed, a menu will appear showing the following display (example selections):

************Load Aircraft Setup Files"""""**
Enter the number of your choice below:
Press QUIT to exit
1 AH64_r 7.01
2 CH47_r 7.01
3 UH60_r 7.01
Choice?

NOTE

The actual aircraft that are displayed may vary depending upon the configuration of the credit card memory. The CCM capacity is smaller than the CADU memory. If no aircraft setup files are currently stored on the CCM, this menu will not appear.

(d) If the user selects option **4**, the following additional instructions will be displayed:

Connect a Hayes compatible modem to a NULL-MODEM. Connect the RS232 port of the CADU to the NULL-MODEM using the 'CADU HOST' cable. Connect the phone cable to the modem. Select the baud rate for your modem:

1: 1200 BAUD

2: 2400 BAUD

3: Return to the main menu

Select (1, 2, or 3):

(e) If the user selects option **5**, the following additional instructions will be displayed:
Note: Help Menu item 2 includes use of WinRADSCOM program with this option.

**********HELP MENU**********

1: Proceed with normal operation. This starts the measurement and the diagnostic program.

2: Set up for host communication. Allows access to the serial port for initializing the RADS-AT, unloading and loading of stored data to and from a host computer (PC), use RADSCOM diskette with this option.

Press any key to continue

**********HELP MENU**********

3: Load aircraft specific setup file Use this option to load aircraft setup files from the Credit Card into the database.

WARNING: Aircraft setup files already loaded into the system, will be overwritten by any new setup files loaded that are specifying the same aircraft type.

Press any key to continue

**********HELP MENU**********

4: Modem Setup This option is used to allow a remote communication with the RADS-AT. Connect a Hayes compatible modem to a NULL-MODEM. Connect the RS232 port of the CADU to the NULL-MODEM using the 'CADU to HOST' cable. Connect the phone cable to the modem.

Select the Baud rate for your modem:

1:1200 BAUD

2:2400 BAUD

3:Return to the main menu
Select (1, 2, or 3):

5: Help menu
Displays Help Information (this menu).
Press any key to continue

Pressing of any key returns the display to the Host Communication Interface menu.

c. **Rebooting the DAU**
The DAU will reboot after power has been applied. Reboot the DAU as follows:

1. Turn the power switch off for two seconds or more.
2. Turn the power switch on. The green power indicator lamp should be illuminated if external power is connected. At reboot, the DAU software is initialized and an internal self-test will run automatically.

END OF WORK PACKAGE

SYSTEM SETUP
AVIATION VIBRATION ANALYZER

Figures

a. Setting Up the AVA for a Particular Aircraft

The AVA requires aircraft-specific setup files in order to make the required measurements and analysis to correct vibration and track problems. If the AVA is configured for the aircraft under test, the following SETUP section is applicable. If the aircraft type does not appear on the Aircraft Type Menu, it will need to be created and installed.

1. **Selecting an Aircraft Type**
   The Aircraft Type Menu is selected by using the UP/DOWN arrow keys to move the inverse video cursor over the Aircraft Type selection in the Main Menu, figure 1, and pressing the **DO** key. The Main Menu is removed from the display and the Aircraft Types Menu appears, figure 1. Using the arrow keys, place the inverse video cursor over the appropriate aircraft type and press the **DO** key to execute the selection. The Main Menu will reappear with the Tail Number selection highlighted for selecting the next category in the setup function. The **QUIT** key can be employed at any time to return to the Main Menu.

2. **Selecting a Particular Aircraft Tail Number**
   The Tail Numbers Menu is selected by using the arrow keys to move the inverse video cursor over the Tail Number selection in the Main Menu, figure 1, and pressing the **DO** key to execute the selection. The Main Menu is removed from the display and the Tail Numbers Menu appears, see figure 1. Using the arrow keys, place the inverse video cursor over the appropriate tail number and press the **DO** key to enter the selection. The Main Menu will reappear with the Flight Plan selection highlighted for selecting the next category in the setup function. The **QUIT** key can be employed at any time to return to the Main Menu.

3. **Selecting a New Tail Number**
   If the tail number of the aircraft under test is not in the list of tail numbers, a new tail number can be entered by selecting NEW from the Tail Numbers Menu and pressing the **DO** key. An Entry Form will appear, figure 1, allowing entry of the new tail number. A numeric tail number can be entered using the numeric keypad. Entering an alphanumeric tail number can be done using the **F1** and **F2** function keys. The **F1** and **F2** keys scroll through the allowed characters set. That set is the blank character, 0 through 9, A to Z, and a to z. **F1** scrolls forward through the list and **F2** scrolls backward. The RIGHT/LEFT arrow keys move the cursor to the next character or previous character in the tail number. After the desired tail number has been entered, press **DO** to store the new tail number and return to the Main Menu. The Main Menu will reappear with the Flight Plan selection highlighted for selecting the next category in the setup function. The **QUIT** key can be employed at any time to cancel the tail number entry and return to the Main Menu.

4. **Selecting a Flight Plan**
   A Flight Plan must be entered in order to identify the set of measurements to be taken. The Flight Plans Menu is selected by placing the inverse video cursor over the Flight Plan selection in the Main Menu, figure 1, using the arrow keys and pressing the **DO** key to execute the selection. The Main Menu is removed from the display and the Flight Plans Menu appears, see figure 1. The Flight Plans Menu contains the set of Test States pre-stored for the selected aircraft type. Test states are the flight conditions at which measurements are taken.

   For example: Flight Plans are categorized into Flight, Ground, Tail, or Power Spectrums. Within each category are the Test States particular to the category selected. Select the desired Flight Plan by using the arrow keys to move the inverse video cursor to the desired Flight Plan and press the **DO** key (a various number of categories can be displayed, not necessarily all those listed here). When the **DO** key is pressed, the selected Flight Plan is stored and the display returns to the Main Menu. The Main Menu will reappear with the Flight ID selection highlighted for selecting the next category in the setup function. The **QUIT** key can be employed at any time to cancel the Flight Plan entry and return to the Main Menu.

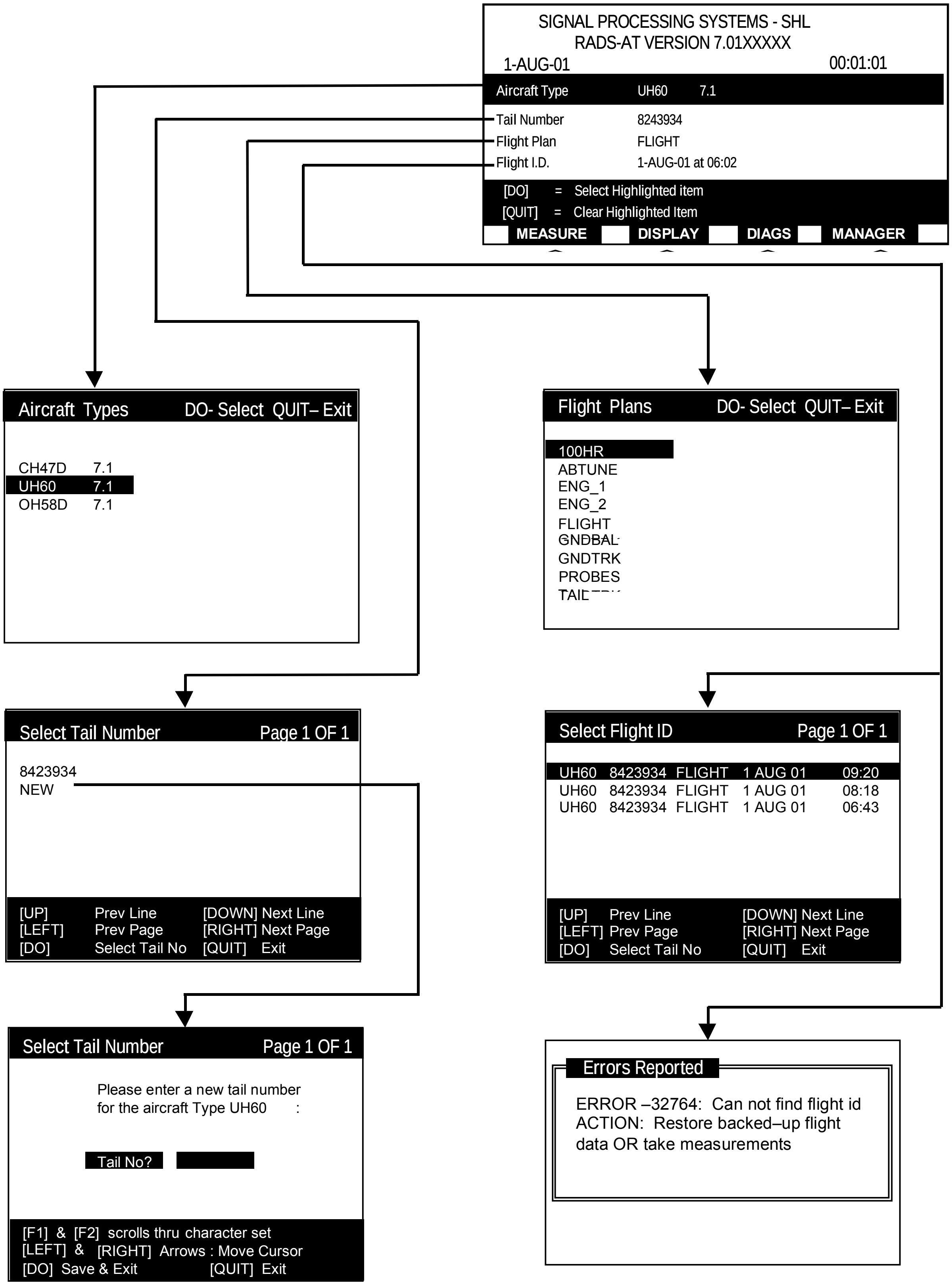


Figure 1. Main Menu Hierarchy

5. **Selecting a Flight ID**
Selection of a flight ID is required in order to display data or run diagnostics on data previously stored in the AVA. A flight ID is a time and date stamp associated with a particular set of collected data identifying when that set of data was collected. A list of existing flight IDs for the aircraft type selected appears when the Flight ID, figure 1, selection in the Main Menu is highlighted by placing the inverse video cursor over the Flight ID selection in the Main Menu and pressing the **DO** key. The Main Menu will reappear with the Aircraft Type selection highlighted. The **QUIT** key can be employed at any time to cancel the flight ID entry and return to the Main Menu.

6. **Discussion**
The AVA contains a database that stores the aircraft configurations, measurement setups, diagnostic coefficients, display formats, and collected data. The entry of the aircraft-specific setup information allows the access of these unique parameters. Each aircraft type has a customized configuration file, which determines the measurements to be made, how the data is to be displayed, and the way that the corrections are generated.

The AVA database features allow the user to access data that has been previously collected and is currently stored in the database. That data can be displayed or the data can be analyzed by the diagnostic algorithm, as examples of the system's flexibility.

Data stored previously in the system can be reviewed by entering the aircraft type, tail number, Flight Plan, and flight ID into the Main Menu. A shorter method is to enter just the flight ID into the main setup menu, since the flight ID is linked with the aircraft type, tail number, and Flight Plan automatically.

Aircraft type names can contain up to six alphanumeric characters. The aircraft type name is typically the name or an abbreviation of the aircraft name or designator (e.g., UH-60, AH-64A, etc.). The operator need not be concerned about what name to enter, since the names of the aircraft are determined by the pre-stored setup files, and appear on the display when the Aircraft Type selection is highlighted and the **DO** key is pressed at the Main Menu.

Tail numbers consist of seven alphanumeric characters. It is meant to be a unique number, which identifies a particular aircraft within that aircraft type. It can be entered by the operator or be entered into the database via the setup file for that particular aircraft type.

Flight Plans that contain the Test States at which measurement data is to be collected are also generated as part of the aircraft configuration file. They are typically arranged so that specific data and diagnostics are run as part of a common required maintenance operation. For instance, there will typically be separate Flight Plans for the ground, flight, and tail. Descriptions of the three typical types of Flight Plans are as follows:

(a) The GROUND Flight Plan is used to collect data and execute diagnostics prior to flight. This allows limits to be checked and preflight corrections to be made so that flight safety limits are not exceeded and valuable flight time wasted. This Flight Plan is used primarily to bring the rotor into a stable condition after major maintenance has been accomplished.

(b) The FLIGHT Flight Plan allows the collection of all the data necessary to assess the main rotor track and balance while in flight and to reduce vibration to acceptable limits.

(c) The TAIL Flight Plan allows the collection of data necessary for evaluating tail rotor balance.

Three separate Flight Plans are used because separate diagnostic programs are employed within each Flight Plan.

As part of each Flight Plan, there are up to ten separate flight conditions where measurements are taken. These flight conditions are called Test States. At each Test State the required measurements are taken, which has been predefined in the aircraft configuration file.

The flight ID number is automatically assigned at the start of data acquisition. The flight ID consists of the date and time at which measurements were started. The ID is generated by the internal system clock.

b. **Main Menu**
Once the main setup selections have been completed, the Main Menu reappears, figure 2, containing the entered data. The options available from this menu are: MEASURE, DISPLAY, DIAGNOSTICS, and

MANAGER (the MANAGER operation contains a number of actions which mostly pertain to managing the database, and reconfiguring the system: Data Maintenance, Data Transfer, Status, Setup and Test).

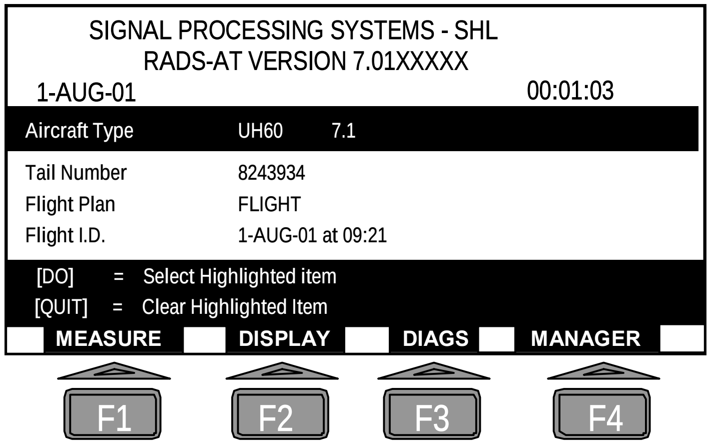


Figure 2. Example of Main Menu

END OF WORK PACKAGE

TAKING A MEASUREMENT
AVIATION VIBRATION ANALYZER

Figures

Tables

a. **Measure**

The measurement operation is started by pressing **F1** at the Main Menu. A sub-menu, figure 1, will appear listing all of the Test States that are associated with the particular aircraft selected earlier. These Test States contain all of the pre-stored setup information (such as the number of rotor revolutions that measurements are to be taken and averaged). This kind of information is directly linked from the Flight Plan chosen for this aircraft.

1. **Selecting a Test State**

From the list of Test States, a Test State can be selected by placing the highlight cursor over it using the arrow keys. The screen display output can be modified by using the four function keys. The current display state is set opposite to the function key label. To toggle between modes, press the desired function key.

(a) DISPLAY. The label DISPLAY above the **F1** function key is an option that enables the display mode for measured Test States after data has been collected. Select this option by positioning the cursor over a Test State in the measurement menu that has already been measured, then press the **F1** function key to view the One Test State displays. (Displays here are the same ones that can be selected from the DISPLAYS section for One Test State.) Pressing the **QUIT** key will cause the displays to terminate and the main measurement screen to be re-displayed.

(b) STROBE. The label STROBE above the **F2** function key is an option that executes the strobing measurement mode for the selected Test State. Selection of a Test State is accomplished by positioning the cursor over the desired Test State for tracking and pressing the **DO** key once. When verification of setup is completed, (*) appears adjacent to selected Test State, press the **F2** function key to enter the strobed data. If more than one rotor or component can be strobed for the selected Test State, then a menu will appear from which the user will need to choose the rotor or component to strobe. Now, the user can strobe the blades and enter strobed based track data into the database. A Track Entry menu will appear allowing the blade values to be entered in inches. The LEFT/RIGHT arrow key is used to change values displayed over a decreasing/increasing value range. Pressing the **QUIT** key will abort the strobe mode without causing the entered values to be added to the database. Pressing the **DO** key, when finished, will add the entered values for track, for the selected Test State, and cause the strobing to be discontinued. At this time, the main measurement screen will be re-displayed.

(c) SETUP. The label SETUP above the **F3** function key is an option that allows the displaying of the aircraft setup configuration data. Select this option by pressing the **F3** function key. A paged menu display will appear containing information for setting up the chosen Flight Plan, such as accelerometer locations, blade ID, and any test installation information. Exit the display by pressing the **QUIT** key, which will then bring back the main measurement menu.

(d) LMT OFF. The label LMT OFF above the **F4** function key indicates that limits checking is currently disabled during measurement mode. To enable limits checking during measurement, press the **F4** function key to toggle to the LMT ON label. This will cause limits checking to be done on collected data for a successfully measured Test State (only if safety checks have been established for the Test State in the aircraft setup file).

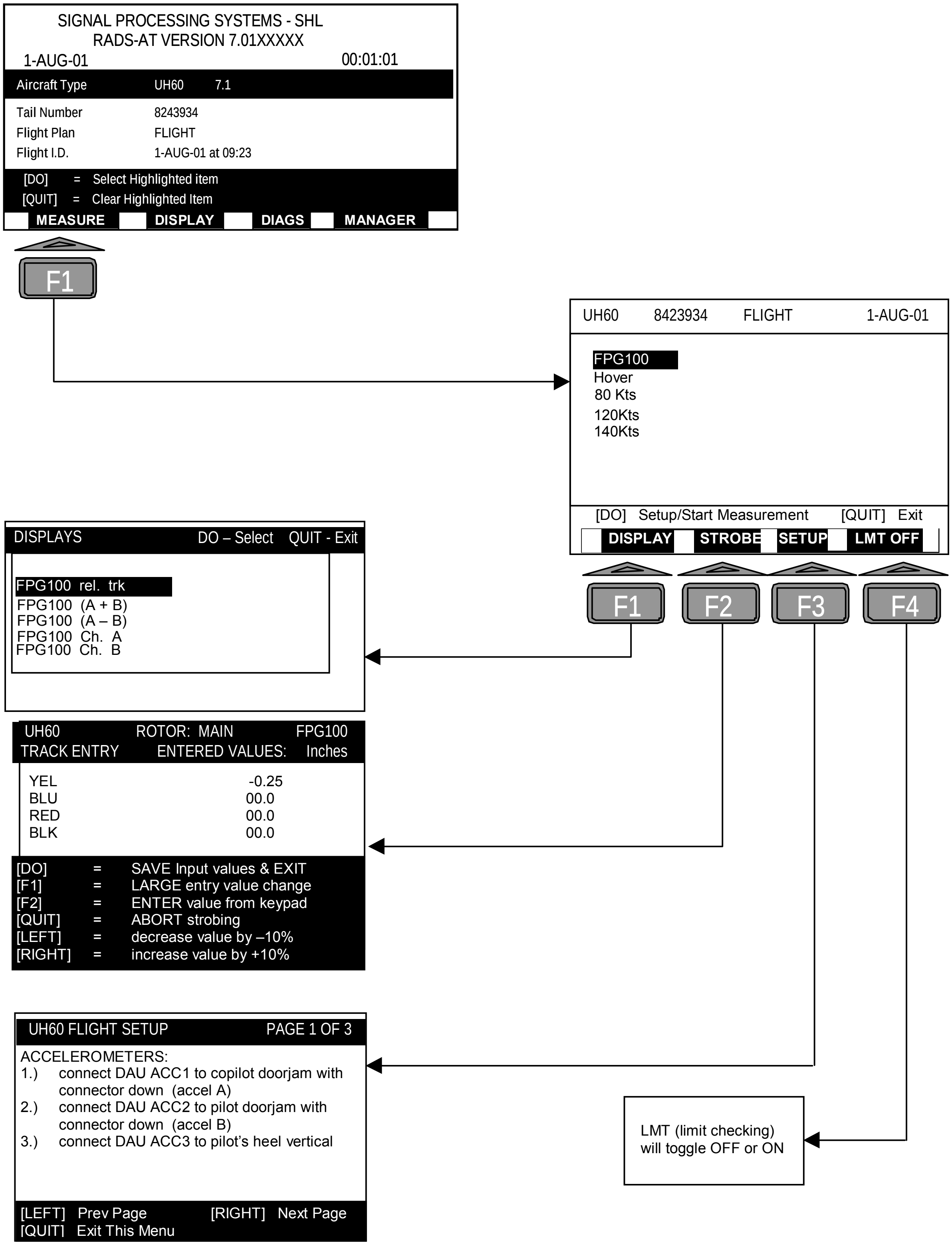


Figure 1. Measure Sub-Menu Hierarchy (Sheet 1 of 2)

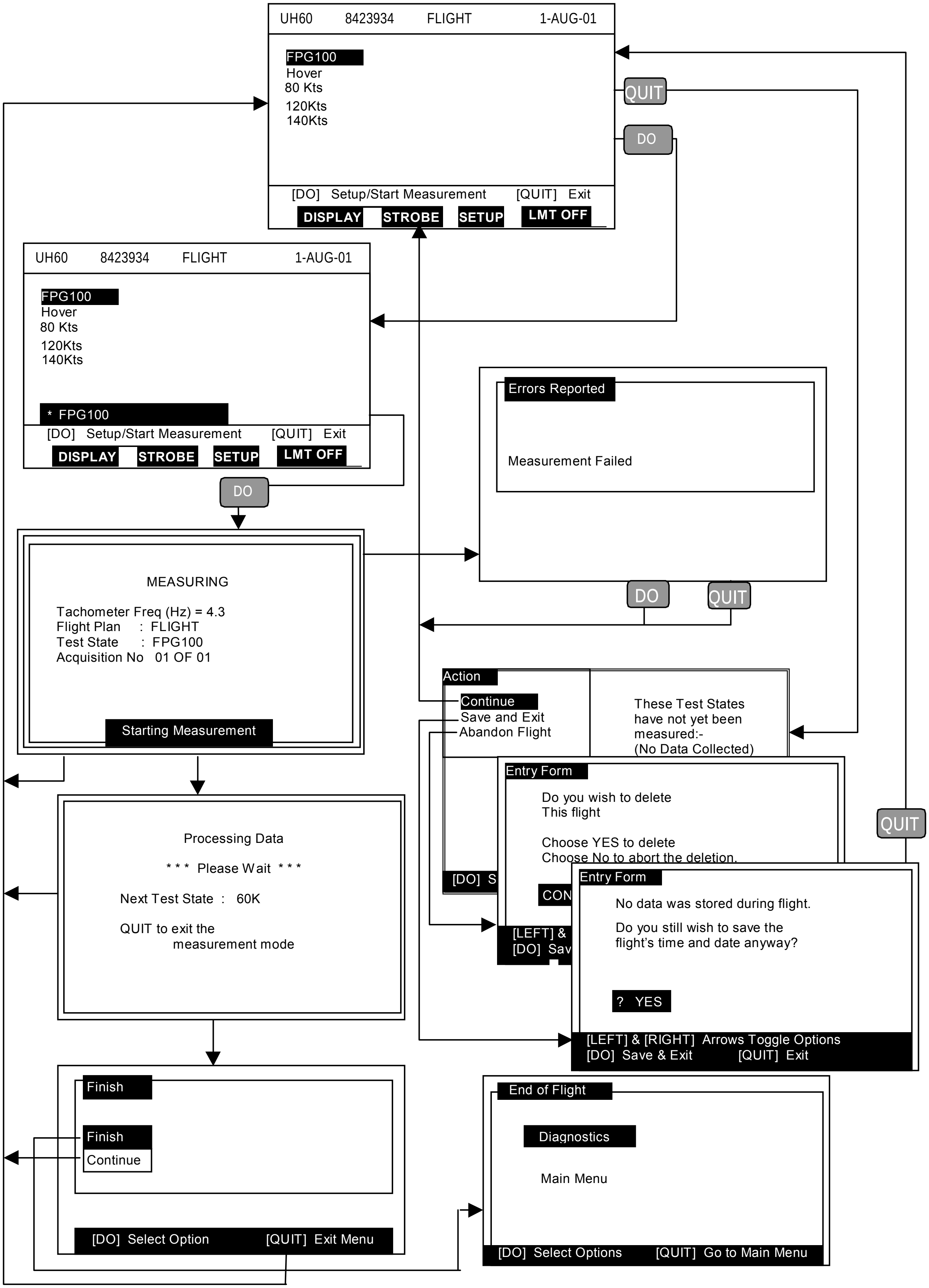


Figure 1. Measure Sub-Menu Hierarchy (Sheet 2 of 2)

2. **Making a Measurement**
Measurements are made in two steps. First the aircraft setup is verified. If the verification is successful the actual measurement can be made and the data acquired.

To make a measurement, position the cursor over the desired Test State and press the **DO** key. A flight condition message will be displayed. If no errors occur, the Test State progress window will be displayed with an asterisk (*) as the first character in the highlighted window, see figure 1. If the verification of setup data fails, an error message will be displayed. Press the **DO** key again to proceed with the measurement.

3. **Aborting a Measurement**
A measurement can be aborted at any time by pressing the **QUIT** key. Measurement data will not be stored if the measurement operation is aborted.

4. **Repeating a Measurement**
Measurements may be repeated as long as the flight condition is maintained. To repeat a measurement, place the cursor over the desired Test State and press the **DO** key. Data previously measured and stored will be overwritten by the new measured data

5. **Completing a Measurement**
Successful acquisition of the measurement data results in a screen that reads:

Processing Data . . .
***** PILOT TRANSITION *****
Next Test State : (selected Test State)
STAND-BY . . . While data is loading

This display is used to indicate to the pilot to proceed to the next flight condition. No key presses are required. The CADU will automatically progress to the next screen.

If the measurement was successful a "done" will appear to the right of Test State, see figure 1. If channel errors occurred for some, but not all, of the channels measured, "partial" will appear to the right of Test State. If no data was acquired due to channel errors, "failed" will appear to the right of Test State.

To exit the measurement mode, press the **QUIT** key. The action screen will be displayed with the following choices, see figure 1:

(a) Continue. Select this option to continue with the measurement mode by pressing **DO** over the Continue selection. Any Test States that have not yet been measured for the flight will appear (below a similar message) in the bottom right hand corner of the screen.

(b) Save and Exit. Select this option to save flight data taken and exit the measurement mode. At this point, an End Of Flight Menu will appear with the following options:

(1) Diagnostics. Place the cursor over this option and press the **DO** key to perform diagnostics on the flight just measured.

(2) Main Menu. Place the cursor over this option and press the **DO** key to return to the Main Menu.

(c) Abandon Flight. Place cursor over this option and press the **DO** key. Follow any further instructions that appear. This will remove all measured data, for this flight, from the database.

6. **General Capabilities**
The AVA performs five basic types of measurements. The results of these measurements are available for use in diagnostics or data displays. The five basic types are:

(a) Asynchronous Sampled Power Averaged (ASPA) vibration spectrum with zoom

(b) Synchronous Sampled Power Averaged vibration spectrum (SSPA) with zoom (signature ratio)

(c) Synchronous Sampled Time Averaged spectrum (SSTA/SSTAR) (harmonic spectrum)

(d) Average Blade Track

(e) Average Blade Lag

The types of measurements performed for a particular aircraft are completely determined by the aircraft configuration file. If the configuration file does not request a particular measurement it will not be made.

The AVA has been designed to provide a flexible system to measure vibration and track for the most sophisticated helicopters. The DAU can interface to the following sensors:

(a) 14 Accelerometers of various types

(b) 2 Magnetic or optical tachometers

(c) 2 Universal Tracking Devices (UTDs)

(d) 1 Strobe Light

The measurement and diagnostic setups for particular helicopters are controlled by the individual aircraft configuration file. This allows easy customization of measurement, display, and diagnostics to an airframe. The AVA has basic measurement capabilities as shown in table 1, and discussed as follows:

Table 1. Measurement Capabilities

Sensor Measurements	Resolution	Range	Sample
Vibration			
Power Average (sync):	400 lines	1/8 R to 50 R	128 Spectra
Power Average (async):	400 lines	2.0 Hz to 20 kHz	128 Spectra
Time Average:	128 lines	1/4 R to 32 R	512 Revs
Zoom Displays (power only)	6400 Lines	x1 x2 x4 x8 x16 x32	
Vibration Amplitude:	2%	68 dB (100 g max.)	
Vibration Phase:	1°	0 to 360°	
Tachometer Frequency:		2 to 485 Hz (120 to 29100 RPM)	
Track:	2 mm		512 Revs
Lag:	2 mm		512 Revs

(1) <u>Asynchronous Sampled Power Averaged Vibration Spectrum (ASPA) (ASPA Zoom):</u> The conventional power spectrum provides a measurement of vibration amplitude vs. frequency. Normally 400 spectral points are provided, but an optional zoom parameter increases the spectral resolution to 6400 (ASPA Zoom) spectral points. The AVA can collect a single vibration channel at a time using this mode. Table 2 provides a list of the possible frequency ranges vs. their respective measurement resolutions. The aircraft configuration file can setup the frequency range, number of Fast Fourier Transforms (FFTs) to average, window type, channel setup, accelerometer type, and output type. The asynchronous vibration measurements can be collected on any of the available fourteen channels

(2) <u>Synchronous Sampled Power Averaged Vibration Spectrum (SSPA)(Signature Ratio):</u> This mode provides a power spectrum measurement with sampling, which is based on the external tachometer frequency. This type of measurement eliminates the spectral smearing commonly found when using a conventional asynchronous spectrum with vibration components that constantly change frequency. Normally 400 spectral points are computed, however there is an optional zoom (SSPA Zoom) capability that increases the resolution to 6400 spectral points. The AVA collects this type of measurement on a single channel at a time. The external tachometer frequency range can vary between 2.0 Hz and 485 Hz. The setup in the aircraft configuration file determines the number of FFTs to average, window type, overlap, output type and acceptable frequency range. This is probably the method of choice for collecting vibration data that does not have a harmonic relationship to the tachometer source, but does have a fixed frequency ratio.

Table 2. Frequency Ranges Vs. Respective Measurement Resolutions

Frequency Range	Normal Resolution	Zoom Resolution
2 Hz to 100 Hz	0.25 Hz	0.016 Hz
2 Hz to 125 Hz	0.313 Hz	0.020 Hz
2 Hz to 200 Hz	0.50 Hz	0.0313 Hz
2 Hz to 250 Hz	0.625 Hz	0.039 Hz
2 Hz to 300 Hz	0.75 Hz	0.0469 Hz
2 Hz to 375 Hz	0.937 Hz	0.0586 Hz
2 Hz to 400 Hz	1.0 Hz	0.063 Hz
2 Hz to 500 Hz	1.25 Hz	0.078 Hz
2 Hz to 800 Hz	2.0 Hz	0.125 Hz
2 Hz to 1 kHz	2.5 Hz	0.156 Hz
2 Hz to 1.2 kHz	3.0 Hz	0.188 Hz
2 Hz to 1.5 kHz	3.75 Hz	0.234 Hz
2 Hz to 1.6 kHz	4.0 Hz	0.250 Hz
2 Hz to 2 kHz	5.0 Hz	0.313 Hz
2 Hz to 4 kHz	10.0 Hz	0.625 Hz
2 Hz to 5 kHz	12.5 Hz	0.781 Hz
2 Hz to 8 kHz	20.0 Hz	1.250 Hz
2 Hz to 10 kHz	25.0 Hz	1.563 Hz
2 Hz to 12 kHz	30.0 Hz	1.875 Hz
2 Hz to 15 kHz	37.5 Hz	2.344 Hz
2 Hz to 16 kHz	40.0 Hz	2.500 Hz
2 Hz to 20 kHz	50.0 Hz	3.126 Hz

(3) Synchronous Sampled Time Averaged Vibration Spectrum (SSTA) (Harmonic Spectrum): The vibration spectrum averages the corresponding samples from each revolution (rev-by-rev averaging), so that the non-harmonic components are progressively eliminated. The sample rate is automatically adjusted to match the rotor frequency. One hundred twenty eight spectral lines are computed from 1/4 R to 32 R in 1/4 R increments. The AVA can measure four channels and track simultaneously using this measurement technique. This measurement type is almost exclusively used for rotor track and balance. The external tachometer can vary from 2.0 Hz to 485 Hz. The setup in the aircraft configuration file determines the number of revs to average and acceptable frequency range. In this case, there are two choices of data storage that can be made. The first would be to store all 128 points of raw data collected for magnitude and phase (SSTA measurement mode). The second would be to store only the first 12R components of raw data collected for magnitude and phase (SSTAR measurement mode). Choosing to store the first 12 harmonic bins per R results in a decrease of disk space usage by ten times the amount needed for the SSTA measurement mode.

(4) Average Track and Lag: The average blade track and lag for each blade can be very accurately measured by the Universal Tracking Device (UTD), up to eight bladed rotor systems can be monitored and the average track and lag for each blade displayed within 1 mm. The track/lag measurements can be made simultaneously with up to four vibration channels yielding highly correlated measurements quickly. The aircraft configuration file contains aircraft-specific track setup information and determines the number of revolutions to collect and average into the track results.

7. **Fault Tolerance Features**
Measurements can be continued even if channel faults or filter faults occur during the measurement, causing acquisition failures for these channels. The remaining good channels will be measured, and bad channel data will be marked as corrupted data. Data received for the channels that were measured successfully will be stored, including both track and vibration data. The availability of displays for the measured data should be used as indicators of data not retrieved, along with the error messages that appear on the screen during measurement. The user will be informed of any such errors via the error report screen.

END OF WORK PACKAGE

DISPLAYS
AVIATION VIBRATION ANALYZER

Figures

The operator can view the results from the measurements taken at any time (in flight, right after completing the measurements of a particular Test State or set of Test States, to a post-flight review in the office) using the DISPLAY function. From these results, the operator can select a variety of graphic or tabular displays.

The displays are grouped by: One Test State, Complete Flight, Trend Flights, View Limits, and Summary Displays, see figure 1. To initiate the DISPLAY mode, press the **F2** key from the Main Menu.

NOTE

Displays are determined by the aircraft-specific setup (script) files, not all displays shown here will appear for all aircraft types.

a. **Selecting One Test State Displays**
One Test State displays present the results from each of the specific measurements made in a specific Test State. Once the **F2** key has been pressed, the operator can select the One Test State display mode by placing the cursor over the One Test State mode selection in the menu, and pressing the **DO** key.

A sequence of screens will allow the operator to select the Test State of interest and then pick the measurement to be viewed. The results will first be displayed graphically. The results can also be seen in tabular form by pressing the **F3** key labeled TABLE.

To display another measurement or Test State, press the **QUIT** key until the appropriate screen (Display or Test State) reappears. Make the new selections and proceed as above. The graphic and tabular form of displays will also appear for the Main Rotor measurements of Track and Lag.

b. **Selecting Complete Flight Displays**
Complete Flight displays present the results from a single measurement taken in each Test State of the flight. Select Complete Flight from the display mode menu by placing the cursor over the Complete Flight selection and pressing **DO**. The Displays screen will appear with the list of measurements whose results can be compared relative to the other Test States. Select the measurement of interest, for example, the 1/REV forward and aft vibration measurement. An entry form will allow the operator to select the number of Test States to be displayed on a polar chart for the A-B 1/REV measurement. The same comparison can be done for the rotor track measurements for each Test State in graphic or tabular form.

c. **Selecting Trend Flights Displays**
Trend Flights displays present the results from a single measurement that was taken on other flights on this particular aircraft. To select the Trend Flights display mode, place cursor over the Trend Flights selection and press **DO**. A screen of measurements will appear from which to choose for comparison with the same measurement data from the other flights on this aircraft. The trend information from each measurement listed can then be evaluated. When the trend data is shown for one measurement, press the **QUIT** key one or more times to backup to the Displays screen. Then choose another measurement.

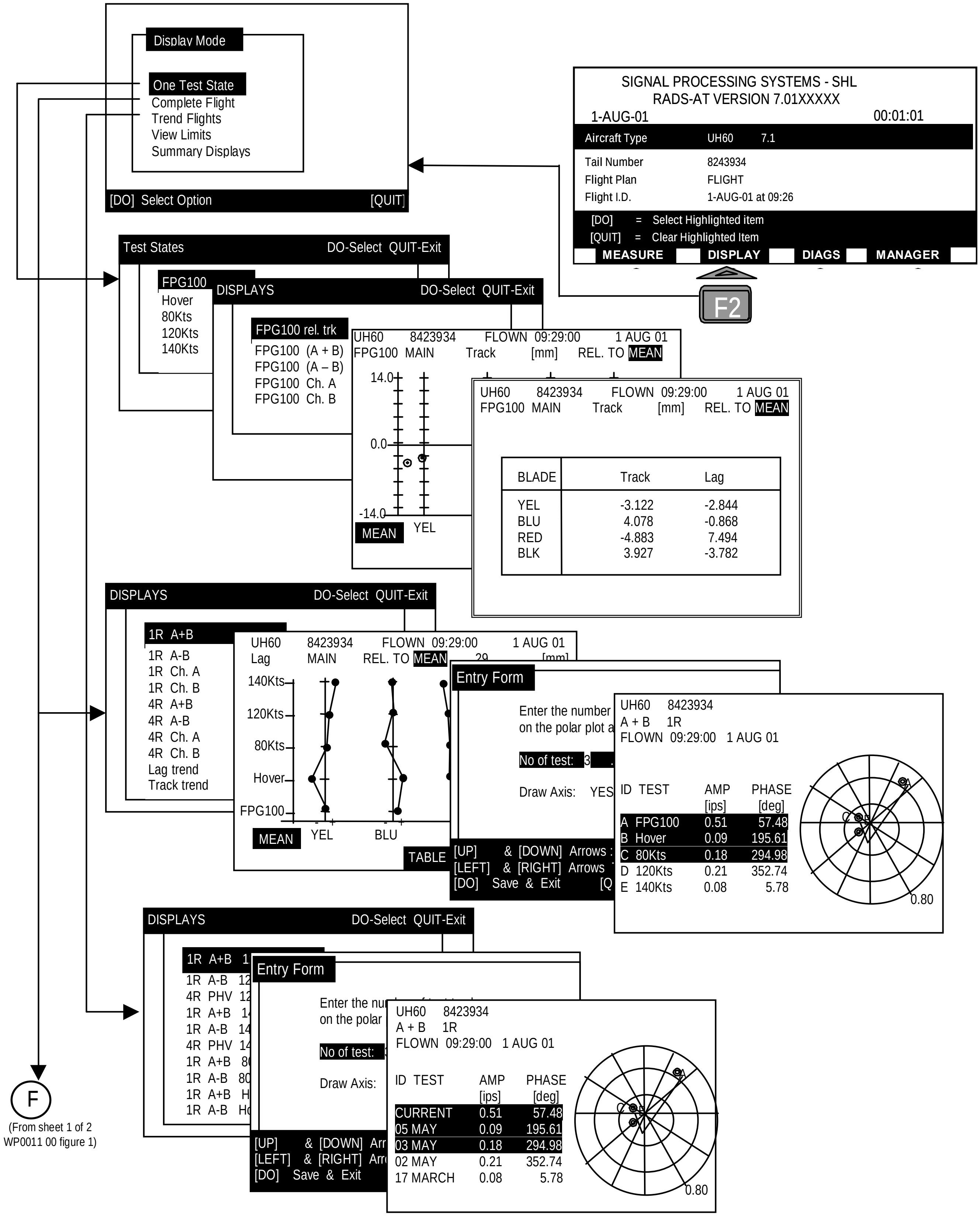


Figure 1. Display Menu Hierarchy (Sheet 1 of 2)

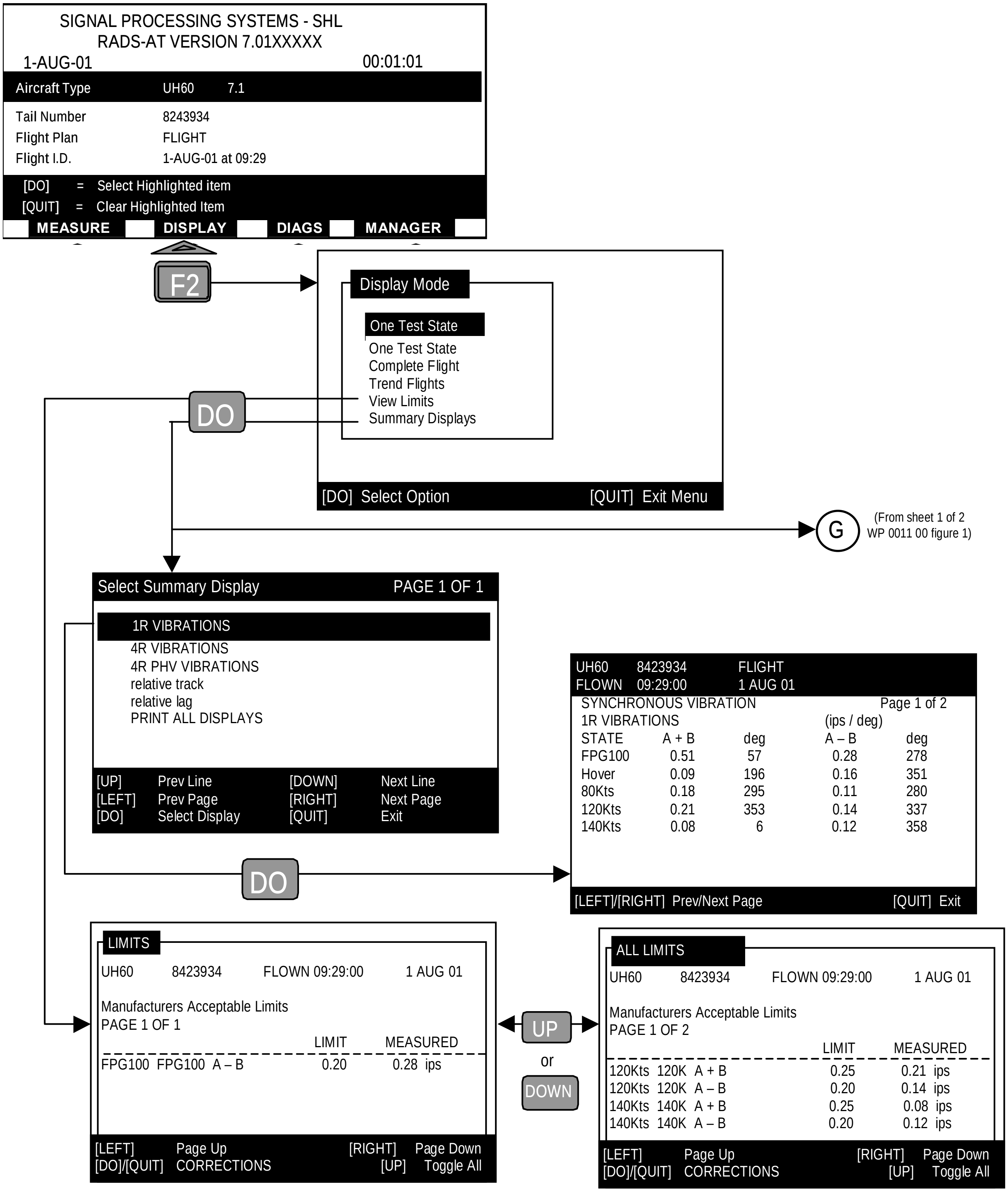


Figure 1. Display Menu Hierarchy (Sheet 2 of 2)

d. **Selecting Limits Display**
The limits display presents the results from limit checking on measured data. This holding of data is done to determine if adjustments will be required on the aircraft. To select the limits display, place the cursor over the View Limits selection and press the **DO** key.

The purpose of the limits checking software is to notify the user that measured data has exceeded specific limits. The limit monitoring system allows for range checking of measured vibration data for a specific limit and allows the calculation and display of the maximum track spread. The maximum track spread is the difference between the highest and lowest flying blades. The limits and data to be limit checked are completely specified in the aircraft-initialization files and are modified by using the DPL language by AMCOM Engineering.

e. **Selecting Summary Displays**
The purpose of the Summary Displays is to provide a general way of picking and displaying a given number of the highest peak points of any of the vibration modes over a specified point range. Track and lag data are also available as Summary Displays. To select the Summary Display mode, place the cursor over the Summary Displays selection and press **DO**.

If a complete printout of the Summary Displays is desired, press the **PRINT** key. A printout of all Summary Displays will be printed, see figure 2. This printout will provide the user with a comprehensive, easy to read report of Test State results for the entire Flight Plan.

The Summary Displays have been created to enable the user to get a summary of collected data for a flight, without having to maneuver through multiple menus to get all of the desired display data. The Summary Displays are set up by aircraft type. The Flight Plan, and flight ID over all acquisitions are specified. They are presented as one menu that the user can quickly page through to view each display setup for the Flight Plan. All data is displayed in a tabular format.

There are four types of Summary Displays available that are determined by the aircraft setup files:

1. **SUM_LAG**: The lag Summary Display provides tables of both the lag values and the standard deviation values of lag for all blades. Use the UP and DOWN arrow keys to switch between these two tables.

2. **SUM TRACK**: The track summary can be set up to give the absolute track values, track values relative to mean track, track values relative to a specified blade, two plane track, or track relative to a target pattern. The standard deviation values for track are always available on the display. Use the UP and DOWN arrow keys to switch between the track display and the standard deviation of track display.

3. **SUM SYNCH**: The synchronous sampled time average display is a point-by-point summary. The display is set up to indicate which point will be displayed (e.g., 1/REV component, 2/REV component, etc.) over all channels for each appropriate Test State in the Flight Plan.

4. **SUM PEAK**: The peak Summary Display is available for gathering high peak points for any of the specified vibration data types (SSTA, SSTAR, SSPA, SSPA ZOOM, ASPA, and ASPA ZOOM). The highest peak point over the specified range will appear in the display.

   If a particular Summary Display does not have any data to display, the following message will appear:

ERROR - 32760: No or inconsistent data for display

f. **Using Various Data Displays**
This paragraph describes the operation of the various display types allowed by the AVA. It is important to note that the particular displays available for the selected aircraft are determined by the aircraft initialization script files. Only selected displays will be available for the aircraft. The units displayed can be changed by entering the Manager Menu and selecting the setup option, then selecting the units option. The following display units are available:

1. Frequency: Hz or RPM
2. Phase: degrees, RADS-AT clock angle (hours and minutes), radians or Chadwick-Helmuth hours (hours and minutes)
3. Vibration: mils, g's or ips
4. Track/Lag: mm, inches, meters, feet or mils

UH60 26049 FLIGHT
FLOWN 15:27:00 01 AUG 01

SYNCHRONOUS VIBRATION
1R VIB (ips / deg)

STATE	(A+B)	deg	(A–B)	deg
FPG100	0.158	189	0.119	291
Hover	0.005	277	0.105	274
80K	0.121	333	0.146	228
120K	0.147	351	0.113	245
140K	0.217	8	0.122	265
Vh	0.420	27	0.183	314

SYNCHRONOUS VIBRATION
1R VIB (ips / deg)

STATE	A	deg	B	deg
FPG100	0.222	247	0.272	146
Hover	0.109	274	0.099	94
80K	0.163	274	0.212	15
120K	0.159	308	0.208	22
140K	0.223	336	0.273	34
Vh	0.505	7	0.407	53

SYNCHRONOUS VIBRATION
1R VIB (ips / deg)

STATE	PhVert	deg
FPG100	0.239	3
Hover	0.167	243
80K	0.154	161
120K	0.170	177
140K	0.261	192
Vh	0.479	210

SYNCHRONOUS VIBRATION
2R VIB (ips / deg)

STATE	(A+B)	deg	(A–B)	deg
FPG100	0.041	30	0.006	130
Hover	0.008	62	0.025	295
80K	0.033	4	0.035	271
120K	0.132	50	0.121	310
140K	0.093	81	0.141	344
Vh	0.089	113	0.132	353

SYNCHRONOUS VIBRATION
2R VIB (ips / deg)

STATE	A	deg	B	deg
FPG100	0.040	370	.042	21
Hover	0.021	312	0.030	103
80K	0.047	316	0.049	49
120K	0.161	3	0.194	88
140K	0.159	19	0.179	133
Vh	0.116	35	0.193	149

CONTINUED

SYNCHRONOUS VIBRATION
2R VIB (ips / deg)

STATE	PhVert	deg
FPG100	0.061	198
Hover	0.021	267
80K	0.052	191
120K	0.217	236
140K	0.168	269
Vh	0.176	298

SYNCHRONOUS VIBRATION
3R VIB (ips / deg)

STATE	(A+B)	deg	(A–B)	deg
FPG100	0.018	254	0.006	176
Hover	0.012	317	0.009	278
80K	0.027	27	0.025	225
120K	0.117	6	0.021	251
140K	0.171	11	0.037	269
Vh	0.262	22	0.047	243

SYNCHRONOUS VIBRATION
3R VIB (ips / deg)

STATE	A	deg	B	deg
FPG100	0.020	238	0.018	273
Hover	0.021	300	0.008	9
80K	0.008	323	0.051	36
120K	0.109	356	0.127	14
140K	0.167	359	0.183	23
Vh	0.229	14	0.299	28

SYNCHRONOUS VIBRATION
3R VIB (ips / deg)

STATE	PhVert	deg
FPG100	0.061	198
Hover	0.021	115
80K	0.085	203
120K	0.252	171
140K	0.334	179
Vh	0.509	193

SYNCHRONOUS VIBRATION
4R VIB (ips / deg)

STATE	(A+B)	deg	(A–B)	deg
FPG100	0.399	101	0.121	209
Hover	0.245	89	0.188	105
80K	0.296	268	0.035	356
120K	0.308	113	0.128	253
140K	0.519	125	0.356	93
Vh	0.566	127	0.422	171

CONTINUED

Figure 2. Summary Display Printout (Sheet 1 of 2)

SYNCHRONOUS VIBRATION

4R VIB (ips / deg)

STATE	A	deg	B	deg
FPG100	0.379	118	0.451	86
Hover	0.428	95	0.084	50
80K	0.299	275	0.296	262
120K	0.268	89	0.388	130
140K	0.844	112	0.286	166
Vh	0.915	146	0.399	79

SYNCHRONOUS VIBRATION

4R VIB (ips / deg)

STATE	PhVert	deg
FPG100	0.091	178
Hover	0.101	156
80K	0.209	255
120K	0.292	256
140K	0.279	190
Vh	0.545	189

MAIN ROTOR

ABSOLUTE TRACK (mm)

STATE	YEL	BLU	RED	BLK
FPG100	1690.6	1679.3	1679.9	1679.3
Hover	2036.3	2047.8	2033.5	2034.0
80K	1888.7	1899.0	1887.1	1885.4
120K	1789.2	1805.3	1788.7	1787.9
140K	1789.2	1802.9	1785.9	1787.7

MAIN ROTOR

STANDARD DEVIATION OF TRACK (mm)

STATE	YEL	BLU	RED	BLK
FPG100	2.29	2.41	2.39	2.46
Hover	8.99	9.58	9.66	10.36
80K	7.96	7.30	6.74	7.09
120K	10.10	8.87	8.30	9.99
140K	19.81	18.15	17.17	21.49

MAIN ROTOR

TRACK RELATIVE TO MEAN (mm)

STATE	YEL	BLU	RED	BLK
FPG100	0.8	0.5	0.1	–0.4
Hover	–1.6	9.9	–4.4	–3.9
80K	–1.4	8.9	–2.9	–4.6
120K	–3.6	12.5	–4.1	–4.9
140K	–2.3	11.5	–5.5	–3.7

MAIN ROTOR

TRACK RELATIVE TO BLADE 3 (mm)

STATE	YEL	BLU	RED	BLK
FPG100	0.7	–0.6	0.0	–0.5
Hover	2.8	14.3	0.0	.5
80K	1.6	11.8	0.0	–1.7
120K	0.5	16.6	0.0	–0.8
140K	3.3	17.0	0.0	1.8

MAIN ROTOR

LAG RELATIVE TO MEAN (mm)

STATE	YEL	BLU	RED	BLK
FPG100	0.09	–2.28	–0.79	2.97
Hover	–56.45	10.39	24.15	21.91
80K	2.42	–7.68	1.24	4.02
120K	2.89	–7.52	0.64	3.99
140K	–40.34	6.55	15.89	17.90

MAIN ROTOR

STANDARD DEVIATION OF LAG (mm)

STATE	YEL	BLU	RED	BLK
FPG100	0.15	0.17	0.21	0.26
Hover	0.50	41.41	41.42	41.37
80K	0.30	0.47	0.53	0.67
120K	0.34	0.56	0.70	0.86
140K	0.82	34.92	34.95	35.21

CONTINUED

Figure 2. Summary Display Printout (Sheet 2 of 2)

g. **Using Spectral Displays**

There are three basic types of spectral displays available on the AVA. These are:

1. 400 Point Power Spectrum. The 400-point power spectrum displays vibration amplitude for the asynchronous or synchronous power spectrum modes, see figure 3. All 400 points are displayed on a single screen. The cursor is controlled by the LEFT and RIGHT arrow keys on the keypad. The amplitude and frequency at the cursor position are displayed in the upper right hand corner of the screen. Function key **F1** allows the cursor to be toggled between one normal (NORMAL) cursor and harmonic (HARMON) cursors. Function key **F2** selects a data table format where lines of peak-peak data are sorted by amplitude in descending order and function key **F3** selects a data table format where lines of peak-peak data are sorted by frequency in increasing order, see figure 3. Function key **F4** displays a menu that allows selection of the number of values (5,10, 20, or 400) to be displayed in tables selected by function keys **F2** and **F3**.

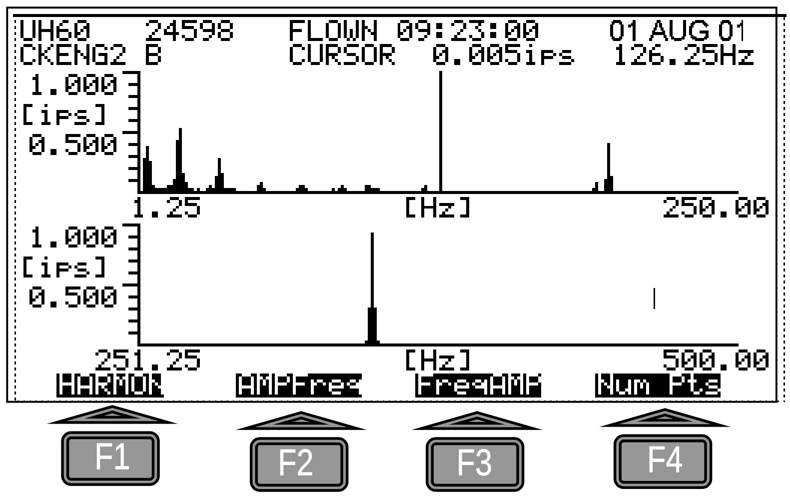
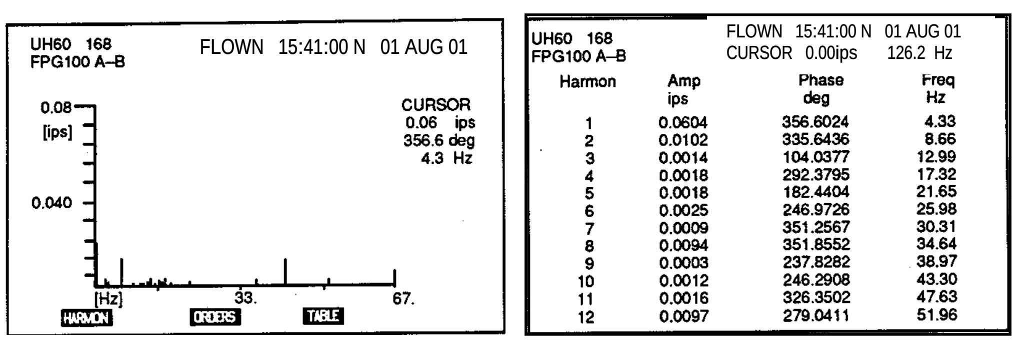


Figure 3. 400 Point Power Spectrum Display

2. 128 Point Synchronous Spectrum Display. The synchronous power spectrum display, see figure 4, allows the display of 128 points of vibration data collected with the synchronous sampled time averaged mode. This display provides up to the 32nd harmonic vibration point with a resolution of 1/4 harmonic. The cursor is controlled by the LEFT and RIGHT arrow keys on the keypad. The amplitude, phase, and frequency of the data point at the cursor is displayed in the right side of the screen. Function key **F1** allows a harmonic cursor to be displayed on the screen. Function key **F2** allows the frequency axis units to be toggled between orders and frequency. Function key **F3** selects a data table format as shown in the figure 4. Any of the selected screens can be printed by pressing the **PRINT** key.



Harmon	Amp ips	Phase deg	Freq Hz
1	0.0604	356.6024	4.33
2	0.0102	335.6436	8.66
3	0.0014	104.0377	12.99
4	0.0018	292.3795	17.32
5	0.0018	182.4404	21.65
6	0.0025	246.9726	25.98
7	0.0009	351.2567	30.31
8	0.0094	351.8552	34.64
9	0.0003	237.8282	38.97
10	0.0012	246.2908	43.30
11	0.0016	326.3502	47.63
12	0.0097	279.0411	51.96

Figure 4. 128 Point Synchronous Power Spectrum Display

3. 6400 Point Zoom Display. The 6400-point Zoom display, figure 5, provides 6400 points of spectral data taken in the zoom measurement mode. This display type is applicable to the asynchronous or synchronous

power spectrum measurement modes. It provides a x32 real zoom, and the capability to display data points on the screen in powers of two. The display works by peak picking from the 6400 points. The LEFT and RIGHT arrows control the frequency position of the cursor. When in the Zoom displays, the UP arrow key causes a zoom-in by a factor of two, and the DOWN arrow key causes a zoom-out by a factor of two. The zoom is always performed about the cursor position. The amplitude and frequency of the cursor position are displayed in the upper right hand corner of the screen.

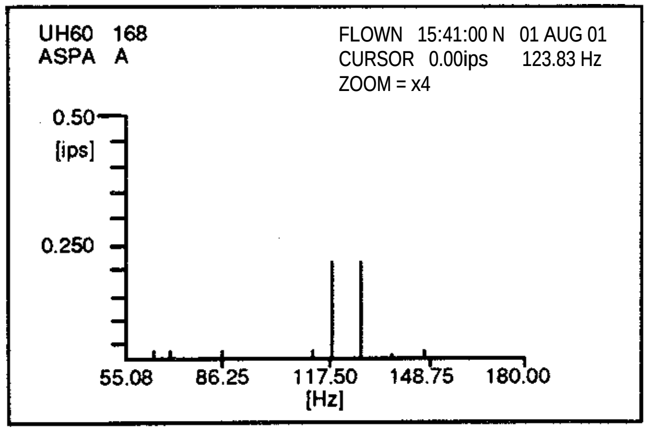


Figure 5. 6400 Point Zoom Display

h. **Using Track/Lag Display**
Track and lag data can be displayed as a single test or as part of a single flight display. There is currently no track trend display that displays track between flights. This paragraph describes the operation of the track/lag display as follows:

1. One Test State Track/Lag Displays. The One Test State track/lag display, figure 6, shows the average track or lag collected at a particular Test State and time. The track/lag can be displayed relative to any blade or relative to the mean. The LEFT and RIGHT arrow keys position the highlighted cursor block over the reference blade. To display relative to the mean, simply place the cursor over MEAN. Function key **F3** provides a tabular display of both track and lag.

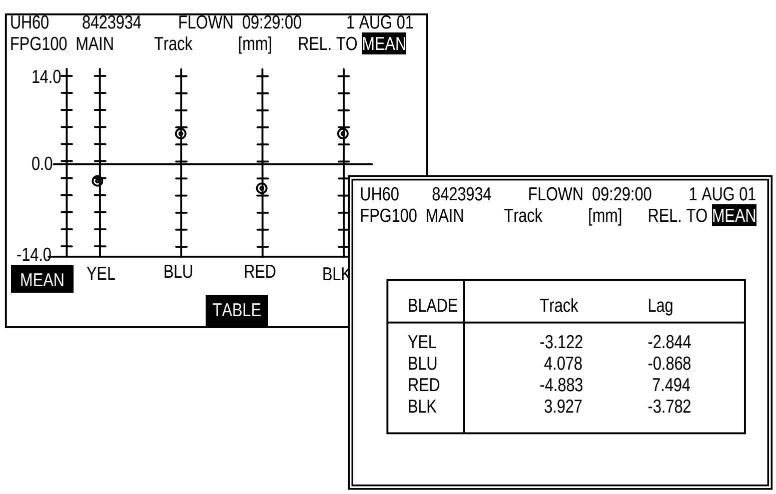


Figure 6. One Test State Track/Lag Display

2. Complete Flight Track/Lag Display. The Complete Flight track/lag display, figure 7, provides relative track/lag data for every measurement in a Flight Plan on a single screen The track/lag can be displayed relative to any blade, relative to two planes, relative to a target pattern, or to the mean. The LEFT and RIGHT arrow keys position the highlighted cursor block over the reference blade. To display relative to the mean, simply place the cursor over MEAN. Function key **F3** provides a tabular display of track or lag data. It is important to note that either track or lag data can be displayed on a single display, but not both.

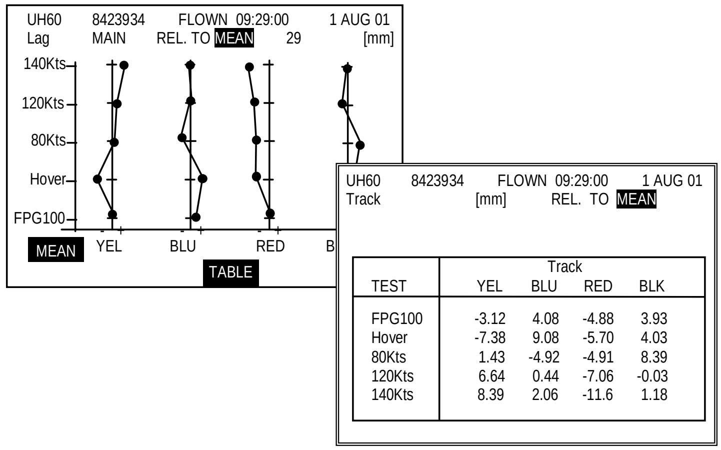


Figure 7. Complete Flight Track/Lag Display

i. **Using Polar Displays**

There are two basic types of polar displays which display vibration amplitude and phase data. The first type displays data collected during a single flight and provides a way of viewing all Test State data for a particular channel. The second provides a trending capability allowing the viewing of amplitude and phase data collected at one Test State, but with different flight IDs.

1. Complete Flight Polar Displays. The Complete Flight polar display, figure 8, allows the viewing of a single channel's amplitude and phase data over every Test State in a selected Flight Plan. When the Complete Flight polar display is selected from the Complete Flight display menu, an entry screen is displayed. This entry screen allows the entry of the number of points to be displayed on the polar chart at a time. As more points are selected, the display becomes more cluttered. The default is four points at a time and up to eight points can be displayed at a time by placing the cursor on the "No of test:" line and entering the desired number on the numeric keypad. Similarly the display of polar chart axes can be defeated by selecting the "Draw Axis " line and using the RIGHT or LEFT arrow key to toggle to NO. Pressing **DO** will advance to the polar chart display and pressing **QUIT** will return to the Display Selection Menu. Once the polar display is visible, the Flight Plan vibration data is displayed in both tabular and polar format. The data displayed on the polar display is highlighted in the table. To change the graphed data, use the UP and DOWN arrow keys. This will change the highlighted data in the table and the points graphed. Press **QUIT** to return to the Display Selection Menu.

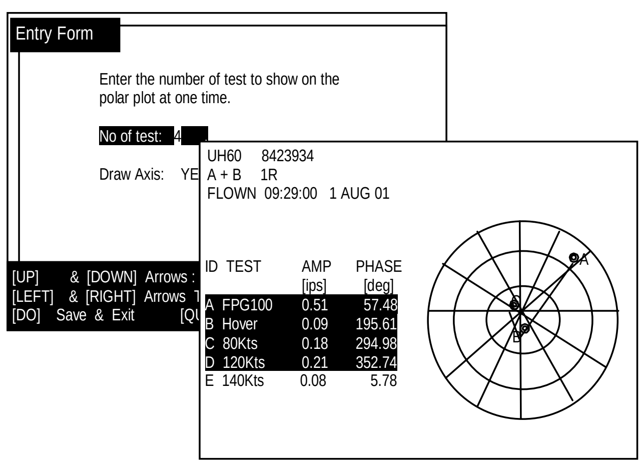


Figure 8. Complete Flight Polar Display

2. Polar Trend Flights Display. The polar Trend Flights display, figure 9, allows the viewing of a single channel's amplitude and phase data collected at different times using the same Flight Plan and aircraft tail number. When the polar Trend Flights display is selected from the Trend Flights display menu, an entry screen is displayed. This entry screen allows the entry of the number of points to be displayed on the polar chart at a time. As more points are selected, the display becomes more cluttered. The default is four points, and up to eight points can be displayed at a time by placing the cursor on the "No of test:" line and entering the desired number on the numeric keypad. Similarly the display of polar chart axes can be

defeated by selecting the "Draw Axis:" line and using the RIGHT or LEFT arrow key to toggle to NO. Pressing **DO** will advance to the polar chart display and pressing **QUIT** will return to the Display Selection Menu. Once the polar display is visible, the vibration data is displayed by flight ID in both tabular and polar format. The data displayed on the polar display is highlighted in the table. Change the graphed data using the UP and DOWN arrow keys. This will change the points highlighted in the table and the points graphed Press **QUIT** to return to the Display Selection Menu.

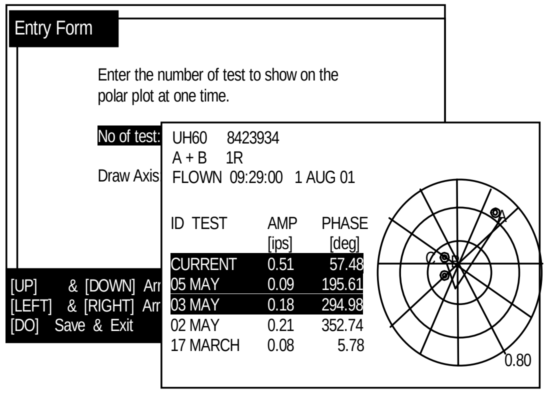


Figure 9. Polar Trend Flights Display

j. **Using Bar Displays**

Bar displays are used to display selected vibration amplitudes. Bar displays are useful when a visual display of relative data is helpful to the user. An example of this would be absorber tuning. Absorber tuning typically requires the collection of multiple data points on different rotor RPMs. This data is usually collected at the same basic flight condition and time. A complete Flight bar display would be very helpful in this case. The following section describes the two different bar displays.

1. Complete Flight Bar Display. The Complete Flight bar display, figure 10, shows vibration amplitude data collected in a single Flight Plan. The display labels the Test State along the horizontal axis and the vibration amplitude along the vertical axis. The screen has the capability to display up to five Test States at one time. Use the LEFT and RIGHT arrow keys to move the screen left and right when more than five Test States are present on the bar graph **F3** provides a tabular display of the graphed data to return to the Display Selection Menu press **QUIT**.

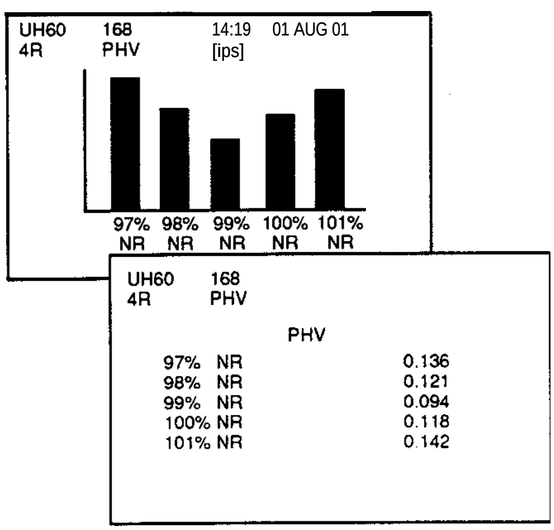


Figure 10. Complete Flight Bar Display

2. Present Flight/Previous Flight Bar Display. This bar display, figure 11, allows the comparison of the previous flight's and the present flight's vibration data on a channel-by-channel basis. The horizontal axis displays the Test State and the vertical axis displays the vibration amplitude. The present and previous vibration data is displayed as bars with different patterns. The screen has the capability to display up to five Test States at one time. Use the LEFT and RIGHT arrow keys to move the screen left and right when more than five Test States are present on the bar graph. F3 provides a tabular display of the selected vibration data. To return to the Trend Flights display menu, press the QUIT key

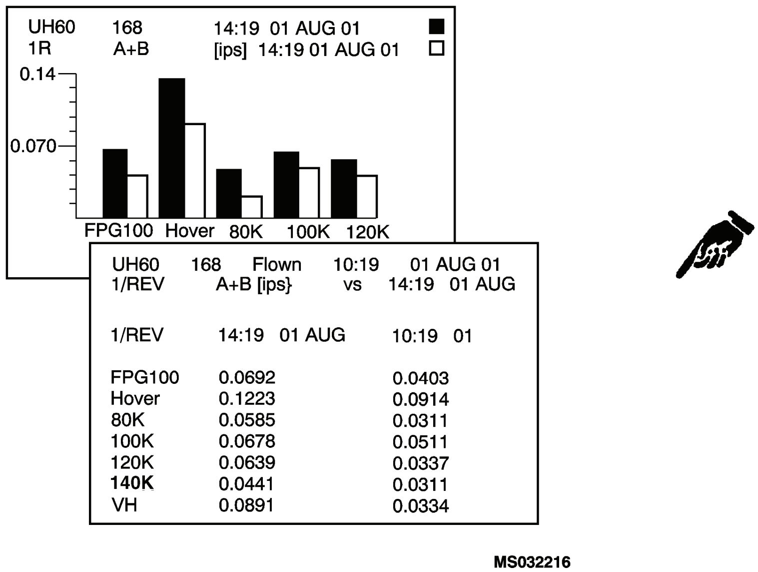


Figure 11. Present Flight/Previous Flight Bar Display

k. **Summary**

The AVA displays provide a variety of ways to review track and vibration data. It is important to remember that the displays available on a particular aircraft are determined by the aircraft initialization file. The displays access the data previously stored in the database by the measuring mode. Data is stored in a generic set of units, which can be easily converted to the desired display units. This conversion is done every time data is displayed.

END OF WORK PACKAGE

SYSTEM DIAGNOSTICS
AVIATION VIBRATION ANALYZER

Figures

DIAGNOSTICS

The Diagnostics function executes the diagnostics routine on the selected Flight Plan's data. The diagnostics routine will typically calculate the required mass balance, pitch rod and tab adjustments necessary to reduce system vibration and track to acceptable levels.

The Diagnostic operation is started by pressing the **F3** key from the Main Menu, see figure 1. The aircraft setup script must have been previously configured with diagnostic coefficients and weighting factors for the diagnostics to function. (Weighting factors can be described as a set of "priorities" for the diagnostics to consider. Certain vibration or track data points can be weighted to have more priority than others in the diagnostics.) The diagnostic operation is executed on data from the currently selected flight ID. These corrections are the optimum set of adjustments that shall be made to reduce the vibration levels to the lowest possible level (all indicated corrections must be made). If a reduced or modified set of adjustments is required or desired, the diagnostic editing functions (Edit Adjustables or Edit Defaults) must be used.

a. **Viewing the Corrections**

Upon pressing the **F3** key at the Main Menu, the first screen will be a comparison of the vibration and/or track split measurements as compared against the limits defined by the script file. If multiple pages exist, the LEFT and RIGHT arrow keys can be used to scroll through the displays. Pressing the UP and DOWN arrow keys will toggle from the default of displaying only "above limits" values to displaying all values as compared to their defined limits. Pressing **QUIT** or **DO** will instruct the system to exit out of the limits page and continue with the diagnostics routine.

NOTE

If "All Measurements are Within Specified Limits" is displayed, pressing **QUIT** will return the system to the Main Menu, while pressing **DO** will instruct the system to continue with the processing and diagnosis of the remaining vibration and track values.

The second screen (optional, dependent on script file configuration) is a display of the system's current record of absolute adjustment values. In the case of a new aircraft being measured for the first time with this system, all values will be zero. In all other cases, the display shows a cumulative record of the adjustments already performed. This display is interactive and provides the operator the ability to enter any information already known about the rotor configuration for the system to consider while calculating corrections. Pressing **DO** will continue the diagnostics calculation with any manual changes entered. Pressing **QUIT** will continue without the changes being saved.

The Diagnostics operation will display a corrections screen indicating the desired corrections. To scroll through the corrections list, use the LEFT and RIGHT arrow keys on the CADU keypad. To print the entire screen, press the **PRINT** key. Pressing the **DO** key will advance to the Diagnostics Menu screen.

b. **Viewing the Predicted Response**

The Predicted Response, assuming the corrections indicated in the corrections screen are fully implemented, is displayed on the Predicted Response screen. This screen can be viewed by selecting the view prediction options from the Diagnostics Menu. The Predicted Response screen shows a table of predicted responses for the various vibration and track measurements at each test condition. For instance, data was collected at a test condition called FPG100, the predicted amplitude and phase of the vibration and the predicted track in mm are displayed. If additional Test States were performed there, predicted vibration and track levels would also be displayed. The predicted response is useful for a couple of reasons. It allows a user to use the diagnostic editor to eliminate a particular adjustment or families of adjustments and view the predicted response. This makes it possible to select a limited set of adjustments that still meet a user's vibration criteria that potentially can save work and time. The second useful aspect is to monitor the effectiveness of the diagnostic solution. The predicted response should be close to the actual response caused by the corrections. If this is not the case, there may be other problems with the aircraft that won't allow the diagnostics to perform properly or converge. The predicted responses can be used to identify what the vibration and track levels would be after implementing the suggested corrections. If the predicted result shows excessively high vibration levels, it is an indication not to conduct additional adjustment flights, but search for other causes.

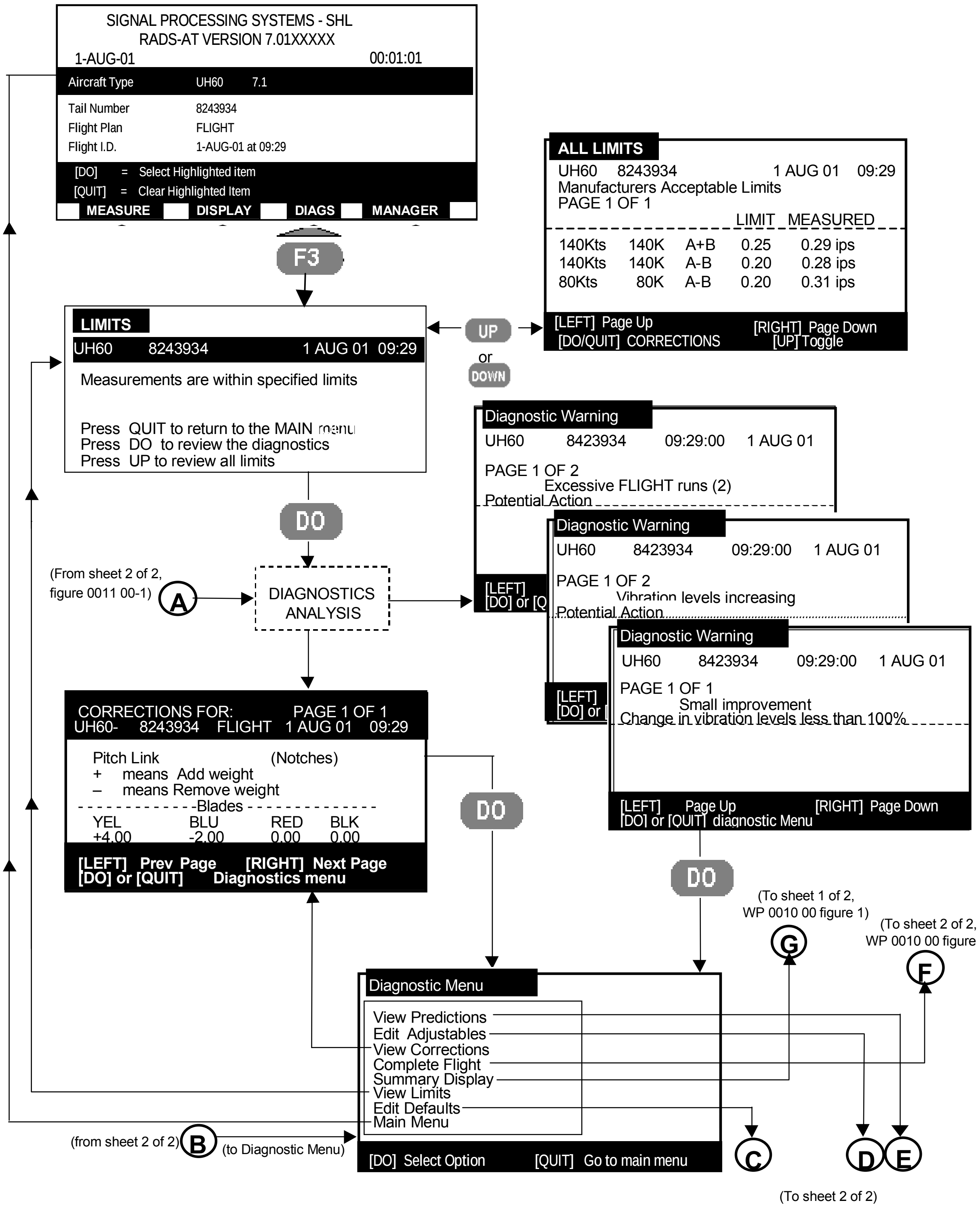


Figure 1. Diagnostic Menu Hierarchy (Sheet 1 of 2)

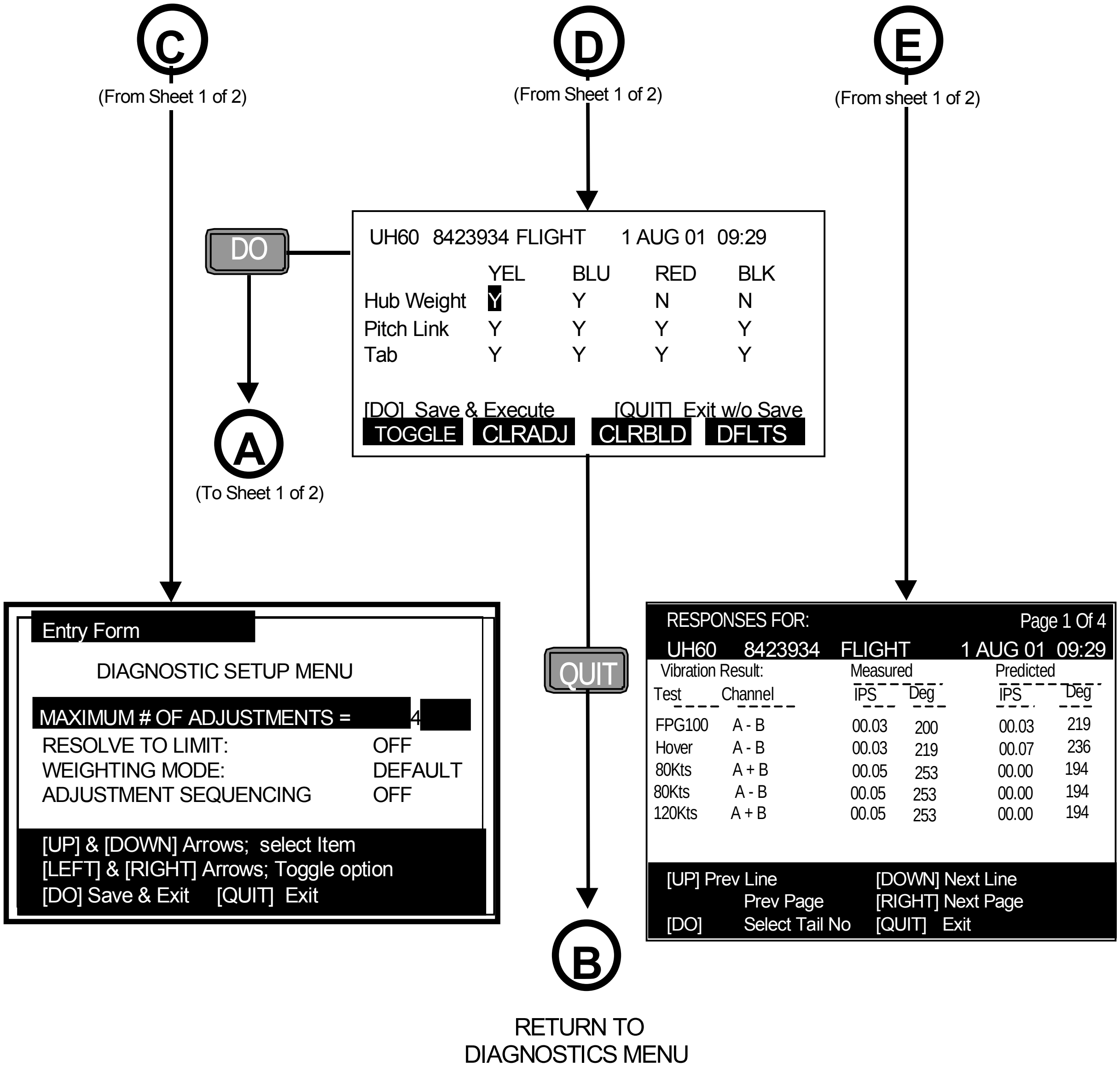


Figure 1. Diagnostic Menu Hierarchy (Sheet 2 of 2)

Pressing the UP or DOWN arrow key selects the previous or next line, respectively. Pressing the LEFT or RIGHT arrow key selects the previous or next page, respectively. Press **QUIT** to exit the menu.

c. **Edit Adjustables**

1. Edit Adjustables is a very powerful feature of the AVA. It allows the elimination of a single correction, a family of corrections, or corrections on a specific blade or adjustment position. After the editor is used to modify the corrections, the prescribed corrections and predicted response are recalculated based on the edited corrections list by pressing the **DO** key. The editor works by eliminating a correction type for a particular adjustment position.

2. The editor, figure 2, consists of a table with the adjustment position labeled horizontally across the top of the screen (e.g. YEL, BLU, RED and BLK) and the adjustment type displayed along a vertical column at the left of the screen (e.g. Hub Weight, Pitch Link, Tab). For each adjustment position/adjustment type intersection, a 'Y' or an 'N' is displayed. A 'Y' indicates that a correction is acceptable for that position and type defined by the intersection. An 'N' indicates that no correction is to be included for that adjustment position/adjustment type. The four function keys provide a mechanism to edit the correction matrix. The following is a description of some of the functions of the Edit Adjustables.

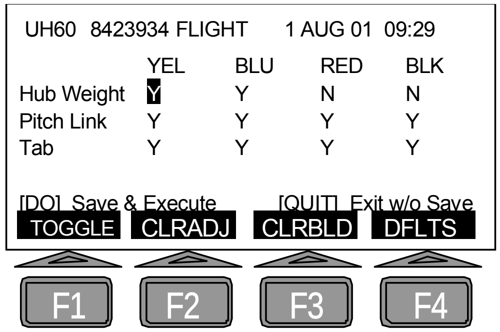


Figure 2. Edit Adjustables Screen

(a) TOGGLE (Modifying a Specific Adjustment). To modify a specific adjustment, position the cursor over the correction position using the arrow keys. Toggle the adjustment from Yes to No by pressing the **F1** key.

(b) CLRADJ (Clearing All Adjustments of a Particular Type). To clear all the adjustments associated with a particular adjustment type, move the cursor to the desired row and press **F2**. This will cause 'N' to appear for the whole row next to the adjustment description.

(c) CLRBLD (Clearing All Adjustments for a Particular Blade). To clear all the adjustments associated with a particular blade or adjustment position, move the cursor to the desired column and press **F3**. This will cause N to appear in the column associated with the desired adjustment position.

(d) DEFLTS (Returning to the Default Adjustment Screen). To return to the default correction screen, press the **F4** key. This will cause any edits to be cleared and the data to default back to what it was upon entry into the editor.

(e) Re-running the Correction Calculations and Displaying the Results. Pressing the **DO** key after any changes have been made by the Adjustments Editor will cause a recalculation and display of the correction adjustments.

(f) Returning to the Diagnostics Main Menu. Pressing the **QUIT** key will cause a return to the Diagnostics Menu without saving changes. From this menu, the user may:

select to View Predictions
select to Edit Adjustables
select to View Corrections
select to View Limits
select to Edit Defaults
select Single Test State
select Complete Flight Summary
return to the AVA Main Menu

d. **Editing Defaults**

What follows is a discussion of the advanced diagnostic tools available to the operator. It is important to have a thorough understanding of these features before attempting to employ them in real world situations. It is also important to note that each of the diagnostic tools described below:

- Operate in conjunction with the Edit Adjustables screen. Any modifications made in the edit adjustables page will further constrain the functions listed below.
- Any changes made to these options are temporary and are not stored in the database, and are therefore returned to the default selection each time the operator returns to the Main Menu then re-enters the diagnostics.
- The use of and setting of each of these options is aircraft script file dependant and will vary depending upon the aircraft type and script file version.

1. **Maximum Number of Adjustments** (Selection Options: Any whole number ≥ 0)

(a) The Best N diagnostic feature is a timesaving tool designed to allow the CADU to automatically disable smaller, less 'valuable' adjustments from the default recommended set. Setting Max Number of Adjustments to '0' disables this function completely, and allows the system to use as many adjustments as necessary to correct the rotor.

(b) This function is most effectively employed by first counting the total number of adjustments of all types in the default solution, then setting Max Number to equal one less than that total. The CADU will then recalculate a diagnostic solution, reducing the total adjustments by at least one (in some cases, the system may remove more than one when two adjustments were working in concert). Each time a new solution is presented, a new set of predicted results are calculated as well. Careful observation of the predictions will indicate if the recent reduction in adjustment count still provides an effective solution. Note that the CADU is considering the vibration and track levels of all airspeeds, so it is important to review ALL prediction levels before deciding upon a specific adjustment set.

(c) While it is possible to manually edit out specific adjustments using the Edit Adjustables screen, it is important to note that the selection of the recommended adjustments is based on a complex interaction of multiple accelerometer channels as well as track. Manually 'turning off' the smallest adjustment (in terms of quantity or 'size' of the adjustment) may not be the best course of action. Using maximum number of adjustments will allow the algorithm to select an adjustment based on its effectiveness rather than size.

2. **Resolve to Limit** (Selection Options: On / Off)

This option is intended to act as an 'automatic best maximum number of adjustments' with one major difference. Whereas all other diagnostic routines are attempting to achieve vibration levels of zero, this option allows the diagnostic a greater latitude when deciding if the solution is acceptable. In simple terms, the diagnostic is attempting to use the smallest set of adjustments to get the aircraft below the vibration levels defined as acceptable limits (typically 0.2 ips). This is often the most rapid method to get the aircraft within limits with as little maintenance activity as possible.

3. **Weighting Mode** (Selection Options: Default / Auto)

(a) Each aircraft script file contains a carefully established weighting structure. This is referred to as the "DEFAULT" weighting structure. It is designed to act as a priority scheme, instructing the diagnostics system, in cases where all Test States and vibration levels can not be reduced, what flight conditions and vibration/track data points are to be targeted first.

(b) This weighting structure is determined by such factors as aircraft mission, type of rotor system, and repeatability/effectiveness of adjustments at certain Test States.

(c) However, it is recognized that there are times when the system seems to be 'disregarding' a particular data point, leaving out adjustments that might help tune the vibration to acceptable levels. One possible reason for this phenomenon is that the default weighting has been 'de-tuned' or reduced in priority at that particular data point for the benefit of others.

(d) Selecting the weighting mode to AUTO will instruct the system to review the vibration and track profile of the current data set, and when necessary, modify the default weighting structure relative to the measured data. This will allow the system to have more flexibility when calculating the optimal set of adjustments.

4. **Adjustment Sequencing** (Selection Options: On / Off)

(a) This setting, when used, employs a recognition that some types of adjustment are more difficult to install than others. A sequencing scheme enables the system to selectively enable an adjustment type based on an effectiveness versus preference. When enabled in the aircraft script file, the diagnostic will sequentially enable the various adjustments based on a predefined pattern until an acceptable diagnostic solution is achieved.

(b) When the default is OFF, the operator can assume that there is no sequencing established in the aircraft script file, and therefore there is no ON option. When the default is ON, a sequence has been defined and will be used for each diagnostic solution, and can be disabled by setting this option to OFF.

e. **Diagnostic DOs and DON'Ts**

Each aircraft type has some unique characteristics and a customized setup file: however, there are some common rules of thumb which should be followed when using the diagnostic editing function and making corrections to the aircraft. For specific airframe instructions, consult the aircraft specific work package or Maintenance Manual. The ability to use the diagnostic editing functions combined with the airframe knowledge will greatly enhance the ability to make proper corrections to the aircraft quickly. The following are some DOs and DON'Ts to observe when making corrections to an aircraft:

1. **DO** verify that the aircraft needs corrections. The vibration and track levels should be reviewed after the initial flight to determine if corrections are needed or if the aircraft is within required limits.

2. **DO** stop making corrections when within acceptable levels. The diagnostic algorithm will always calculate a correction even though the airframe levels are within spec. At low vibration levels, the predicted corrections will generally improve track, but not make significant vibration level improvements.
3. **DO** use the Edit Adjustables to limit the number of corrections. The diagnostic routine will calculate corrections for all locations not constrained by the aircraft setup file. Many times by using this editor, you can reduce the number of corrections to be made and still reach the desired limit. If this is the case, use the editor and put an N for the particular correction and review the predicted response. If the predicted response is within limits, follow the new set of corrections.
4. **DO** make the corrections properly. The diagnostics won't work if the corrections are installed improperly.
5. **DO** monitor the vibration/track convergence. Generally there should be steady improvements in vibration and track levels for each round of corrections. If this is not happening, there may be other abnormal mechanical conditions that are preventing a proper solution. Improvements of greater than 50% per round of adjustments should be anticipated for rough aircraft.
6. **DO** compare the previous predicted response vs. the actual response. They should generally be close. If they are drastically different, there may be an abnormal mechanical condition that will prevent the diagnostics from working properly.
7. **DO** monitor the track spread. Even though many of the diagnostic aircraft setups weigh vibration improvements more importantly than track spread, if the calculated correction results in a large track spread there may be other abnormal mechanical faults.
8. **DON'T** keep making corrections without an improvement in levels. When all else fails it may be time to do a flat track on the ground and start over.
9. **DON'T** follow the recommendations blindly. The operator is still responsible for the airframe maintenance, and the operator's judgment will make the AVA an effective tool. If some of the corrections don't make sense, don't implement them. Corrections that don't make sense could be caused by a mechanical fault in the rotor that is influencing the rotor diagnostics.

f. **Summary**

The diagnostics capability of the AVA allows the simultaneous prediction of weight, pitch link, trim tab and other adjustments for configured aircraft. The advanced measurement capability along with a sophisticated diagnostic algorithm results in a system that typically corrects normal rotor track and balance problems within a few flights. The Test States, measurements, and diagnostics are custom tailored for each airframe by the aircraft configuration file. The diagnostic algorithm utilizes all the track and vibration measurements made at each of the test conditions to come up with an optimum solution, which minimizes vibration and track over the complete operating envelope. Weighting factors within the aircraft configuration file allow a trade off between track and vibration levels allowing specific test conditions or types of vibration to be corrected at the expense of other test conditions or vibration levels.

END OF WORK PACKAGE

MANAGER MENU
AVIATION VIBRATION ANALYZER

CAUTION

This operation [deleting data records] will permanently delete collected data.

Figures

The MANAGER function encompasses five separate functions that allow the user to change, control, or test. They include:

- Data Maintenance
- Data Transfer
- Status
- Setup
- Test

The MANAGER is initiated from the Main Menu by pressing **F4**. The five functions appear in the Manager Menu screen, see figure 1.

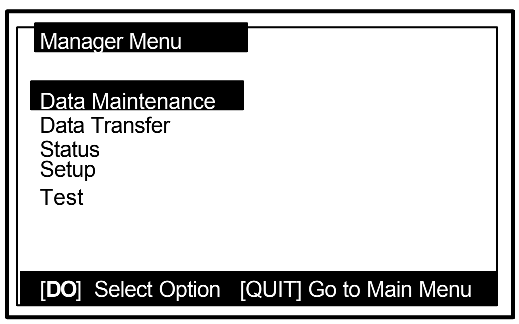


Figure 1. Manager Menu

a. **Selecting Data Maintenance (Database Maintenance)**
Place the cursor over the Data Maintenance, figure 2, selection from the Manager Menu and press **DO**. The data maintenance option allows the operator to delete old files from the system.

NOTE

Verify CADU is on external power. A power down due to low battery may cause loss of data during a compression.

1. **Compressing Data Records**
This operation will recover disk space that is allocated, but currently unused. Use this operation after data has been deleted to get maximum usage of the disk to store flight results. Select this option by placing the cursor over Compress and pressing the **DO** key. At times it will be necessary to run the compress option. As data is added, records are created in the database. These records have a particular structure that is unique by aircraft type and Flight Plan. If a different aircraft type and Flight Plan is requested, it is not possible to use the previous structure even though it may be empty because of data deletion. This has some important implications. If a wide variety of aircraft types and Flight Plans are used, it is possible that deleting data will

not free up space for the measurement that is being attempted. At this point it is necessary to run the Compress utility.

Compress basically frees all the old structures and recopies data into new clean files. This tendency to not re-use old database records results in what is commonly referred to as database fragmentation.

2. **Deleting Data Records**

CAUTION

This operation [deleting data records] will permanently delete collected data.

This operation will delete data from the database. Select the option by placing the cursor over Delete and pressing the **DO** key. Data can be deleted in one of the following ways:

(a) Delete Aircraft Data. Deletes all flight data records for this type of aircraft.

(b) Delete by Tail Number. Deletes all flight data for the chosen tail number of the aircraft.

(c) Delete by Flight. Deletes selected flight data for the chosen aircraft and tail number.

(d) Delete Aircraft Setup. Deletes all flight data and the setup information for the chosen aircraft.

(e) Delete Credit Card Data. If backed-up data exists on the installed CCM, this option may be used to delete the stored data by Aircraft Type, Tail Number, or Flights.

After selecting one of the above options, prompting will occur one more time by a safety screen. Use the RIGHT or LEFT arrow keys to place a Yes in the question box and press the **DO** key.

NOTE

When operation is to delete aircraft setup, a special 8-digit number must be entered in the Entry Form that is displayed. When prompted, enter the following number:

27182818

The deletion operation allows deletions based on aircraft type, tail number, and flights. If an aircraft is deleted, all setup data and flight results will be removed. If a flight or tail number is chosen, then the flight results will be deleted. Tail numbers and aircraft can be deleted whether or not flight results exist.

Deletion by Flight ID is a more discriminating way of removing data and freeing space. Remember, the Flight ID is a unique number that is assigned to a particular flight. For instance, if a measurement is desired on the flight line and a database full error occurs, it will be necessary to delete data. Returning to the oldest data for that Flight ID and deleting the oldest data associated with that Flight ID would enable retaining more recent data.

NOTE

Always compress after deleting data.

b. **Selecting Data Transfer**
Place the cursor over the Data Transfer, figure 3, selection from the manager menu and press **DO**. Three data transfer options will appear in the next screen. The functions and operation of these three functions are explained in the following paragraphs.

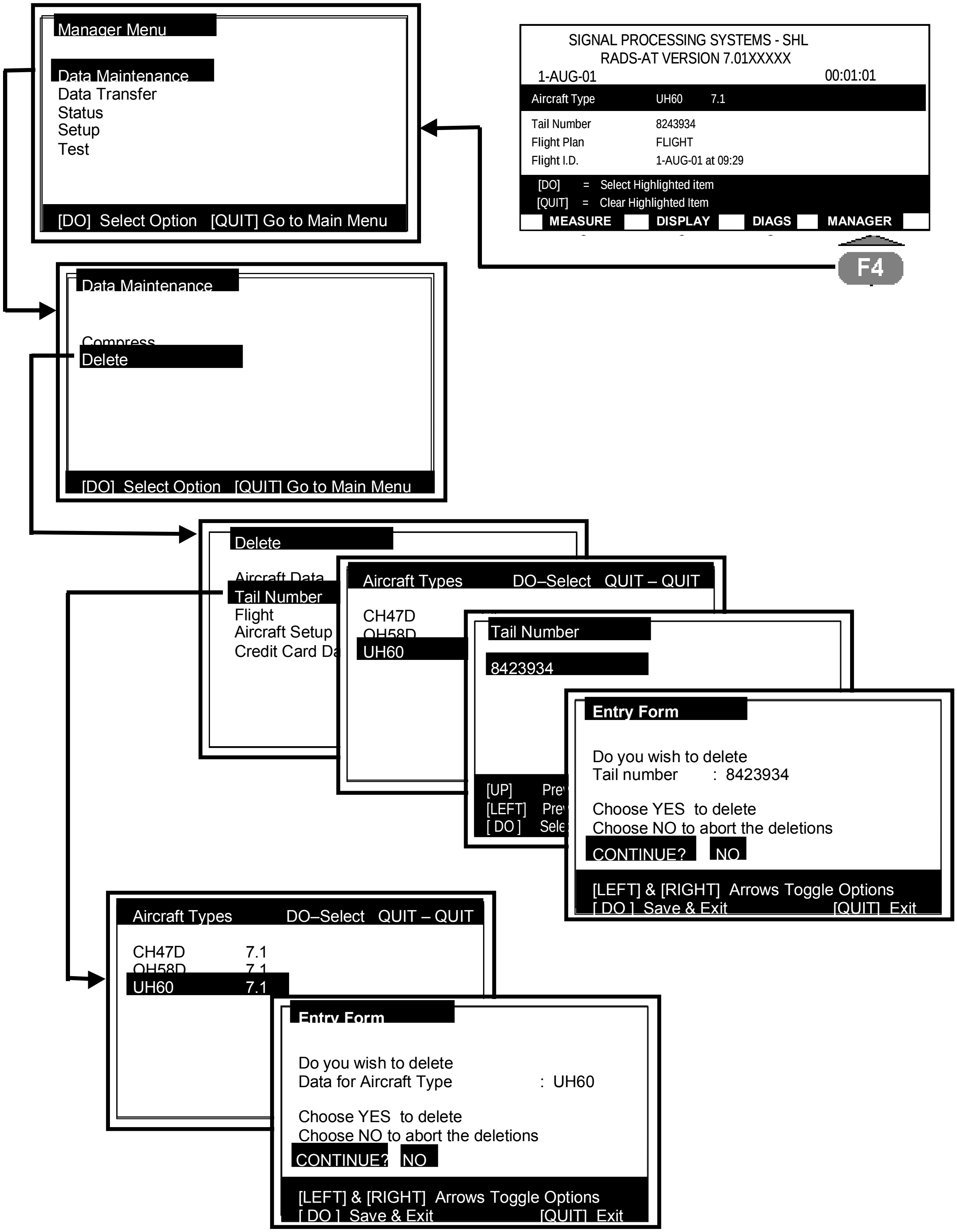


Figure 2. Data Maintenance Option Menu Hierarchy (Sheet 1 of 3)

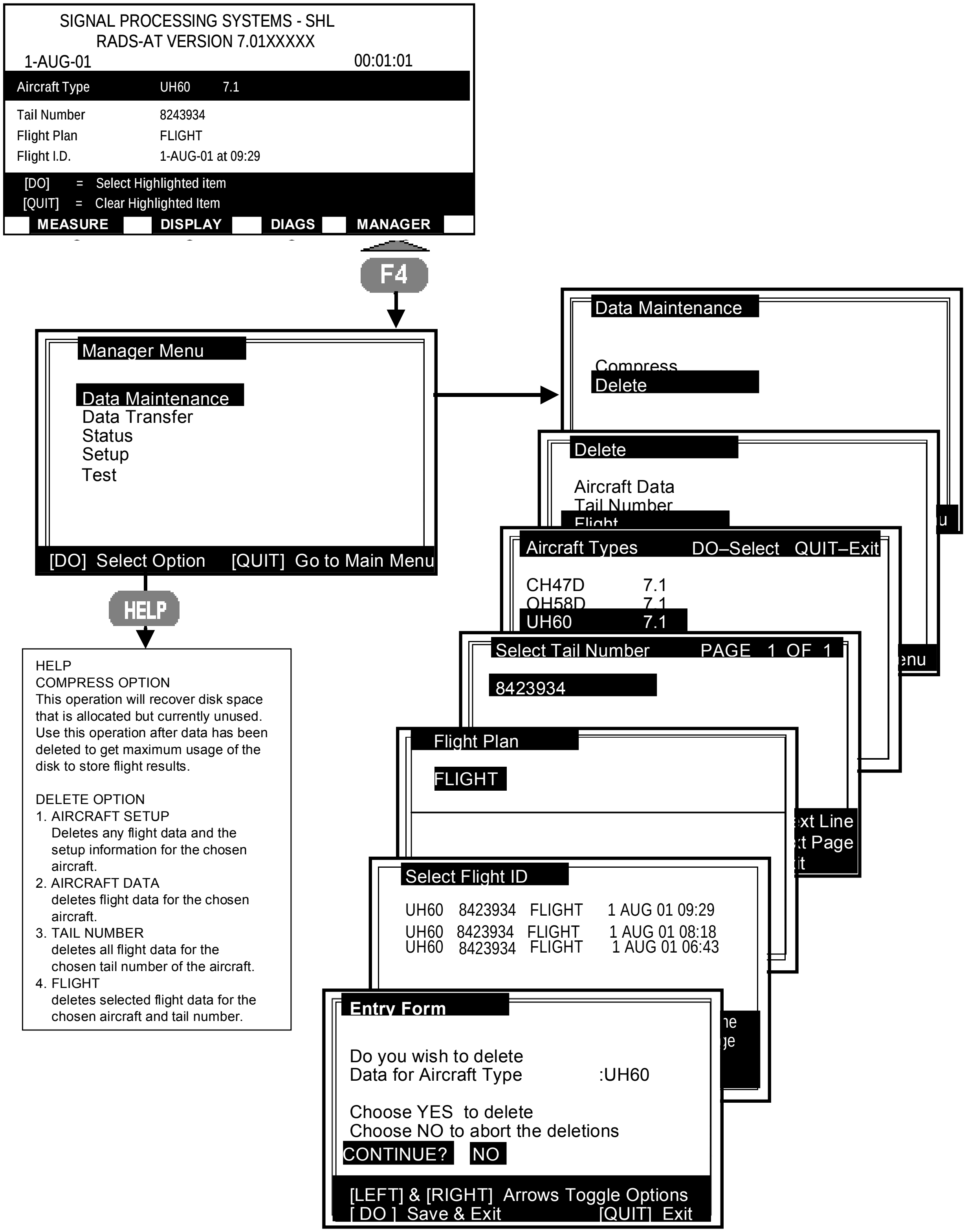
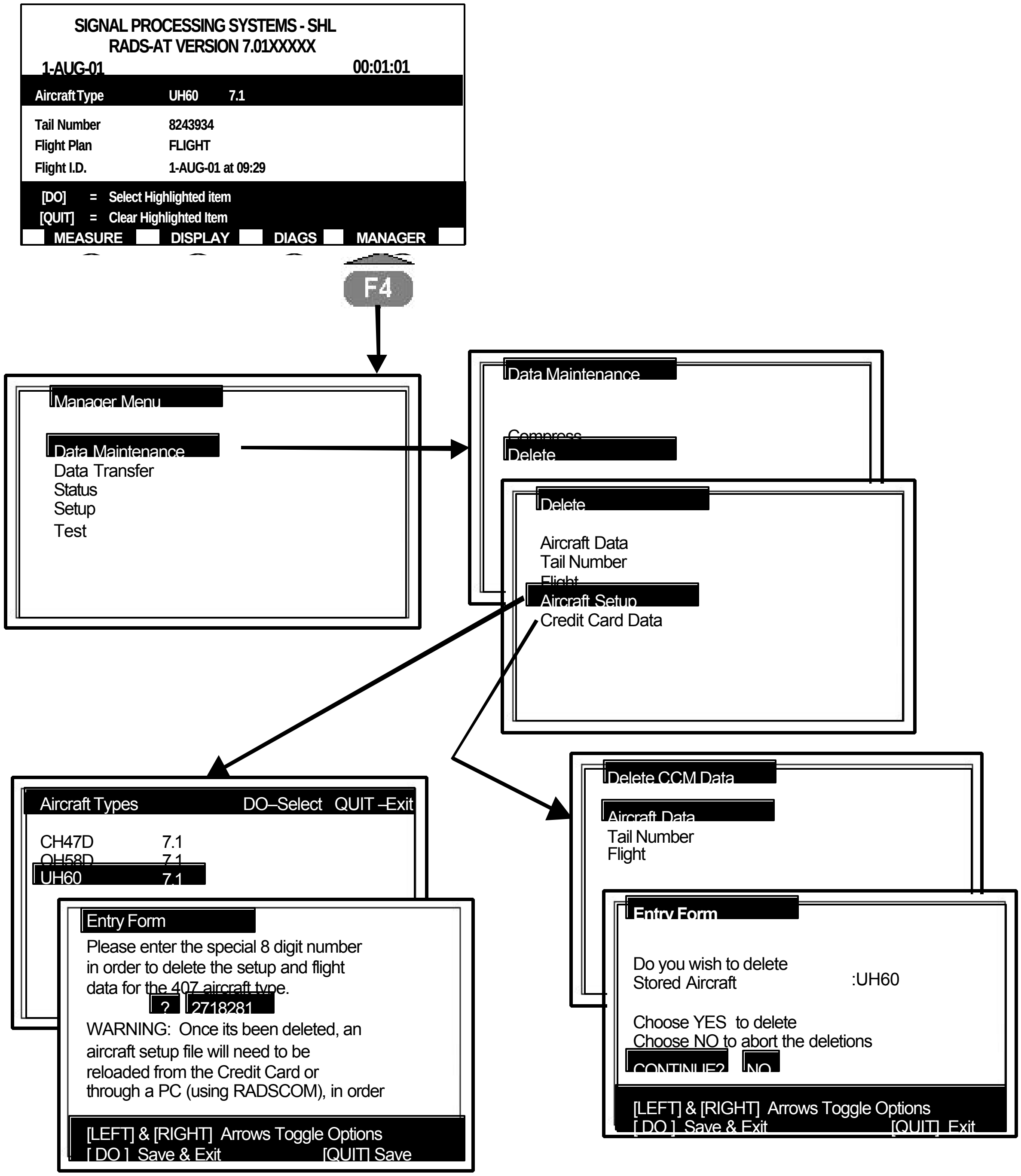


Figure 2. Data Maintenance Option Menu Hierarchy (Sheet 2 of 3)



Note: WARNING in Entry Form above includes
the use of the WinRADSCOM program.

Figure 2. Data Management Option Menu Hierarchy (Sheet 3 of 3)

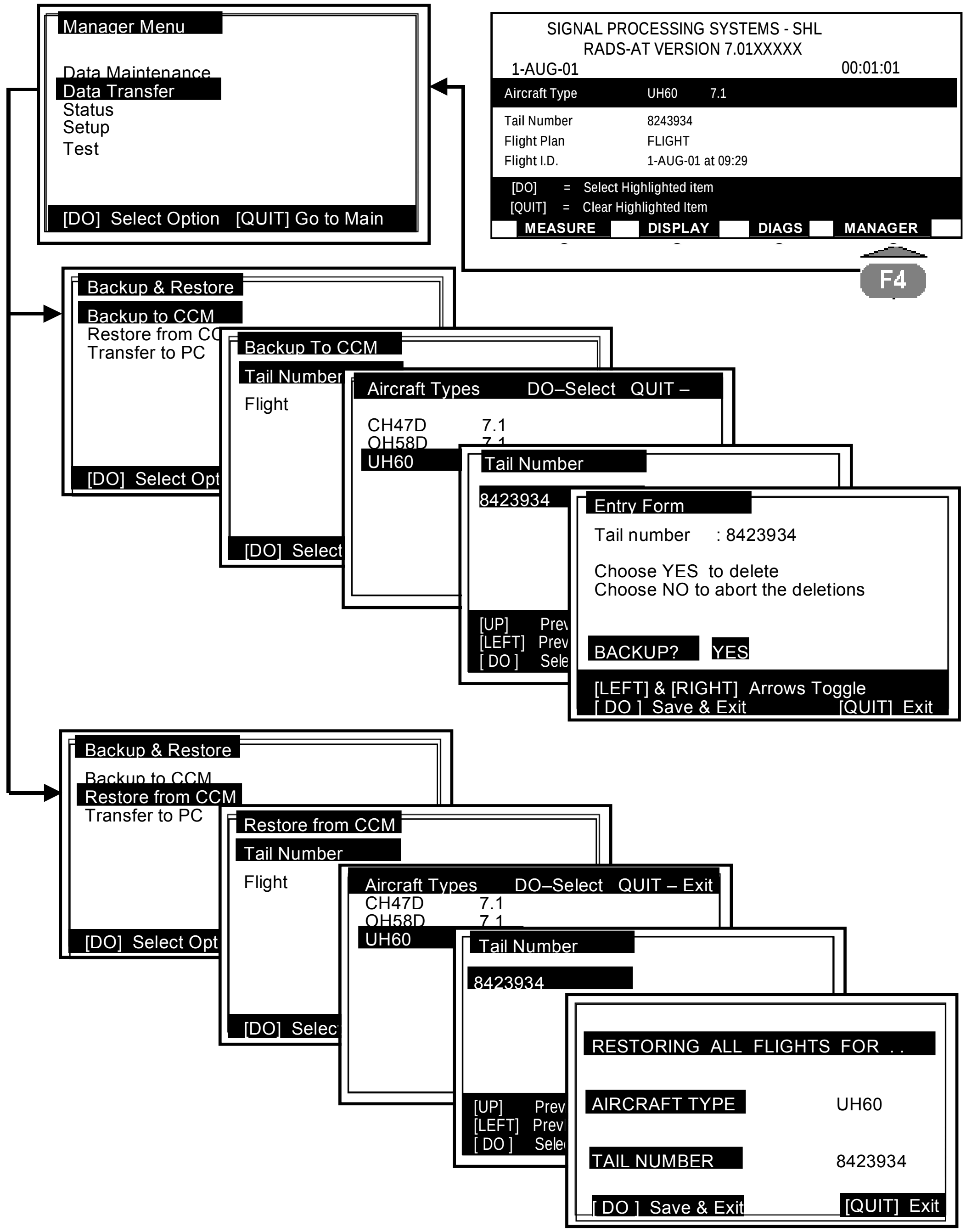
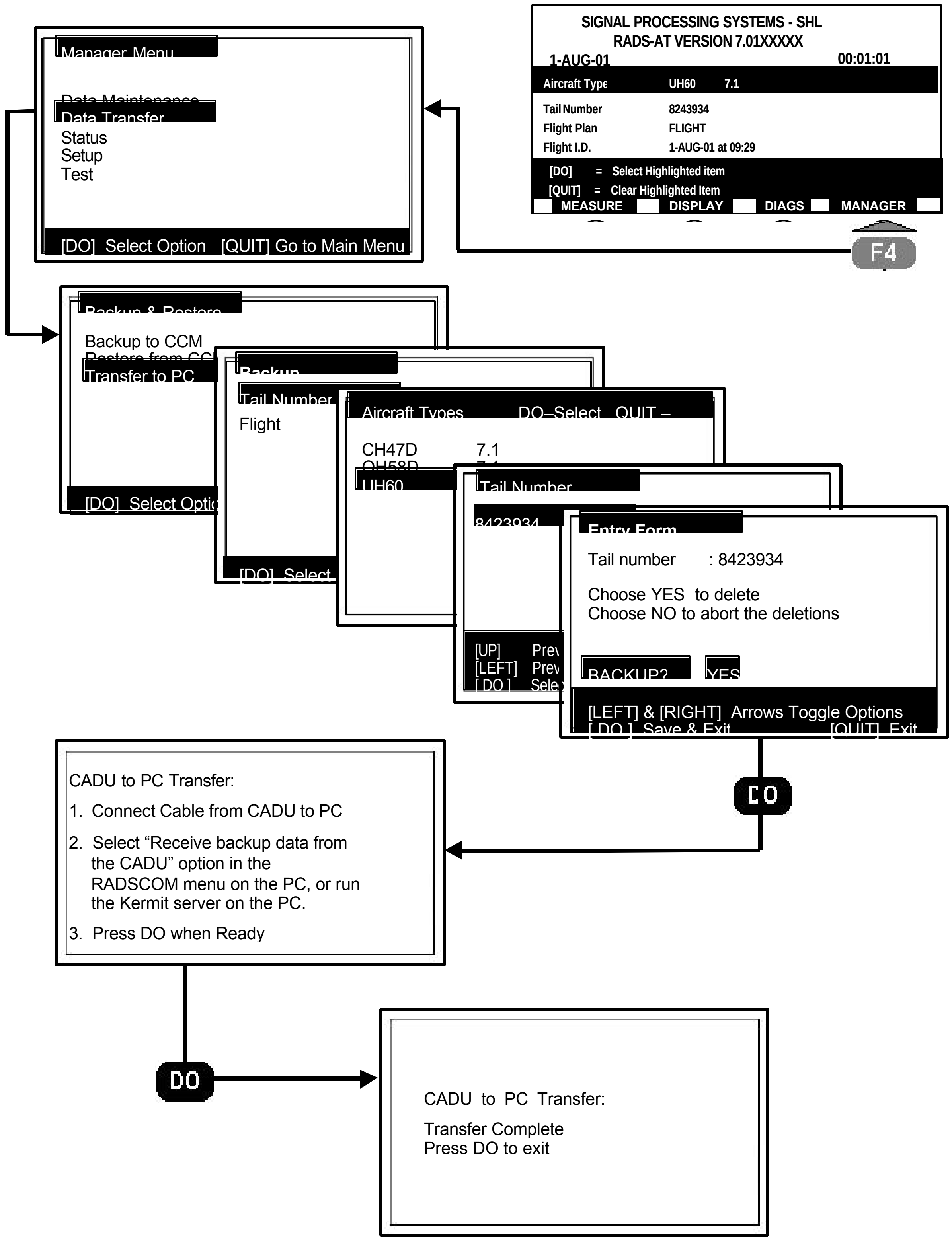


Figure 3. Data Transfer Option Menu Hierarchy (Sheet 1 of 2)



Note: CADU to PC Transfer step 2. above includes
the use of the WinRADSCOM program.

Figure 3. Data Transfer Option Menu Hierarchy (Sheet 2 of 2)

1. **Backup to Credit Card Memory (CCM)**
   Backup means transferring data stored in the AVA to a transportable memory that looks like a credit card. Ensure the small battery cover on the CCM is facing away and that the end opposite the battery cover is the end inserted into the slot. Insert the CCM into the slot at the back edge of the CADU (behind the panel). A firm push on the CCM is necessary to engage it with the CCM interface mechanism inside the CADU.

   To execute transferring data to the CCM, place the cursor over the Backup to CCM option and press **DO**. The data to be backed up has to be identified by Tail number, Aircraft type, or Flight ID number via a set of five screens. The last screen asks if data backup is really desired and whether to delete the original data stored in the CADU.

2. **Restore from Credit Card Memory (CCM)**
   Restore means downloading data from the CCM to the CADU memory To restore data from the CCM, place the cursor over the Restore from CCM option and press **DO**. The restore procedure requires identifying the data needing to be restored. The data to be restored has to be identified by Tail number, Aircraft type, or Flight ID number via a set of five screens.

3. **Transfer to PC**
   Transfer means downloading data directly from the CADU to an external computer. To transfer data to an external computer, place the cursor over the Transfer to PC option and press **DO**. The data to be transferred has to be identified by Tail number, Aircraft type, or Flight ID number via a set of screens. The last screen, Entry Form, will ask if data back up is still desired. A YES answer is followed by two screens with explicit instructions to follow in making the transfer to the PC. At the completion of the data transfer to the PC, a menu appears prompting the user to enter either "yes" or "no" as to whether they want to delete the data which was just transferred to the PC from the CADU database. The RADSCOM or WinRADSCOM communication package can be used on the PC to simplify the backup to PC operation.

4. **Summary**
   The data transfer option allows the backup of collected data onto either a CCM device onto a computer running RADSCOM or WinRADSCOM. The information that has been transferred can be reloaded into the CADU database and used or reviewed again, even to the point of re-running diagnostics on the old data.

   (a) The files transferred to the CCM are in a minimized binary format that allows for a maximum amount of flight data to be stored. A directory is created on the CCM that stores the flight data by aircraft type, tail number, and flight ID.

   (b) The backup operation is usually performed when the CADU internal memory space is filled and the user wants to make new measurements. First, the user performs a backup of the data that he wants to save onto the CCM. Then he deletes this data from the CADU and performs a compress function (under Data Management) to obtain more disk memory space.

   (c) The directory structure of data backed up onto the CCM allows the user to restore flight data for a selected aircraft by tail number or flight.

   (d) It is not necessary to use a credit card for data storage if there is access to an IBM compatible computer. Data can be archived on inexpensive floppies or the hard disk. The data transferred to an external computer is written in text format in the form of eight separate files. The format of these eight files is:

c. **Selecting Status**
The status report screen, figure 4, provides a variety of system information that may be useful in system setup and equipment setup. Not all the information will be displayed on the screen, but will be printed if the **PRINT** key is pressed. Place the cursor over the Status selection and press the **DO** key. The Status Report provides the following information:

1. Current setup including the current Aircraft Type, Flight Plan, Tail Number and Flight Flown.

2. Available aircraft types that have been loaded into the CADU database.

3. Printer Status. This block indicates the current printer type that has been selected and whether the printer is running. In order to print screens, the printer type should be selected to be compatible with the printer. Printing should be enabled and the spooler should be running.

4. Measured Results. This block provides a list of the number of each of the measurement types currently stored in the database.

5. Current Units. This block provides a table of the current selected display units. Display units can be modified from the Manager Menu Setup option.

6. Required Installation. This section provides basic setup information for the aircraft type currently selected. It includes the UTD installation angle and the type of accelerometer selected for each of the channels.

d. **Selecting Setup**
The Setup Menu contains all the operations to change the current system's setups, see figure 5. The following is a description of those operations:

1. **Printer Options**
The AVA contains a print spooler that is capable of storing up to twenty selected screen images and sending them to the printer. The CADU provides both parallel and serial interfaces for printers. The serial interface is used with the AVA printer or a serial printer with Epson graphics. The parallel interface is used with printers containing a Centronix parallel interface with Epson graphics. In order to change the number of screen images that can be stored, refer to ENABLE command. The CADU is designed to control several different serial interface type printers, such as Epson compatible printers and the AVA printer. Place the cursor over the Printer selection and press **DO**. Use the UP and DOWN arrow keys to maneuver through the menu selections described in the following paragraphs.

(a) **Changing Printer Types**
To change the printer type, position the cursor over the Change Type selection in the Printer Control Menu, figure 6, and press **DO**. A list of available printer types will be displayed. Position the cursor over the desired type and press **DO**. The new printer type will be installed.

(b) **Changing Printer Ports**
To change the printer port type, position the cursor over the Change Ports selection in the Printer Control Menu and press **DO**. A Printer Ports selection menu allows the operator to select either the parallel or serial printer port, which ever is required for the printer being used.

(c) **Enabling/Disabling Print Spooler**
The print spooler buffers screen images for printing while the printer is not hooked up. Once the printer is hooked up, the screens will be printed out in the order that the screens were spooled to the buffer. When the spooler is enabled, screens are printed. When the spooler is disabled, screens are just buffered in the CADU's internal memory. After the CADU is rebooted, the print spooler is returned to the enabled state. To enable or disable the print spooler, position the cursor over the desired selection in the Printer Control menu and press **DO**. It is recommended to leave print spooling enabled.

(d) **Flushing Print Spooler Buffer**
Screens that have been previously spooled can be deleted, if printing is no longer desired or a user prefers to print new screens rather than old screens. To delete old buffered screens, position the cursor over the Flush Queue selection and press **DO**.

(e) **Printer Spooler Failure**
In the event of a printer spooler failure, it will be necessary to restart the spooler. To restart the spooler, position the cursor over the Restart Spooler option and press the **DO** key. This option is only available if the printer spooler is not running.

2. **Setting System Time and Date Function**
This function allows the current time and date to be changed. To select this function, place the cursor over the Set Time & Date option and press the **DO** key. An entry will appear. Use the UP and DOWN arrow keys to move through the selections. Use the **HELP** key on a chosen selection (highlighted) for specific information on that choice. Use the numeric keypad to enter values. In cases where two digit values are required (such as the date) use the LEFT and RIGHT arrows keys to position over the appropriate digit to be changed. To cancel changes, press the **QUIT** key to exit anytime.

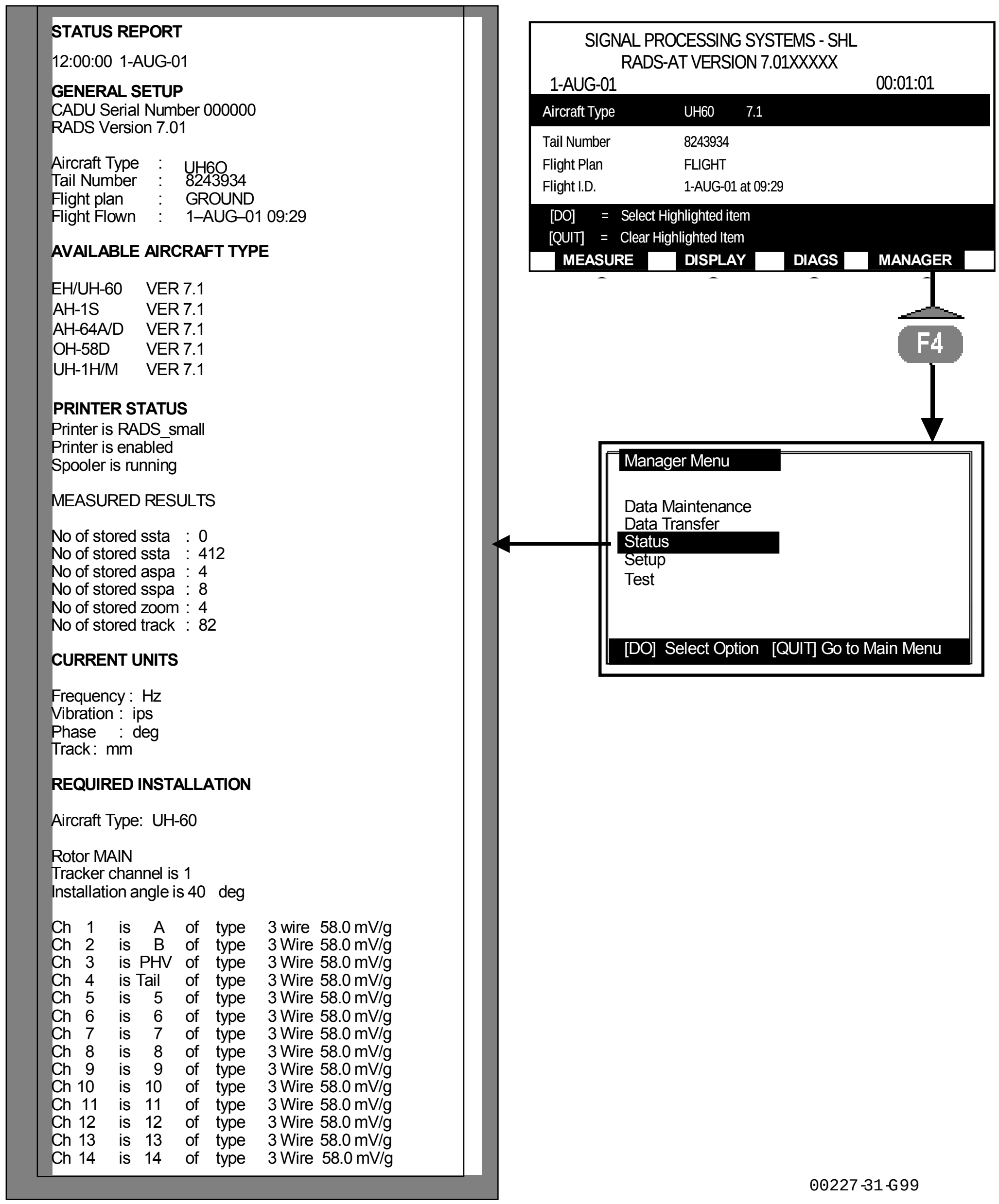


Figure 4. Status Report

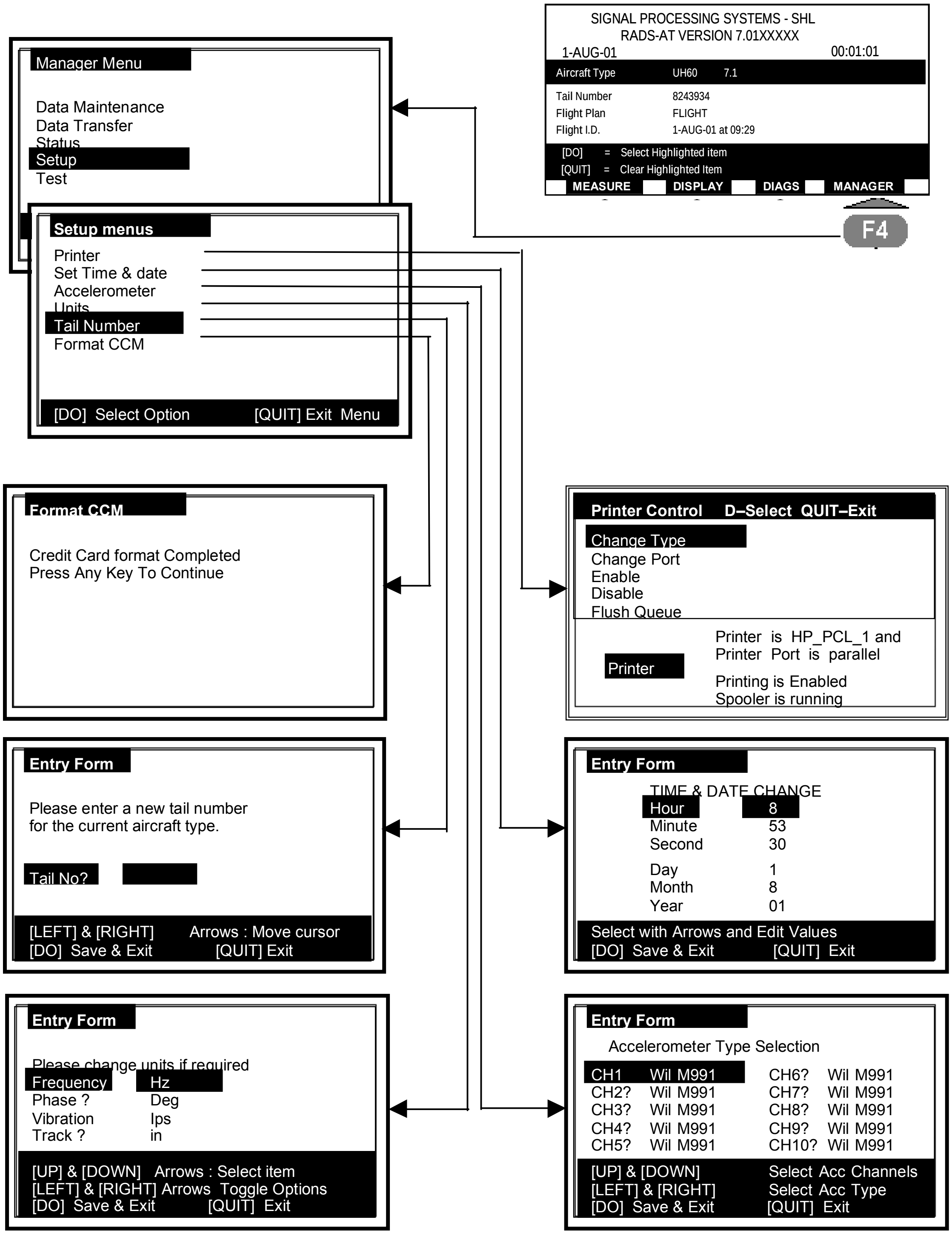


Figure 5. Setup Option Menu Hierarchy

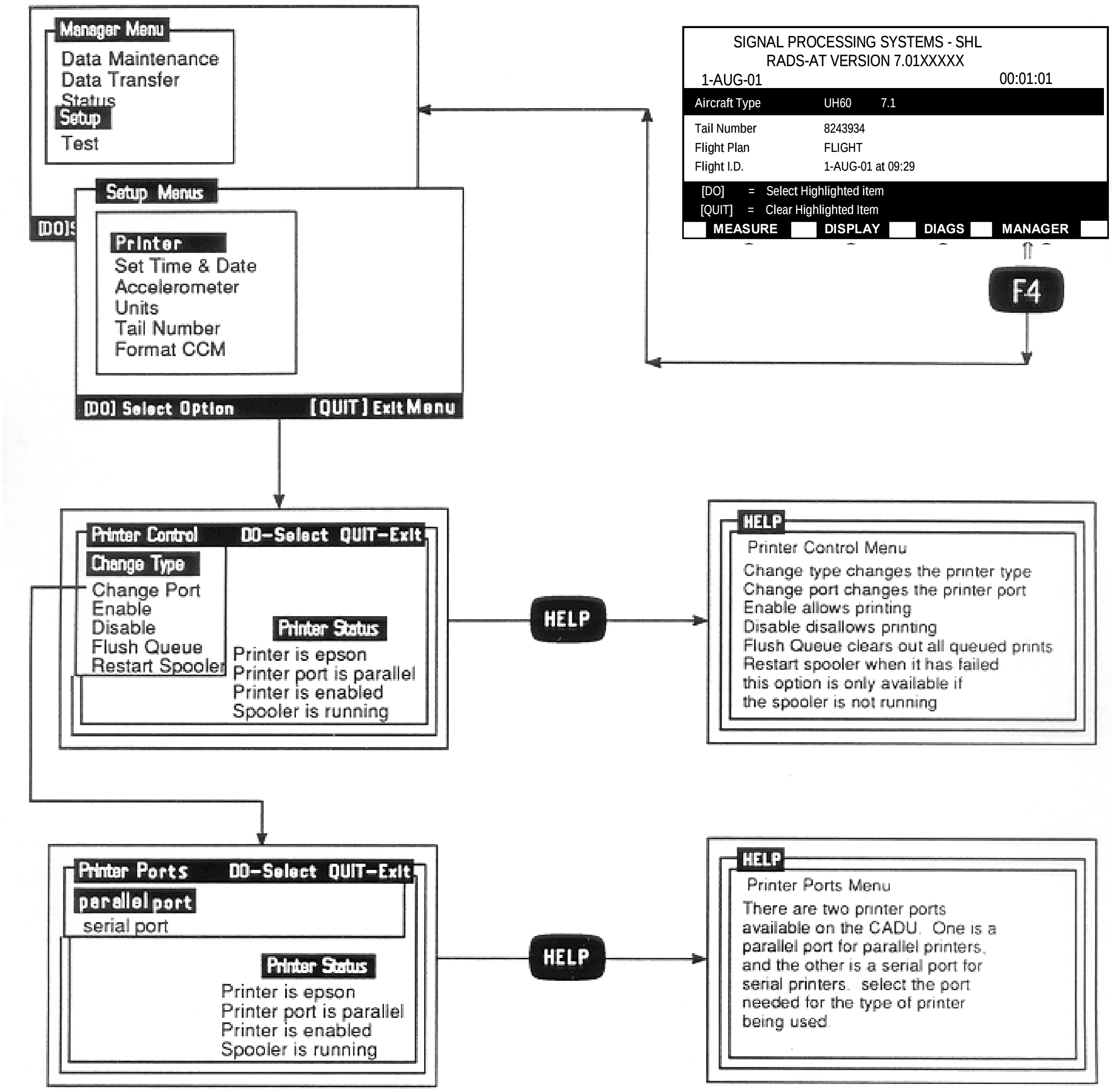


Figure 6. Printer Setup Menu Hierarchy

3. **Changing Accelerometer Type**

NOTE

Changing accelerometer types will generally require a different cable. Ensure an applicable cable is available prior to making an accelerometer change.

This function allows the changing of the current type of accelerometers in use. To select this function, place the cursor over the Accelerometer option and press the **DO** key. An entry form will appear displaying the current accelerometer in use for the selected aircraft. Use the LEFT and RIGHT arrow keys to change accelerometer types. Use the UP and DOWN arrow keys to move to another choice. When the changes have been made, press the **DO** key to accept changes and exit. To cancel changes, press the **QUIT** key to exit anytime.

4. **Changing Display Units**
The AVA is capable of changing units used for display by using a simple menu. It is possible to display vibration in units of ips, mils or g's. Phase can be displayed in units of degrees, clock hours, radians, or Chadwick-Helmuth clock hours. Track can be displayed in units of mm, meters, feet, inches, or mils. Once the units are set, they remain installed until they are changed using this menu or the system is reformatted. To modify the selected display units, place the cursor over the Units selection and press **DO**. The entry screen will appear. Use the UP and DOWN arrow keys to select the type of unit to be modified. Use the LEFT and RIGHT arrow keys to toggle between the possible unit choices. One or all of the unit types can be modified while in the Entry Form. Once the choices have been made, press the **DO** key to install the choices in the database. To cancel changes, press the **QUIT** key to exit anytime.

5. **Adding a New Tail Number**
A new tail number can be added from the setup menu by positioning the cursor over the Tail Number selection and pressing the **DO** key. An Entry Form will appear. The numbers can be entered from the numeric keypad and letters can be entered by toggling through the alphabet using the **F1** and **F2** function keys. **F1** will toggle forward through the alphabet one character at a time and **F2** will toggle backward. The RIGHT and LEFT arrow keys can be used to select a specific character position. After the desired number has been entered, press the **DO** key to store the result in the database. To cancel changes, press the **QUIT** key to exit anytime.

e. **Selecting Test**
The Test selection of the Manager Menu, figure 7, allows the operator to select either testing of the CADU keypad or the CADU display screen. The Keypad Test provides the operator with a means of verifying the proper operation of the CADU input keys, while the Display Test allows the operator to verify that the display screen is operating properly.

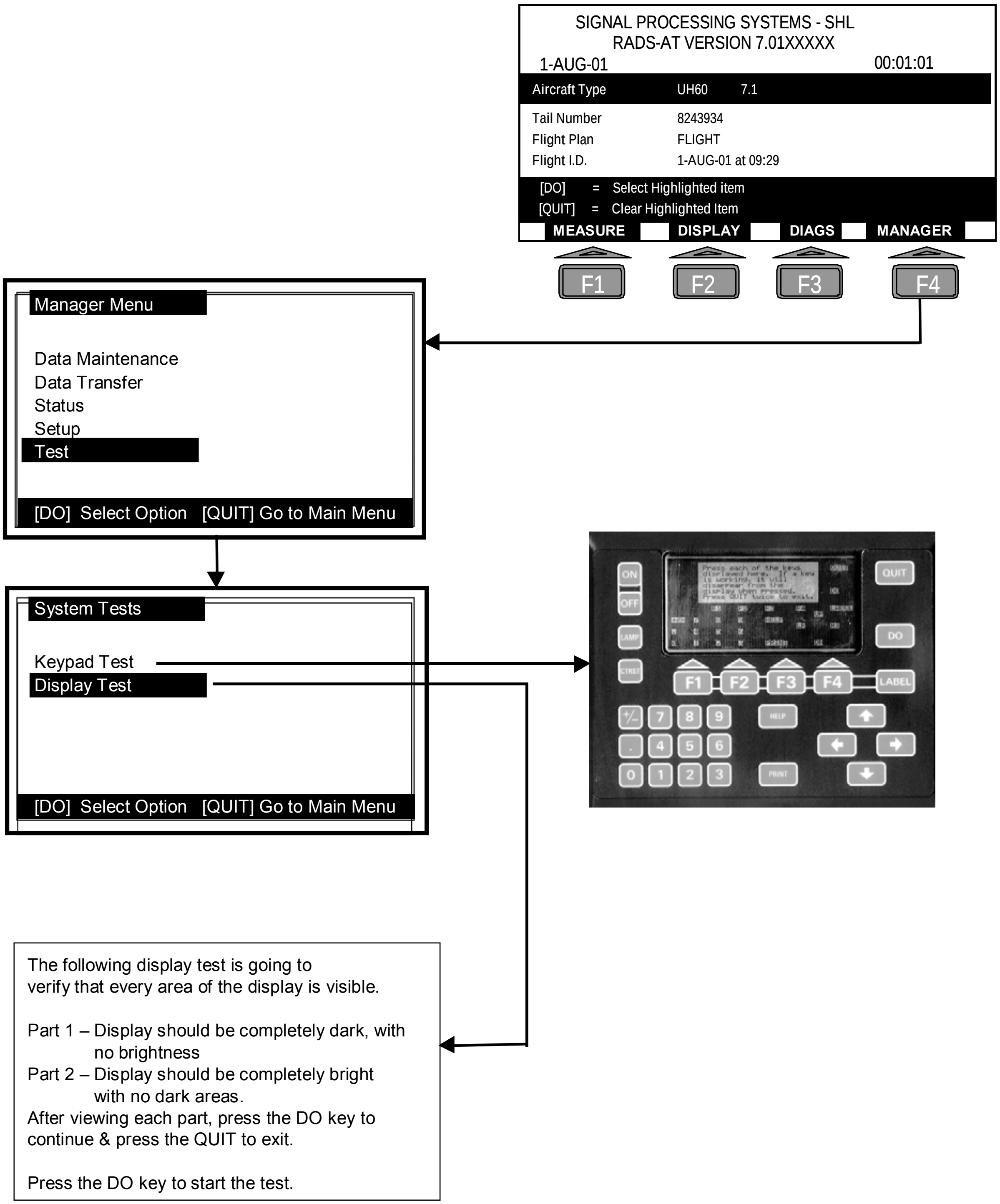


Figure 7. Test Menu

END OF WORK PACKAGE

OPERATION
GRAM/OUNCE SCALE

CAUTION

(29323700 Only) Always turn the scale OFF before selecting a display mode of Gram or Ounce. Changing modes while weighing may affect the accuracy of the scale.

CAUTION

Do not exceed the total capacity of the Gram/Ounce scale (2000 g / 70 oz) when weighing objects or combinations of objects. Exceeding the total capacity of the scale will cause a readout display of "E" and may cause damage to the scale.

The AVA system contains an electronic gram/ounce scale (WP0004 00 figure 3) for measurement of the weights used in the balance of aircraft equipment. The scale is capable of measuring weights of up to 2000 grams / 70 ounces in either the "normal" or "TARE" (TARE mode on 29323700 only) modes.

a. **Normal Mode of Operation**
The normal mode of operation is as follows:

1. Place the scale on a flat surface that is not subject to vibration or air movement.

CAUTION

(29323700 Only) Always turn the scale OFF before selecting a display mode of Gram or Ounce. Changing modes while weighing may affect the accuracy of the scale.

2. (29323700 Only) Select a weighing mode by sliding the Gram/Ounce selector switch to either the Gram or Ounce mode.
3. (29323700) Turn the scale on by pressing the **ON/TARE** switch on the front panel and wait for a "0" (zero) indication.
(29323703) Turn the scale on by pressing the **On/Off/Zero** switch on the front panel and wait for a "0" (zero) indication.

CAUTION

Do not exceed the total capacity of the Gram/Ounce scale (2000 g / 70 oz) when weighing objects or combinations of objects. Exceeding the total capacity of the scale will cause a readout display of "E" and may cause damage to the scale.

4. (29323703 Only) Select a weighing mode by briefly pressing the **Cal/Unit** switch. There are two units available; gram (g) or pound-ounces (lb-oz).
5. Place the weight to be measured as near to the center of the top tray as possible.
6. Read the weight of the object on the front panel display. The readout may wander slightly due to the sensitivity that is affected by the slightest vibration or air movement. . If the internal battery is weak, the front panel readout will display "LO". When this occurs the battery must be replaced

b. **TARE Mode of Operation** (29323700 Only)
The TARE mode of operation is as follows:

1. Place the scale on a flat surface that is not subject to vibration or air movement, and gently insert the top tray.

CAUTION

Always turn the scale OFF before selecting a display mode of Gram or Ounce. Changing modes while weighing may affect the accuracy of the scale.

2. Select a weighing mode by sliding the Gram/Ounce selector switch to either the Gram or Ounce mode.

NOTE

Placing an object on the scale top tray prior to an indication of "0" (zero) can cause inaccurate measurements. Wait for the scale to indicate "0" before placing objects on the scale top tray.

3. Turn the scale on by pressing the **ON/TARE** switch on the front panel and wait for a "0" (zero) indication.

CAUTION

Do not exceed the total capacity of the Gram/Ounce scale (2000 g / 70 oz) when weighing objects or combinations of objects. Exceeding the total capacity of the scale will cause a readout display of "E" and may cause damage to the scale.

4. Place the weight to be measured as near to the center of the top tray as possible.
5. Read the weight of the object on the front panel display. The readout may wander slightly due to the sensitivity that is affected by the slightest vibration or air movement.
6. Press the **ON/TARE** switch on the front panel to place the scale in the Multiple TARE mode of operation. The display readout will automatically reset to "0" (zero) and a small triangle will appear in the upper left hand corner of the display.

CAUTION

Do not exceed the total capacity of the Gram/Ounce scale (2000 g / 70 oz) when weighing objects or combinations of objects. Exceeding the total capacity of the scale will cause a readout display of "E" and may cause damage to the scale.

7. Place the next weight on the scale. The readout displays the measurement of the second weight only.
8. Press the **ON/TARE** switch on the front panel. The readout displays the measurement of both weights, combined.
9. Repeat steps 6 through 8 for additional items to be weighed. If the internal 9-volt battery is weak, the front panel readout will display "LO". When this occurs the battery must be replaced.

END OF WORK PACKAGE

SHUTDOWN PROCEDURES
AVIATION VIBRATION ANALYZER

a. If DAU power is supplied to the CADU, both the ON and OFF keys of the CADU are active. Placing the DAU power switch to OFF removes power from DAU circuits and external power to the CADU. Placing the CADU power switch to OFF removes internal battery power.

b. There are, however, certain conditions under which the CADU will automatically power down such as if the unit is left unattended for longer than 10 minutes while operating on internal battery power. If the CADU powers down after the 10 minute period, it can be reactivated by pressing the ON key and the operational process will be at the same place in the sequence as existed prior to the power down.

NOTE

If the CADU powers down due to a low battery charge, a warning message will be displayed the next time the CADU is turned on.

c. Another CADU initiated power down occurs when the NiCad battery charge gets low. In order to prevent reversal of the battery voltage, the CADU automatically powers down.

END OF WORK PACKAGE

OPERATION UNDER UNUSUAL CONDITIONS
AVIATION VIBRATION ANALYZER

Index

1. UNUSUAL CONDITIONS

a. Under adverse conditions (e.g., strong backlighting, high rotation speed, rain, or dense fog), the maximum operating range for the optical sensor will be reduced to approximately 30 inches.

b. In wet conditions the 3M tapes on the rotors does not perform well. An overcoat of clear tape or 3M #38-70 (hex pattern tape) is recommended.

c. Extremes of Heat and Cold operating temperatures:

-40 to +131°F (-40° to +55° C) (external power)
-4 to +131°F (-20° to +55° C) (internal power)

d. Extreme conditions – (e.g., of snow, ice, rain, mud, dust, salt air, or similar conditions), do everything possible to prevent foreign material from entering the AVA units.

2. EXTREME ENVIRONMENTAL MAINTENANCE

After operation in extreme conditions, thoroughly clean and dry the AVA and accessories.

END OF WORK PACKAGE

CHAPTER 3

TROUBLESHOOTING INSTRUCTIONS

TROUBLESHOOTING INSTRUCTIONS

PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) AVIATION VIBRATION ANALYZER

Index

1. GENERAL

Inspect Aviation Vibration Analyzer for missing or damaged components. Check for physical damage such as breaks, cracks, wear, etc.

2. CLEANING

Use spray cleaner (item 6, WP0066 00) to clean the outside surfaces of the major items. Wipe clean and dry with a soft rag. Clean lens on the CADU and UTD with lens cleaner.

3. LUBRICATION

There are no lubrication tasks required.

4. EXTREME ENVIRONMENTAL MAINTENANCE

There are no requirements for extreme environmental maintenance for the AVA equipment.

5. CALIBRATION

Calibration of the AVA will be performed by a TMDE Support Team in accordance with guidelines specified in Calibration and Repair Requirements for the Maintenance of Army Material (TB 43-180).

6. TROUBLESHOOTING

Possible failures to the AVA system as well as diagnostic procedures are provided in the following Inspection/Fault Isolation procedures.

Corrective actions, as shown in the following procedures, are outlined in WP0033 00 through WP0057 00.

END OF WORK PACKAGE

CONTROL AND DISPLAY UNIT (CADU) INSPECTION AND FAULT ISOLATION

Initial Setup:

Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians** **Voltmeter, Fluke 8020 or equivalent**
References:	
Equipment Condition:	**CADU on Workbench with Electro-Static Discharge (ESD)**

a. Examine CADU for visible damage.

b. Replace a damaged keypad, lens, or cable connector. See WP0038 00 and 0039 00.

c. Operate the CADU to Manager Mode/Test (see WP0012 00 figure 7) and conduct listed tests:

1. Keypad - replace if any push switch fails to operate.

2. Display - replace CADU PWA if test is failed.

d. Check battery pack voltage at battery pack cable connector P1 (see WP0035 00), black wire is ground, red wire should measure between 6 and 10 Vdc. Replace if less than 6 Vdc. Ensure batteries have been charged prior to testing voltage.

END OF WORK PACKAGE

DATA ACQUISITION UNIT (DAU) INSPECTION AND FAULT ISOLATION

Tables

Initial Setup:	**Workbench with ESD capability**
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**As listed in TM 1-6625-736-13&P, NSN 6625-01-347-8667 P/N 29085800**
References:	**Operator's Manual for Test Set, Electronic NSN 6625-01-347-8667**
Equipment Condition:	**AVA system on workbench, DAU cover removed and connected to test set.**

a. Examine DAU for visible damage. Replace items that are broken.

b. Connect the DAU to the test set following instructions in the Operator's Manual for Test Set, Electronic, Section V-Calibration paragraph 2-11 (2) SETUP.

c. Perform Operator's manual instructions Section V-Calibration, paragraph 2-11 (1) PROGRAM THE CADU.

d. Observe LEDs on power supply PWA. All five green and no red LEDs indicate PWA is operating normally. If any green light is not illuminated, establish ESD procedures and disconnect the acquisition PWA and the processor PWA from the back plane connectors. Replace power supply PWA if all green LEDs are not illuminated or red lights are illuminated.

e. Perform Operator's manual instructions Section V-Calibration, paragraph 2-11 (3) PROCEDURE TO VERIFY CALIBRATION OF THE DAU.

f. If no errors are reported complete instructions in Section V-Calibration, paragraph 2-11 (4) CALIBRATED DATA.

g. If errors are reported on CADU display replace the PWA as outlined in the appropriate Work Packages WP0044 00 to WP0045 00 and perform steps e and f above. Reference table 1 below for suggested PWA replacement relative to error codes.

Acquisition PWA			Processor PWA
4160	16426	16433	4163
4161	16427	16434	4164
16421	16428		
16422	16429		
16423	16430		
16424	16431		
16425	16432		

Table 1. Recommended PWA Replacement By Error Code

NOTE

Refer to Chapter 3, WP0021 00 for definitions of the above error codes.

END OF WORK PACKAGE

UNIVERSAL TRACKING DEVICE (UTD) INSPECTION AND FAULT ISOLATION

Initial Setup:	**Workbench with ESD capability**
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**As listed in TM 1-6625-736-13&P, NSN 6625-01-347-8667 P/N 29085800**
References:	**Operator's Manual for Test Set, Electronic NSN 6625-01-347-8667**
Equipment Condition:	**AVA system on workbench, DAU cover removed and connected to test set.**

a. Examine UTD for visible damage. Replace items that are broken. See appropriate work packages for removal and installation procedures.

b. Connect the DAU to the test set following instructions in the Operator's Manual for Test Set, Electronic, Section V-Calibration paragraph 2-11 (2) SETUP.

c. Perform Operator's manual instructions Section V-Calibration, paragraph 2-11 (1) PROGRAM THE CADU, if not previously accomplished.

d. Perform Operator's manual instructions Section V-Calibration, paragraph 2-11 (5) UTD Test.

e. If no errors are reported, verify UTD values in Table 2-1, UTD Expected Output. If values are outside of tolerance given, open UTD, inspect and replace PWA as outlined in WP 0051-001/2.

f. Repeat steps b. through f.

END OF WORK PACKAGE

CHAPTER 4

AVIATION UNIT MAINTENANCE (AVUM) AND AVIATION INTERMEDIATE MAINTENANCE (AVIM) INSTRUCTIONS

AVIATION UNIT MAINTENANCE

REPAIR PARTS, SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT
AVIATION VIBRATION ANALYZER

Index

1. GENERAL

This chapter contains maintenance procedures that are the responsibility of the aviation unit maintenance technician as authorized by the Maintenance Allocation Chart (MAC) and Source Maintenance and Recoverability (SMR) coded items in the Repair Parts and Special Tools List (RPSTL). The maintenance procedures in this chapter are prepared in the form of summary and detailed procedures.

2. MAINTENANCE OPERATIONS

These instructions provide the proper technique and detailed procedures required to perform the maintenance operations. Each maintenance operation provides step-by-step instructions in the order in which the work is most logically accomplished. Any unusual or critical steps are covered in detail.

3. TOOLS AND TEST EQUIPMENT LIST

Tools and test equipment required for maintenance of AVA are identified in the MAC work package. For authorized common tools and equipment refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

4. SPECIAL TOOLS TMDE AND SUPPORT EQUIPMENT

There are no special tools required for test or inspection procedures at the AVUM level.

5. REPAIR PARTS

Repair parts are listed in WP 0061 00 of this manual.

END OF WORK PACKAGE

SERVICE UPON RECEIPT
AVIATION VIBRATION ANALYZER

CAUTION

The Control and Display Unit (CADU) contains rechargeable batteries. This unit must be recharged prior to use in accordance with the following:

Open credit card memory door (located on the top side of the CADU) by loosening the two hold down screws. The 12 Vdc power jack input is located next to the exposed credit card memory drive. Plug the 12 Vdc Battery Charger (supplied with the AVA) into the CADU first, then plug the charger into a 110 Vac wall outlet.

For a full charge that will give approximately eight hours of use, charge the CADU for at least eight hours.

a. Visually check exterior surfaces of all individual units of the AVA system for apparent damage. Check contents of carrying cases to assure that all components listed on the inventory card located in the carrying/storage case are enclosed and undamaged.

b. If any unit has been damaged, report the damage on SF368 (Quality Deficiency Report). Report any missing items in accordance with DA PAM 738-751. Mail it to us at:

U.S. Army Aviation and Missile Command
ATTN: AMSAM-MMC-MA-NM
Redstone Arsenal, AL 35898-5230

CAUTION

The Control and Display Unit (CADU) contains rechargeable batteries. This unit must be recharged prior to use in accordance with the following:

Open credit card memory door (located on the top side of the CADU) by loosening the two hold down screws. The 12 Vdc power jack input is located next to the exposed credit card memory drive. Plug the 12 Vdc Battery Charger (supplied with the AVA) into the CADU first, then plug the charger into a 110 Vac wall outlet.

For a full charge that will give approximately eight hours of use, charge the CADU for at least eight hours.

END OF WORK PACKAGE

PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) AVIATION VIBRATION ANALYZER

Index

1. GENERAL

Inspect Aviation Vibration Analyzer for missing or damaged components. Check for physical damage such as breaks, cracks, wear, etc.

2. LUBRICATION

There are no lubrication tasks required.

3. CLEANING

Use spray cleaner (WP0066, item 6) to clean the outside surfaces of the major items. Wipe clean and dry with a soft rag. Clean lens on the CADU and UTD with lens cleaner.

4. CALIBRATION

Calibration of the AVA will be performed by a TMDE Support Team in accordance with guidelines specified in Calibration and Repair Requirements for the Maintenance of Army Material (TB 43-180).

5. TROUBLESHOOTING

Troubleshooting at the Aviation Unit Maintenance (AVUM) level is limited to checking for indications of normal operation, inspecting and replacing the CADU strap, DAU Tracker Mode knob, and DAU fuse, scale adjustment, and scale battery removal and installation.

END OF WORK PACKAGE

AVA BASIC KIT AND AIRCRAFT ADAPTER KIT INSPECTION

Initial Setup:	
Personnel Required:	**Aircraft Technician**
Parts:	**AVA Basic Kit, PN 29313107 and Aircraft Adapter Kit**
Equipment Condition:	**Equipment in carrying cases**

a. Check that all items in the carrying cases are accounted for and undamaged.

b. Check all knobs, controls, latches, and cables for damage.

c. Report any missing parts.

d. Clean all items.

END OF WORK PACKAGE

AUTOMATIC SYSTEM TEST
AVIATION VIBRATION ANALYZER

4. A self-test is automatically performed every time the DAU is powered up. This power-up test takes approximately two seconds to complete. This tests the unit's basic operation and ability to make measurements. If a test fails, a failure error message appears on the CADU screen.
5. A self-test is automatically performed at 24-hour intervals. This test takes approximately ten seconds to complete. Results are stored in memory and are used to correct measured data.
6. The following procedures will verify basic operation of the AVA system.

<u>Initial Setup</u>:	
<u>Personnel Required</u>:	**Aircraft Technician**
<u>Parts</u>:	
<u>Equipment Condition</u>:	**Connected for normal operation**

a. Connect external power to the DAU.

b. Connect the DAU and CADU using the CADU-to-DAU cable.

c. Turn on DAU.

d. Verify DAU power lamp turns on.

e. Reboot CADU by pressing **DO** and **QUIT**.

f. Verify CADU comes up in startup screen and then press Option 1.

g. Select an aircraft type (any).

h. Verify proper aircraft type is present in the CADU.

i. Select a tail number (any).

j. Select a FLIGHT Flight Plan.

k. Select MEASURE Mode (press **F1** key).

l. Make a measurement by pressing **DO** two times.

m. Verify CADU returns a tachometer fault type message.

n. If another fault message is returned, consult the error codes (WP0021 00-8 to 23) for corrective action.

END OF WORK PACKAGE

AVA SYSTEM
FAULT LOCATION

Figures

Tables

Initial Setup:

Personnel Required: **Aircraft Technician**

Parts:

Equipment Condition: **Connected for normal operation**

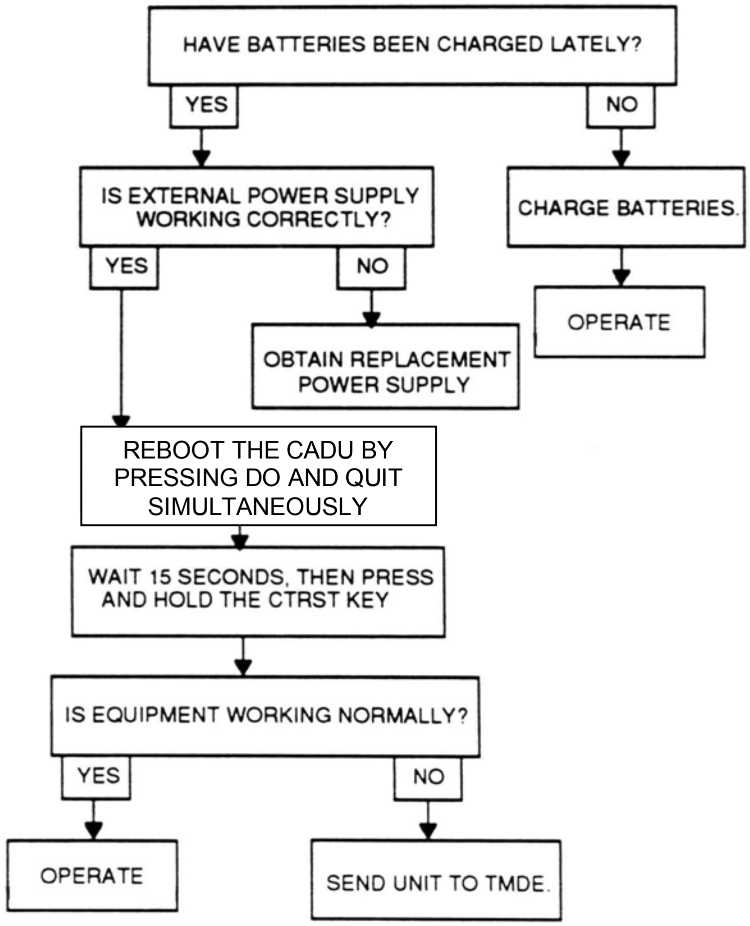


Figure 1. CADU Doesn't Power On Under Battery Power

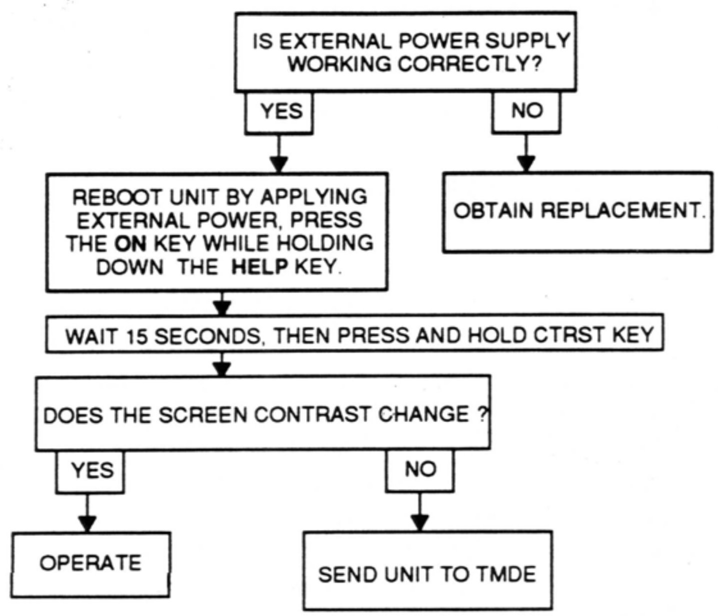


Figure 2. CADU Display is Blank Under External Power

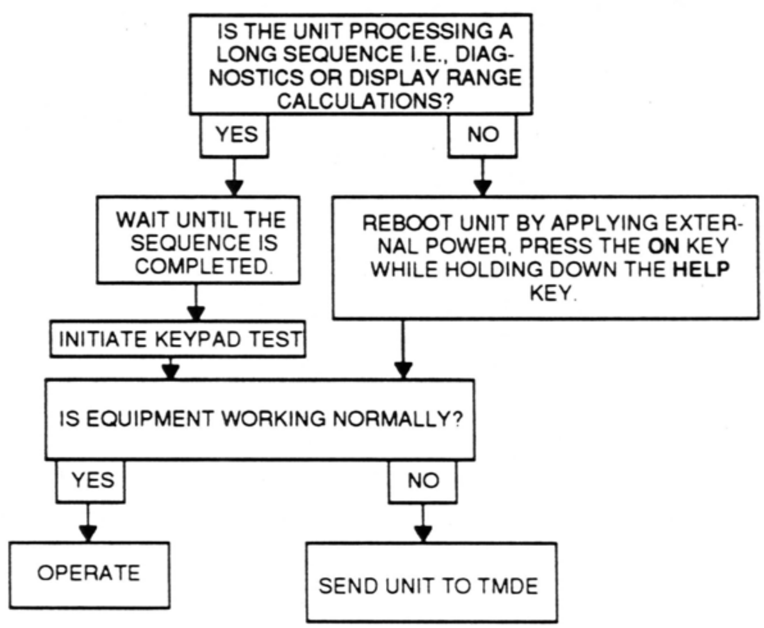


Figure 3. CADU Won't Accept Keypad Entries

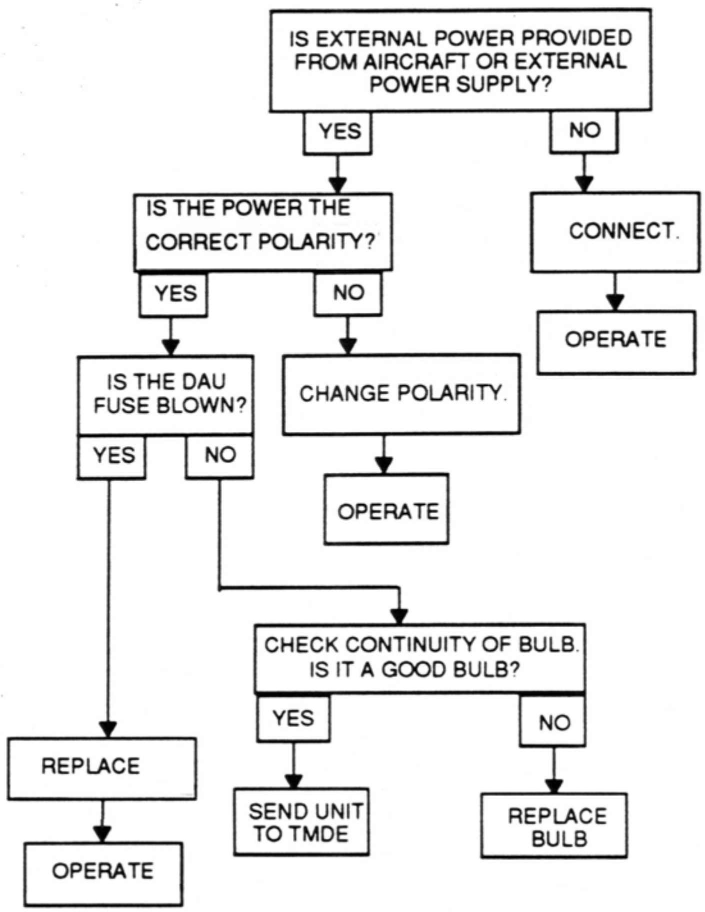


Figure 4. DAU Power Light Won't Light

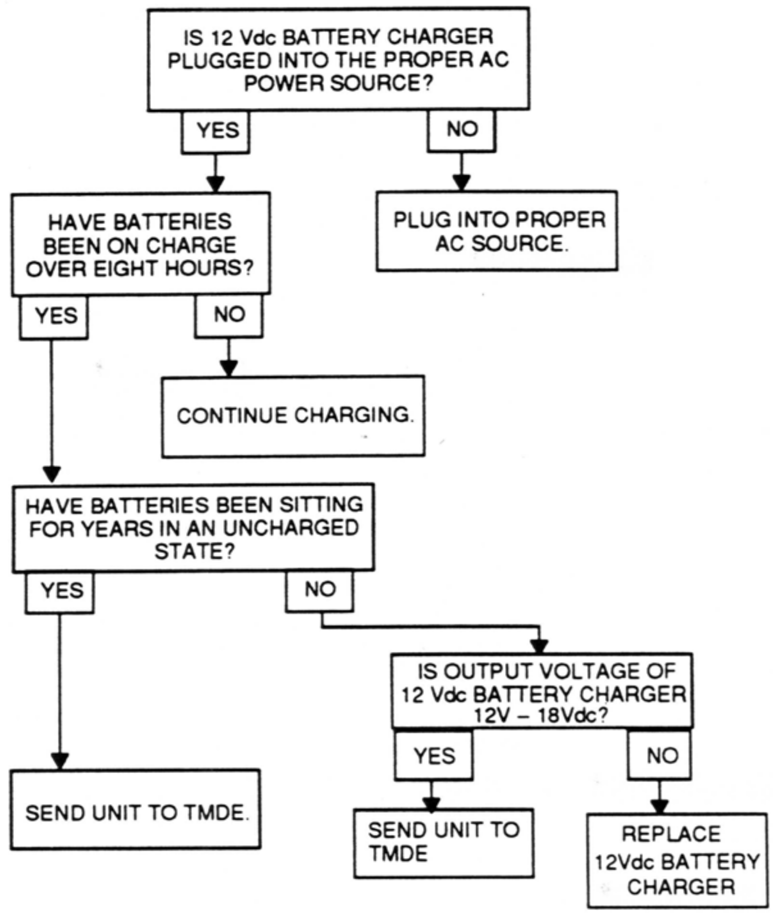


Figure 5. Batteries Won't Hold Charge

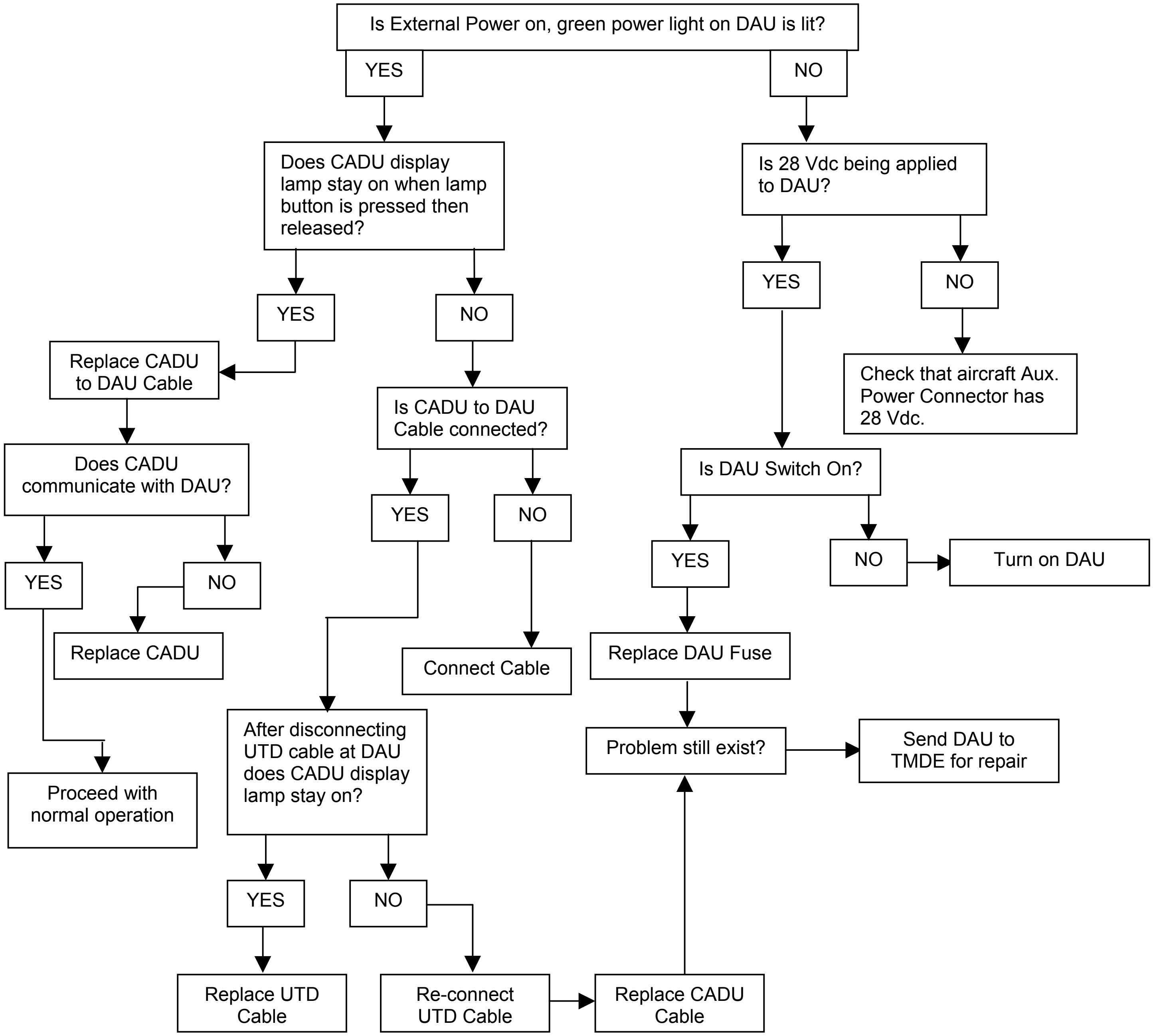


Figure 6. CADU Won't Communicate With the DAU

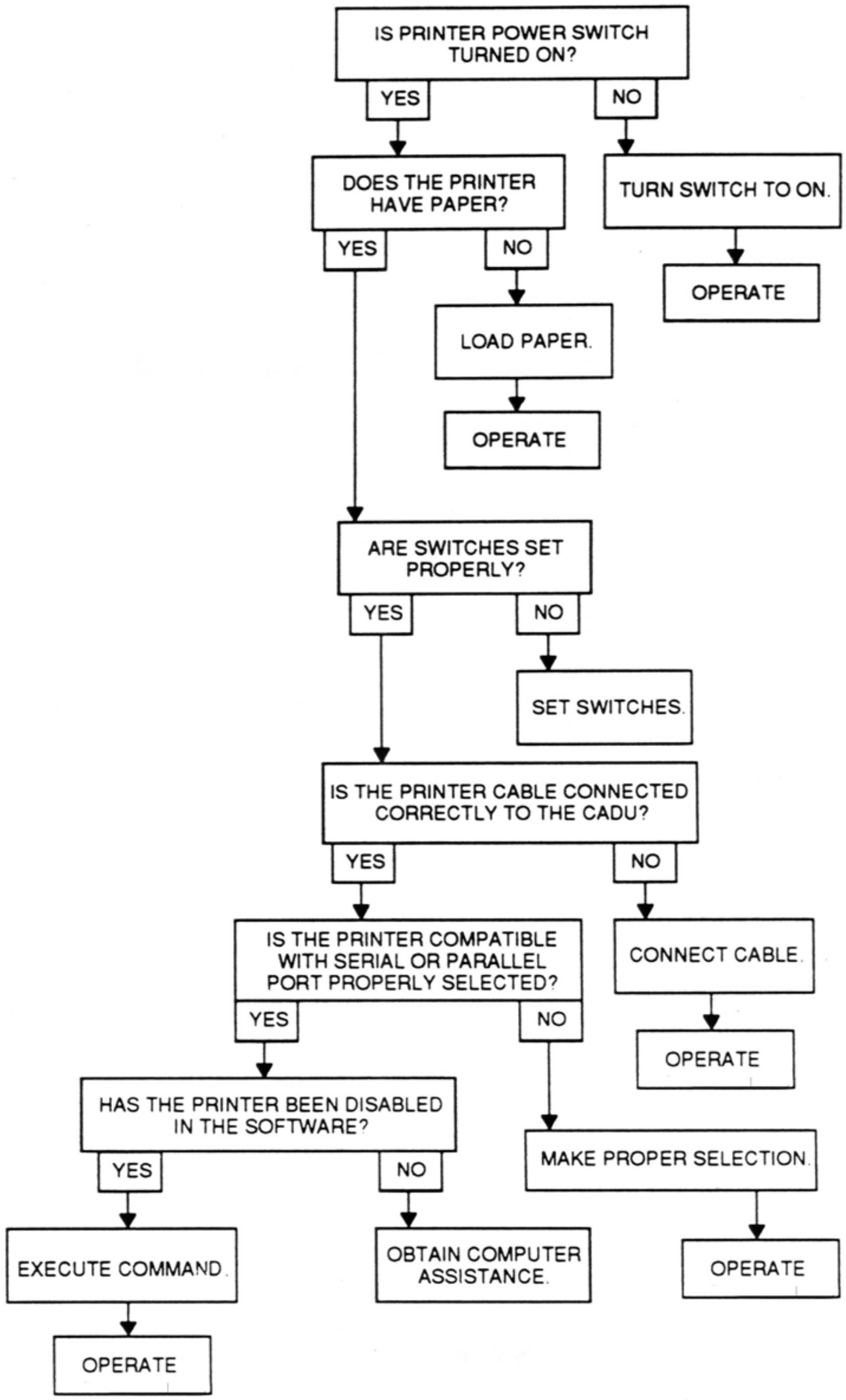


Figure 7. Printer Won't Print

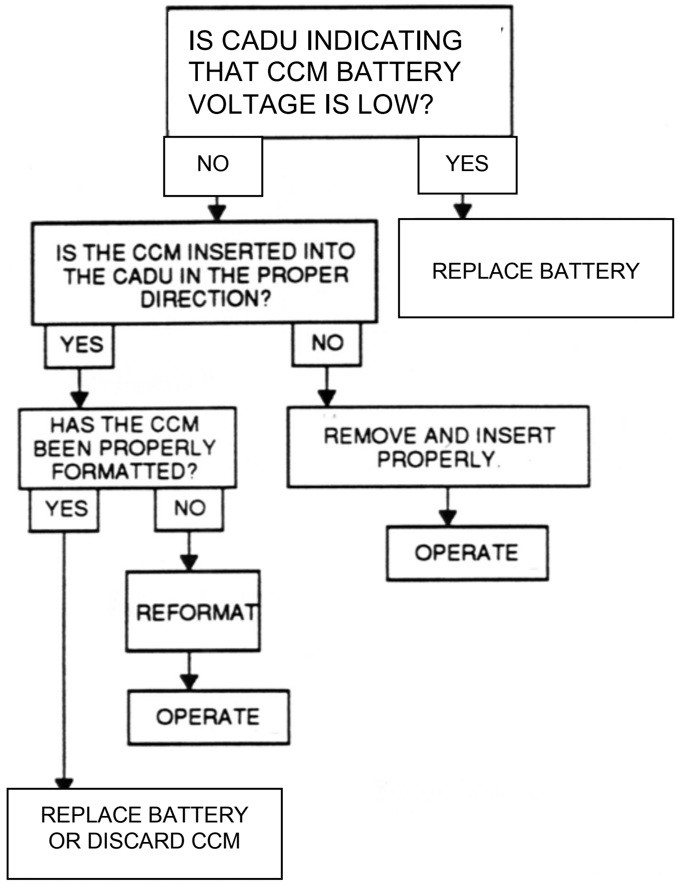


Figure 8. CCM Won't Hold Data

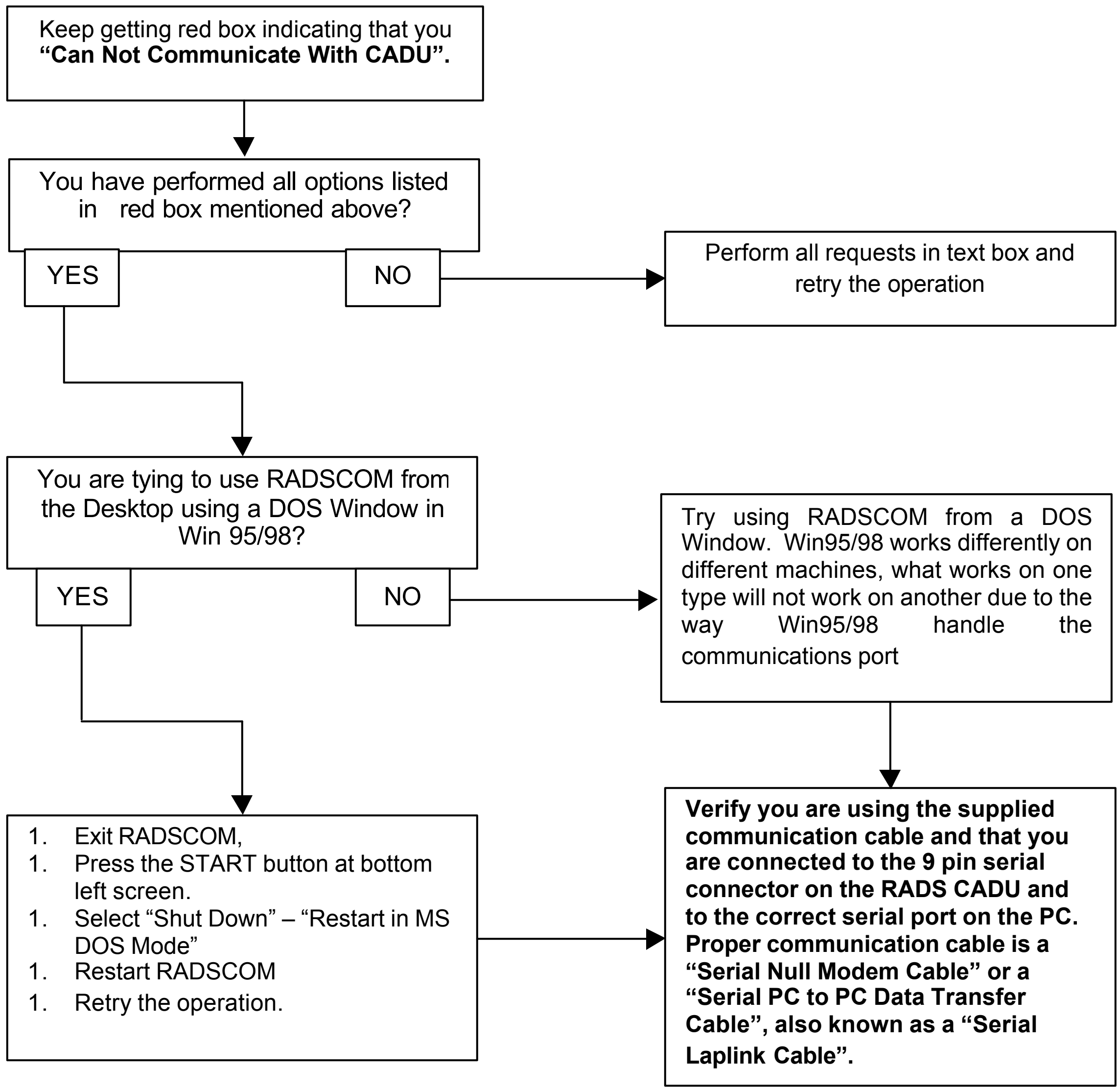


Figure 9. No Communications Between the CADU and Host Computer when running RADSCOM

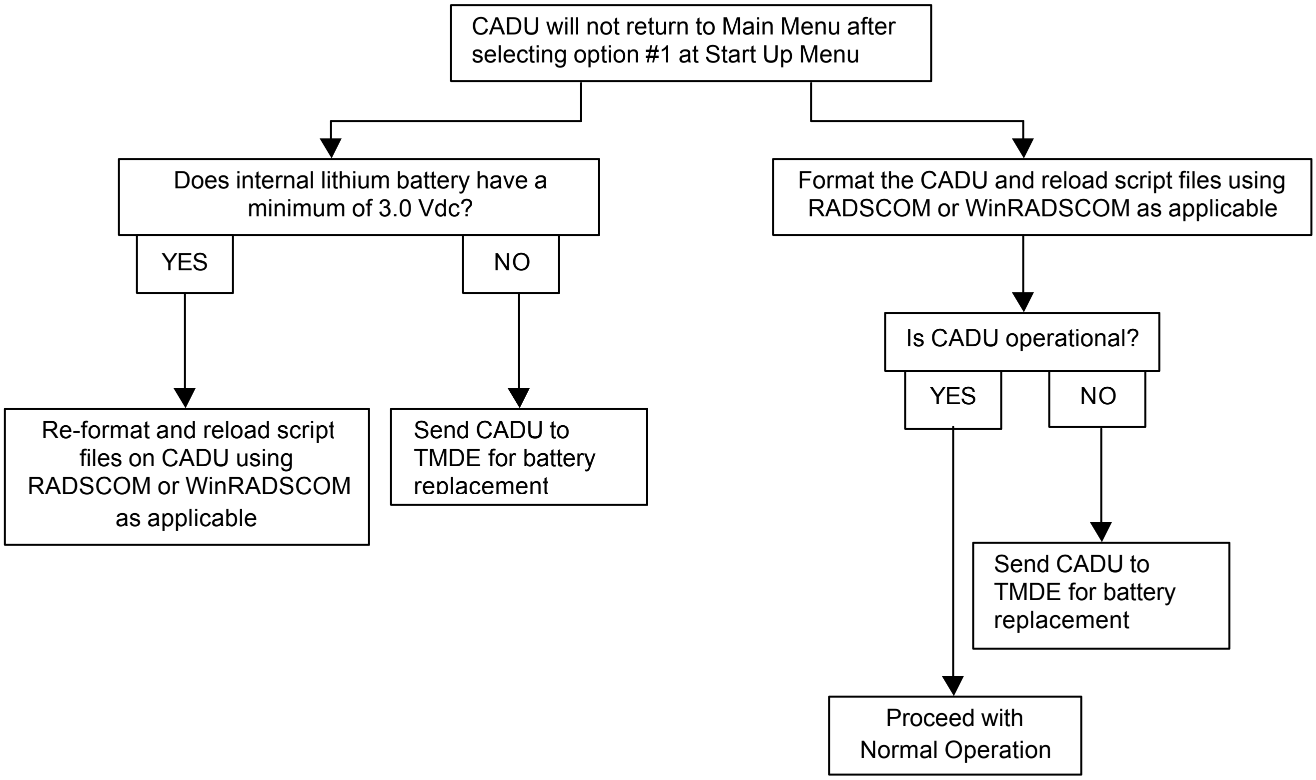


Figure 10. CADU Will Not Return to Main Menu After Boot

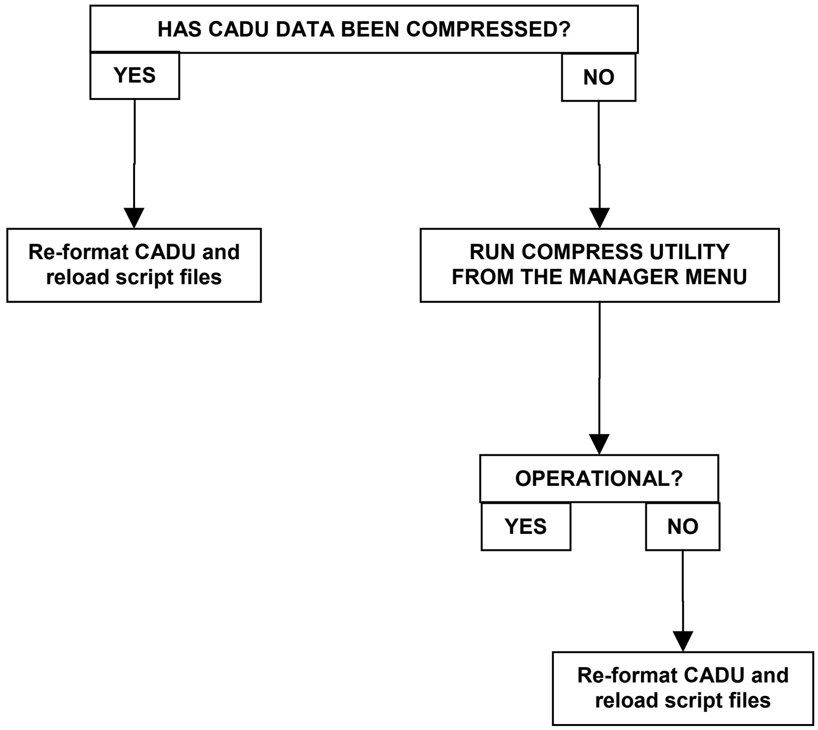


Figure 11. Disk Space Not Available Even After Files Have Been Deleted

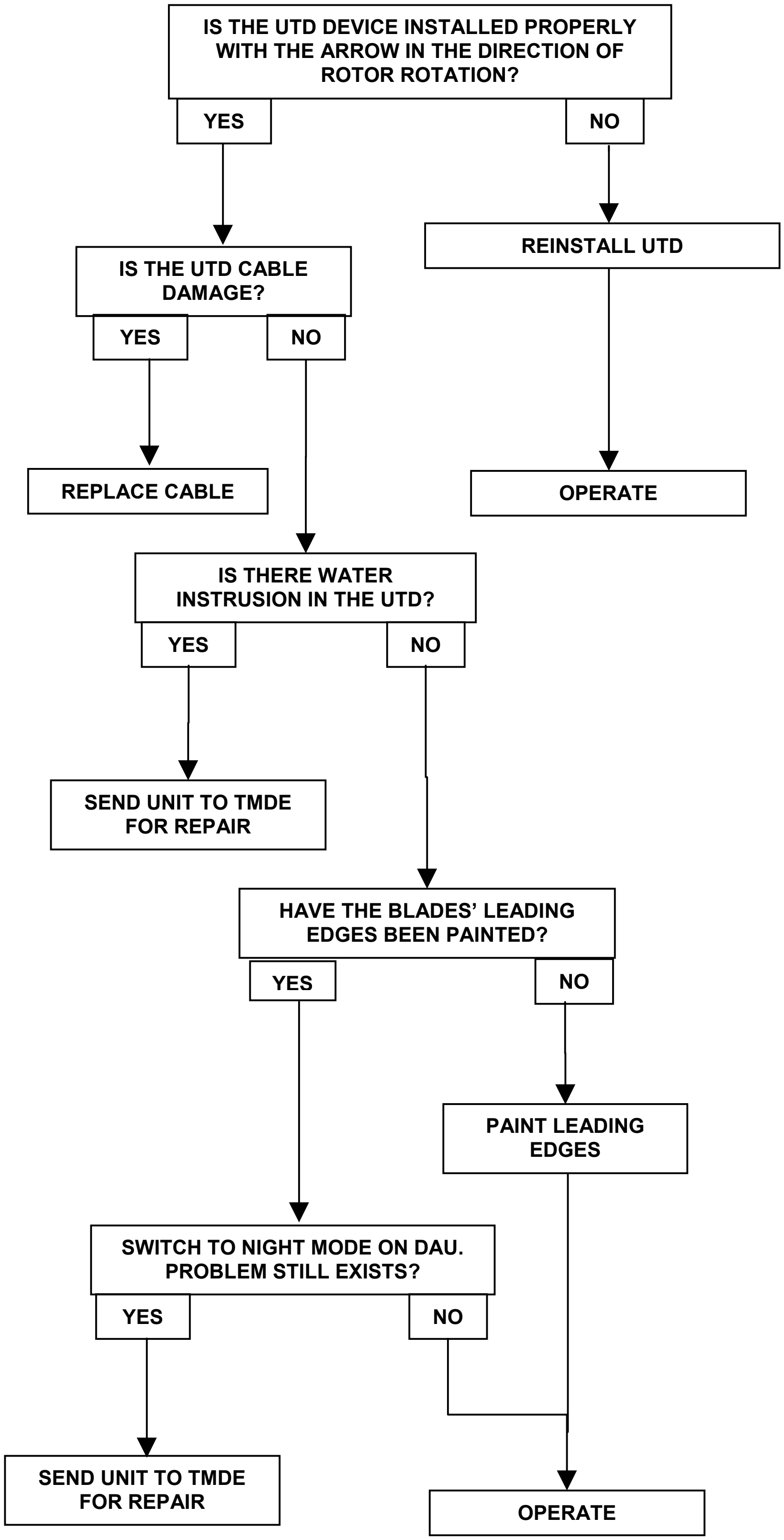


Figure 12. UTD Tracking Errors Such As: track sensor fault, blades apparently moving at wrong speed, blade chords different or track FIFO overrun

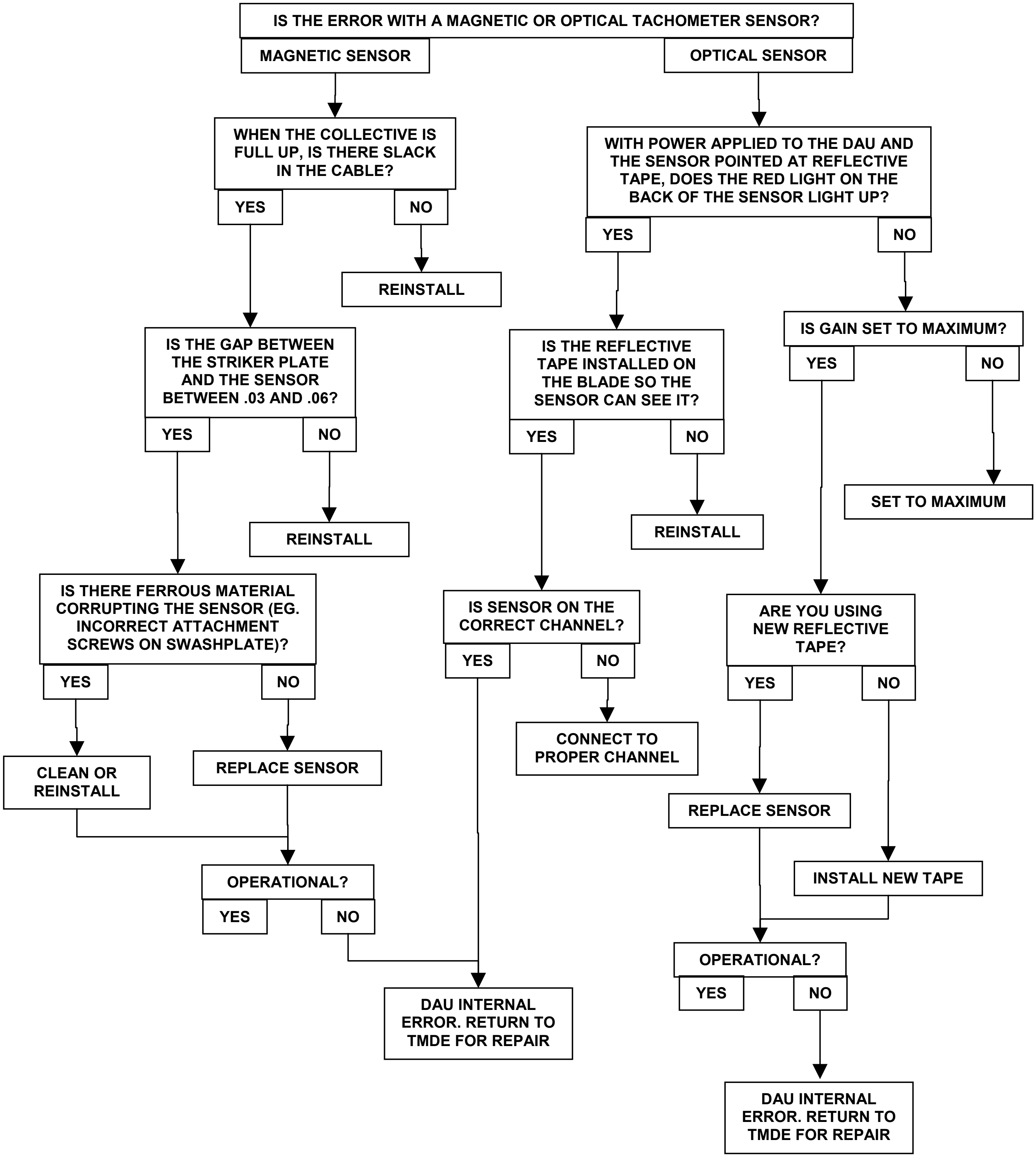


Figure 13. Tachometer Errors Such As: tacho out of bounds, tacho too high, tacho too low or tacho failure

NOTE

Errors are returned from a variety of sources and are meant to diagnose system problems. Sources of errors can be equipment setup errors, software setup errors, internal hardware failures, or internal software failures. Each error type contains an error code number, a text description of the error, and proposes corrective action.

NOTE

Operating System (OS9) error codes are not listed below. If an OS9 error code is displayed, perform actions displayed and contact factory for support.

Table 1. Error Reported on CADU Error Screen

Code #	Message
4097:	**Vibration FIFO Test Failure ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4098:	**Unstable Ground Reference ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4099:	**Unstable Maximum Reference ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4100:	**Unstable Minimum Reference ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4101:	**Ground Ref Offset Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4102:	**Maximum Ref Gain Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4103:	**Minimum Ref Gain Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4104:	**A/D Consistency Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement** The A/D consistency check failed on power up. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of the DAU Acquisition board.
4105:	**A/D Dynamic Performance Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement** The A/D dynamic performance check failed on power up. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of the DAU Acquisition board.

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
4106:	**Filter 1 Ripple Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The 2 kHz, filter 1 has failed the filter ripple test during calibration. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of the DAU Acquisition board.
4107:	**Fitter 1 Stop band Gain ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The 2 kHz, filter 1 has failed the filter stopband test during calibration. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of the DAU Acquisition board.
4108:	**Filter 2 Ripple Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The 2 kHz, filter 2 has failed the filter ripple test during calibration. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TM DE for repair. Suspect failure of the DAU Acquisition board.
4109:	**Filter 2 Stopband Gain ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The 2 kHz, filter 2 has failed the filter stopband test during calibration. Power the DAU off and on and try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of the DAU Acquisition board.
4110:	**Filter 3 Ripple Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The 2 kHz, filter 3 has failed the filter ripple test during calibration. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of the DAU Acquisition board.
4111:	**Filter 3 Stopband Gain ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The 2 kHz, filter 3 has failed the filter stopband test during calibration. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of the DAU Acquisition board.
4112:	**Filter 4 Ripple Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The 500 Hz, filter 4 has failed the filter ripple test during calibration. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of the DAU Acquisition board.
4113:	**Filter 4 Stopband Gain ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The 500 Hz, filter 4 has failed the filter stopband test during calibration. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of the DAU Acquisition board.
4114:	**Filter 5 Ripple Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The 2 kHz, filter 5 has failed the filter ripple test during calibration. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of the DAU Acquisition board.

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
4115:	**Filter 5 Stopband Gain ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The 2 kHz, filter 5 has failed the filter stopband test during calibration. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of the DAU Acquisition board.
4116:	**Filter 6 Ripple Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The 20 kHz, filter 6 has failed the filter ripple test during calibration. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of the DAU Acquisition board.
4117:	**Filter 6 Stopband Gain ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The 20 kHz, filter 6 has failed the filter stopband test during calibration. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of the DAU Acquisition board.
4118:	**Freq. Cal Consistency Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The internal reference frequency test has failed on power up. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair.
4119:	**Freq. Test Timeout ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The internal frequency test has failed on power up. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair.
4120:	**Bad Test Module Parameter ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4121:	**Bad Pipe Operation ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4122:	**Failed to Fork FFT or Aout ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4123:	**Aout Module Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4124:	**FFT Module Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4125:	**Fork Error for Aout or FFT ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4126:	**DAC Filter Gain Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The internal DAC filter test has failed on calibration. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair.

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
4127:	**DAC Filter Ripple Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The internal DAC filter test has failed on calibration. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair.
4128:	**Filter 1 Gain Tolerance ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The filter 1 gain tolerance is larger than 2% and has failed its calibration test on power up. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of DAU Acquisition board.
4129:	**Filter 2 Gain Tolerance ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The filter 2 gain tolerance is larger than 2% and has failed its calibration test on power up. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of DAU Acquisition board.
4130:	**Filter 3 Gain Tolerance ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The filter 3 gain tolerance is larger than 2% and has failed its calibration test on power up. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of DAU Acquisition board.
4131:	**Filter 4 Gain Tolerance ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The filter 4 gain tolerance is larger than 2% and has failed its calibration test on power up. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of DAU Acquisition board.
4132:	**Filter 5 Gain Tolerance ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The filter 5 gain tolerance is larger than 2% and has failed its calibration test on power up. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of DAU Acquisition board.
4133:	**Filter 6 Gain Tolerance ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement (3) If error persists, possible hardware failure** The filter 6 gain tolerance is larger than 2% and has failed its calibration test on power up. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair. Suspect failure of DAU Acquisition board.
4144:	**Multiple Measurement Failure: view error log ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4145:	**Accelerometer Failure on Input 1 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status in Manager Menu)**
4146:	**Accelerometer Failure on Input 2 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status In Manager Menu)**
4147:	**Accelerometer Failure on Input 3 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status In Manager Menu)**

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
4148:	**Accelerometer Failure on Input 4 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status in Manager Menu)**
4149:	**Accelerometer Failure on Input 5 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status in Manager Menu)**
4150:	**Accelerometer Failure on Input 6 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status In Manager Menu)**
4151:	**Accelerometer Failure on Input 7 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status in Manager Menu)**
4152:	**Accelerometer Failure on Input 8 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status in Manager Menu)**
4153:	**Accelerometer Failure on Input 9 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status in Manager Menu)**
4154:	**Accelerometer Failure on Input 10 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status in Manager Menu)**
4155:	**Accelerometer Failure on Input 11 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status in Manager Menu)**
4156:	**Accelerometer Failure on Input 12 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status in Manager Menu)**
4157:	**Accelerometer Failure on Input 13 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status in Manager Menu)**
4158:	**Accelerometer Failure on Input 14 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status in Manager Menu)**
4159:	**Tachometer Failure on PIT Timer ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement** Internal software fault. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair.
4160:	**Tachometer Failure on Input 1 ACTION: (1) Verify connection (2) Verify gap or Check tape for optical Interrupter (3) Check cable** The DAU is receiving no timing pulses from the external magnetic or optical tachometer. Verify the following: 1. Interrupter is connected to the correct channel. 2. Interrupter is gapped properly and working. 3. Optical interrupter is aimed at the reflective tape. 4. Correct cable is installed and working. Repeat measurements, as necessary. This is a common problem caused by improper sensor connection to the DAU.

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
4161:	**Tachometer Failure on Input 2 ACTION: (1) Verify connection (2) Verify gap or Check tape for optical Interrupter (3) Check cable** The DAU is receiving no timing pulses from the external magnetic or optical tachometer. Verify the following: 7. Interrupter is connected to the correct channel. 8. Interrupter is gapped properly and working. 9. Optical interrupter is aimed at the reflective tape. 10. Correct cable is installed and working. Repeat measurements, as necessary. This is a common problem caused by improper sensor connection to the DAU.
4162:	**Tachometer Failure on CAL Source ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement** An internal hardware failure. Power DAU off and on and repeat the measurements. If failure persists, send unit to TMDE for repair. Suspect bad Acquisition board in DAU.
4163:	**Track Sensor Fault on Channel 1 ACTION: (1) Check cable (2) Check Installation angle (ABT Installed backwards?) (3) Check lens (4) Possible Contrast Problem - Ensure underside of blades are evenly darkened, or attempt to acquire data with UTD approximately 10-15 degrees left or right of directly into sun** Verify the following: 1. The tracker is installed properly, including cable connection, installation angle, tracker arrow pointing in the direction of rotation, and the sun is not shining directly into the tracker lens. 2. There is a proper light level for passive tracker or that reflective target is installed properly for active tracker. Replace the tracker with different unit and repeat measurements.
4164:	**Track Sensor Fault on Channel 2 ACTION: (1) Check cable (2) Check Installation angle (ABT installed backwards?) (3) Check lens (4) Verify light level** Either an incorrect number of pulses, or no pulses, are being returned from the tracker. Verify the following: 1. The UTD is installed properly, including cable connection, installation angle, tracker arrow pointing in the direction of rotation, and the sun is not shining directly into the tracker lens. 2. There is a proper light level for passive tracker or that reflective target is installed properly for active tracker. Replace the tracker with different unit and repeat measurements.
4165:	**ABT Signal Corrupted ACTION: (1) Check cable (2) Check Installation angle (ABT Installed backwards?) (3) Check lens (4) Verify light level** Either an incorrect number of pulses, or no pulses are being returned from the UTD. Verify the following: 1. The UTD is installed properly, including cable connection, installation angle, tracker arrow pointing in the direction of rotation, and the sun is not shining directly into the tracker lens. 2. There is a proper light level for passive tracker or that reflective target is installed properly for active tracker. Replace the tracker with different unit and repeat measurements.
4166:	**Blade Apparently Too Close ACTION: (1) Verify tracker Installation (2) Verify SETUP - Check and Reload aircraft script file** System measures the blade velocity too slowly. Verify the UTD is installed properly and the setup file agrees with the aircraft configuration. Repeat measurements, as necessary.
4167:	**ABT Apparently Looking Beyond Blade Tip ACTION: (1) Verify tracker Installation (2) Verify SETUP - Check and Reload aircraft script file** Verify the proper installation of the UTD. Repeat measurements as necessary.

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
4168:	**Blades Apparently Moving at Wrong Speed ACTION: (1) Verify tracker Installation (2) Verify SETUP - Check and Reload aircraft script file** Verify the proper installation of the UTD. Repeat measurements as necessary.
4169:	**Blade Chords Apparently Different ACTION: (1) Verify tracker Installation (2) Verify SETUP - Check and Reload aircraft script file** Verify the proper installation of the UTD. Paint or darken the leading edge of blades. The UTD is detecting a blade non-uniformity possibly caused by paint wear at the blades leading edge
4170:	**Blade Apparently Below ABT Field of View ACTION: (1) Verify tracker installation (2) Verify SETUP - Check and Reload aircraft script file** Verify the proper installation of the UTD. Repeat measurements as necessary.
4171:	**Blade Apparently Above ABT Field of View ACTION: (1) Verify tracker installation (2) Verify SETUP - Check and Reload aircraft script file** Verify the proper installation of the UTD. Repeat measurements as necessary.
4172:	**Track Sensor Fault ACTION: (1) Check cable (2) Check Installation angle (ABT Installed backwards?) (3) Check lens (4) Verify light level** None or incorrect number of pulses are being returned from the UTD. Verify the following: 1. The UTD is installed properly, including cable connection, installation angle, tracker arrow pointing in the direction of rotation, and the sun is not shining directly into the tracker lens. 2. There is a proper light level for passive tracker or that reflective target is installed properly for active tracker. Replace the UTD with different unit and repeat measurements.
4173:	**Insufficient ABT Data ACTION: (1) Check cable (2) Check Installation angle (ABT Installed backwards?) (3) Check lens (4) Verify light level** None or incorrect number of pulses are being returned from the UTD. Verify the following: 1. The UTD is installed properly, including cable connection, installation angle, tracker arrow pointing in the direction of rotation, and the sun is not shining directly into the tracker lens. 2. There is a proper light level for passive tracker or that reflective target is installed properly for active tracker.
4177:	**Accelerometer fail, Internal Channel 1 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status In Manager Menu)**
4178:	**Accelerometer fail, Internal Channel 2 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status In Manager Menu)**
4179:	**Accelerometer Fail, Internal Channel 3 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status in Manager Menu)**
4180:	**Accelerometer fail, Internal Channel 4 ACTION: (1) Check cable (2) Check accelerometer (3) Verify SETUP (also go to Setup/Status In Manager Menu)**
4181:	**FIFO Overflow ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement** Internal software fault. Power the DAU off and on and try to make a measurement, if the failure persists, send unit to TMDE for repair.

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
4182:	**Tacho Failure ACTION: (1) Verify connection (2) Verify gap or check tape for optical interrupter (3) Check cable** DAU is receiving no timing pulses from the external magnetic or optical tachometer. Verify the following: 1. The interrupter is connected to the correct channel. 2. The interrupter is gapped properly and working. 3. The optical interrupter is aimed at the reflective tape 4. The correct cable is installed and working. Repeat measurements as necessary. This is a common problem caused by improper sensor connection to the DAU.
4183:	**ACQ Processor Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement** Internal hardware/software fault. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair.
4184:	**Tach Frequency Too High ACTION: (1) Verify tach Installation (2) Check tach frequency (3) Check tape for optical interrupter** The measured tachometer frequency is higher than the limits specified by the aircraft setup file. This is commonly caused by an aircraft with a double interrupter when the setup file expects a single interrupter. Verify the following: 1. The interrupter is the proper type and gapped correctly. 2. The rotor frequency is within the required operating range. For optical interrupters, verify the tape is placed correctly.
4185:	**Tach Frequency Too Low ACTION: (1) Verify tach Installation (2) Check tach frequency (3) Check tape for optical Interrupter** The measured tachometer frequency is lower than the limits specified by the aircraft setup file. Verify the following: 1. The rotor under observation is rotating at the proper frequency. 2. The optical or magnetic interrupter is properly installed. Repeat measurements as required.
4186:	**Accelerometer Saturation, Internal Channel 1 ACTION: (1) Verify SETUP (Setup/Status in Manager Menu) (2) Change accelerometer type (3) Relocate accelerometer**
4187:	**Accelerometer Saturation, Internal Channel 2 ACTION: (1) Verify SETUP (Setup/Status in Manager Menu) (2) Change accelerometer type (3) Relocate accelerometer**
4188:	**Accelerometer Saturation, Internal Channel 3 ACTION: (1) Verify SETUP (Setup/Status in Manager Menu) (2) Change accelerometer type (3) Relocate accelerometer**
4189:	**Accelerometer Saturation, Internal Channel 4 ACTION: (1) Verify SETUP (Setup/Status in Manager Menu) (2) Change accelerometer type (3) Relocate accelerometer**
4193:	**Tacho Sample rate Phase Lock Error ACTION: Decrease the rate of rotational acceleration or deceleration** This error indicates the tachometer frequency is changing too rapidly to make accurate measurements. Slow the rate of tachometer frequency change and repeat the measurements. This error can occur on SSTA or SSPA vibration measurements.
4194:	**Rect. Window Size not Power of Two ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
4195:	**Illegal Packet Size ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4209:	**Too Many Arguments ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4210:	**Internal Software Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4211:	**Internal Table Overflow ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4212:	**Invalid Command from CADU ACTION: (1) Retry measurement (2) Check CADU to DAU cable (3) Check that DAU's power switch is on (4) Reboot CADU**
4213:	**Data Set Consistency Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4214:	**Invalid Argument ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4215:	**Not Enough Arguments ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4225:	**Illegal Tacho Channel ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4226:	**Missing or Illegal Tacho Limit ACTION: (1) Retry Measurement (2) Verify SETUP - Check and Reload aircraft script file** The tachometer range specified in the aircraft setup file is incorrect. Verify the setup ranges.
4227:	**Illegal Desample Rate ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4228:	**Missing Async Range ACTION: (1) Retry Measurement (2) Verify SETUP- Check and Reload aircraft script file** The asynchronous frequency range is not specified in the aircraft setup file. Verify the asynchronous setup range.
4229:	**Missing ACQ Channel ACTION: (1) Retry Measurement (2) Verify SETUP - Check and Reload aircraft script file** No acquisition channel is specified in the aircraft setup file. Verify the channel setup for SSTA, SSPA, or ASPA modes.
4230:	**Illegal Mode ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4231:	**Illegal Window Type ACTION: (1) Retry Measurement (2) Verify SETUP - Check and Reload aircraft script file** The window type specified for ASPA or SSPA measurements is an incorrect type. Verify aircraft setup file.

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
4232:	**Illegal Output Type ACTION: (1) Retry Measurement (2) Verify SETUP - Check and Reload aircraft script file** The output type specified for ASPA or SSPA measurements is an incorrect type. Verify aircraft setup file.
4233:	**Illegal Number of Revs ACTION: (1) Retry Measurement (2) Verify SETUP – Check and Reload aircraft script file** The number of revs. specified in the aircraft setup file is incorrect. Verify the aircraft setup file.
4234:	**Missing Ratio Command ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4235:	**Missing Strobe Command ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4236:	**Number out of Range ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4237:	**Illegal Data Set ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4238:	**No Rotor Parameters ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
4239:	**Accelerometer Saturation on Accelerometer Channel 1 ACTION: (1) Verify Setup (Setup Status In Manager Menu) (2) Change accelerometer Type (3) Relocate accelerometer**
4240:	**Accelerometer Saturation on Accelerometer Channel 2 ACTION: (1) Verify Setup (Setup Status in Manager Menu) (2) Change accelerometer Type (3) Relocate accelerometer**
4241:	**Accelerometer Saturation on Accelerometer Channel 3 ACTION: (1) Verify Setup (Setup Status in Manager Menu) (2) Change accelerometer Type (3) Relocate accelerometer**
4242:	**Accelerometer Saturation on Accelerometer Channel 4 ACTION: (1) Verify Setup (Setup Status in Manager Menu) (2) Change accelerometer Type (3) Relocate accelerometer**
4243:	**Accelerometer Saturation on Accelerometer Channel 5 ACTION: (1) Verify Setup (Setup Status In Manager Menu) (2) Change accelerometer Type (3) Relocate accelerometer**
4244:	**Accelerometer Saturation on Accelerometer Channel 6 ACTION: (1) Verify Setup (Setup Status in Manager Menu) (2) Change accelerometer Type (3) Relocate accelerometer**
4245:	**Accelerometer Saturation on Accelerometer Channel 7 ACTION: (1) Verify Setup (Setup Status in Manager Menu) (2) Change accelerometer Type (3) Relocate accelerometer**
4246:	**Accelerometer Saturation on Accelerometer Channel 8 ACTION: (1) Verify Setup (Setup Status in Manager Menu) (2) Change accelerometer Type (3) Relocate accelerometer**
4247:	**Accelerometer Saturation on Accelerometer Channel 9 ACTION: (1) Verify Setup (Setup Status in Manager Menu) (2) Change accelerometer Type (3) Relocate accelerometer**
4248:	**Accelerometer Saturation on Accelerometer Channel 10 ACTION: (1) Verify Setup (Setup Status in Manager Menu) (2) Change accelerometer Type (3) Relocate accelerometer**

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
4249:	**Accelerometer Saturation on Accelerometer Channel 11 ACTION: (1) Verify Setup (Setup Status In Manager Menu) (2) Change accelerometer Type (3) Relocate accelerometer**
4250:	**Accelerometer Saturation on Accelerometer Channel 12 ACTION: (1) Verify Setup (Setup Status In Manager Menu) (2) Change accelerometer Type (3) Relocate accelerometer**
4251:	**Accelerometer Saturation on Accelerometer Channel 13 ACTION: (1) Verify Setup (Setup Status In Manager Menu) (2) Change accelerometer Type (3) Relocate accelerometer**
4252:	**Accelerometer Saturation on Accelerometer Channel 14 ACTION: (1) Verify Setup (Setup Status In Manager Menu) (2) Change accelerometer Type (3) Relocate accelerometer**
8193:	**Reception Not Acknowledged ACTION: (1) Retry measurement (2) Check CADU to DAU cable (3) Check that DAU's power switch Is on (4) Reboot CADU**
8194:	**Spkt missed a Recvack Event ACTION: (1) Retry measurement (2) Check CADU to DAU cable (3) Check that DAU's power switch is on (4) Reboot CADU**
8195:	**Spkt Missed a Xmitack Event ACTION: (1) Retry measurement (2) Check CADU to DAU cable (3) Check that DAU's power switch is on (4) Reboot CADU**
8196:	**Illegal Communication Channel Number ACTION: (1) Reboot CADU (2) Repeat key sequence (3) If error reoccurs, Please report error to RADS-AT manufacturer (instead of reporting error to manufacturer, report error to AVSCOM).**
8197:	**Data Transmission Error ACTION: (1) Retry measurement (2) Check CADU to DAU cable (3) Check that DAU's power switch Is on (4) Reboot CADU**
8198:	**Data Reception Error ACTION: (1) Retry measurement (2) Check CADU to DAU cable (3) Check that DAU's power switch Is on (4) Reboot CADU**
8199:	**Communications Failure ACTION: (1) Retry measurement (2) Check CADU to DAU cable (3) Check that DAU's power switch is on (4) Reboot CADU**
16385:	**Measurement Aborted** The measurement has been aborted due to user initiated abort or other failure. This message is usually a reported after another error message.
16386:	**Too Many Samples Out-of-Range ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement** The DAU has detected too many samples that saturate the internal sampling circuit. Repeat the measurement. This error is caused by amplitude ranges changing drastically during acquisition. May be caused by extreme turbulence.
16387:	**Sensor Fault on Internal Channel 1 ACTION: (1) Check cable (2) Check accelerometer - find channel associated with position number above, In script file**
16388:	**Sensor Fault on Internal Channel 2 ACTION: (1) Check cable (2) Check accelerometer - find channel associated with position number above, In script file**
16389:	**Sensor Fault on Internal Channel 3 ACTION: (1) Check cable (2) Check accelerometer - find channel associated with position number above, In script file**

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
16390:	**Sensor Fault on Internal Channel 4 ACTION: (1) Check cable (2) Check accelerometer - find channel associated with position number above, In script file**
16391:	**Bad Accelerometer Type ACTION: (1) Retry measurement (2) Verify Setup – Check and Reload aircraft script file** The accelerometer type specified in the aircraft setup file is incorrect. Verify accelerometer type in the aircraft setup file.
16392:	**Illegal Channel Number ACTION: (1) Retry measurement (2) Verify Setup - Check and Reload aircraft script file** The accelerometer channel specified in the aircraft setup file is incorrect. Verify the channel setups in the aircraft setup file.
16393:	**ACQ Min Limit > Max Limit ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16394:	**Bad Power of 2 for Strobe Adjust ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16395:	**Gain - Illegal Number of Samples ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16396:	**Cal - Illegal Number of Samples ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16397:	**Illegal Oversampling Factor ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16398:	**Illegal Filter Selected ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16399:	**Flash Rate Too Big or Zero ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16400:	**Illegal Gain Setting ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16401:	**Could Not Start Acquisition ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16402:	**Illegal Physical Channel ACTION: (1) Retry measurement (2) Verify Setup – Check and Reload aircraft script file** The physical channel in the aircraft setup file is specified incorrectly. Verify the aircraft setup file.
16403:	**Illegal Sample Rate ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16404:	**Illegal Rev Count ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
16405:	**ACQ ROM Checksum Error ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement** The checksum on the DAU acquisition board has returned a fault condition. Power the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair.
16406:	**Zero Denominator ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16407:	**Illegal Tacho Channel ACTION: (1) Retry measurement (2) Verify Setup - Check and Reload aircraft script file** An illegal tachometer input channel has been specified in the aircraft setup file. Verify the tachometer channel in the setup file.
16408:	**Illegal Frequency Option ACTION: (1) Retry measurement (2) Verify Setup – Check and Reload aircraft script file** An illegal ASPA frequency range has been specified in the aircraft setup file. Verify the ASPA frequency range in the aircraft setup file.
16409:	**ADC Error > 12 Bits ACTION. (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement** Turn the DAU off and on, and then try to make a measurement. If the failure persists, send unit to TMDE for repair.
16410:	**Attempt to Read Too Much Data ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16411:	**Zero Revs Specified ACTION: (1) Retry measurement (2) Verify Setup - Check and Reload aircraft script file** A measurement has been specified with no revolutions. Check the aircraft setup file for the number of revolutions for each acquisition.
16412:	**No Revs in FFT Block ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16413:	**Failed to Read FIFO In Time ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16414:	**Tacho Out of Bounds ACTION: (1) Retry measurement (2) Verify Setup - Check and** Reload aircraft script file The measured tachometer frequency is higher than the limits specified by the aircraft setup file. This is commonly caused by an aircraft with a double interrupter, when the setup file expects a single interrupter. Verify the following: 1. The interrupter is the proper type and gapped correctly. 2. Rotor frequency is within the required operating range. For optical interrupters, verify the tape is placed correctly.
16415:	**ACQ Already in Use ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16416:	**Driver Buffer Overflow ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
16417:	**ACQ ROM Failure ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement** The DAU Acquisition board has failed a ROM self-test. Power the DAU off and on, try to make a measurement. If the failure persists, send unit to TMDE for repair.
16418:	**Tacho Limits Inconsistent ACTION: (1) Retry measurement (2) Verify Setup – Check and Reload aircraft script file** The specified low and high tachometer ranges are inconsistent. Verify the low and high tach limits in the aircraft setup file.
16419:	**SSTA Driver Buffer Too Small ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16420:	**Sensor Fault ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16421:	**Sensor fault on accelerometer channel 1 ACTION: (1) Check cable (2) Check accelerometer**
16422:	**Sensor fault on accelerometer channel 2 ACTION: (1) Check cable (2) Check accelerometer**
16423:	**Sensor fault on accelerometer channel 3 ACTION: (1) Check cable (2) Check accelerometer**
16424:	**Sensor fault on accelerometer channel 4 ACTION: (1) Check cable (2) Check accelerometer**
16425:	**Sensor fault on accelerometer channel 5 ACTION: (1) Check cable (2) Check accelerometer**
16426:	**Sensor fault on accelerometer channel 6 ACTION: (1) Check cable (2) Check accelerometer**
16427:	**Sensor fault on accelerometer channel 7 ACTION: (1) Check cable (2) Check accelerometer**
16428:	**Sensor fault on accelerometer channel 8 ACTION: (1) Check cable (2) Check accelerometer**
16429:	**Sensor fault on accelerometer channel 9 ACTION: (1) Check cable (2) Check accelerometer**
16430:	**Sensor fault on accelerometer channel 10 ACTION: (1) Check cable (2) Check accelerometer**
16431:	**Sensor fault on accelerometer channel 11 ACTION: (1) Check cable (2) Check accelerometer**
16432:	**Sensor fault on accelerometer channel 12 ACTION: (1) Check cable (2) Check accelerometer**

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
16433:	**Sensor fault on accelerometer channel 13 ACTION: (1) Check cable (2) Check accelerometer**
16434:	**Sensor fault on accelerometer channel 14 ACTION: (1) Check cable (2) Check accelerometer**
16640:	**ABT Driver Lost Track ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16641:	**ABT Unexpected EOF ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16642:	**Wrong ABT Reset Code ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16643:	**Lamp Not ON or OFF ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement**
16644:	**Not Channel 1 or 2 ACTION: (1) Retry measurement (2) Verify Setup - Check and Reload aircraft script file** The tracker channel specified in the aircraft setup file is incorrect. Verify tracker channel in the setup file.
16645:	**Track FIFO Overran - Corrupt Track Signal ACTION: (1) Check cable (2) Check Installation angle (ABT Installed backwards?) (3) Check lens (4) Verify light level** Either an incorrect number of pulses, or no pulses are being returned from the tracker. Verify the following: 1. The UTD is installed properly, including cable connection, installation angle, tracker arrow pointing the direction of rotation, and the sun is not shining directly into the tracker lens. 2. There is a proper light level for passive tracker or that reflective target is installed properly for active tracker. Replace the tracker with a different unit and repeat measurements.
32360:	**Attempt To Read Backup Directory Failed**
32361:	**Failed To Create Restore File In Database Directory**
32362:	**The File Size Of Backup File (Minus Header) Isn't A Multiple Of The Record Length Of The Collection**
32363:	**Bad Header File In Backup File Being Restored**
32364:	**Bad Header File In Collection Type Being Backed-up**
32365:	**Failed to create backup file. Is the credit card in? Is it write protected? Is it formatted? ACTION: change the credit card battery** Repeat the backup operation. If the failure persists, send unit to TMDE for repair.
32366:	**KERMIT Failed Because the RADS Unit Is Not Correctly Setup ACTION: (1) Repeat key sequence (2) Reboot CADU** Reboot the CADU and repeat the backup operation. If the failure persists, Send unit to TMDE for repair.

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
32367:	**KERMIT Lost Connection, Please Check Cable and PC, and Try Again** The CADU to PC cable is not connected properly. Verify the proper cable is being used and the cable is plugged into the correct PC port. Repeat the backup to PC operation.
32368:	**KERMIT Failed to Establish Connection, Please Check Cable and PC, and Try Again** The CADU to PC cable is not connected properly. Verify the proper cable is being used and the cable is plugged into the correct PC port. Repeat the backup to PC operation.
32453:	**Unknown Module Failure - Please Report ACTION: (1) Repeat key sequence (2) Reboot CADU** Internal software failure. Reboot the CADU. If the failure persists, send unit to TMDE for repair.
32454:	**CADU Still Setting Up The DAU, Please Wait 10 Seconds And Retry Measurement ACTION: (1) Check CADU to DAU cable (2) Check that DAU's power switch Is on (3) Reboot DAU** The DAU, which is currently connected to the CADU, was not started connected to the current CADU. Turn the DAU power off and on, and then repeat the measurement.
32455:	**Monitor Power Not Running, Try Reboot of CADU ACTION: (1) Retry measurement (2) Check CADU to DAU cable (3) Check that DAU's power switch Is on (4) Reboot CADU** The process that starts the DAU is not running properly in the CADU. Reboot the CADU and repeat the measurement. If the failure persists, send unit to TMDE for repair.
32456:	**Non-module in DAU download directory, CADU wrongly configured**
32457:	**DAU Test Error, Possible Hardware Failure ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement** The power on self-test has not returned properly. Turn the DAU off and on and repeat the measurement. If the failure persists, send unit to TMDE for repair.
32458:	**Failed to Set EEPROM date in DAU, Possible Hardware Failure ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement** The date has not been properly set in the DAU EEPROM. Turn DAU off and on, and then repeat the measurement. If the failure persists, send unit to TMDE for repair.
32468:	**Insufficient Space to Store Results ACTION: (1) Backup and delete some flight data (2) (not for the Credit Card) After deleting data - run the Manager Menu's compress option**
32563:	**Too Many Adjustments, Best N Can't Optimize More Than 30. Use EDIT Adjustables to add constraints**
32564:	**Invalid Point Range (Low- point % -high-point %) in setup. This limit check Is not possible. ACTION: Check setup defined In aircraft script file AND/OR Reload aircraft script file**
32565:	**Impossible to Calculate Corrections - Please Edit the Adjustments to Add Constraints** Not enough data has been collected to run the diagnostics without going to the diagnostics editor and eliminating some adjustments. Either collect more data or go to diagnostics editor.
32566:	**Failed to Load Enough Data** Not enough data is available to run the diagnostics. Acquire the required data, as specified in the Flight Plan.

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
32567:	**No Diagnostics Setup For This Flight Plan Of The Aircraft** An attempt was made to run diagnostics on an aircraft that has not been configured for diagnostics. Verify the aircraft type under test has diagnostics configured in the aircraft setup file.
32568:	**No Measurements Exist for Current Flight** There are no acquisition setups in the aircraft configuration file for the current Flight Plan. Verify correct aircraft configuration file.
32668:	**DAU Failure Without Error Code ACTION: (1) Power the DAU off and on (2) Wait 20 seconds, make a measurement** Internal software fault. Power the DAU off and on, and then repeat measurements. If the fault persists, send unit to TMDE for repair.
32678:	**Tracker Not Connected ACTION: (1) Check cable (2) Check installation angle (ABT installed backwards?)(3) Check lens (4) Verify light level** None or incorrect number of pulses are being returned from the tracker. Verify the following: 1. The UTD is installed properly, including cable connection, installation angle, tracker arrow pointing the direction of rotation, and the sun is not shining directly into the tracker lens. 2. There is a proper light level for passive tracker or that reflective target is installed properly for active tracker. Replace the tracker with a different unit and repeat measurements.
32698:	**Attempt to Read Illegal Channel** Send unit to TMDE for repair.
32707:	**Restore Failed** Data could not be restored from the credit card. See previous error message for a better indication of the failure.
32708:	**Backup Failed** A backup to either PC or credit card has failed. This is usually a secondary message. See the previous message for a better indication of the fault. Possible causes are: improper connection to a PC, no credit card installed, write protect on the credit card, and credit card failure.
32714:	**Printer Type Not Set** A printer type has not been selected. Enter the MANAGER Menu and select a printer type.
32715:	**Can Not Set Printer Type** Send unit to TMDE for repair.
32716:	**Can Not Disable Printing** Send unit to TMDE for repair.
32717:	**Can Not Enable Printing** Send unit to TMDE for repair.
32718:	**Printer System Incorrectly Setup** Send unit to TMDE for repair.
32728:	**DAU Not Ready, Wait 10 Seconds and Retry Measurement. ACTION: Verify that the DAU's power switch Is on** The CADU and DAU are not talking. Turn the DAU off and on, and then try to make a measurement. If this does not work, reboot the CADU. Verify that the CADU-to-DAU cable is properly installed. If it is still inoperable, send unit to TMDE for repair.

Table 1. Error Reported on CADU Error Screen (cont.)

Code #	Message
32738:	**Overflow In HEX-to-INT Conversion** Send unit to TMDE for repair.
32747:	**Illegal Data Read from DAU** Send unit to TMDE for repair.
32748:	**Illegal Unit Conversion** Send unit to TMDE for repair.
32752:	**CADU Is Not Receiving External Power From The DAU ACTION: (1) Check CADU to DAU cable (2) Check that DAU's power switch is on (3) Reboot DAU**
32753:	**No Flight Data Present**
32754:	**User Quit Measurement** The user pressed the **QUIT** key during an acquisition to abort the acquisition. Repeat the desired acquisitions.
32755:	**No Valid Track Data** There was no valid track data measured. Repeat the measurement and correct any track fault problems.
32756:	**CADU-DAU Comms Failure ACTION: (1) Repeat key sequence (2) Reboot CADU** There has been an unexplained communication failure. Repeat the last measurement. If that does not work, turn the DAU power off and on. If that does not work, reboot the CADU.
32757:	**Power Failure, Repeat Test State** There has been an inadvertent power failure during acquisition. Repeat the last Test State.
32758:	**Not Enough Data to Do Trending** Not enough data exist to do trending. There is probably no or a single flight worth of data. Collect more data to do trending.
32759:	**Can Not Find Test State ACTION: Check setup defined In aircraft script file AND/OR Reload aircraft script file** No Test States exist for the current Flight Plan. This is due to an error in the selected aircraft configuration file.
32760:	**No or Inconsistent Data For Display** No data has been collected for the given Test State and selected aircraft.
32761	**Can not Find Display ACTION: Check setup defined in aircraft script file AND/OR Reload aircraft script file** No display setup exists for the selected Test State. This is probably due to an error in the aircraft configuration file.
32762:	**Measurement Failed** This error occurs after a failed measurement attempt. It usually occurs after some other sort of failure. Repeat the desired measurement.

Table 1. Error Reported on CADU Error Screen (Cont.)

Code #	Message
32763:	**Cannot Find Flight Plan ACTION: Load aircraft script file** No Flight Plan exists for the current aircraft type. This is probably due to an error in the aircraft configuration file.
32764:	**Cannot Find Flight ID ACTION: Restore back-up flight data or take measurements** No data has been collected for the selected aircraft type and tail number, therefore no flight ID has been generated.
32765:	**Cannot Find Aircraft Type ACTION: Load aircraft script file** There are no aircraft configuration files loaded into the database. Load the desired aircraft configuration file. See manual section on loading aircraft configuration files.
32766:	**Cannot Find Tail Number ACTION: Define a tail number or Restore backup flight data** There are no tail numbers specified for the current aircraft type. Enter the desired tail number. See manual section on setup.
32767:	**Illegal Channel in Acquisition ACTION: (1) Check gap (2) Verify Setup- Check and reload aircraft script file** A setup channel (accelerometer, tachometer or UTD) is incorrectly specified in the aircraft setup file. Verify channel setups in the aircraft setup file.

END OF WORK PACKAGE

CADU STRAP ASSEMBLY
REMOVAL AND REPLACEMENT

Index

Initial Setup:

Personnel Required:	**Aircraft Technician**
Tools and Equipment:	**Tool Kit, Electricians, Needle-nosed pliers**
Parts/Materials:	**Strap, PN 29324300, Thread-lock adhesive**
Equipment Condition:	**CADU on a workbench with keypad face down.**

a. REMOVAL: Remove screw (1), washer (2), strap assembly (3), and lock washer (4) from bottom plate (5). Use needle-nosed pliers as required to remove lock washer.

b. INSTALLATION:

1. Assemble screw (1), washer (2), new strap assembly (3), and lock washer (4). Use needle-nosed pliers as required to install lock washer.
2. Apply thread-lock adhesive to screw threads (1).
3. Install assembled items to pre-threaded mounting (6).

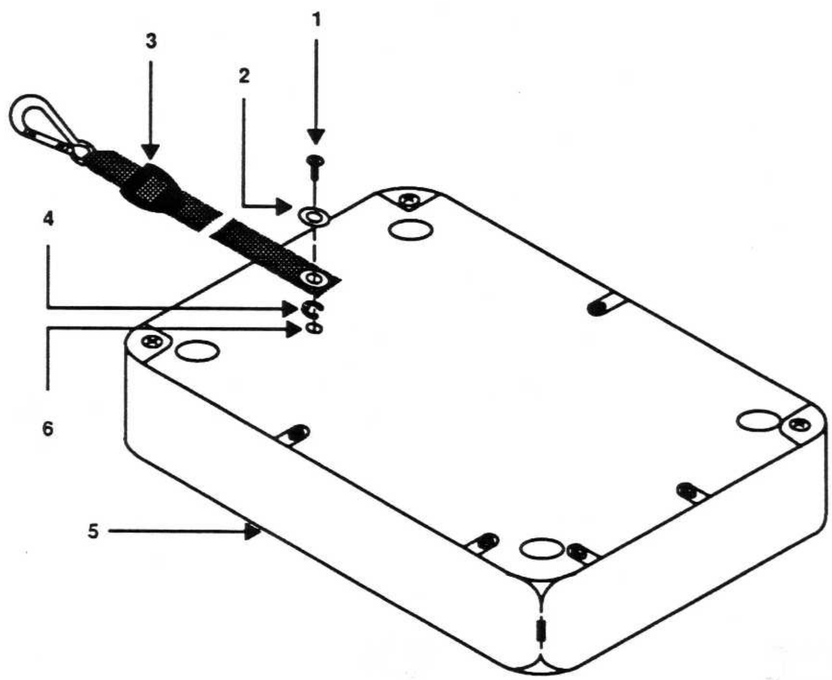


Figure 1. CADU Strap Assembly Removal and Installation

END OF WORK PACKAGE

DAU FUSE
REMOVAL AND INTALLATION

Index

Initial Setup:

Personnel Required: **Aircraft Technician**

Tools and Equipment: **Tool Kit, Electricians**

Parts: **Fuse, PN GMA15**

Equipment Condition: **Power switch turned to OFF and power removed from DAU.**

a. REMOVAL:

1. Remove fuse holder (1).
2. Remove fuse (2) from fuse holder (1).

b. INSTALLATION:

1. Insert new fuse (2) into fuse holder (1).
2. Install fuse holder (1).

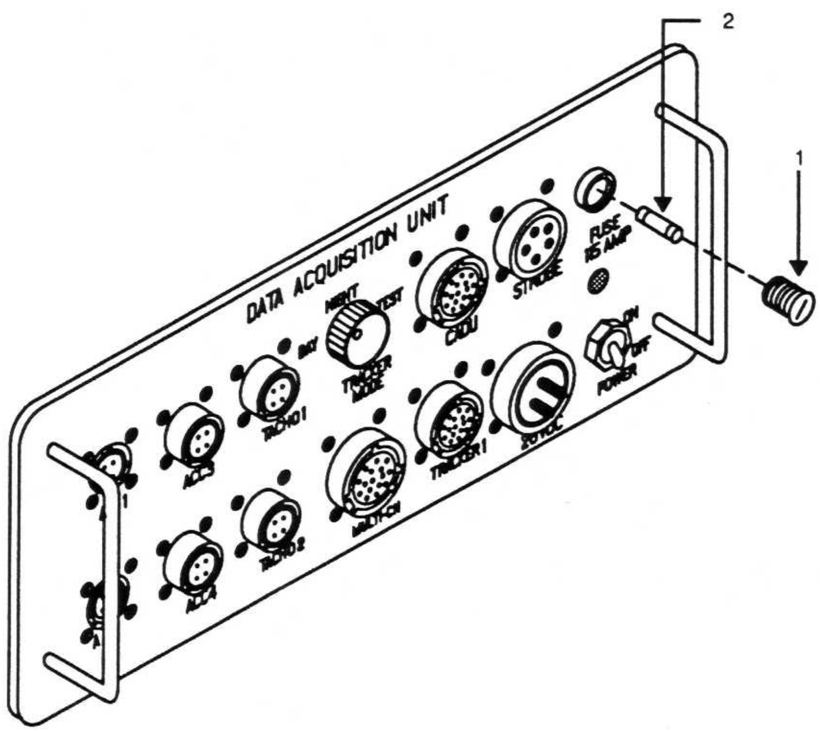


Figure 1. DAU Fuse Removal and Installation

END OF WORK PACKAGE

DAU TRACKER MODE KNOB
REMOVAL AND INSTALLATION

Index

Initial Setup:

Personnel Required:	**Aircraft Technician**
Tools and Equipment:	**Tool Kit, Electricians**
Parts:	**PN MS91528-1C3B**
Equipment Condition:	**DAU power switch turned to OFF**

a. REMOVAL: Remove knob (1) from switch (2) by loosening two setscrews inside body of the knob (1).

b. INSTALLATION: Install new knob (1) on switch shaft (2) positioning one of the setscrews on flat shoulder of switch shaft (2).

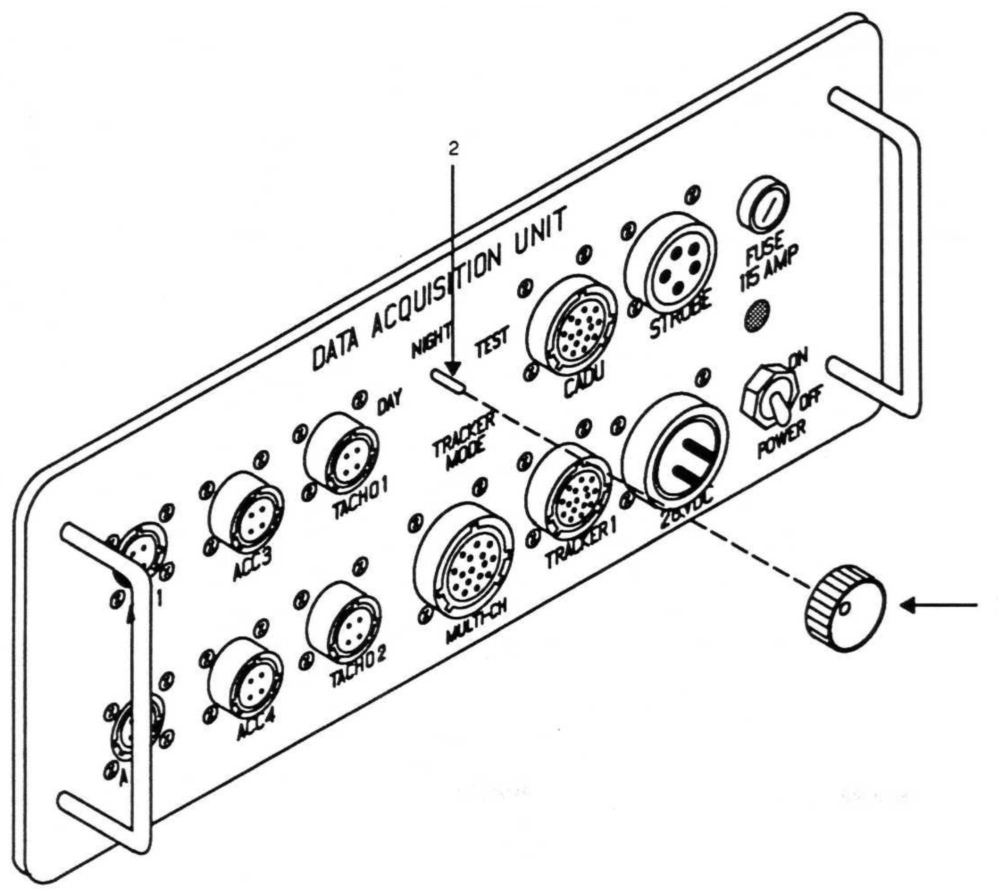


Figure 1. DAU Tracker Mode Knob Removal and Installation

END OF WORK PACKAGE

GRAM/OUNCE SCALE
ADJUSTMENT

Initial Setup:

Personnel Required: **Aircraft Technician**

Tools and Equipment: **Tool Kit, Electricians**

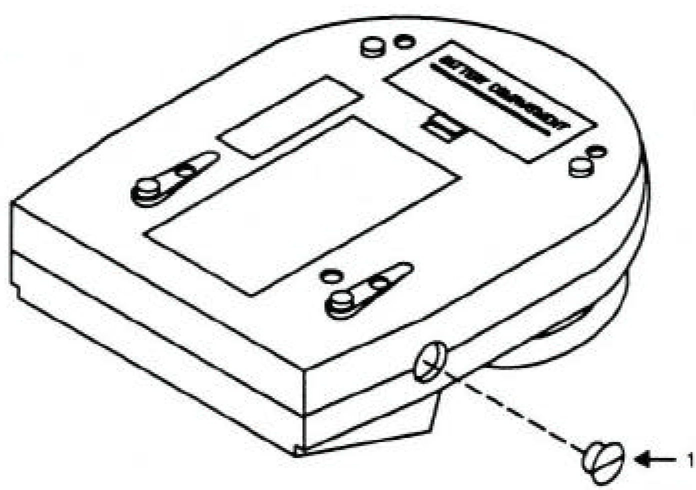
Parts: **None**

Equipment Condition: **Scale on workbench**

ADJUSTMENT:

a. Part Number 29323700

1. Remove adjustment port access cover (1).
2. Place scale on a flat surface where it is not subject to vibration or air motion.
3. Press the ON button, set OZ-GMS switch to GMS position, and allow the scale to read "0" (zero).
4. Place a 1000-gram standard (available from local source) on the scale tray.
5. Scale should read 1000 +1 gram. If reading is correct, perform step 9. If incorrect, perform step 6.
6. Using a straight-slot screwdriver, gently adjust calibration screw until the scale reads 1000 grams.
7. Remove the weight, turn the scale off, then on again.
8. Place 1000-gram weight on the scale tray. Scale should read 1000 +1 gram. If incorrect reading, repeat steps 3 through 7.
9. Install calibration port access cover (1).



BOTTOM VIEW

Figure 1. Gram/Ounce Scale Adjustment (29323700)

b. Part Number 29323703

1. Place scale on a flat surface where it is not subject to vibration or air motion.
2. Press the **On/Off/Zero** button and allow the scale to read "0" (zero). Allow the scale to warm up and stabilize for two minutes.
3. Press and hold the **Cal/Unit** key untill the calibration weight flashes on the display.
4. With the calibration weight value flashing, press the **On/Off/Zero** key, and the display will read "Cal O".
5. After pausing for at least two seconds, place a 1000-gram standard (available from local source) gently on the scale tray.
6. The display will momentarily show CAL F and then return to active weighing.
7. Remove the weight, turn the scale off, then on again.
8. Place 1000-gram weight on the scale tray. Scale should read 1000 +1 gram. If incorrect reading, repeat steps 2 through 7.

END OF WORK PACKAGE

SCALE BATTERY
REMOVAL AND INSTALLATION

Index

Initial Setup:

Personnel Required:	**Aircraft Technician**
Tools and Equipment:	**Tool Kit, Electricians**
Parts:	**Battery (9.0V) -10693400 or MN1604 (used on P/N 29323700)** **Battery (1.5V) -10693410 or MN1500 (used on P/N 29323703) (3 required)**
Equipment Condition:	**Scale on workbench**

Part Number 29323700

a. REMOVAL:

1. Remove battery cover (1) located on bottom of scale (4).
2. Remove battery (2) from scale.
3. Disconnect connector (3) from battery (2).

b. INSTALLATION:

1. Connect new battery (2) to connector (3).
2. Install battery (2) into compartment of the scale (4).
3. Install battery cover (1).

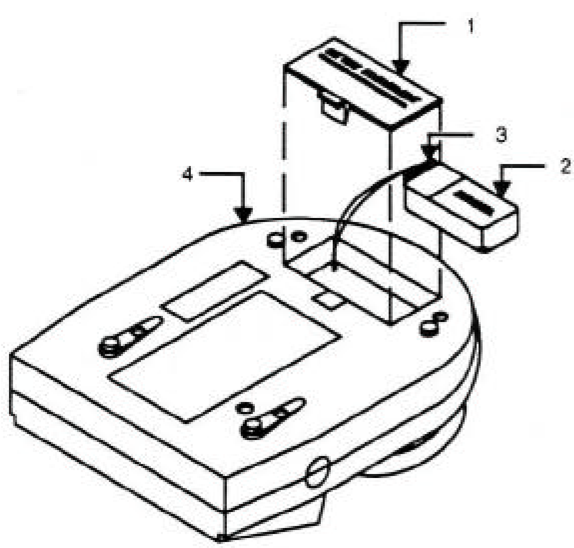


Figure 1. Scale Battery Removal and Installation (29323700)

Part Number 29323703

a. REMOVAL:

1. Remove battery cover (3) located on bottom of scale (1).
2. Remove three batteries (2) from scale.

b. INSTALLATION:

1. Install three batteries (2) into compartment of the scale (1).
2. Install battery cover (3).

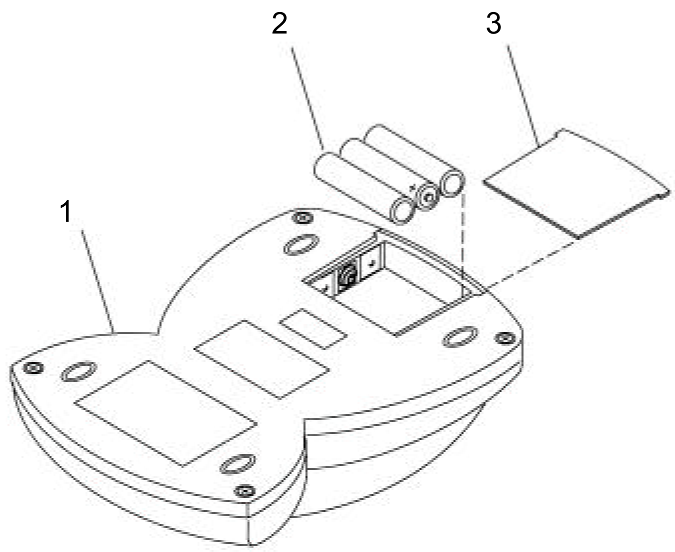


Figure 2. Scale Battery Removal and Installation (29323703)

END OF WORK PACKAGE

CADU CREDIT CARD MEMORY (CCM) BATTERY REMOVAL AND INSTALLATION

Index

Initial Setup:	
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts:	**Battery PN 28131210**
Equipment Condition:	**Credit Card Memory on workbench with ESD capabilities.**

a. REMOVAL:

1. Insert screwdriver (2) into side hole (3) to release the battery case (4).
2. Pull battery case (4) out of CCM (6).
3. Remove battery (5) from battery case (4).

b. INSTALLATION:

1. Place new battery (5) into the battery case (4) observing '+' and '-' marked on the battery (5) and case (4).
2. Install the battery case (4) into the CCM (6).

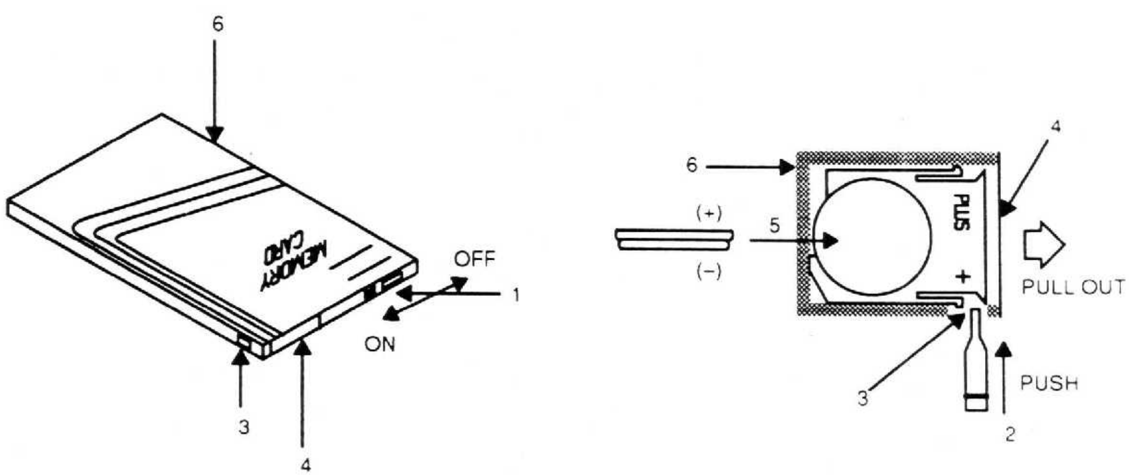


Figure 1. CCM Battery Removal and Installation

END OF WORK PACKAGE

OPTICAL RPM SENSOR
GAIN ADJUSTMENT

Figures

Initial Setup:	
Personnel Required:	**Aircraft Technician**
Tools and Equipment:	**Tool Kit, Electricians**
Parts:	**Optical RPM Sensor PN 29314700, NSN 6625-01-327-5323**
Equipment Condition:	**Sensor on workbench**

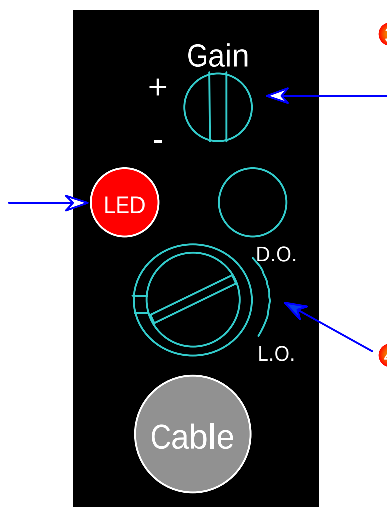
a. Remove clear cover.

b. Adjust gain as indicated in figure 1.

c. Reinstall clear cover

OPTICAL RPM SENSOR P/N 29314700
ERROR CODE 16414, TACHO OUT OF BOUNDS

1 When photocell is connected to DAU and DAU has power, red LED should illuminate when reflective tape is placed in photocell's path. LED should pulsate, the faster the pulse the stronger the signal.



3 Set gain to maximum. Adjusting screw is turned clockwise until a click is heard or felt. If no click is detected then turn screw 15 turns. Potentiometer is clutched at end of travel, you will not damage by turning past maximum stop.

4 D.O./L.O. Screw should be turned clockwise until it hits stop. This will align the screw with the D.O.

2 Reflective tape must be clean. Make sure that you do not use your fingers to press tape into position. Use paper backing to press tape into place. Oils from your fingers can smudge tape and reduce reflectivity. Water (rain) or oil leaks can cause same problem. Minimum distance from photocell to tape should be no less than 4.5 inches.

Figure 1. Optical RPM Sensor PN 29314700 (NSN 6625-01-327-5323)

END OF WORK PACKAGE

AVIATION INTERMEDIATE MAINTENANCE (AVIM)

REPAIR PARTS, SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT AVIATION VIBRATION ANALYZER

Index

1. GENERAL

This chapter contains maintenance procedures that are the responsibility of the United States Army TMDE Support Group (USATSG) Specialist as authorized by the Maintenance Allocation Chart (MAC) and Source, Maintenance and Recoverability (SMR) coded items in the Repair Parts and Special Tools List (RPSTL). The maintenance procedures in this chapter are prepared in the form of summary and detailed procedures.

2. MAINTENANCE OPERATIONS

These instructions provide the proper technique and detailed procedures required to perform the maintenance operations. Each maintenance operation provides step-by-step instructions in the order in which the work is most logically accomplished. Any unusual or critical steps are covered in detail.

3. TOOLS AND TEST EQUIPMENT LIST

For authorized tools and test equipment refer to the MAC work package.

4. REPAIR PARTS

Repair parts are listed in the Repair Parts and Special Tools List (RPSTL) work package of this manual.

5. SERVICE UPON RECEIPT

a. Visually check exterior surfaces of all individual units of the AVA system for apparent damage. Check contents of carrying cases to assure that all components listed in the RPSTL work package of this manual are enclosed and undamaged.

b. If any unit has been damaged or is missing, report the discrepancies in accordance with DA PAM 738-751.

END OF WORK PACKAGE

MAINTENANCE PROCEDURES INTRODUCTION

Index

Figures **WP No.**

1. MAINTENANCE PROCEDURES - GENERAL

When a maintenance procedure is required, it usually will involve removal of the part being repaired or replaced. Removal procedures are given only to the extent necessary to repair or replace authorized parts. The following maintenance procedures are contained in the following work packages:

WP No.	Title	WP No.	Title
0035 00	CADU Battery Pack	0046 00	DAU Front Panel Assembly
0036 00	CADU Printed Wiring Assembly (PWA)	0047 00	DAU Card Guide
0037 00	CADU Liquid Crystal Display (LCD) Assembly	0048 00	DAU LED Assembly
0038 00	CADU Lens and Lens Gasket	0049 00	DAU PWA Back plane
0039 00	CADU Keypad	0050 00	DAU Card Cage
0040 00	CADU Harness Assembly	0051 00	UTD Printed Wiring Assembly (PWA)
0041 00	DAU Recessed Rubber Bumper	0052 00	UTD Cable Assembly
0042 00	DAU Fan	0053 00	UTD Bulb Socket
0043 00	DAU Power Supply PWA	0054 00	UTD Infrared (IR) Filter
0044 00	DAU Processor PWA	0055 00	UTD Bulb
0045 00	DAU Acquisition PWA	0056 00	UTD Window Lens
		0057 00	UTD Convex Lens

2. CALIBRATION

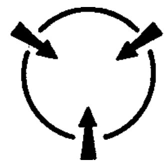
The calibration of the AVA will be accomplished by using the Test Set, Electronic, and AVA.

END OF WORK PACKAGE

CADU BATTERY PACK
REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



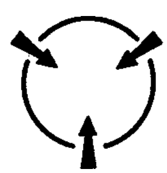
Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

Index

Initial Setup:	**Workbench with ESD capability**
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**Battery Pack 29324000, Thread-lock adhesive, Permabond 910, Lint-free cloth, Lint-free pad, Dry-forced air**
Equipment Condition:	**CADU power turned off. Lay unit with keypad down on support strips to protect facing.**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove nine screws (1), nine lock washers (2), and nine flat washers (3) from bottom plate (4).
2. Remove bottom plate (4) from top case (5).
3. Disconnect battery cable connector (6) from J6 on the PWA.
4. Disconnect cable connector (7) from J4 on the PWA.

5. Remove three screws (8), three lock washers (9), and three flat washers (10) from PWA edge adjacent to battery pack.
6. Remove six standoffs (11), six flat washers (12), and ground lug (13).
7. Remove four lock screw assemblies (14).
8. Stand PWA (16) on end to the extent allowed by keypad connectors (17) and (18).
9. Remove gasket (15).
10. Remove two hex nuts (19), two lock washers (20), and two flat washers (21).
11. Remove battery pack (22) with two clamps (23).

b. INSTALLATION:

1. Install two mounting clamps (23) on battery pack (22).
2. Apply thread-lock adhesive to threaded hardware. Position mounting clamps (23) on two mounting studs (24).
3. Install two flat washers (21), two lock washers (20), and two hex nuts (19).
4. Stand PWA (16) on end to gain access to clean the lens (25) and display face.
5. Clean lens as follows:
   (a) Wipe display face with a lint-free pad containing special lens cleaner.
   (b) Wipe dry with a lint-free cloth and dry-forced air.
   (c) Repeat steps (a) and (b) to clean the lens (25) and lens gasket (26).
   (d) Install gasket (15).
   (e) Put PWA (16) in place and inspect lens surface from operator's side of CADU.
   (f) If lint or smudges are still present, repeat steps (a) through (e).
6. Install four lock screw assemblies (14).
7. Install six standoffs (11), six flat washers (12), and ground lug (13).
8. Install three screws (8), three lock washers (9), and three flat washers (10) on PWA edge adjacent to battery pack.
9. Connect battery pack cable connector (6) to J6 on the PWA.
10. Connect cable connector (7) to J4 on the PWA.
11. Inspect O-ring (27). If replacement is needed, use Permabond 910 (item 3 WP0066 00) to seal O-ring.
12. Place bottom plate (4) in place in top case (5).
13. Install nine screws (1), nine lock washers (2), and nine flat washers (3).

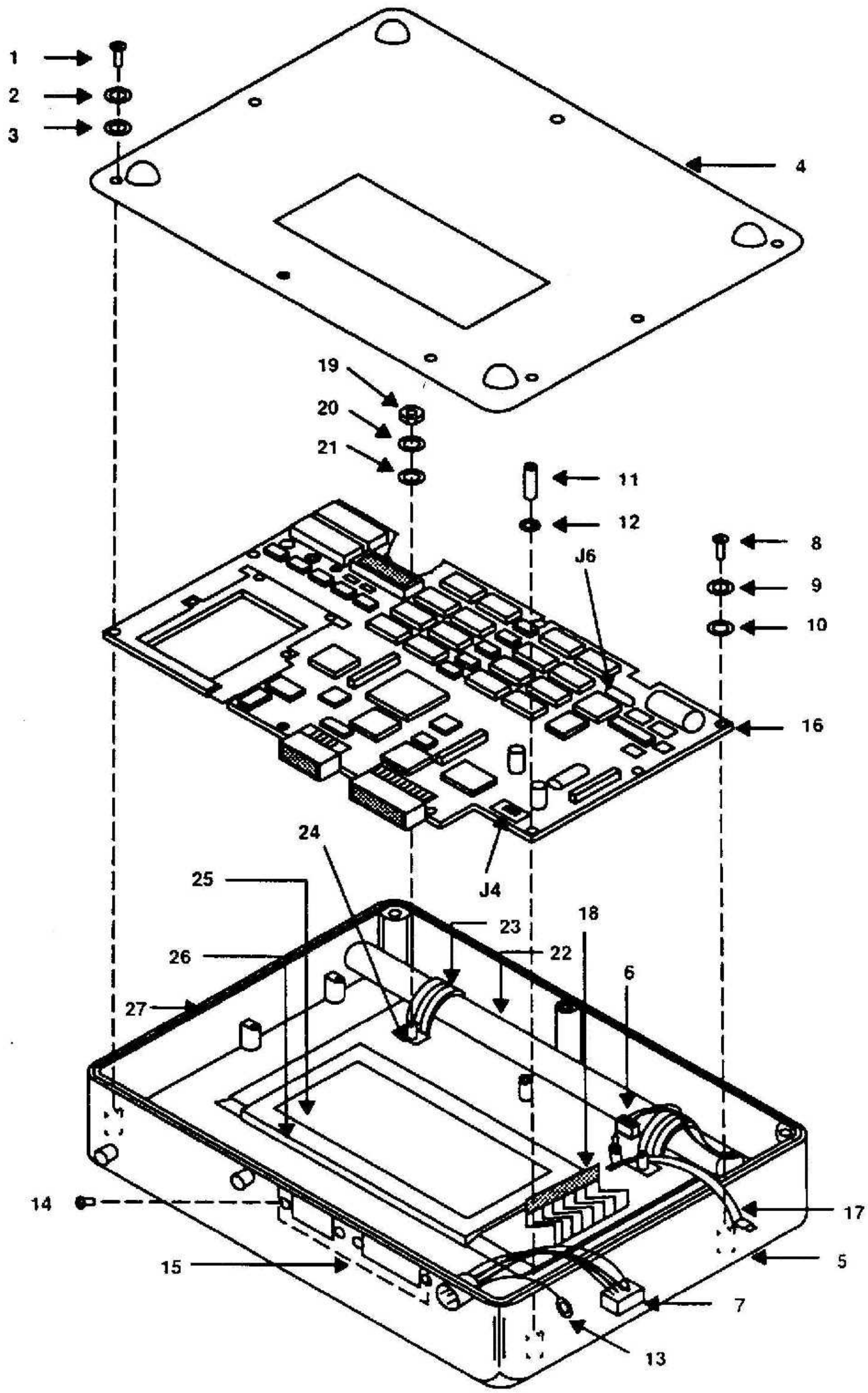


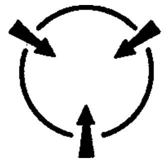
Figure 1. CADU Battery Pack Removal and Installation

END OF WORK PACKAGE

CADU PRINTED WIRING ASSEMBLY (PWA) REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



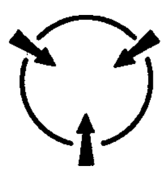
Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

Index

Initial Setup:	**Workbench with ESD capability**
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**PWA, PN 29324607, Thread-lock adhesive, Permabond 910, Lens Cleaner, Lint-free cloth, Lint-free pad, Dry-forced air**
Equipment Condition:	**CADU power turned off. Lay unit with keypad down on support strips to protect facing.**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove nine screws (1), nine lock washers (2), and nine flat washers (3) from bottom plate (4).
2. Remove bottom plate (4) from top case (5).
3. Disconnect battery cable connector (6) from J6 on the PWA.

4. Disconnect cable connector (7) from J4 on the PWA.
5. Remove three screws (8), three lock washers (9), and three flat washers (10) from PWA edge adjacent to battery pack.
6. Remove six standoffs (11), six flat washers (12), and ground lug (13).
7. Remove four lock screw assemblies (14).
8. Lift PWA (16) and disconnect keypad connectors (17) from J10 and (18) from J7 on the PWA.
9. Remove gasket (15).

b. INSTALLATION:

1. Apply thread-lock adhesive to threaded hardware.
2. Connect two keypad connectors (17) to J10 and (18) to J7 on the PWA.
3. Stand PWA (16) on end to gain access to clean the lens (19) and display face.
4. Clean lens as follows:
    (a) Wipe display face with a lint-free pad (item 8, WP0066 00) containing special lens cleaner (item 5, WP0066 00).
    (b) Wipe dry with a lint-free cloth (item 7, WP0066 00) and dry-forced air.
    (c) Repeat steps (a) and (b) to clean the lens (19) and lens gasket.
    (d) Install gasket (15).
    (e) Put PWA (16) in place and inspect lens surface from operator's side of CADU.
    (f) If lint or smudges are still present, repeat steps (a) through (e).
5. Install four lock screw assemblies (14).
6. Install six standoffs (11), six washers (12), and ground lug (13).
7. Install three washers (10), three lock washers (9), and three screws (8) on PWA edge adjacent to battery pack.
8. Connect battery pack cable connector (6) to J6 on the PWA.
9. Connect cable connector (7) to J4 on the PWA.
10. Inspect O-ring (21). If replacement is necessary, use Permabond 910 to seal O-ring.
11. Place bottom plate (4) in place in top case (5).
12. Install nine screws (1), nine lock washers (2), and nine washers (3).

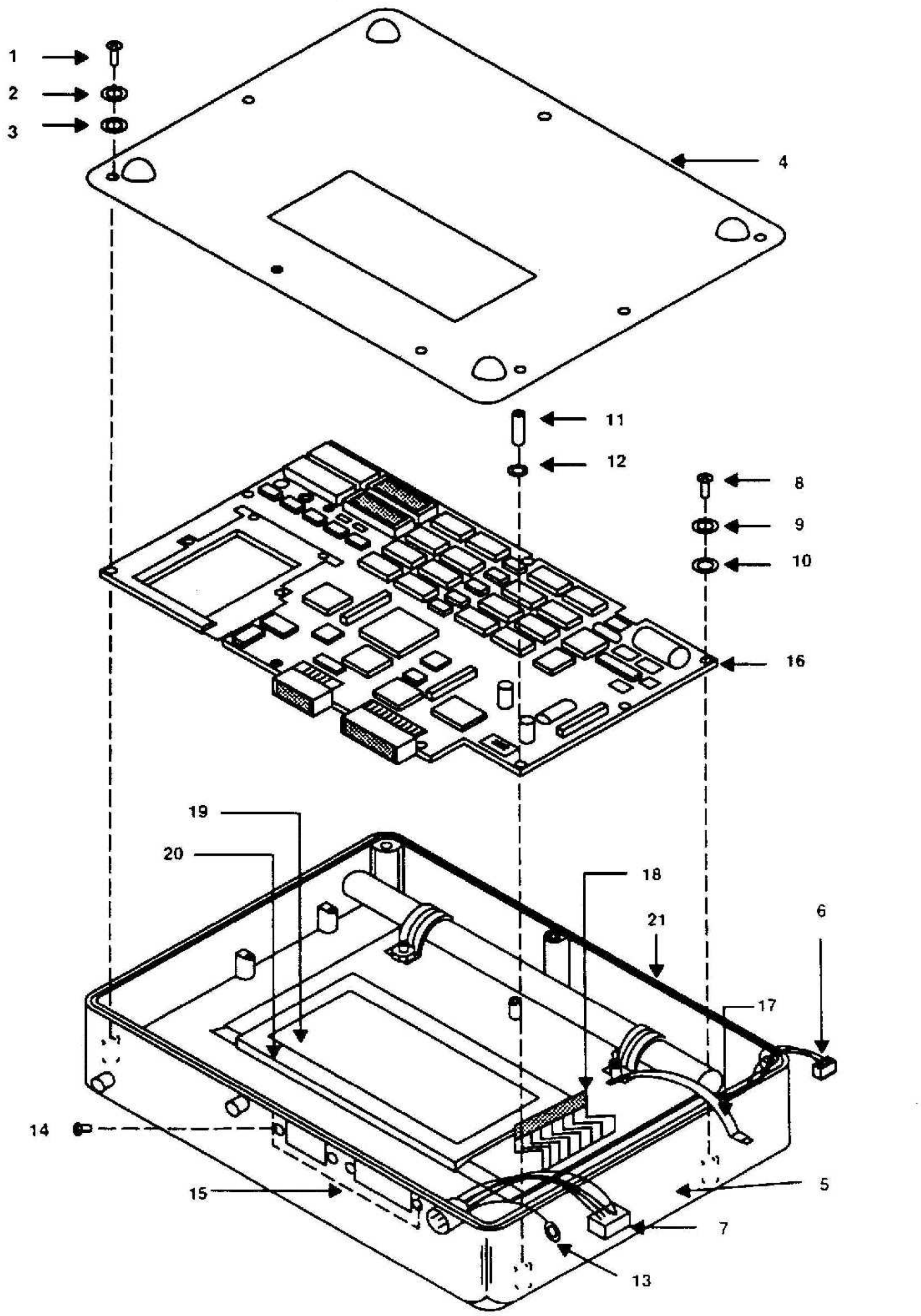


Figure 1. CADU PWA Removal and Installation

END OF WORK PACKAGE

CADU LCD ASSEMBLY
REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).

Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

Index

Initial Setup:	**Workbench with ESD capability**
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**LCD Assy PN 29324501, Threadlock adhesive, Permabond 910, Lens cleaner**
Equipment Condition:	**CADU power turned off. Lay unit with keypad down on support strips to protect facing.**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).

Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove nine screws (1), nine lock washers (2), and nine flat washers (3) from bottom plate (4).
2. Remove bottom plate (4) from top case (5).
3. Disconnect battery cable connector (6) from J6 on the PWA.

4. Disconnect cable connector (7) from J4 on the PWA.
5. Remove three screws (8), three lock washers (9), and three flat washers (10).
6. Remove six standoffs (11), six flat washers (12), and ground lug (13).
7. Remove four lock screw assemblies (14).
8. Lift PWA (16) and disconnect two keypad connectors (17) from J10 and (18) from J7 on the PWA.
9. Remove gasket (15).
10. Remove PWA (16) from top case (5) and turn board over to gain access to the bottom side.
11. Remove four hex nuts (19) and four washers (20).
12. Disconnect cable connector (21) from J1 (22) on the PWA.
13. Remove LCD assembly (23) for replacement.

b. INSTALLATION:

1. Apply thread-lock adhesive (item 1, WP0066 00) to threaded hardware.
2. Place new LCD assembly (23) on mounting studs (24) on PWA (16).
3. Install four hex nuts (19) and flat washers (20).
4. Connect cable connector (21) to J1 (22) on PWA (16).
5. Place PWA (16) into top case (5).
6. Connect two keypad connectors (17) to J10 and (18) to J7 on the PWA.
7. Stand PWA (16) on end to gain access to clean the lens (25) and display face (26).
8. Clean lens as follows:
   (a) Wipe display face with a lint-free pad containing special lens cleaner.
   (b) Wipe dry with a lint-free cloth and dry-forced air.
   (c) Repeat steps (a) and (b) to clean the lens (25) and lens gasket (27).
   (d) Install gasket (15).
   (e) Put PWA (16) in place and inspect lens surface from operator's side of CADU.
   (f) If lint or smudges are still present, repeat steps (a) through (e).
9. Install four lock screw assemblies (14).
10. Install six standoffs (11), six flat washers (12), and ground lug (13).
11. Install three screws (8), three lock washers (9), and three washers (10).
12. Connect battery pack cable connector (6) to J6 on PWA.
13. Connect cable connector (7) to J4 on PWA.
14. Inspect O-ring (28). If replacement is needed, use Permabond 910 (item 3, WP0066 00) to seal O-ring.
15. Place bottom plate (4) in place in top case (5).
16. Install nine screws (1), nine lock washers (2), and nine washers (3).

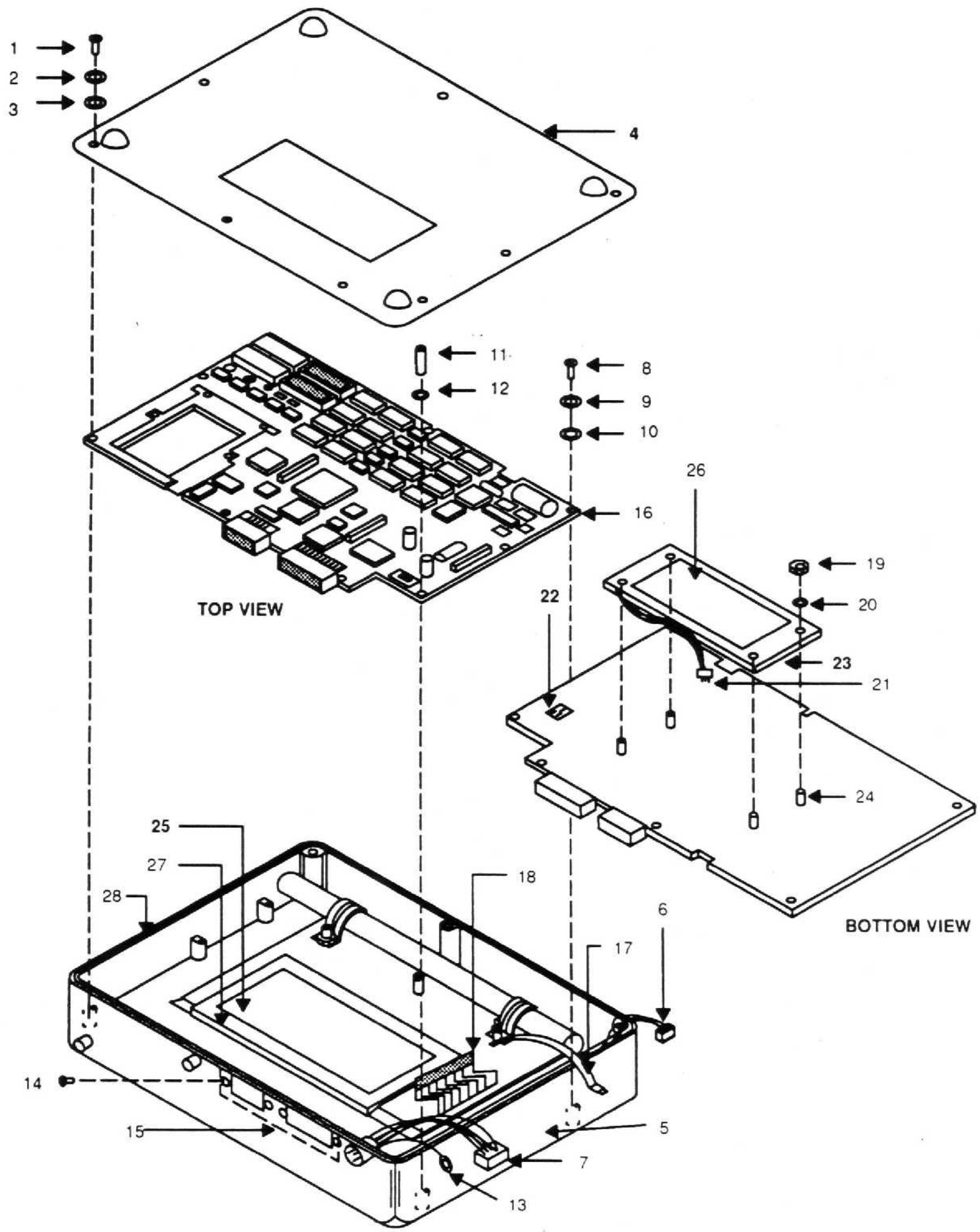


Figure 1. CADU LCD Assembly Removal and Installation

END OF WORK PACKAGE

CADU LENS AND LENS GASKET
REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).

Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

Index

Initial Setup:	**Workbench with ESD capability**
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**Lens PN 29323200, Lens Gasket PN 29324400, Silicone adhesive, Thread-lock adhesive, Permabond 910, Lens Cleaner, Lint-free cloth, Lint-free pad, Dry-forced air**
Equipment Condition:	**CADU power turned off. Lay unit with keypad down on support strips to protect facing.**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).

Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove nine screws (1), nine lock washers (2), and nine flat washers (3) from bottom plate (4).
2. Remove bottom plate (4) from top case (5). Disconnect battery cable connector (6) from J6 on the PWA.

3. Disconnect cable connector (7) from J4 on the PWA.
4. Remove three screws (8), three lock washers (9), and three flat washers (10) from PWA edge adjacent to battery pack.
5. Remove six standoffs (11), six flat washers (12), and ground lug (13).
6. Remove four lock screw assemblies (14).
7. Lift PWA (16) and disconnect keypad connectors (17) from J10 and (18) from J7 on the PWA.
8. Remove gasket (15).
9. Remove lens (19) and lens gasket (20).
10. Clean silicone adhesive from lens cavity (21).

b. INSTALLATION:

1. Apply silicone adhesive (item 2, WP0066 00) to lens cavity (21).
2. Install new lens (19).
3. Peel off backing and install new lens gasket (20).
4. Place PWA (16) into top case (5).
5. Connect two keypad connectors (17) to J10 and (18) to J7 on the PWA.
6. Stand PWA (16) on end to gain access to clean the lens (19) and display face.
7. Clean lens as follows:
   (a) Wipe display face with a lint-free pad containing special lens cleaner.
   (b) Wipe dry with a lint-free cloth and dry-forced air.
   (c) Repeat steps (a) and (b) to clean the lens (19) and lens gasket (20).
   (d) Install gasket (15).
   (e) Put PWA (16) in place and inspect lens surface from operator's side of CADU.
   (f) If lint or smudges are still present, repeat steps (a) through (e).
8. Apply Thread-lock adhesive to threaded hardware.
9. Install four lock screw assemblies (14).
10. Install six standoffs (11), six flat washers (12), and ground lug (13).
11. Install three washers (10), three lock washers (9), and three screws (8) on PWA edge adjacent to battery pack.
12. Connect battery pack cable connector (6) to J6 on PWA.
13. Connect cable connector (7) to J4 on PWA.
14. Inspect O-ring (29). If replacement is necessary, use Permabond 910 to seal O-ring.
15. Place bottom plate (4) in place in top case (5).
16. Install nine washers (3), nine lock washers (2), and nine screws (1).

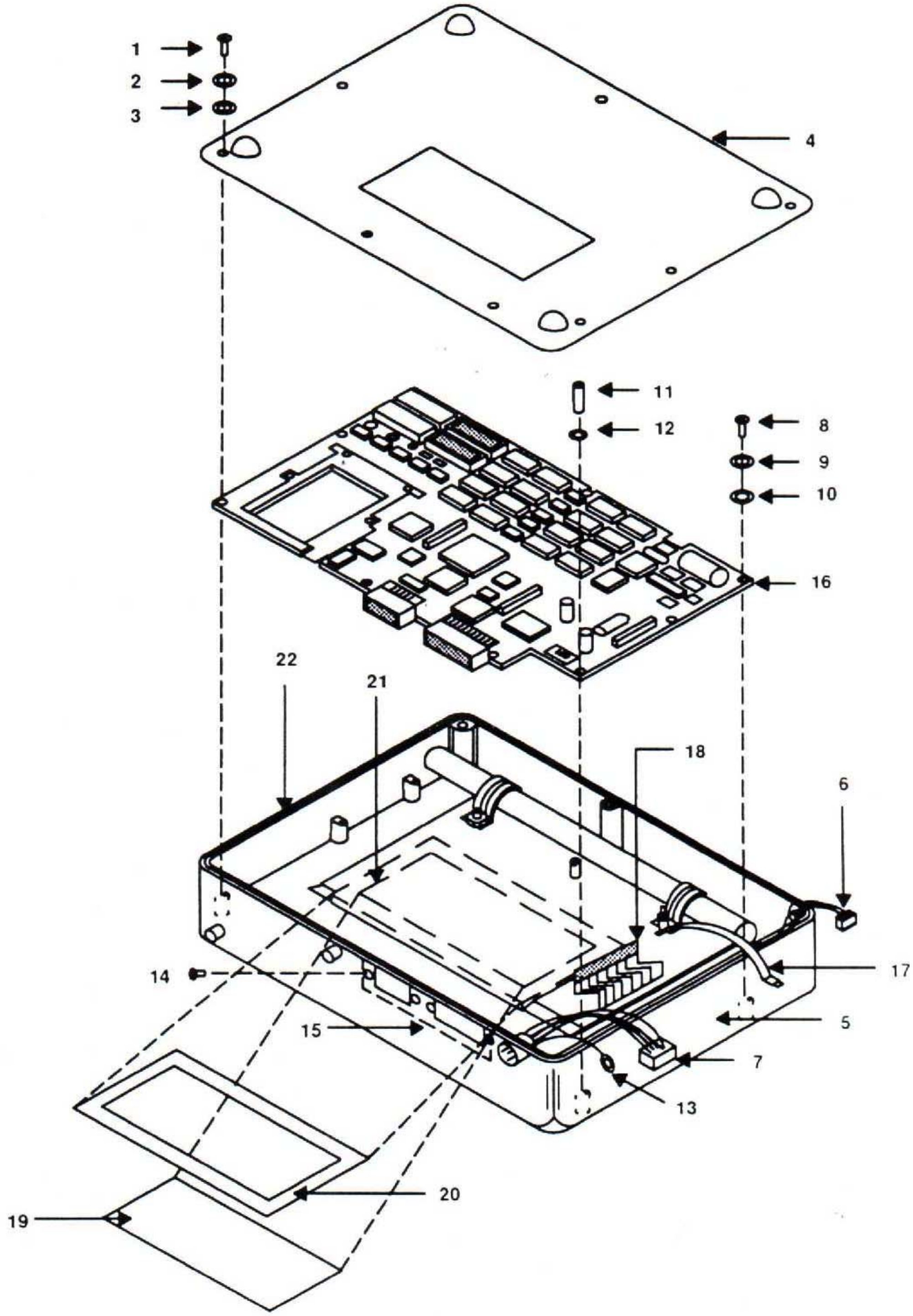


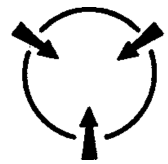
Figure 1. CADU Lens and Lens Gasket Removal and Installation

END OF WORK PACKAGE

CADU KEYPAD
REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

CAUTION

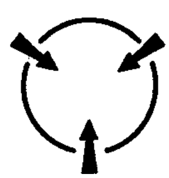
Be careful not to allow keypad ribbon cables to touch adhesive surface of new keypad.

Index

<u>Initial Setup</u>:	**Workbench with ESD capability**
<u>Personnel Required</u>:	**TMDE Support Specialist**
<u>Tools and Equipment</u>:	**Tool Kit, Electricians**
<u>Parts/Materials</u>:	**Keypad PN 29323400, Silicone adhesive, Thread-lock adhesive, Permabond 910, Lens Cleaner, Lint-free cloth, Lint-free pad, Dry-forced air**
<u>Equipment Condition</u>:	**CADU power turned off. Lay unit with keypad down on support strips to protect facing.**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove nine screws (1), nine lock washers (2), and nine flat washers (3) from bottom plate (4).
2. Remove bottom plate (4) from top case (5).
3. Disconnect battery cable connector (6) from J6 on the PWA.
4. Disconnect cable connector (7) from J4 on the PWA.
5. Remove three screws (8), three lock washers (9), and three flat washers (10) from PWA edge adjacent to battery pack.
6. Remove six standoffs (11), six flat washers (12), and ground lug (13).
7. Remove four lock screw assemblies (14).
8. Lift PWA (16) and disconnect keypad connectors (17) from J10 and (18) from J7 on the PWA.
9. Remove gasket (15).
10. Remove PWA (16) from top case (5).
11. Remove silicone (25) from around keypad ribbon cable P1 (18).
12. Remove plastic protector cap (19).
13. Remove hex nut (20), lock washer (21), and washer (22).
14. Remove ground strap (23) from threaded post (24).
15. Turn top case (5) over, face up.
16. Peel the keypad (26) off of the top case (5).
17. Remove keypad (26) from top case (5) carefully pulling ribbon cables (17) and (18) through slots in the top case (5).

b. INSTALLATION:

CAUTION

Be careful not to allow keypad ribbon cables to touch adhesive surface of new keypad.

1. Remove paper backing from new keypad (26).
2. Insert keypad ribbon cables (17) and (18) through slots in top case (5).
3. Install keypad (26) onto face of top case (5).
4. Apply silicone adhesive (25) around keypad ribbon cable (18). Allow adhesive to dry (8 hours).
5. Apply lock-adhesive to all threaded hardware.
6. Install ground strap (23) onto threaded post (24).
7. Install washer (22), lock washer (21), hex nut (20), and plastic protector cap (19).
8. Place PWA (16) into top case (5).
9. Connect two keypad connectors (17) to J10 and (18) to K7 on the PWA.
10. Stand PWA (16) on end to gain access to clean the lens (27) and display face.
11. Clean lens as follows:
    (a) Wipe display face with a lint-free pad containing special lens cleaner.
    (b) Wipe dry with a lint-free cloth and dry-forced air.
    (c) Repeat steps (a) and (b) to clean the lens (27) and lens gasket (28).
    (d) Install gasket (15).

(e) Put PWA (16) in place and inspect lens surface from operator's side of CADU.

(f) If lint or smudges are still present, repeat steps (a) through (e).

12. Install four lock screw assemblies (14).
13. Install six standoffs (11), six flat washers (12), and ground lug (13).
14. Install three washers (10), three lock washers (9), and three screws (8) on PWA edge adjacent to battery pack.
15. Connect battery pack cable connector (6) to J6 on PWA (16).
16. Connect cable connector (7) to J4 on PWA (16).
17. Inspect O-ring (29). If replacement is needed, use Permabond 910 (item 3, WP0066 00) to seal O-ring.
18. Place bottom plate (4) in place in top case (5).
19. Install nine washers (3), nine lock washers (2), and nine screws (1).

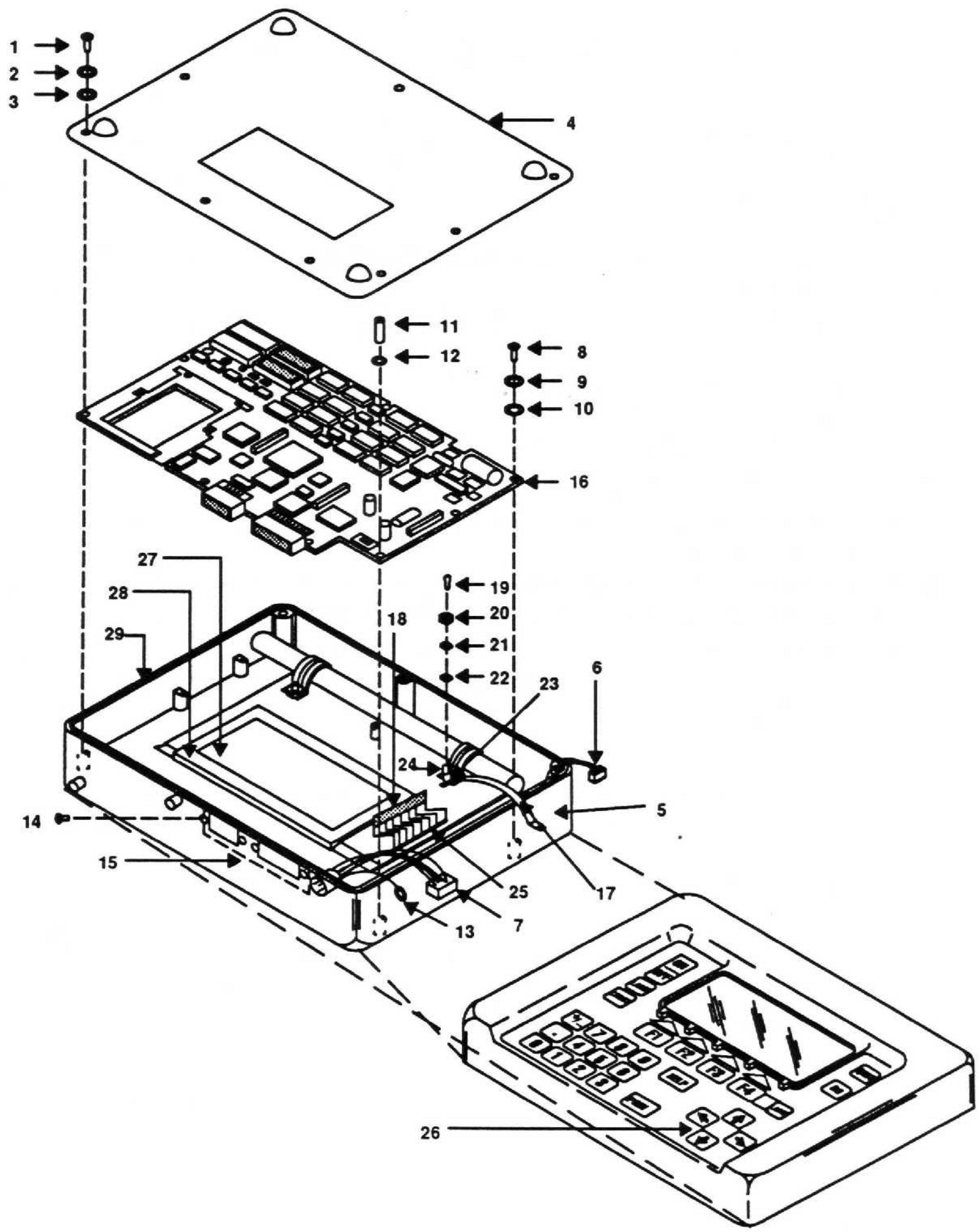


Figure 1. CADU Keypad Removal and Installation

END OF WORK PACKAGE

CADU HARNESS ASSEMBLY
REMOVAL AND INSTALLATION

Index

Initial Setup:	
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**Harness PN 29324200, Thread-lock adhesive, Permabond 910**
Equipment Condition:	**CADU power turned off. Lay unit with keypad down on support strips to protect facing.**

a. REMOVAL:

1. Remove nine screws (1), nine lock washers (2), and nine flat washers (3) from bottom plate (4).
2. Remove bottom plate (4) from top case (5).
3. Disconnect cable connector (6) from J4 on PWA.
4. Remove one standoff (7), one flat washer (8), and ground lug (9).
5. Remove four screws (10) from nut plate (11).
6. Remove cable harness assembly (12) for replacement.
7. Remove gasket (13) from cable harness assembly (12).

b. INSTALLATION:

1. Install gasket (13) on cable harness assembly (12).
2. Place new cable harness assembly (12) into top case (5).
3. Place nut plate (11) in place to backup mounting.
4. Apply thread-lock adhesive to threaded hardware.
5. Install four screws (10).
6. Connect cable connector (6) to J4.
7. Install ground lug (9), one flat washer (8), and one standoff (7).
8. Inspect O-ring (14). If replacement is needed, use Permabond 910 to seal O-ring.
9. Install bottom plate (4) in place in top case (5).
10. Install nine washers (3), nine lock washers (2), and nine screws (1).

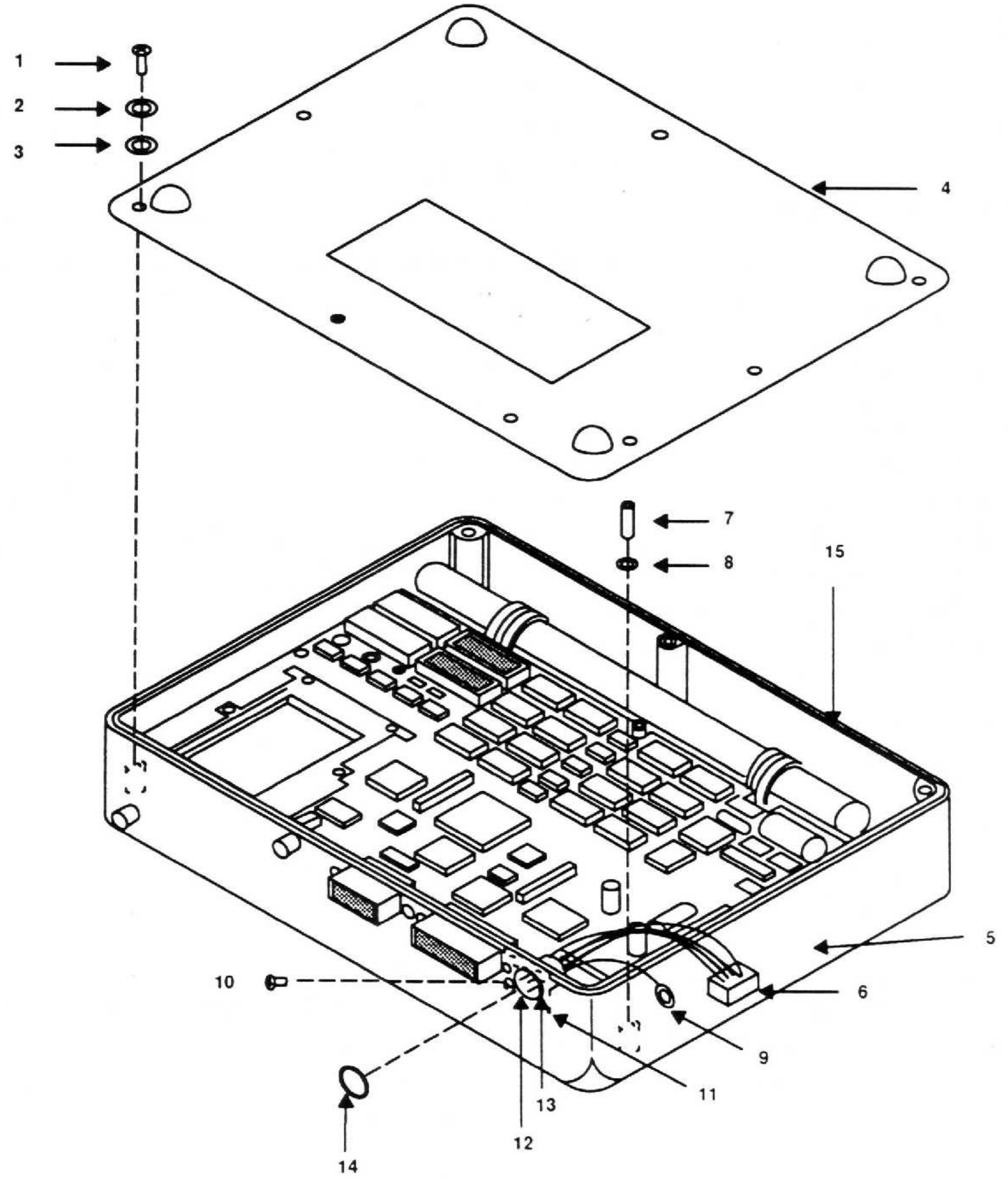


Figure 1. CADU Harness Assembly Removal and Installation

END OF WORK PACKAGE

DAU RECESSED RUBBER BUMPER
REMOVAL AND INSTALLATION

Index

Initial Setup:

Personnel Required: TMDE Support Specialist

Tools and Equipment: Tool Kit, Electricians

Parts/Materials: Rubber Bumper PN 28031302, Thread-lock adhesive

Equipment Condition: DAU on workbench

a. REMOVAL:

1. Remove screw (1), lock washer (2), and recessed rubber bumper (3) from case (4).

b. INSTALLATION:

1. Assemble new recessed rubber bumper (3), lock washer (2), and screw (1).
2. Apply small amount of thread-lock adhesive on exposed threads of screw (1).
3. Install assembled items into pre-threaded hole (5) of case (4).

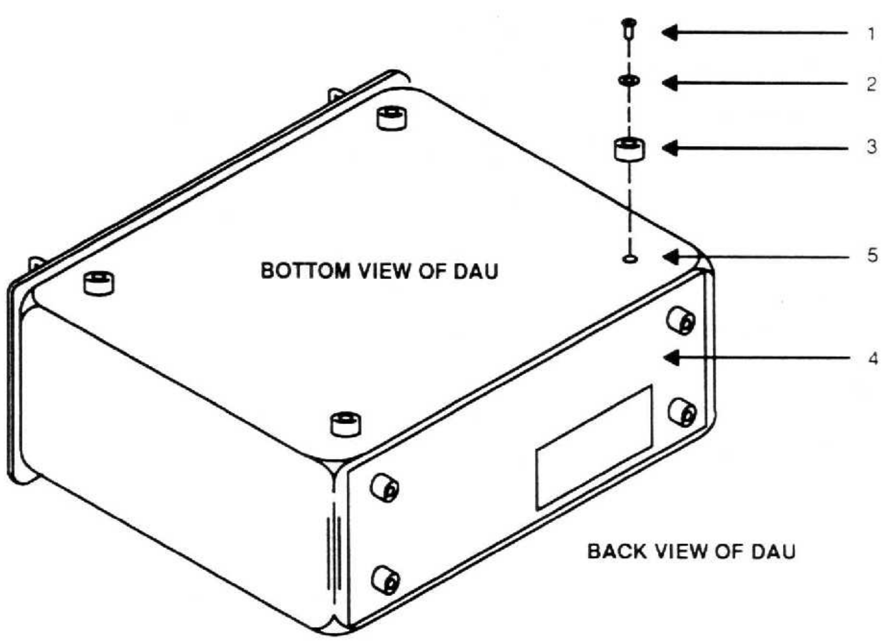


Figure 1. DAU Recessed Rubber Bumper Removal and Installation

END OF WORK PACKAGE

DAU FAN
REMOVAL AND INSTALLATION

Index

Initial Setup:	
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**DAU Fan PN 28113202, Thread-lock adhesive**
Equipment Condition:	**DAU on workbench**

a. REMOVAL:

1. Remove four screws (1), four lock washers (2), and four flat washers (3) from enclosure (4).
2. Remove enclosure (4) from card cage (5).
3. Disconnect power terminal lug (6) from PWA back plane (7).
4. Pull wire and power terminal lug (6) out through access hole (8).
5. Remove screw (9), lock washer (10), and terminal lug ring (11).
6. Remove four screws (12), four lock washers (13), and four flat washers (14).
7. The fan and cable assembly (15) are now available to be replaced.

b. INSTALLATION:

1. Apply thread-lock adhesive to threaded hardware.
2. Install four screws (12), four lock washers (13), and four flat washers (14) through mounting holes in fan (15) into pre-threaded holes of the card cage (5).
3. Install screw (9), lock washer (10), and terminal lug ring (11) into pre-threaded hole of card cage (5).
4. Pass power terminal lug (6) through access hole (8) and connect onto PWA back plane (7).
5. Install enclosure (4) on to card cage (5).
6. Install four screws (1), four lock washers (2), and four flat washers (3) through four holes in the enclosure (4) into the card cage (5).

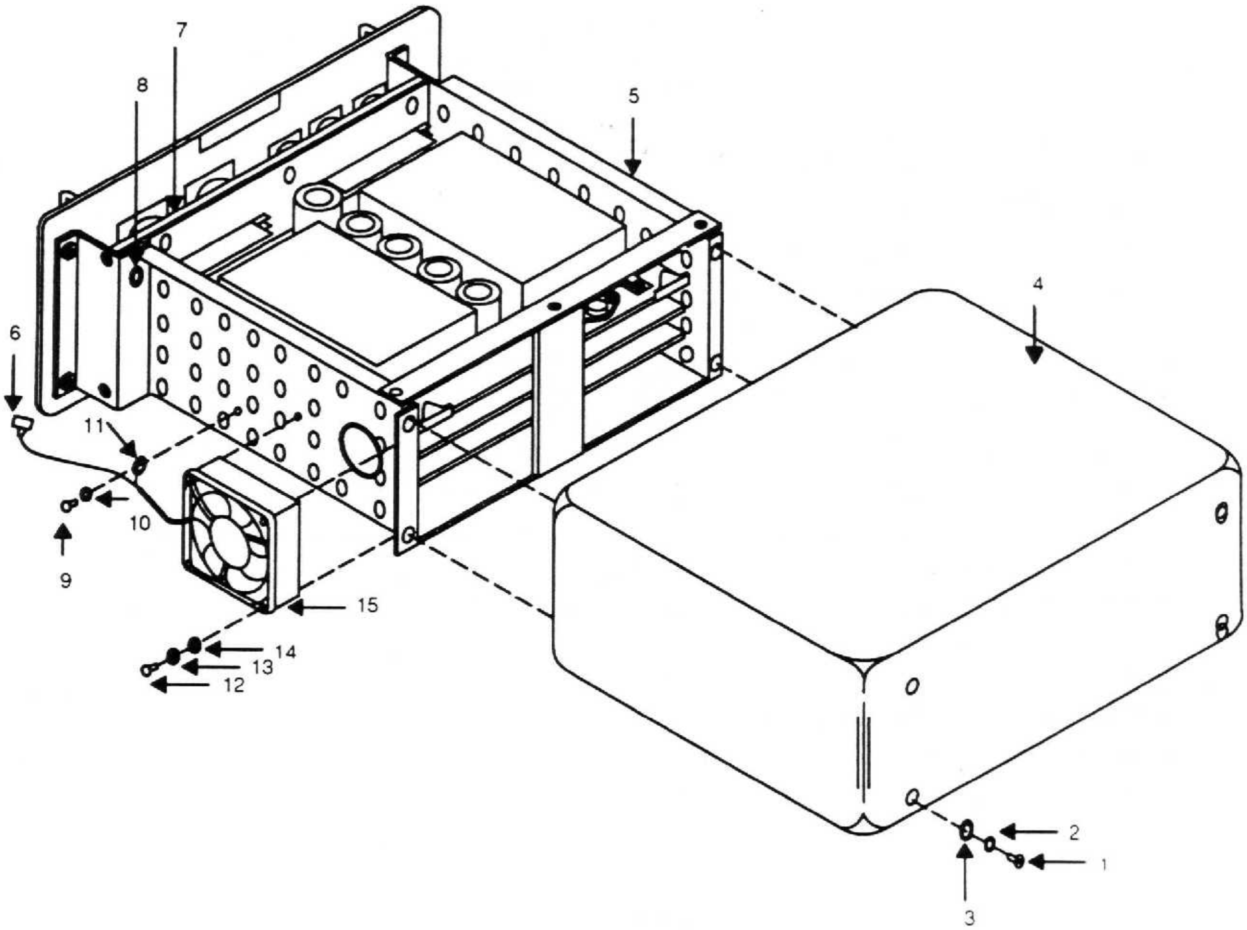


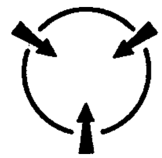
Figure 1. DAU Fan Removal and Installation

END OF WORK PACKAGE

DAU POWER SUPPLY PRINTED WIRING ASSEMBLY (PWA) REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



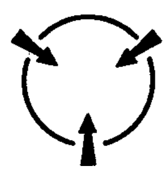
Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

Index

<u>Initial Setup</u>:	
<u>Personnel Required</u>:	**TMDE Support Specialist**
<u>Tools and Equipment</u>-	**Tool Kit, Electricians**
<u>Parts/Materials</u>:	**PWA PN 29111900, Thread-lock adhesive**
<u>Equipment Condition</u>:	**Set DAU on workbench with ESD capability.**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove four screws (1), four lock washers (2), and four flat washers (3) from enclosure (4).
2. Remove enclosure (4) from card cage (5).
3. Remove two screws (top and bottom) (6) from PWA hold-down bracket (7).
4. Remove PWA hold-down bracket (7).
5. Rotate extractors (8) to loosen power supply card (9) from back plane connectors (10).
6. Pull power supply card (9) out of card guides (11).

b. INSTALLATION:

1. Install new power supply card (9) into card guides (11) pushing card into back plane connector (10).
2. Apply thread-lock adhesive (item 1, WP0066 00) on threaded hardware.
3. Install PWA hold-down bracket (7) into the card cage (5) using two screws (top and bottom) (6).
4. Install enclosure (4) on to card cage (5).
5. Install four screws (1), four lock washers (2), and four flat washers (3) through four holes in the enclosure (4) into the card cage (5).

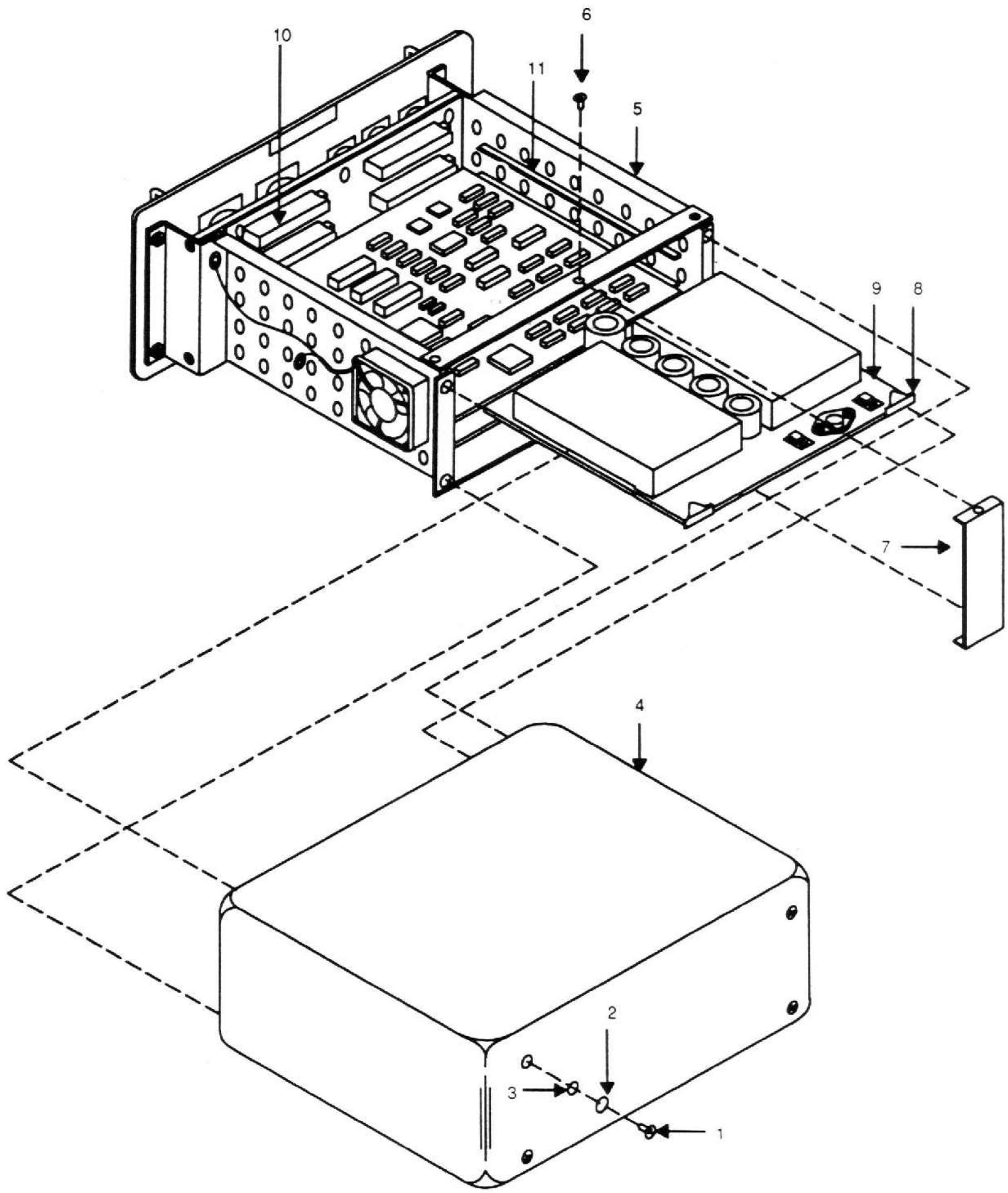


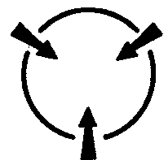
Figure 1. DAU Power Supply PWA Removal and Installation

END OF WORK PACKAGE

DAU PROCESSOR PWA
REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

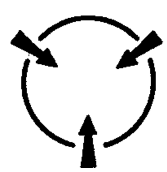
Index

Initial Setup:

Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**PWA PN 29356504, Thread-lock adhesive**
Equipment Condition:	**Place DAU on workbench with ESD capability.**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove four screws (1), four lock washers (2), and four flat washers (3) from enclosure (4).
2. Remove enclosure (4) from card cage (5).
3. Remove two screws (top and bottom) (6) from PWA hold-down bracket (7).
4. Remove PWA hold-down bracket (7).
5. Rotate extractors (8) to loosen processor card (9) from back plane connectors (10).
6. Pull processor card (9) out of card cage (5).

b. INSTALLATION:

1. Apply thread-lock adhesive (item 1, WP0066 00) to threaded hardware.
2. Install new processor card (9) into card guides (11) pushing card into back plane connectors (10).
3. Install PWA hold-down bracket (7) into the card cage (5) using two screws (top and bottom) (6).
4. Install enclosure (4) on to card cage (5).
5. Install four screws (1), four lock washers (2), and four flat washers (3) through four holes in the enclosure (4) into the card cage (5).

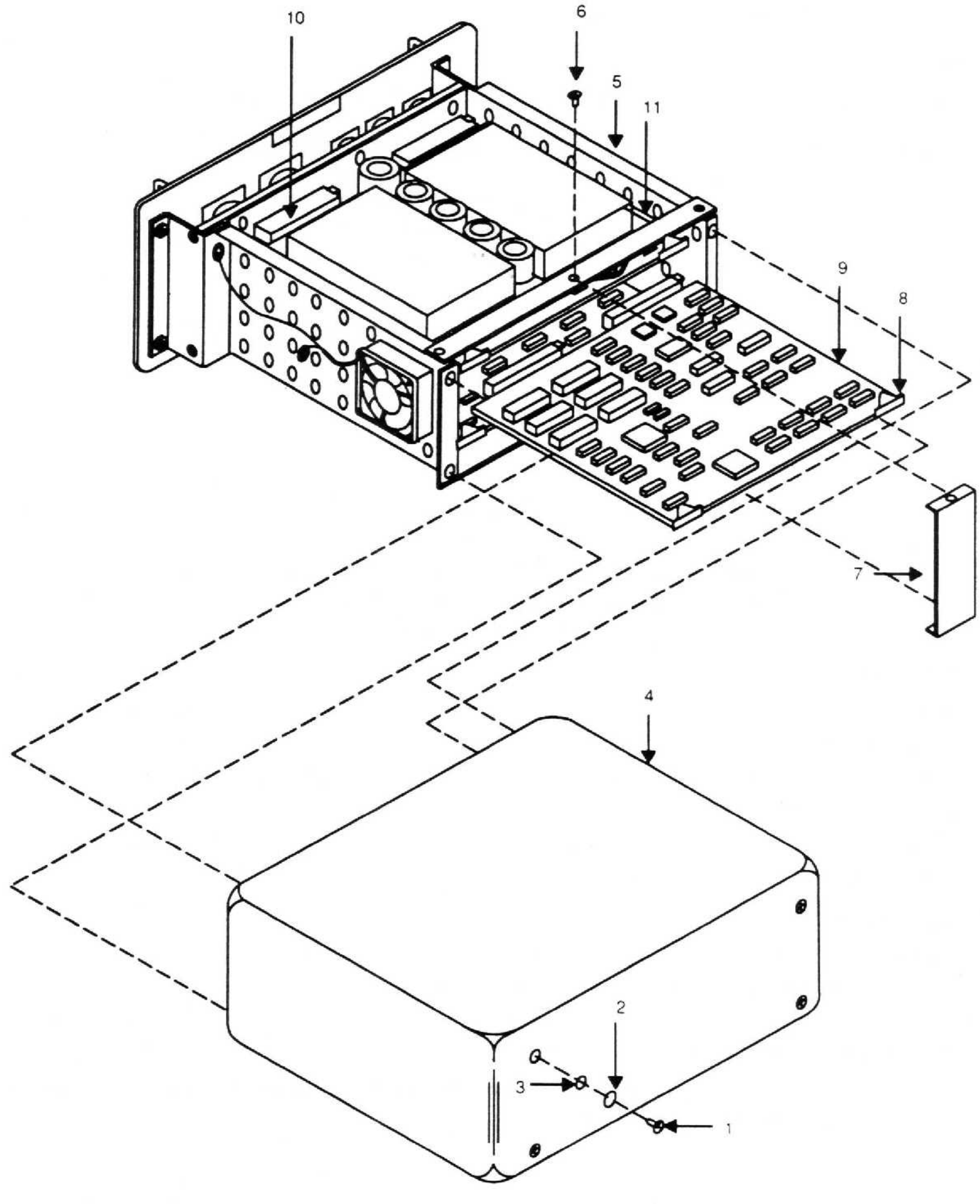


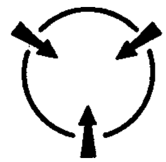
Figure 1. DAU Processor PWA Removal and Installation

END OF WORK PACKAGE

DAU ACQUISITION PWA REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

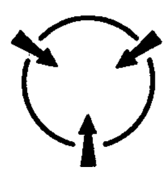
Index

Initial Setup:

Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**PWA PN 29111100, Thread-lock adhesive**
Equipment Condition:	**Place DAU on workbench with ESD capability.**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove four screws (1), four lock washers (2), and four flat washers (3) from enclosure (4).
2. Remove enclosure (4) from card cage (5).
3. Remove two screws (top and bottom) (6) from PWA hold-down bracket (7).
4. Remove hold-down bracket (7) from card cage (5).
5. Rotate extractors (8) to loosen acquisition card (9) from back plane connectors (10).

6. Pull acquisition card (9) out of card cage (5).

b. INSTALLATION:

1. Apply thread-lock adhesive to threaded hardware.
2. Install new acquisition card (9) into card guides (11) pushing card into back plane connectors (10).
3. Install PWA hold-down bracket (7) into the card cage (5) using two screws (top and bottom) (6).
4. Install enclosure (4) onto card cage (5).
5. Install four screws (1), four lock washers (2), and four flat washers (3) through four holes in the enclosure (4) into the card cage (5).

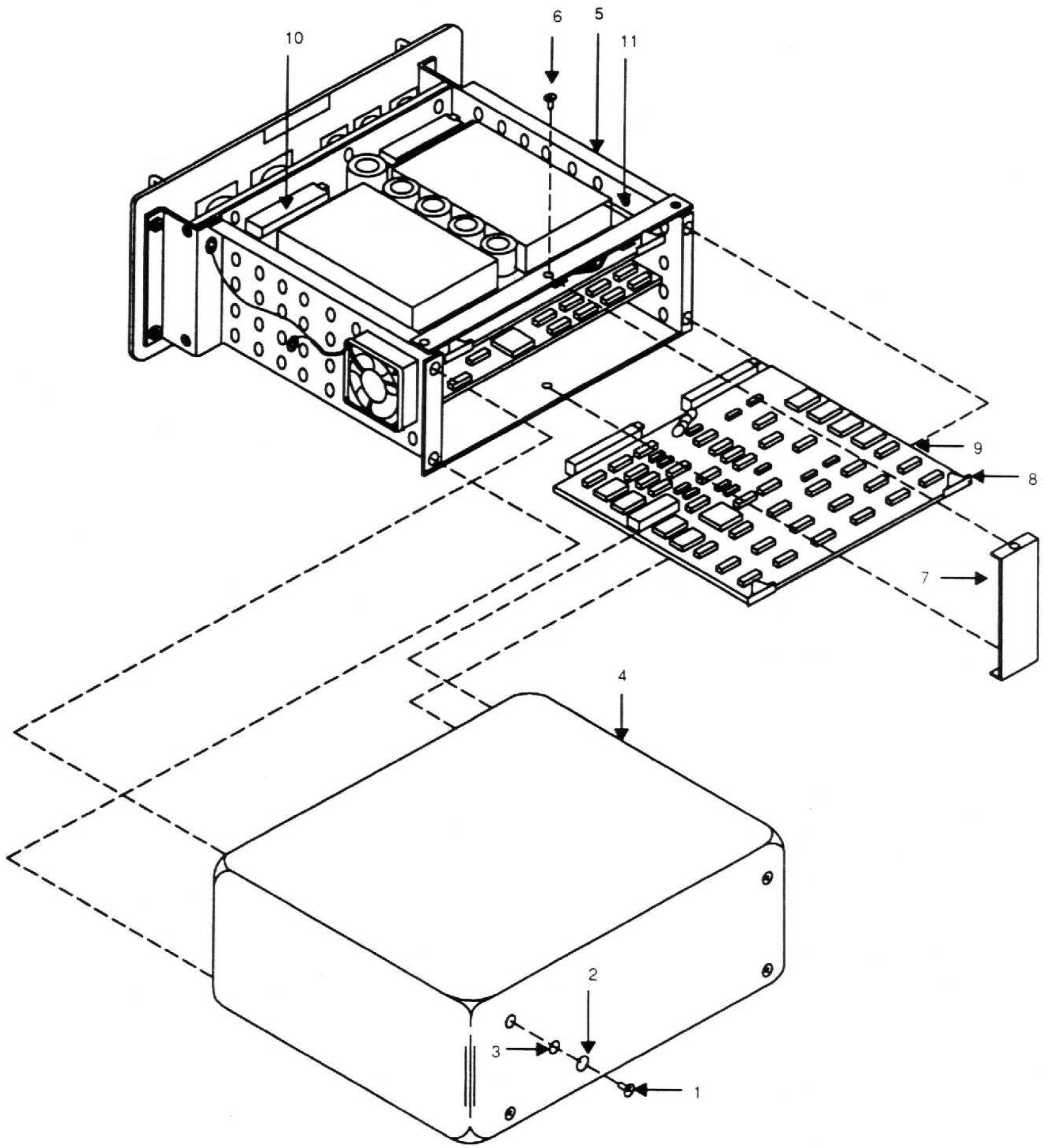


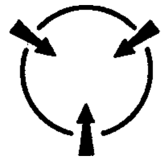
Figure 1. DAU Acquisition PWA Removal and Installation

END OF WORK PACKAGE

DAU FRONT PANEL ASSEMBLY
REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



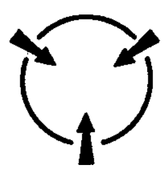
Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

Index

<u>Initial Setup</u>:	
<u>Personnel Required</u>:	**TMDE Support Specialist**
<u>Tools and Equipment</u>:	**Tool Kit, Electricians**
<u>Parts/Materials</u>:	**Front Panel Assembly PN 29325900, Thread-lock adhesive**
<u>Equipment Condition</u>:	**Place DAU on workbench with ESD capability.**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove four screws (1), four lock washers (2), and four flat washers (3) from enclosure (4).
2. Remove enclosure (4) from card cage (5).
3. Remove two screws (top and bottom) (6) from PWA hold-down bracket (7).
4. Remove hold-down bracket (7) from card cage (5).

5. Rotate extractor (8) to loosen acquisition card (9) from back plane connectors (10).
6. Pull acquisition card (9) from card cage (5).
7. Rotate extractor (11) to loosen processor card (12) from back plane connectors (10).
8. Pull processor card (12) from card cage (5).
9. Rotate extractor (13) to loosen power supply card (14) from back plane connectors (10).
10. Pull power supply card (14) from card cage (5).
11. Remove four hex nuts (16), and four lock washers (17) from four positioning bolts (18).
12. Remove front panel assembly (19) from card cage (5).
13. Remove two cable connectors (20 and 21) and two terminal rings (22) from PWA back plane (23).

b. INSTALLATION:

1. Connect two cable connectors (20 and 21) and two terminal rings (22) onto PWA back plane (23).
2. Install front panel assembly (19) onto card cage (5) four positioning bolts (18), and attach with four hex nuts (16), and four lock washers (17).
3. Install acquisition card (9) into card guides (15) pushing card into back plane connectors (10).
4. Install processor card (12) into card guides (15) pushing card into back plane connectors (10).
5. Install power supply card (14) into card guides (15) pushing card into back plane connectors (10).
6. Apply thread-lock adhesive (item 1, WP0066 00) to threaded hardware.
7. Install PWA hold-down guide (7) in place in the card cage (5) using two screws (top and bottom) (6).
8. Install enclosure (4) onto card cage (5).
9. Install four screws (1), four lock washers (2), and four flat washers (3) through four holes in the enclosure (4) into the card cage (5).

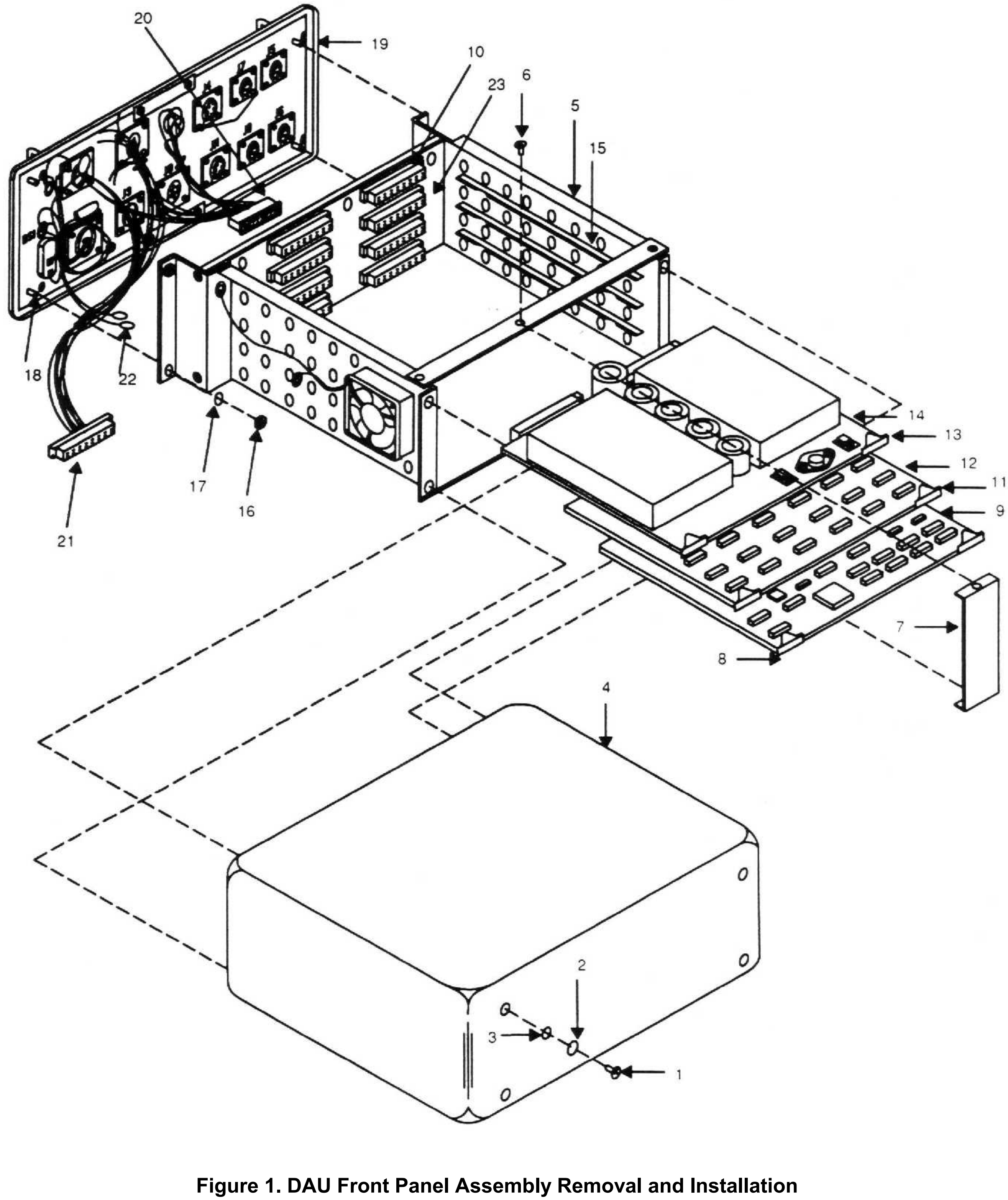


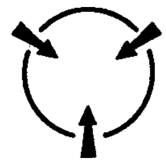
Figure 1. DAU Front Panel Assembly Removal and Installation

END OF WORK PACKAGE

DAU CARD GUIDE
REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



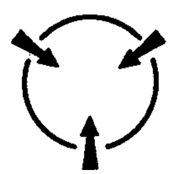
Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

Index

Initial Setup:	
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**Card Guide PN 28055202, Thread-lock adhesive**
Equipment Condition:	**Place DAU on workbench with ESD capability.**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove four screws (1), four lock washers (2), and four flat washers (3) from enclosure (4).
2. Remove enclosure (4) from card cage (5).
3. Remove two screws (top and bottom) (6) from PWA hold-down bracket (7).
4. Remove hold-down bracket (7) from card cage (5).
5. Rotate extractor (8) to loosen acquisition card (9) from back plane connectors (10).

6. Pull acquisition card (9) from card cage (5).
7. Rotate extractor (11) to loosen processor card (12) from back plane connectors (10).
8. Pull processor card (11) from card cage (5).
9. Rotate extractor (13) to loosen power supply card (14) from back plane connectors (10).
10. Pull power supply card (14) from card cage (5).
11. Remove faulty card guide (15) from card cage (5).
12. Card guide (15) is now available to be replaced.

b. INSTALLATION:

1. Install new card guide (15) in mounting holes of card cage (5).
2. Install acquisition card (9) into card guides (15) pushing card into back plane connectors (10).
3. Install processor card (12) into card guides (15) pushing card into back plane connectors (10).
4. Install power supply card (14) into card guides (15) pushing card into back plane connectors (10).
5. Apply thread-lock adhesive (item 1, WP0066 00) to threaded hardware.
6. Install PWA hold-down bracket (7) in place in the card cage (5) using two screws (top and bottom) (6).
7. Install enclosure (4) onto card cage (5).
8. Install four screws (1), four lock washers (2), and four flat washers (3) through four holes in the enclosure (4) into the card cage (5).

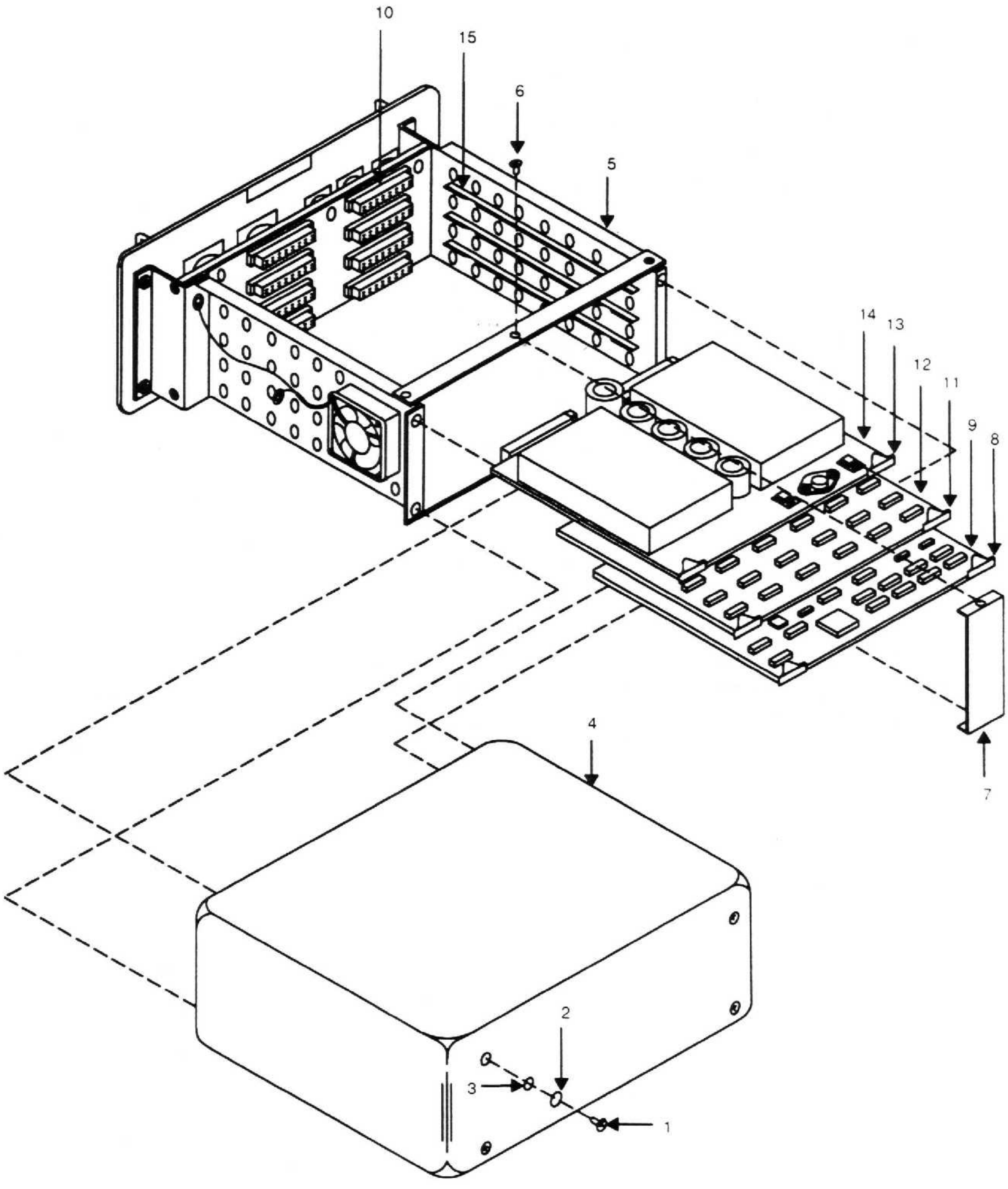


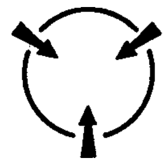
Figure 1. DAU Card Guide Removal and Installation

END OF WORK PACKAGE

DAU LED ASSEMBLY
REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

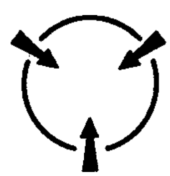
Index

Initial Setup:

Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**LED Assembly PN 28110700 or 5400A5, Thread-lock adhesive, Silicone Adhesive, Tie-wraps**
Equipment Condition:	**Place DAU on workbench with ESD capability.**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove four screws (1), four lock washers (2), and four flat washers (3) from enclosure (4).
2. Remove enclosure (4) from card cage (5).
3. Remove two screws (top and bottom) (6) from PWA hold-down bracket (7).
4. Remove hold-down bracket (7) from card cage (5).

5. Rotate extractor (8) to loosen acquisition card (9) from back plane connectors (10).
6. Pull acquisition card (9) from card cage (5).
7. Rotate extractor (11) to loosen processor card (12) from back plane connectors (10).
8. Pull processor card (12) from card cage (5).
9. Rotate extractor (13) to loosen power supply card (14) from back plane connectors (10).
10. Pull power supply card (14) from card cage (5).
11. Remove four hex nuts (16), and four lock washers (17) from four positioning bolts (18).
12. Remove front panel assembly (19) from card cage (5).
13. Remove two cable connectors (20 and 21) and two terminal rings (22) from PWA back plane (23).
14. Cut tie wraps and de-solder two wires from the LED assembly (24).
15. Remove adhesive around the LED assembly (24).
16. Pull LED assembly (24) from front panel (19) releasing green cover (25) from front side of front panel (19).

b. INSTALLATION:

1. Install LED assembly (24) into back of front panel (19) at hole (26).
2. Install green cover (25) at the front side of front panel (19). Items will snap together.
3. Apply silicone adhesive (item 2, WP0066 00) around LED assembly (24) to hold assembly in place.
4. On LED assembly (24), solder white wire to J1-1, and red wire to J2 insulated terminal. Secure wires with tie-wraps (item 10, WP0066 00).
5. Connect two cable connectors (20 and 21) and two terminal rings (22) onto PWA back plane (23).
6. Apply thread-lock adhesive to threaded hardware.
7. Install front panel assembly (19) onto card cage (5) four positioning bolts (18), and attach with four hex nuts (16), and four lock washers (17).
8. Install acquisition card (9) into card guides (15) pushing card into back plane connectors (10).
9. Install processor card (12) into card guides (15) pushing card into back plane connectors (10).
10. Install power supply card (14) into card guides (15) pushing card into back plane connectors (10).
11. Install PWA hold-down bracket (7) in place in the card cage (5) using two screws (top and bottom (6).
12. Install enclosure (4) onto card cage (5).
13. Install four screws (1), four lock washers (2), and four flat washers (3) through four holes in the enclosure (4) into the card cage (5).

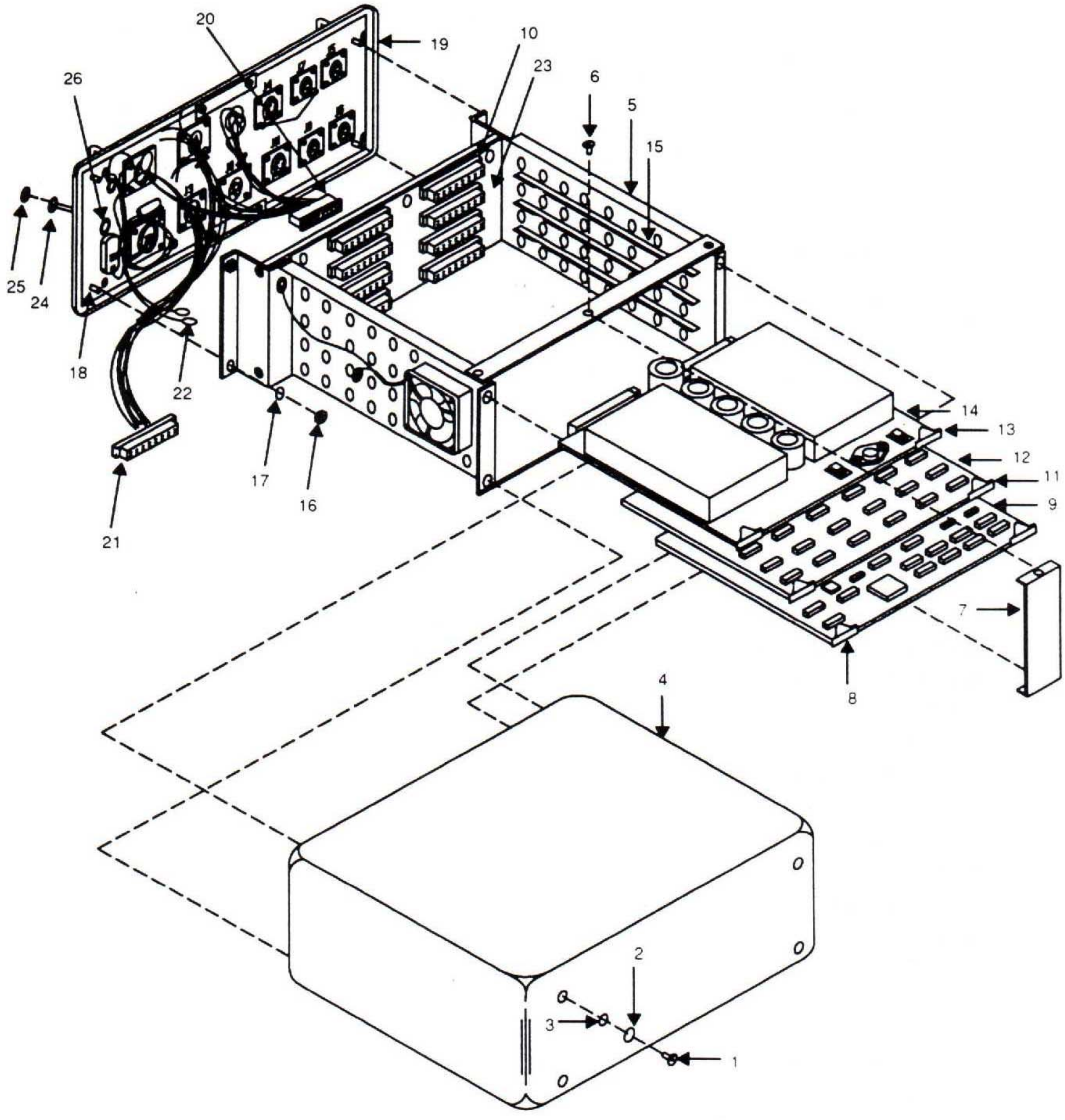


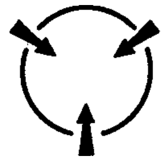
Figure 1. DAU LED Assembly Removal and Installation

END OF WORK PACKAGE

DAU PWA BACKPLANE
REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



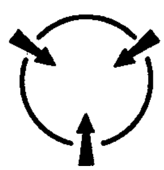
Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

Index

Initial Setup:	
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**Back plane PN 29112800, Thread-lock adhesive**
Equipment Condition:	**Place DAU on workbench with ESD capability.**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove four screws (1), four lock washers (2), and four flat washers (3) from enclosure (4).
2. Remove enclosure (4) from card cage (5).
3. Remove two screws (top and bottom) (6) from PWA hold-down bracket (7).
4. Remove hold-down bracket (7) from card cage (5).

5. Rotate extractor (8) to loosen acquisition card (9) from back plane connectors (10).
6. Pull acquisition card (9) from card cage (5).
7. Rotate extractor (11) to loosen processor card (12) from back plane connectors (10).
8. Pull processor card (12) from card cage (5).
9. Rotate extractor (13) to loosen power supply card (14) from back plane connectors (10).
10. Pull power supply card (14) from card cage (5).
11. Remove four hex nuts (16), and four lock washers (17) from four positioning bolts (18).
12. Remove front panel assembly (19) from card cage (5).
13. Remove two cable connectors (20 and 21) and two terminal rings (22) from PWA back plane (23).
14. Disconnect fan cable and terminal lug (24) from PWA back plane (23).
15. Remove four screws (25), four lock washers (26), four flat washers (27), and PWA back plane (23) from card cage (5).
16. Remove six screws (28), six lock washers (29), six flat washers (30), and two back plane bar supports (31) from PWA back plane (23).
17. PWA back plane (23) is now available to be replaced.

b. INSTALLATION:

1. Apply thread-lock adhesive on threaded hardware.
2. Install new PWA back plane (23) onto two back plane bar supports (31) with six screws (28), six lock washers (29), and six flat washers (30).
3. Install PWA back plane (23) into card cage (5) with four screws (25), four lock washers (26) and four flat washers (27).
4. Connect fan cable and terminal lug (24) onto PWA back plane (23).
5. Connect two cable connectors (20 and 21) and two terminal rings (22) onto PWA back plane (23)
6. Install front panel assembly (19) onto card cage (5) with four positioning bolts (18), and attach with four hex nuts (16), and four lock washers (17).
7. Install acquisition card (9) into card guides (15) pushing card into back plane connectors (10).
8. Install processor card (12) into card guides (15) pushing card into back plane connectors (10).
9. Install power supply card (14) into card guides (15) pushing card into back plane connectors (10).
10. Install PWA hold-down bracket (7) in place in the card cage (5) using two screws (top and bottom) (6).
11. Install enclosure (4) onto card cage (5).
12. Install four screws (1), four lock washers (2), and four flat washers (3) through four holes in the enclosure (4) into the card cage (5).

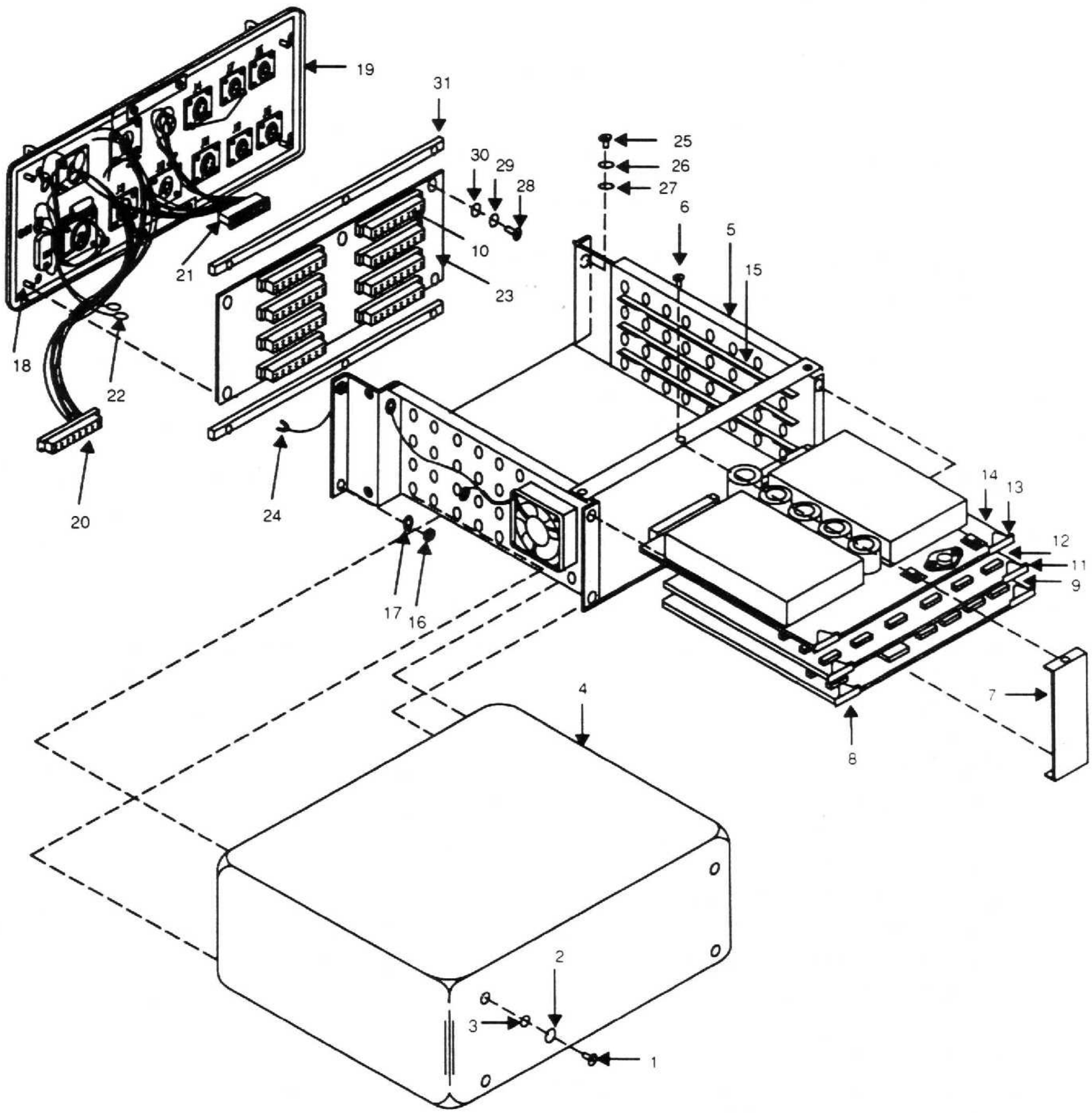


Figure 1. DAU PWA Back plane Removal and Installation

END OF WORK PACKAGE

DAU CARD CAGE
REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).

Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

Index

Initial Setup:	
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**Card Cage PN 29109800, Thread-lock adhesive**
Equipment Condition:	**DAU on workbench with ESD capability**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).

Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove four screws (1), four lock washers (2), and four flat washers (3) from enclosure (4).
2. Remove enclosure (4) from card cage (5).
3. Remove two screws (top and bottom) (6) from PWA hold-down bracket (7).
4. Remove hold-down bracket (7) from card cage (5).
5. Rotate extractor (8) to loosen acquisition card (9) from back plane connectors (10).

6. Pull acquisition card (9) from card cage (5).
7. Rotate extractor (11) to loosen processor card (12) from back plane connectors (10).
8. Pull processor card (12) from card cage (5).
9. Rotate extractor (13) to loosen power supply card (14) from back plane connectors (10).
10. Pull power supply card (14) from card cage (5).
11. Remove four hex nuts (16), and four lock washers (17) from four positioning bolts (18).
12. Remove front panel assembly (19) from card cage (5).
13. Remove two cable connectors (20 and 21) and two terminal rings (22) from PWA back plane (23).
14. Disconnect fan cable and terminal lug (24) from PWA back plane (23).
15. Pull fan cable and terminal lug (24) out through access hole (29).
16. Remove four screws (25), four lock washers (26), four flat washers (27), and PWA back plane (23) from card cage (5).
17. Remove screw (30), lug ring (31), and lock washer (32) from side of card cage (5).
18. Remove four screws (33), four lock washers (34), four flat washers (35) and fan (36) from card cage (5).

b. INSTALLATION:

1. Apply thread-lock adhesive on threaded hardware.
2. Install four screws (33), four lock washers (34), four flat washers (35), and fan (36) onto new card cage (5).
3. Install screw (30), lug ring (31), and lock washer (32) on side of card cage (5).
4. Install PWA back plane (23) into card cage (5) with four screws (25), four lock washers (26) and four flat washers (27).
5. Connect fan cable and terminal lug (24) onto PWA back plane (23).
6. Connect two cable connectors (20 and 21) and two terminal rings (22) (TB1 red and TB2 black) onto PWA back plane (23).
7. Install front panel assembly (19) onto card cage (5) with four positioning bolts (18), and attach with four hex nuts (16), and four lock washers (17).
8. Install acquisition card (9) into card guides (15) pushing card into back plane connectors (10).
9. Install processor card (12) into card guides (15) pushing card into back plane connectors (10).
10. Install power supply card (14) into card guides (15) pushing card into back plane connectors (10).
11. Install PWA hold-down bracket (7) in the card cage (5) using two screws (top and bottom) (6).
12. Install enclosure (4) onto card cage (5).
13. Install four screws (1), four lock washers (2), and four flat washers (3) through four holes m the enclosure (4) into the card cage (5).

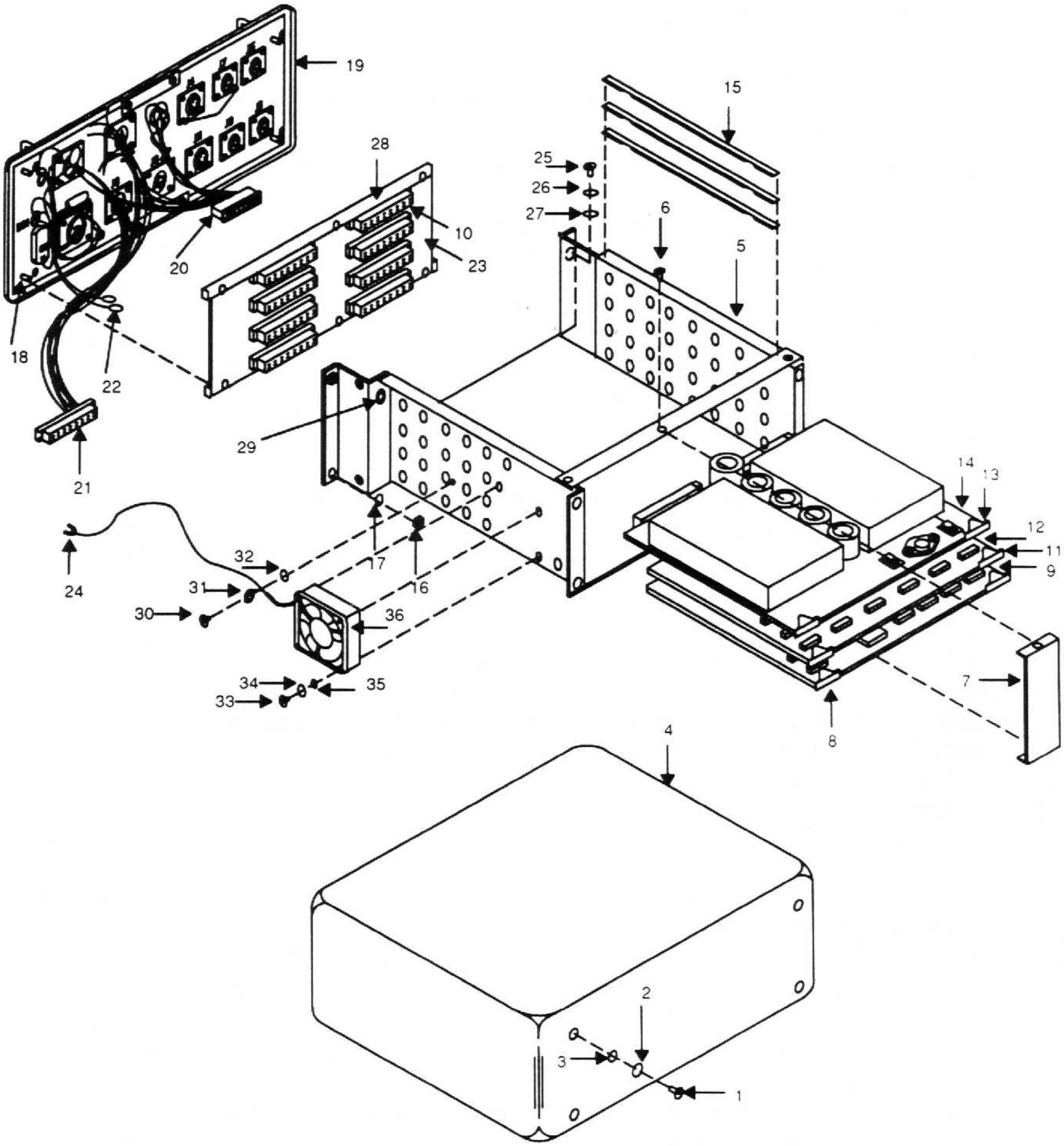


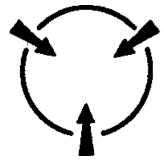
Figure 1. DAU Card Cage Removal and Installation

END OF WORK PACKAGE

UTD PRINTED WIRING ASSEMBLY (PWA) REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



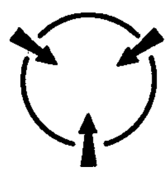
Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

Index

Initial Setup:	
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**PWA PN 29322500, Thread-lock adhesive, Silicone adhesive**
Equipment Condition:	**Place UTD on workbench with ESD capability**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove eight screws (1), eight flat washers (2), eight hex nuts (3), and eight flat washers (4), from base (5).
2. Using a sharp knife, break seal and remove base (5) with O ring (6) from top body (7).
3. De-solder two connecting wires (8) from terminals (9).
4. Remove two screws (10), two split lock washers (11) and two flat washers (12) from lower section of PWA (13).

5. Remove three screws (14), three lock washers (15), three flat washers (16) and three nylon spacers (17) from top section of PWA (13) allowing removal of PWA (13).

6. Disconnect cable connector P1 (18) from bottom side of the PWA (13) at J1 (19).

7. Remove two diode caps (20) from holes.

8. The PWA is now available for replacement.

b. INSTALLATION:

1. Apply thread-lock adhesive on threaded hardware.

2. Connect cable connector P1 (18) to bottom side of the PWA (13) at J1 (19).

3. Install two diode caps (20) into two holes.

4. Slowly position the PWA (13) aligning the two sensors on the bottom side of the PWA (13) into two holes (20) in the top body (7).

5. Install three screws (14), three lock washers (15), three flat washers (16), and three nylon spacers (17).

6. Install two screws (10), two split lock washers (11), and two flat washers (12).

7. Solder two connector wires (8) onto two terminals (9).

8. Verify O-ring (6) is in the base (5).

9. Apply silicone adhesive (item 2, WP0066 00) to mating surfaces of base (5) and body (7).

10. Install base (5) using eight hex nuts (3), eight flat washers (4), eight screws (1), and eight flat washers (2).

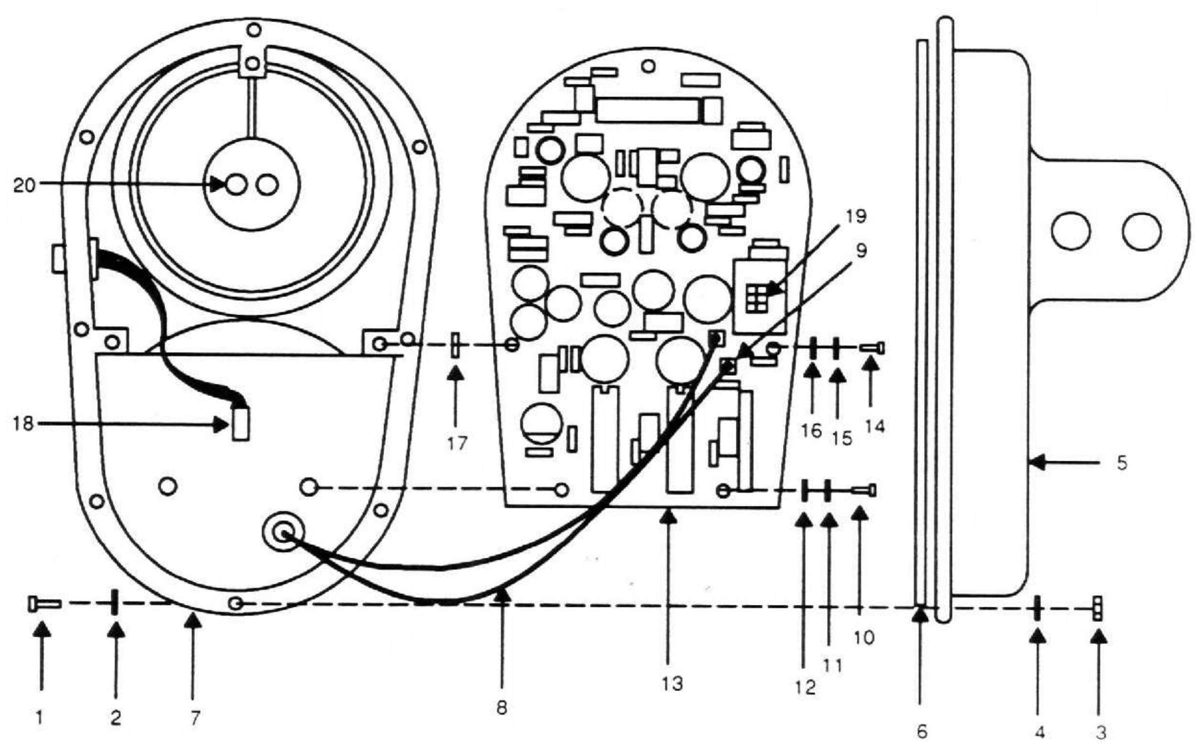


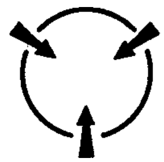
Figure 1. UTD PWA Removal and Installation

END OF WORK PACKAGE

UTD CABLE ASSEMBLY
REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

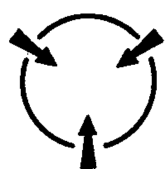
Index

Initial Setup:

Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**Cable Assembly PN 29310800, Thread-lock adhesive, Silicone adhesive**
Equipment Condition:	**UTD on workbench with ESD capability**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

a. REMOVAL:

1. Remove eight screws (1), eight flat washers (2), eight hex nuts (3), and eight flat washers (4) from base (5).
2. Using a sharp knife, break seal and remove base (5) with O ring (6) from top body (7).
3. Remove two screws (8), two split lock washers (9), and two flat washers (10) from lower section of PWA (11).

4. Remove three screws (12), three lock washers (13), three flat washers (14), and three nylon spacers (15) from top section of PWA (11) allowing access to interior of top body (7).
5. Remove two diode caps (22) from two holes.
6. Disconnect cable connector P1 (16) from bottom side of the PWA (11) at J1 (17).
7. Remove four screws (18), gasket (19), and connector nut plate (20) allowing the cable assembly (21) to be removed from the top body (7) for replacement.

b. INSTALLATION:

1. Apply thread-lock adhesive (item 1, WP0066 00) on threads of hardware.
2. Install diode caps (22) into two holes.
3. Install new cable assembly (21) into top body (7) with four screws (18), gasket (19), and connector nut plate (20).
4. Connect cable connector P1 (16) to J1 (17) on bottom side of PWA (11).
5. Slowly position the PWA (11) aligning the two sensors on the bottom side of the PWA (11) into two holes (22) in the top body (7).
6. Install three screws (12), three lock washers (13), three flat washers (14), and three nylon spacers (15).
7. Install two screws (8), two split lock washers (9), and two flat washers (10).
8. Verify O-ring (6) is in the base (5).
9. Apply silicone adhesive (item 2, WP0066 00) to mating surfaces of base (5) and body (7).
10. Install base using eight hex nuts (3), eight flat washers (4), eight screws (1), and eight flat washers (2).

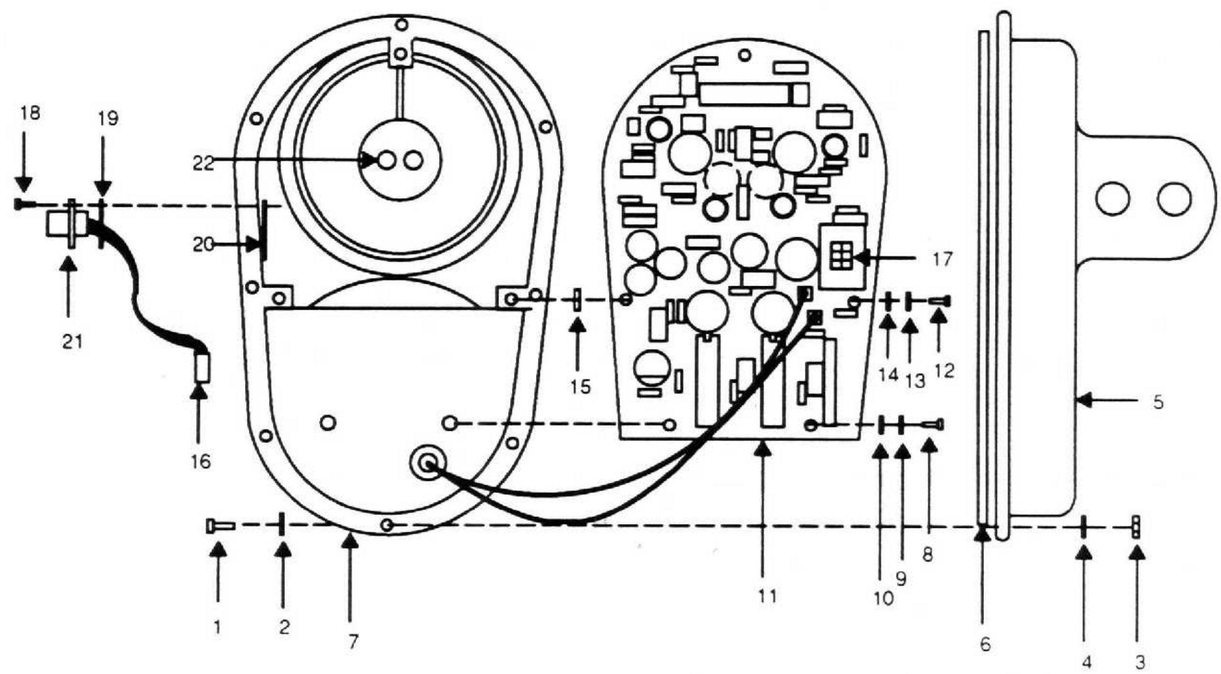


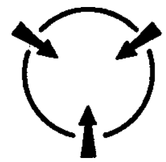
Figure 1. UTD Cable Assembly Removal and Installation

END OF WORK PACKAGE

UTD BULB SOCKET REMOVAL AND INSTALLATION

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



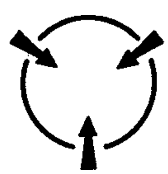
Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

Index

Initial Setup:	
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**Bulb Socket PN 28131300 or H989, Thread-lock adhesive, Teflon thread tape, Silicone Adhesive**
Equipment Condition:	**Place UTD on workbench with ESD capabilities.**

CAUTION

This assembly contains parts sensitive to damage by Electrostatic Discharge (ESD).



Use precautionary ESD procedures when touching, removing or inserting. Use static-free material to wrap the assembly for shipment or storage.

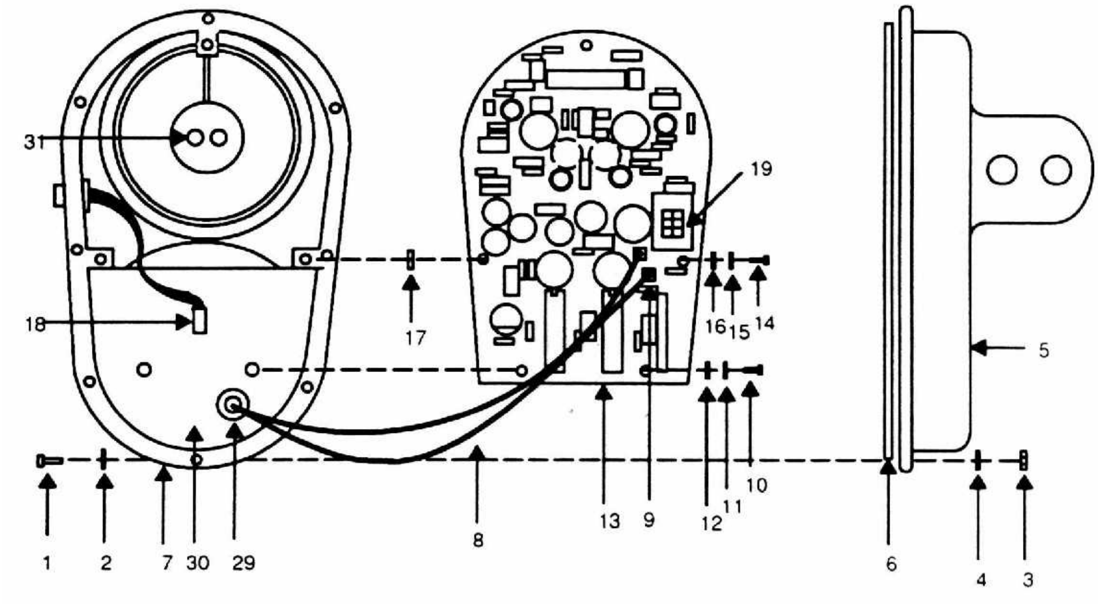
a. REMOVAL:

1. Remove eight screws (1), eight flat washers (2) eight hex nuts (3), and eight flat washers (4), from base (5).
2. Using a sharp knife, break seal and remove base (5) with O ring (6) from top body (7).
3. De-solder two connecting wires (8) from terminals (9).
4. Remove two screws (10), two split washers (11), and two flat washers (12) from lower section of PWA (13).

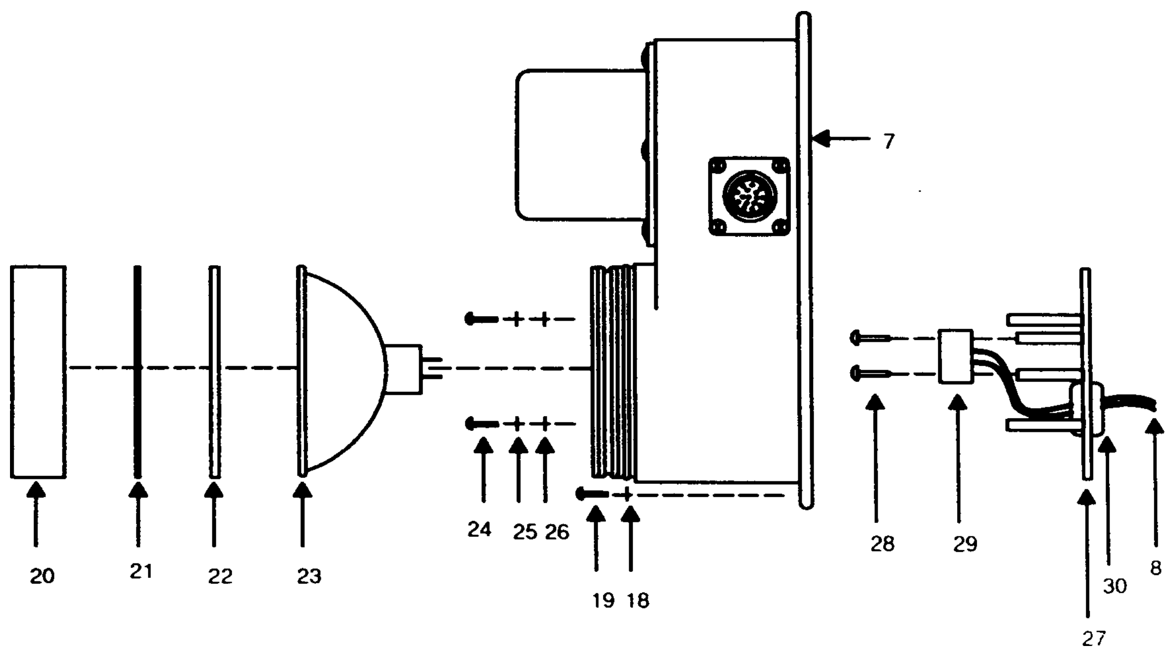
5. Remove three screws (14), three lock washers (15), three flat washers (16) and three nylon spacers (17) from top section of PWA (13) allowing removal of the PWA.
6. Remove two diode caps (31) from two holes.
7. Disconnect cable connector P1 (18) from bottom side of PWA (13) at J1 (19).
8. Remove infrared filter face cap (20) and O-ring (21).
9. Remove infrared filter (22).
10. Using connector pliers, remove bulb (23).
11. Remove three screws (24), three split lock washers (25) and three flat washers (26) allowing removal of bulb housing plate mounting (27) from top body (7).
12. Remove two screws (28).
13. Remove bulb socket (29) pulling wires (8) through grommet (30).

b. INSTALLATION:

1. Apply thread-lock adhesive on threads of hardware except step 8.
2. Pass connecting wires (8) of new bulb socket (29) through grommet (30).
3. Install bulb socket (29) with two screws (28).
4. Place bulb housing plate mounting (27) into top body (7).
5. Install three screws (24), three lock washers (25), and three flat washers (26).
6. Install bulb (23) into bulb socket (29).
7. Install infrared filter (22), and O-ring (21) into infrared filter face cap (20).
8. Install Teflon thread tape (item 4, WP0066 00) on threads for mounting infrared filter face cap (20).
9. Install infrared filter face cap (20).
10. Connect cable connector P1 (18) to bottom side of the PWA (13) at J1 (19).
11. Install two diode caps (31) into two holes.
12. Slowly position PWA (13), aligning two sensors on bottom side of PWA (13) into two diode caps (31) in top body (7).
13. Install three screws (14), three lock washers (15), three flat washers (16), and three nylon spacers (17).
14. Install two screws (10), two split lock washers (11), and two flat washers (12).
15. Solder two connecting wires (8) onto two terminals (9).
16. Verify O-ring (6) is in place in the base (5).
17. Apply silicone adhesive to mating surfaces of base (5) and body (7).
18. Install base (5) using eight hex nuts (3), eight flat washers (4), eight screws (1), and eight flat washers (2).



BOTTOM VIEW



SIDE VIEW

Figure 1. UTD Bulb Socket Removal and Installation

END OF WORK PACKAGE

UTD INFRARED FILTER
REMOVAL AND INSTALLATION

Index

Initial Setup:

Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**Filter PN 28131700, Teflon thread tape**
Equipment Condition:	**Place UTD on workbench.**

a. REMOVAL:

1. Remove infrared filter face cap (1) and O-ring (2).
2. Remove infrared filter (3) for replacement.

b. INSTALLATION:

1. Install Teflon thread tape on threads for mounting infrared filter face cap (1).
2. Verify O-ring (2) is in place in the infrared filter face cap (1).
3. Install new infrared filter (3) into top body (4).
4. Install infrared filter face cap (1).

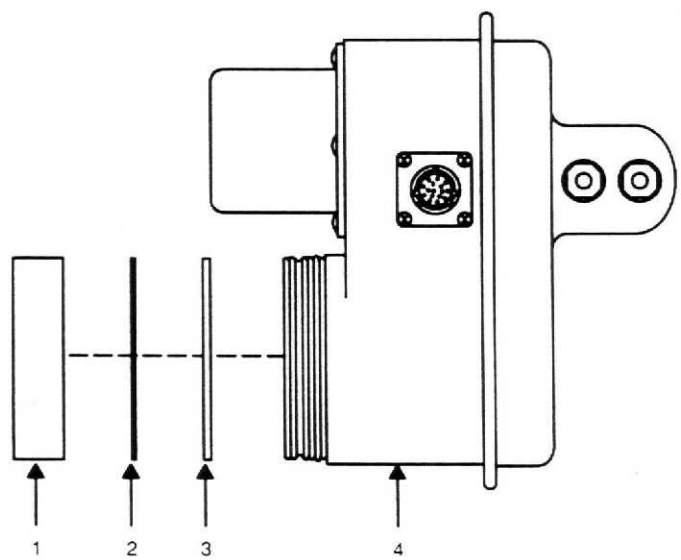


Figure 1. UTD Infrared Filter Removal and Installation

END OF WORK PACKAGE

UTD BULB
REMOVAL AND INSTALLATION

Index

Initial Setup:

Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**Bulb PN 28127400 or 1000000, Teflon thread tape**
Equipment Condition:	**Place UTD on workbench.**

a. REMOVAL:

1. Remove INFRARED filter face cap (1) and O-ring (2).
2. Remove infrared filter (3).
3. Remove bulb (4) for replacement.

b. INSTALLATION:

1. Install Teflon thread tape on threads for mounting infrared filter face cap (1).
2. Install bulb (4) into socket located in the top body (5).
3. Install infrared filter (3), and O-ring (2) into infrared filter face cap (1).
4. Install infrared filter face cap (1) into top body (5).

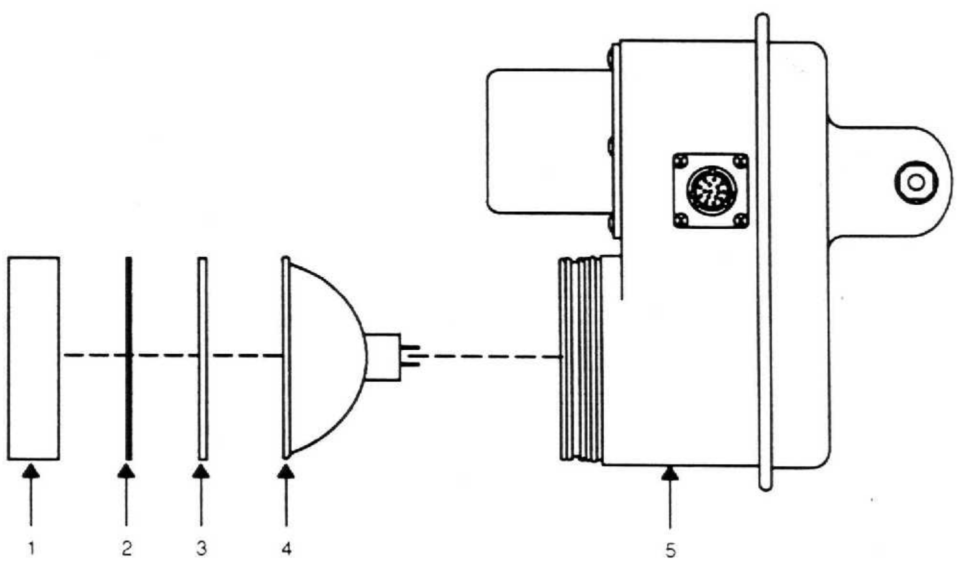


Figure 1. UTD Bulb Removal and Installation

END OF WORK PACKAGE

UTD WINDOW LENS
REMOVAL AND INSTALLATION

Index

Initial Setup:	
Personnel Required:	**TMDE Support Specialist**
Tools and Equipment:	**Tool Kit, Electricians**
Parts/Materials:	**Lens PN 28107501 or 55.1248, Thread-lock adhesive**
Equipment Condition:	**Place UTD on workbench.**

a. REMOVAL:

1. Remove six screws (1) and six flat washers (2) from top body (3).
2. Remove lens enclosure (4) from top body (3).
3. Remove window lens gasket (5).
4. Remove window lens (6) for replacement.

b. INSTALLATION:

1. Install window lens (6) into seat in top body (3).
2. Install window lens gasket (5).
3. Install lens enclosure (4) onto top body (3).
4. Install six screws (1) and six flat washers (2). Apply thread-lock adhesive to threads.

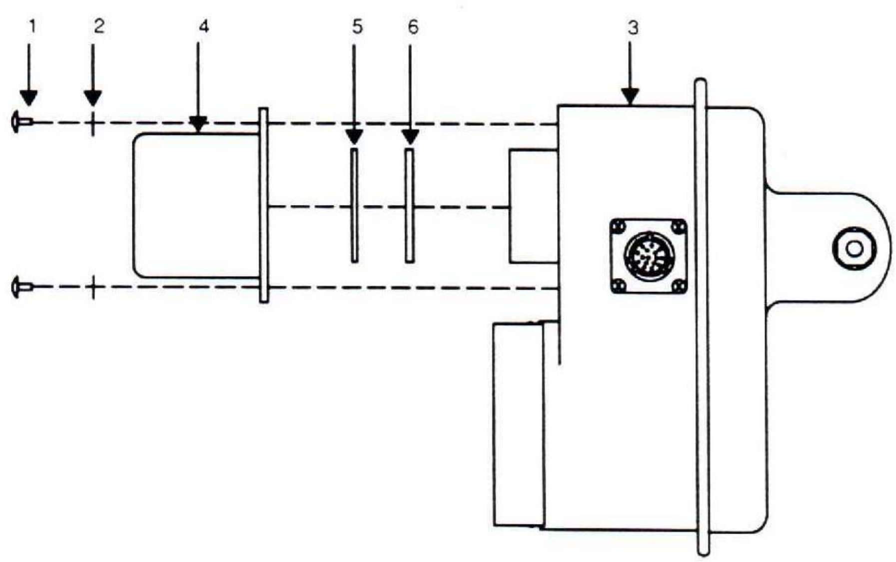


Figure 1. UTD Window Lens Removal and Installation

END OF WORK PACKAGE

UTD CONVEX LENS
REMOVAL AND INSTALLATION

Index

<u>Initial Setup</u>:

<u>Personnel Required</u>:	**TMDE Support Specialist**
<u>Tools and Equipment</u>:	**Tool Kit, Electricians**
<u>Parts/Materials</u>:	**Lens PN 28128500 or 10.0145, Thread-lock adhesive**
<u>Equipment Condition</u>:	**Place UTD on workbench.**

a. REMOVAL:

1. Remove six screws (1) and six flat washers (2) from top body (3).
2. Remove lens enclosure (4).
3. Remove window lens gasket (5) and window lens (6).
4. Remove three screws (7).
5. Remove lens retaining ring (8).
6. Remove O-ring (9).
7. Remove convex lens (10) for replacement.

b. INSTALLATION:

1. Install convex lens (10) into seat in top body (3).
2. Install O-ring (9).
3. Apply thread-lock adhesive on threaded hardware.
4. Install lens retaining ring (8) using three screws (7).
5. Install window lens (6).
6. Install window lens gasket (5).
7. Install lens enclosure (4).
8. Install six screws (1) and six flat washers (2).

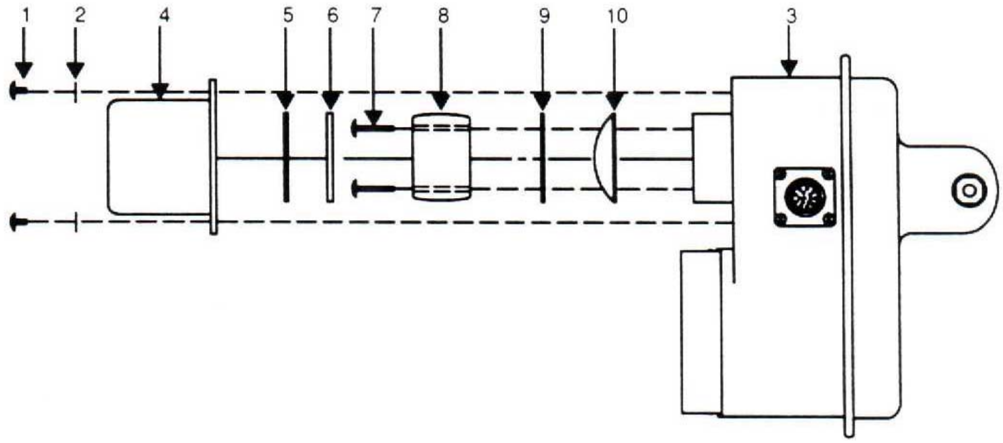


Figure 1. UTD Convex Lens Removal and Installation

END OF WORK PACKAGE

CHAPTER 5

SUPPORTING INFORMATION

REFERENCES

DICTIONARIES OF TERMS AND ABBREVIATIONS

JOINT PUBLICATION 1-02	DOD Dictionary of Military and Associated Terms
AR 310-50	Abbreviations and Brevity Codes

PUBLICATION INDEXES

DA PAM 25-30	Consolidated Index of Army Publications and Blank Forms

LOGISTICS AND STORAGE

TM 1-1500-204-23 (Series)	General Aircraft Maintenance Manual

MAINTENANCE OF SUPPLIES AND EQUIPMENT

AR 750-1	Army Materiel Maintenance Policy and Retail Maintenance Operations
DA PAM 738-751	Functional Users Manual for The Army Maintenance Management System-Aviation (TAMMS-A)
TM 43-0139	Painting Instructions for Army Materiel
TB 43-180	Interactive Electronic Technical Manual for Calibration and Repair Requirements for the Maintenance of Army Materiel

OTHER PUBLICATIONS

AR 420-90	Fire and Emergency Services
AR 55-38	Reporting of Transportation Discrepancies in Shipment
AR 735-11-2	Reporting of Supply and Packaging Discrepancies
DA PAM 25-40	Administrative Publication: Action Officers Guide
FM 4-25.11	First Aid
TM 750-244-1-4	Procedures for the Destruction of Aviation Ground Support Equipment (FSC 4920) to Prevent Enemy Use

MAINTENANCE ALLOCATION CHART

INTRODUCTION

The Army Maintenance System MAC

This introduction provides a general explanation of all maintenance and repair functions authorized at various maintenance levels under the standard Army Maintenance System concept.

The Maintenance Allocation Chart (MAC) designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions—Aviation Unit Maintenance (AVUM), Aviation Intermediate Maintenance (AVIM), and Depot Maintenance—to the end item or component will be consistent with the capacities and capabilities of the designated maintenance levels, which are shown on the MAC in column (4) as:

AVUM – corresponds to an “O” code in the Repair Parts and Special Tools List (RPSTL).

AVIM – corresponds to “F” code in the RPSTL.

DEPOT – corresponds to a “D” code in the RPSTL.

The maintenance to be performed at the depot and in the field is described as follows:

Aviation Unit Maintenance (AVUM) - AVUM activities will be staffed and equipped to perform high frequency “On-Aircraft” maintenance tasks required to retain or return equipment to a serviceable condition. The maintenance capability of the AVUM will be governed by the MAC and limited by the amount and complexity of Ground Support Equipment (GSE) facilities required, authorized manning strength, and critical skills available. The range and quantity of authorized spare modules/components will be consistent with the mobility requirements dictated by the air mobility concept. (Assignments of maintenance tasks to divisional company-sized aviation units will consider the overall maintenance capability of the division, the requirement to conserve personnel and equipment resources, and air mobility requirements.)

1. Company-Sized Aviation Units. Perform those tasks that consist primarily of preventative maintenance and maintenance repair and replacement functions associated with sustaining a high level of aircraft operational readiness. Perform maintenance inspections and servicing to include preflight, daily, intermediate, periodic (or phased) and special inspections as authorized by the MAC or higher headquarters. Identify the cause of equipment/system malfunctions using applicable technical manual troubleshooting instructions, Built-In Test Equipment (BITE), installed aircraft instruments, or Test, Measurement and Diagnostic Equipment (TMDE). Replace worn or damaged modules/components that do not require complex adjustments or system alignment and which can be removed/installed with available skills, tools, and ground support equipment. Perform operational and continuity checks and makes minor repairs to the electrical system. Inspect, service, and make operational, capacity, and pressure checks to hydraulic systems. Perform servicing, functional adjustments, and minor repair/replacement to the flight control, propulsion, power train, and fuel systems. Accomplish airframe repair that does not require extensive disassembly, jigging, or alignment. The manufacture of airframe parts will be limited to those items that can be fabricated with tools and equipment found in current airmobile tool and shop sets. Evacuate unserviceable modules/components and end items beyond the repair capability of AVUM to the support AVIM.
2. Less than Company-Sized Aviation Units. Aviation elements organic to brigade, group, battalion headquarters, and detachment-sized units are normally small and have less than ten aircraft assigned. Maintenance tasks performed by these units will be those which can be accomplished by the aircraft crew chief or assigned aircraft repairman and will normally be limited to preventative maintenance, inspections, servicing, spot painting, module/component fault diagnosis, and replacement of selected modules/components. Repair functions will normally be accomplished by the support AVIM unit.

Aviation Intermediate Maintenance (AVIM) – United States Army TMDE Support Group (USATSG) provides AVIM support. Authorized maintenance includes replacement and repair of modules/components and end items that can be accomplished efficiently with available skills, tools, and equipment. USATSG inspects, troubleshoots, tests, diagnoses, repairs, adjusts, calibrates, and aligns system modules and components.

1. Provides mobile, responsive “one-stop” maintenance support. (Maintenance functions that are not conducive to sustaining air mobility will be assigned to depot maintenance.)

2. May perform all maintenance functions authorized to be done at AVUM. Repair of equipment for return to user will emphasize support of operational readiness requirements. Authorized maintenance includes replacement and repair of modules/components and end items that can be accomplished efficiently with available skills, tools, and equipment.
3. Establishes the Direct Exchange (DX) program for AVUM units by repairing selected items for return to stock when such repairs cannot be accomplished at the AVUM level.
4. Inspects, troubleshoots, performs diagnostic tests, repairs, adjusts, calibrates, and aligns aircraft system modules/components. AVIM units will have the capability to determine the serviceability of specified modules/components removed prior to the expiration of the Time Between Overhaul (TBO) or finite life. Module/component disassembly and repair will support the DX program and will normally be limited to tasks requiring cleaning and the replacement of seals, fittings, and items of common hardware. Airframe repair and fabrication of parts will be limited to those maintenance tasks that can be performed with available tools and test equipment. Unserviceable reparable modules/components and end items that are beyond the capability of AVIM to repair will be evacuated to depot maintenance.
5. Performs aircraft weight and balance inspections and other special inspections that exceed AVUM capability.
6. Provides quick response maintenance support, including aircraft recovery and air evacuation, on-the-job training, and technical assistance through the use of mobile maintenance contact teams.
7. Maintains authorized operational readiness float aircraft.
8. Provides collection and classification services for serviceable/unserviceable material.
9. Operates a cannibalization activity in accordance with AR 710-2 (Supply Policy Below the Wholesale Level) and DA PAM 710-2-2 (Supply Support Activity System Manual Procedures). The aircraft maintenance company within the maintenance battalion of a division will perform AVIM functions consistent with air mobility requirements and conservation of personnel and equipment resources. Additional intermediate maintenance support will be provided by the supporting non-divisional AVIM unit.

Depot - The printed wiring assemblies (PWAs) are sent back to the depot/factory for repairs.

The Tools and Test Equipment Requirements work package (immediately following the MAC) lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from the MAC.

The Remarks (immediately following the Tools and Test Equipment Requirements) contain supplemental instructions and explanatory notes for a particular maintenance function.

Use of the MAC

NOTE

Approved item names are used throughout this MAC. Generic terms/nomenclature (if any) are expressed in parentheses and are not to be considered as official terminology.

This MAC assigns maintenance functions to the lowest level of maintenance, based on past experience and the following considerations:

Skills available

Work time required

Tools and test equipment required and/or available

Only the lowest level of maintenance authorized to perform a maintenance function is indicated. If the lowest maintenance level cannot perform all tasks of any single maintenance function (e.g., test, repair), then the higher maintenance level(s) that can accomplish additional tasks will also be indicated.

A maintenance function assigned to a maintenance level will automatically be authorized to be performed at any higher maintenance level.

A maintenance function that cannot be performed at the assigned level of maintenance for any reason may be evacuated to the next higher maintenance level. Higher maintenance levels will perform the maintenance functions of lower maintenance levels when required by the commander who has the authority to direct such tasking.

The assignment of a maintenance function will not be construed as authorization to carry the related repair parts or spares in stock. Information to requisition or otherwise secure the necessary repair parts will be as specified in the associated RPSTL.

Normally there will be no deviation from the assigned level of maintenance. In cases of operational necessity, at the request of a lower maintenance level and on a one-time basis, transfer of maintenance functions to the lower level may be accomplished by specific authorization of the maintenance officer of the higher level of maintenance to which the function is assigned. The special tools, equipment, etc. required by the lower level of maintenance to perform this function will be furnished by the maintenance level to which the function is assigned. This transfer of a maintenance function to a lower maintenance level does not relieve the higher level of the responsibility for the function. The higher level of maintenance will provide technical supervision and inspection of the function being performed at the lower level.

Maintenance Functions

Maintenance functions are limited to and defined as follows:

1. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g. by sight, sound or feel).
2. Test. To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.
3. Service. Operations required periodically to keep an item in proper operating condition; e.g., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.
4. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper position, or by setting the operating characteristics to specified parameters.
5. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.
6. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments of test, measuring, and diagnostic equipment used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.
7. Remove/Install. To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of placing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.
8. Replace. To remove an unserviceable item and install a serviceable counterpart in its place. "Replace" is authorized by the MAC and the assigned maintenance level is shown as the third position code of the Source, Maintenance and Recovery (SMR) code.
9. Repair. The application of maintenance services, including fault location/troubleshooting, removal/installation, and disassembly/assembly procedures, and maintenance actions to identify trouble and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

NOTE

The following definitions are applicable to the “repair” maintenance function:

Services–Inspect, test, service, adjust, align, calibrate, and/or replace.

Fault location/troubleshooting–The process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or Unit Under Test (UUT).

Disassembly/assembly – The step-by-step breakdown (taking apart) of a spare/functional group coded item to the level of its least component that is assigned an SMR code for the level of maintenance under consideration.

Actions – Welding, grinding, riveting, straightening, facing, machining, and/or resurfacing.

10. Overhaul. That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.
11. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (e.g., hours/miles) considered in classifying Army equipment/components.

Explanation of Columns in the MAC

Column (1) – Group Number. Column (1) lists Functional Group Code (FGC) numbers, the purpose of which is to identify maintenance of significant components, assemblies, subassemblies, and modules with the Next Higher Assembly (NHA). End item group number shall be "00".

Column (2) – Component/Assembly. Column (2) contains the item names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

Column (3) – Maintenance Function. Column (3) lists the functions to be performed on the item listed in Column (2). (For detailed explanation of these functions, refer to “Maintenance Functions” outlined above.)

Column (4) – Maintenance Level. The Maintenance Levels AVUM, AVIM and DEPOT are listed on the MAC with individual columns that include work times for maintenance functions at each maintenance level. Work time presentations such as “0.1” indicate the average time (expressed as man-hours in whole hours or decimals) it requires a maintenance level to perform a specified maintenance function. If a work time has not been established, the columnar presentation will indicate “—.” Maintenance levels higher than the level of maintenance indicated are authorized to perform the indicated function.

Column (5) – Tools and Equipment Reference Code. Column (5) specifies, by code, those common tool sets (not individual tools), common TMDE, and special tools, special TMDE and special support equipment required to perform the designated function.

Column (6) – Remarks Code. When applicable, this column contains a letter code, in alphabetic order, which is keyed to the remarks.

Explanation of Columns in Tool and Test Equipment Requirements

Column (1) – Tool or Test Equipment Reference Code. The tool or test equipment reference code correlates with a code used in column (5) of the MAC.

Column (2) – Maintenance Level. The lowest level of maintenance authorized to use the tool or test equipment.

Column (3) – Nomenclature. Name or identification of the tool or test equipment.

Column (4) – National Stock Number (NSN). The NSN of the tool or test equipment.

Explanation of Columns in the Remarks

Column (1) – Remarks Code. The code recorded in column (6) of the MAC.

Column (2) – Remarks. This column lists information pertinent to the maintenance function being performed as indicated in the MAC.

MAINTENANCE ALLOCATION CHART – AVIATION VIBRATION ANALYZER (NSN: 6625-01-282-3746)

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINT. CATEGORY AVUM	AVIM*	DEPOT	(5) TOOLS AND EQUIPMENT	(6) REMARKS
00	AVA SYSTEM						
01	CONTROL AND DISPLAY UNIT (CADU)	Inspect	0.1				A
		Test	0.2			4	B,C
		Replace	0.1	0.1		3	E
		Repair		0.1		1-2	
0101	CADU PWA	Inspect		0.1			A
		Replace		0.6		3	E
		Repair			X	1-2	
02	DATA ACQUISITION UNIT (DAU)	Inspect	0.1				A
		Test	0.2				B
		Replace		0.1		3	C,E
		Repair		0.1		1-2-5	
0201	DAU POWER SUPPLY PWA	Inspect		0.1			A
		Replace		0.5		3	E
		Repair			X	1-2	
0202	DAU PROCESSOR PWA	Inspect		0.1			A
		Replace		0.5		3	E
		Repair			X	1-2	
0203	DAU ACQUISITION PWA	Inspect		0.1			A
		Replace		0.5		3	E
		Repair			X	1-2	
0204	FRONT PANEL ASSEMBLY	Inspect		0.1			A
		Replace	0.1	0.5		3	E
		Repair		0.5		1-3	
0205	CARD CAGE ASSEMBLY	Inspect		0.1			A
		Replace		0.5		3	E
		Repair		0.5		1-2	
03	UNIVERSAL TRACKING DEVICE (UTD)	Inspect	0.1				A
		Test		0.2		1-2	
		Replace		0.1		3	C,E
		Repair		0.1			
04	TEST CABLE ASSEMBLIES	Inspect	0.2				A
		Test		0.2		1	C
		Replace		0.2		3	
		Repair		0.1		3-4	D
05	TEST ADAPTER KITS	Inspect	0.2				A
		Replace		0.1		3	E
		Repair		0.1		3-4	
06	ACCESSORIES	Inspect	0.1				A
		Replace		0.1		3	E
		Repair		0.1		3-4	

* U. S. Army Test, Measurement and Diagnostic Equipment Support Group (USATSG)

TOOL AND TEST EQUIPMENT REQUIREMENTS

(1) TOOL OR TEST EQUIP. REF CODE	(2) MAINTENANCE CATEGORY	(3) NOMENCLATURE	(4) NATIONAL / NATO STOCK NUMBER
1	AVIM-DEPOT	Cable, Test Set	6150-01-356-5825
2	AVIM-DEPOT	Test Set, Electronic	6625-01-347,8667
3	AVIM – AVUM	Tool Kit, Electricians	5180-01-195-0855
4	AVIM	Multimeter	
5	AVIM	IBM Compatible Computer	

MAC REFERENCE CODE AND REMARKS

(1) REFERENCE CODE	(2) REMARKS / NOTES
A	Visual inspection without disassembly
B	Conduct Self-Test
C	To verify repair and that unit operates within the system.
D	Repairable cable assemblies will only be listed in this section of the MAC.
E	All repair and replacement actions performed are limited to authorized items listed below:

Reference code D:

NOMENCLATURE	PART NUMBER	MFG.	QTY.
Cable Assembly	29104700	1G3P5	1
Cable Assembly	29325601	1G3P5	1
Cable Assembly	29325701	1G3P5	1
Cable Assembly	29105403	1G3P5	1
Cable Assembly	29105605	1G3P5	1
Cable Assembly	29105600	1G3P5	1
Cable Assembly	29317100	1G3P5	1
Cable Assembly	29304600	1G3P5	1
Cable Assembly	29312800	1G3P5	1
Cable Assembly	29085700	1G3P5	1
Cable Assembly	29283200	1G3P5	1

Reference code E:

TASK NO.	PART NUMBER	DESCRIPTION
CADU		
0022 00	29324300	Strap Assembly
0035 00	29324000	Battery Pack
0036 00	29324602	CADU PWA
0037 00	29324501	LCD Assembly
0038 00	29323200	Lens
0038 00	29324400	Lens Gasket
0039 00	29323400	Keypad
0040 00	29324200	Cable Harness Assembly

MAC REFERENCE CODE AND REMARKS (cont)

	TASK NO.	PART NUMBER	DESCRIPTION
	DAU		
	0023 00	PN GMA15	Fuse
	0024 00	MS91528-1 C3B	Tracker Mode Knob
	0041 00	28031302	Rubber Bumper
	0042 00	28113202	Fan
	0043 00	29111900	Power Supply PWA
	0044 00	29356504	Processor PWA
	0045 00	29111100	Acquisition PWA
	0046 00	29325900	Front Panel Assembly
	0047 00	28055202	Card Guide
	0048 00	28110700	LED Assembly
	0049 00	29112800	PWA Back plane
	0050 00	29109800	Card Cage
	UTD		
	0051 00	29322500	PWA
	0052 00	29310800	Cable Assembly
	0053 00	28131300	Bulb Socket
	0054 00	28131700	Infrared Filter
	0055 00	28127400	Bulb
	0056 00	28107501	Window Lens
	0057 00	28128500	Convex Lens
	SCALE		
	0026 00	10693400	Battery

END OF WORK PACKAGE

REPAIR PARTS AND SPECIAL TOOLS LIST

INTRODUCTION

Scope

This RPSTL lists and authorizes spare and repair parts; special tools; special test, measurement, and diagnostic equipment (TMDE); and other special support equipment required for performance of AVUM/AVIM maintenance of the Test Set, Aviation Vibration Analyzer (AVA). It authorizes the requisitioning, issue, and disposition of spares, repair parts and special tools as indicated by the source, maintenance and recoverability (SMR) codes.

General

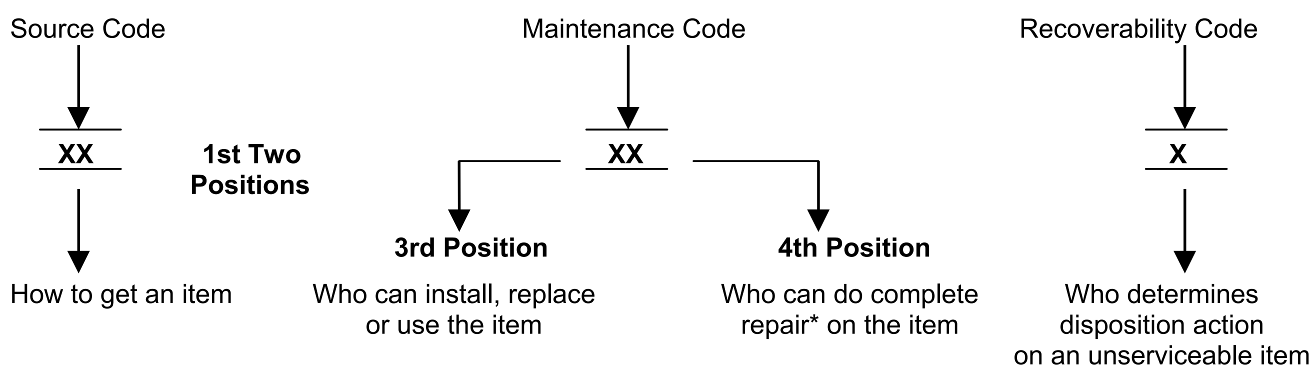
In addition to the Introduction work package, this RPSTL is divided into the following work packages:

1. Repair Parts List Work Packages. Work packages containing lists of spares and repair parts authorized by this RPSTL for use in the performance of maintenance. These work packages also include parts that must be removed for replacement of the authorized parts. Parts lists are composed of functional groups in ascending alphanumeric sequence, with the parts in each group listed in ascending figure and item number sequence. Sending units, brackets, filters, and bolts are listed with the component they mount on. Bulk materials are listed in item name sequence. Repair parts kits are listed separately in their own functional group and work package. Repair parts for repairable special tools are also listed in a separate work package. Items listed are shown on the associated illustration(s)/figure(s).
2. Special Tools List Work Packages. Work packages containing a list of special tools, special TMDE, and special support equipment authorized by this RPSTL (as indicated by Basis of Issue (BOI) information in the DESCRIPTION AND USABLE ON CODE (UOC) column). Tools that are components of common tool sets and/or class VII are not listed.
3. Cross-Reference Indexes Work Packages. There are two cross-reference indexes work packages in this RPSTL: the National Stock Number (NSN) Index work package and the Part Number (PN) Index work package. A list, in National Item Identification Number (NIIN) sequence, of all National Stock Numbered items appearing in the listing, followed by a list in alphanumeric sequence of all part numbers appearing in the listings. National stock numbers and part numbers are cross-referenced to each illustration figure and item number appearance.

Explanation of Columns in the RPSTL Work Packages

ITEM NO. (Column (1)). Indicates the number used to identity items called out in the illustration.

SMR CODE (Column (2)). The SMR code is a 5-position code containing supply/requisitioning information, maintenance level authorization criteria, and disposition instruction, as shown in the following breakout:



*Complete Repair: Maintenance capacity, capability, and authority to perform all corrective maintenance tasks of the "Repair" function in a use/user environment in order to restore serviceability to a failed item.

1. Source Code. The source code tells you how to get an item needed for maintenance, repair, or overhaul of an end item/equipment. Explanations of source codes follow:

Source Code	Application/Explanation
PA, PB, PC**, PD, PE, PF, PG	Stocked items: use the applicable NSN to request/requisition items with these source codes. They are authorized to the category indicated by the code entered in the 3rd position of the SMR code. **NOTE**: Items coded PC are subject to deterioration.
KD, KF, KB	Items with these codes are not to be requested/requisitioned individually. They are part of a kit that is authorized to the maintenance category indicated in the 3rd position of the SMR code. The complete kit must be requisitioned and applied.
MO (made at unit/AVUM Level) MF (made at DS/AVIM Level) MH (made at GS Level) ML (made at SRA) MD (made at Depot)	Items with these codes are not to be requested/requisitioned individually. They must be made from bulk material which is identified by part number in the DESCRIPTION AND USABLE ON CODE (UOC) column and listed in the Bulk Material group of the repair parts list in this RPSTL. If the item is authorized to you by the 3rd position code of the SMR code, but the source code indicates it is made at a higher level, order the item from the higher level of maintenance.
AO (assembled by unit/AVUM Level) AF (assembled by DS/AVIM Level) AH (assembled by GS Level) AL (assembled by SRA) AD (assembled by Depot)	Items with these codes are not to be requested/requisitioned individually. The parts that make up the assembled item must be requisitioned or fabricated and assembled at the level of maintenance indicated by the source code. If the 3rd position code of the SMR code authorizes you to replace the item, but the source code indicates the item is assembled at a higher level, order the item from the higher level of maintenance.
XA-	Do not requisition an "XA" coded item. Order its next higher assembly. (Also refer to the **NOTE** below.)
XB-	If an "XB" item is not available for salvage, order it using the Commercial and Government Entity (CAGE) and part number given.
XC-	Installation drawing, diagram, instruction sheet, field service drawing, that is identified by manufacturer's part number.
XD-	Item is not stocked. Order an "XD" coded item through normal supply channels using the CAGE and part number given if no NSN is available.
	NOTE: Cannibalization or controlled exchange, when authorized, may be used as a source of supply for items with the above source codes, except for those source coded "XA" or those aircraft support items restricted by requirements of AR 750-1.

2. Maintenance Code. The maintenance code tells you the level(s) of maintenance authorized to USE and REPAIR support items. The maintenance codes are entered in the third and fourth positions of the SMR Code as follows:

Third position. The maintenance code entered in the third position tells you the lowest maintenance level authorized to remove, replace, and use an item. The maintenance code entered in the third position will indicate authorization to one of the following levels of maintenance.

Maintenance Code	Application/Explanation
C	-Crew or operator maintenance done within organizational or aviation unit maintenance.
O	-Organizational or aviation unit category can remove, replace and use the item.
F	-Direct support or aviation intermediate level can remove, replace and use the item.
H	- General support level can remove, replace, and use the item
L	- Specialized repair activity can remove, replace, and use the item
D	- Depot level can remove, replace, and use the item

Fourth position. The maintenance code entered in the fourth position tells whether or not the item is to be repaired and identifies the lowest maintenance level with the capability to do complete repair (i.e., perform all authorized repair functions).

NOTE

Some limited repair may be done on the item at a lower level of maintenance, if authorized by the Maintenance Allocation Chart (MAC) and SMR codes.

Maintenance Code	Application/Explanation
O	- Organizational or (aviation unit) is the lowest level that can do complete repair of the item.
F	- Direct support or aviation intermediate is the lowest level that can do complete repair of the item.
H	- General support is the lowest level that can do complete repair of the item.
L	- Specialized repair activity (designates the specialized repair activity) is the lowest level that can do complete repair of the item.
D	- Depot is the lowest level that can do complete repair of the item.
Z	- Non-repairable. No repair is authorized.
B	- No repair is authorized. (No parts or special tools are authorized for the maintenance of a "B" coded item.) However, the item may be reconditioned by adjusting, lubricating, etc., at the user level.

3. Recoverability Code. Recoverability codes are assigned to items to indicate the disposition action on unserviceable items. The recoverability code is entered in the fifth position of the SMR Code as follows:

Recoverability Code	Application/Explanation
Z	- Non-repairable item. When unserviceable, condemn and dispose of the item at the level of maintenance shown in 3rd position of SMR Code.
O	- Repairable item. When uneconomically repairable, condemn and dispose of the item at organizational or aviation unit level.
F	- Repairable item. When uneconomically repairable, condemn and dispose of the item at the general support level.
H	- Repairable item. When uneconomically repairable, condemn and dispose of the item at the general support level
D	- Repairable item. When beyond lower level repair capability, return to depot. Condemnation and disposal of item not authorized below depot level.
L	- Repairable item. Condemnation and disposal not authorized below specialized repair activity (SRA).
A	- Item requires special handling or condemnation procedures because of specific reasons (e.g., precious metal content, high dollar value, critical material, or hazardous material). Refer to appropriate manuals/directives for specific instructions.

CAGE (Column (3)). The Commercial and Government Entity (CAGE) code is a 5-digit code that is used to identify the manufacturer, distributor, or Government agency/activity that supplies the item.

PART NUMBER (Column (4)). Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements to identify an item or range of items.

NOTE:

When you use an NSN to requisition an item, the item you receive may have a different part number from the part ordered.

DESCRIPTION AND USABLE ON CODE (Column (5)). This column includes the following information:

1. The Federal item name and, when required, a minimum description to identify the item.
2. The physical security classification of the item is indicated by the parenthetical entry (insert applicable physical security classification abbreviation, e.g., Phy Sec C1 (C) -Confidential, Phy Sec C1 (S) - Secret, Phy Sec C1 (T) Top Secret).
3. Items that are included in kits and sets are listed below the name of the kit or set
4. Spare/repair pans that make up an assembled item are listed immediately following the assembled item line entry.
5. Part numbers for bulk materials are referenced in this column in the line item entry for the item to be manufactured/fabricated.
6. When the item is not used with all serial numbers of the same model, the effective serial numbers are shown on the last line of the description (before UOC)
7. The usable on code, when applicable (see paragraph 5, Special information).
8. In the Special Tools List work package, the basis of issue (BOI) appears as the last lines in the entry for each special tool, special TMDE, and other special support equipment. When density of equipment supported exceeds density spread indicated in the basis of issue, the total authorization is increased proportionately.
9. The statement "END OF FIGURE" appears just below the last item description in Column 5 for a given figure.

QTY (Column (6)). The QTY (quantity per figure) indicates the quantity of the item used in the breakout shown on the illustration/figure, which is prepared for a functional group, sub-functional group or an assembly. A "V" appearing in this column instead of a quantity indicates that the quantity is variable and may vary from application to application.

Explanation of Cross-Reference Indexes Work Packages Format and Columns

NATIONAL STOCK NUMBER (NSN) WORK PACKAGE.

1. STOCK NUMBER Column. This column lists the NSN by National Item Identification Number (NIIN) sequence. The NIIN consists of the last nine digits of the NSN.

   example: 5305-01-674-1467 - NIIN

   When using this column to locate an item, ignore the first 4 digits of the NSN. However, the complete NSN should be used when ordering items by stock number.
2. FIG. Column. This column lists the number of the figure where the item is identified/located. The figures are in numerical order in the repair parts list and special tools list work packages.
3. ITEM Column. The item number identifies the item associated with the figure listed in the adjacent figure column. This item is also identified by the NSN listed on the same line.

PART NUMBER INDEX WORK PACKAGE. Part numbers in this index are listed in ascending alphanumeric sequence (i.e., vertical arrangement of letter and number combination which places the first letter or digit of each group in order A through Z, followed by the numbers 0 through 9 and each following letter or digit in like order).

1. CAGE Column. The Commercial and Government Entity (CAGE) is a 5-digit numeric code used to identify the manufacturer, distributor, or Government agency, etc. that supplies the item. CAGE consolidates the former H4 Federal Supply Code for Manufacturers (FSCM) and H8 Federal Supply Code for Non-Manufacturers (FSCNM)
2. PART NUMBER Column. Indicates the primary number used by the manufacturer (individual, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements to identify an item or range of items

3. STOCK NUMBER Column. This column lists the NSN for the associated part number and manufacturer identified in the PART NUMBER and FSCM columns to the left.

4. FIG. Column. This column lists the number of the figure where the item is identified/located in the repair parts list and special tools list work packages.

5. ITEM Column. The item number is that number assigned to the item as it appears in the figure referenced in the adjacent figure number column.

SPECIAL INFORMATION

1. USABLE ON CODE. The UOC appears in the lower left corner of the Description column heading. Usable on codes are shown as "UOC: ……" in the Description Column (justified left) on the first line under the applicable item description/nomenclature. Uncoded items are applicable to all models. Identification of the UOCs used in the RPSTL are:

Code	Used On
N/A	N/A

2. FABRICATION INSTRUCTIONS. Bulk materials required to manufacture items are listed in the Bulk Material Functional Group of this RPSTL. Part number for bulk materials are also referenced in the description column of the line item entry for the item to be manufactured/fabricated.

3. ASSEMBLY INSTRUCTIONS. N/A

4. KITS. Line item entries for repair parts kits appear in a group in the repair parts list work package.

5. INDEX NUMBERS. Items that have the word BULK in the figure column will have an index number shown in the item number column. This index number is a cross-reference between the NSN/PN index work packages and the bulk material list in the repair parts list work package.

6. ASSOCIATED PUBLICATIONS. N/A

How to Locate Repair Parts

WHEN THE NSNs OR P/Ns ARE NOT KNOWN

FIRST. Using the table of contents, determine the assembly group or subassembly group to which the item belongs. This is necessary since figures are prepared for assembly and subassembly groups, and listings are divided into the same groups.

SECOND. Find the figure covering the assembly group or subassembly group to which the item belongs.

THIRD. Identify the item on the figure and note the item number(s).

FOURTH. Look in the repair parts list work packages for the figure and item numbers. The NSNs and P/Ns are on the same line as the associated item numbers.

FIFTH. Refer to the Part Number Index to find the NSN, if assigned.

WHEN NSN IS KNOWN

FIRST. If you have the NSN, look in the Stock Number Column of the NSN work package. The NSN is arranged in NIIN sequence. Note the figure and item number next to the NSN.

SECOND. Turn to the figure and locate the item number. Verify that the item is the one you are looking for.

WHEN P/N IS KNOWN

FIRST. If you have the P/N and not the NSN, look in the Part Number column of the P/N index work package. Identify the figure and item number.

SECOND. Look up the item on the figure in the applicable repair parts list work package.

REPAIR PARTS AND SPECIAL TOOLS LIST
ITEM LISTING

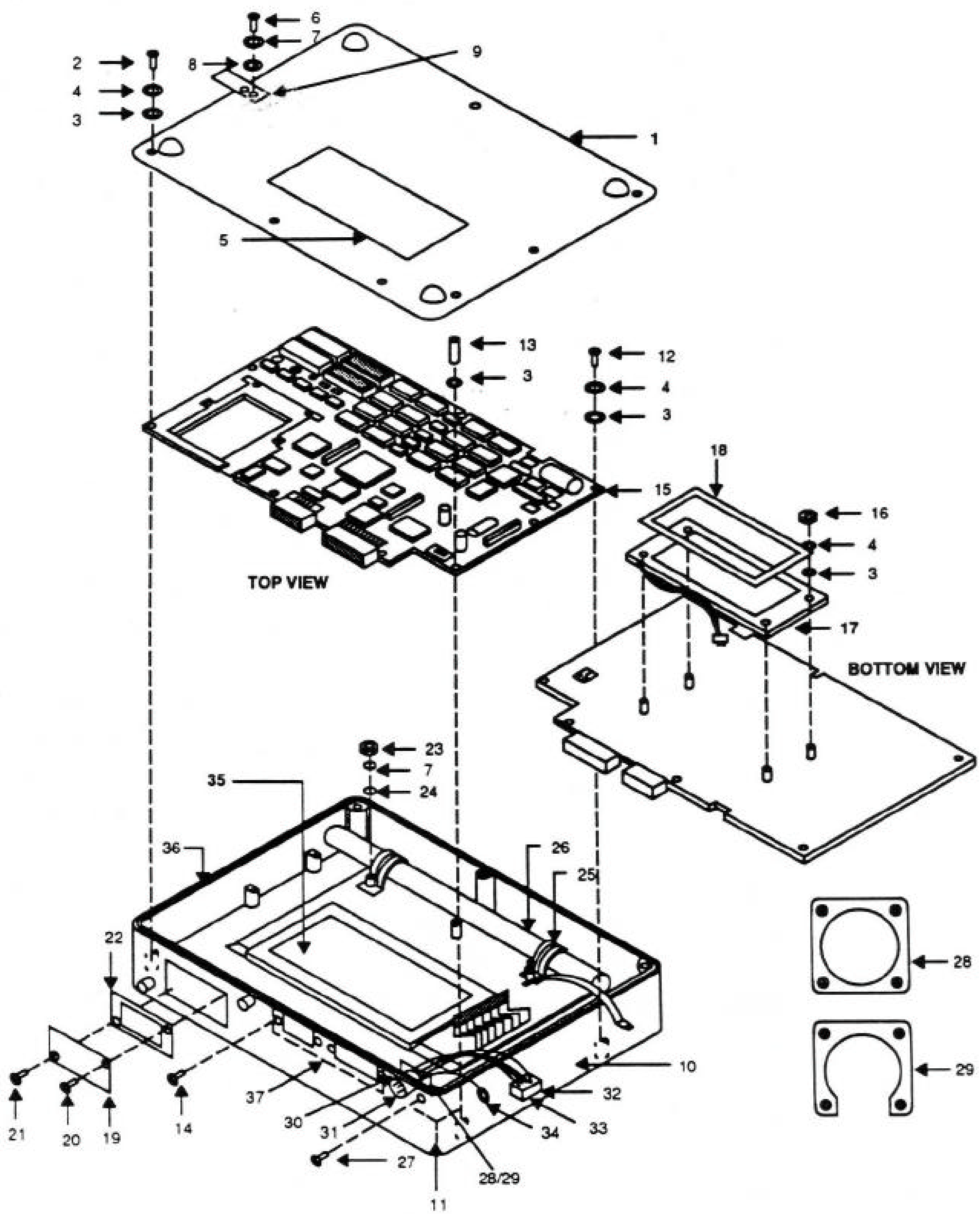


Figure 1. Control and Display Unit (CADU) (29314106)

Figure 1. Group 01 Control and Display Unit (CADU) (29314106)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODE (UOC)	(6) QTY
	PAOLL	1G3P5	29314106	CADU Assembly	1
1	XDFZZ	1G3P5	29306300	.Case, Bottom	1
2	PAFZZ	96906	MS51957-16	.Screw, Pan Head	10
3	PAFZZ	96906	MS15795-803	.Washer, Flat	22
4	PAFZZ	96906	MS35338-135	.Washer, Lock	16
5	XDFZZ	1G3P5	29327200	.Ident Plate	1
6	PAFZZ	96906	MS51957-27	.Screw, Pan Head	1
7	PAFZZ	96906	MS35338-136	.Washer, Lock	3
8	PAFZZ	96906	MS3215-4012	.Ring, Retaining	1
9	XDOZZ	1G3P5	29324300	.Strap Assembly	1
10	XDFZZ	1G3P5	29306400	.Case, Top	1
11	XDFZZ	1G3P5	29323400	.Keypad	1
12	PAFZZ	96906	MS51957-14	.Screw, Pan Head	3
13	XDFZZ	1G3P5	29329600	.Standoff	6
14	PAFZZ	81349	M24308/26-1	.Screw, Lock Assembly	4
15	PBFLL	1G3P5	29324607	.PWA, CADU	1
16	PAFZZ	80205	NAS671C4	.Nut, Hex	5
17	PAFFF	1G3P5	29324501	.LCD Assembly	1
18	XDFZZ	1G3P5	29324400	.Gasket	1
19	XDFFF	1G3P5	29323500	.Door, CCM	1
20	XAFZZ	94222	47-60-101-50	.Fastener, Panel	1
21	XAFZZ	94222	47-63-101-50	.Fastener, Panel	1
22	XDFZZ	1G3P5	29491200	.Gasket	1
23	XDFZZ	80205	NAS671C6	.Nut, Hex	2
24	PAFZZ	96906	MS15795-805	.Washer, Flat	4
25	XDFZZ	OGT95	JM44LC1216HR	.Clamp (SI P/N 28131600)	2
26	PAFZZ	1G3P5	29324000	.Battery Pack	1
27	PAFZZ	96906	MS24693-C4	.Screw, Flat Head	4
28	PAFZZ	77820	10-101949-14	.Gasket (SI P/N 28132506)	1
29	XDFZZ	OA554	AT327-14	.Connector Nut Plate (SI P/N 29084803)	1
30	XDFFF	1G3P5	29324200	.Harness Assembly	1
31	XAFZZ	96906	MS3112E14-18PW	..Connector Plug	1
32	XAFZZ	00779	87631-6	..Connector Housing (SI P/N 28091212)	1
33	XAFZZ	00779	1-87523-8	..Contact, Female (SI P/N 28091203)	7
34	PAFZZ	96906	MS25036-101	..Lug, Terminal	1
35	XDFZZ	1G3P5	29323200	.Lens	1
36	XDFZZ	1G3P5	29324100	.O-Ring	1
37	XDFZZ	1G3P5	29331300	.Gasket	1

END OF FIGURE

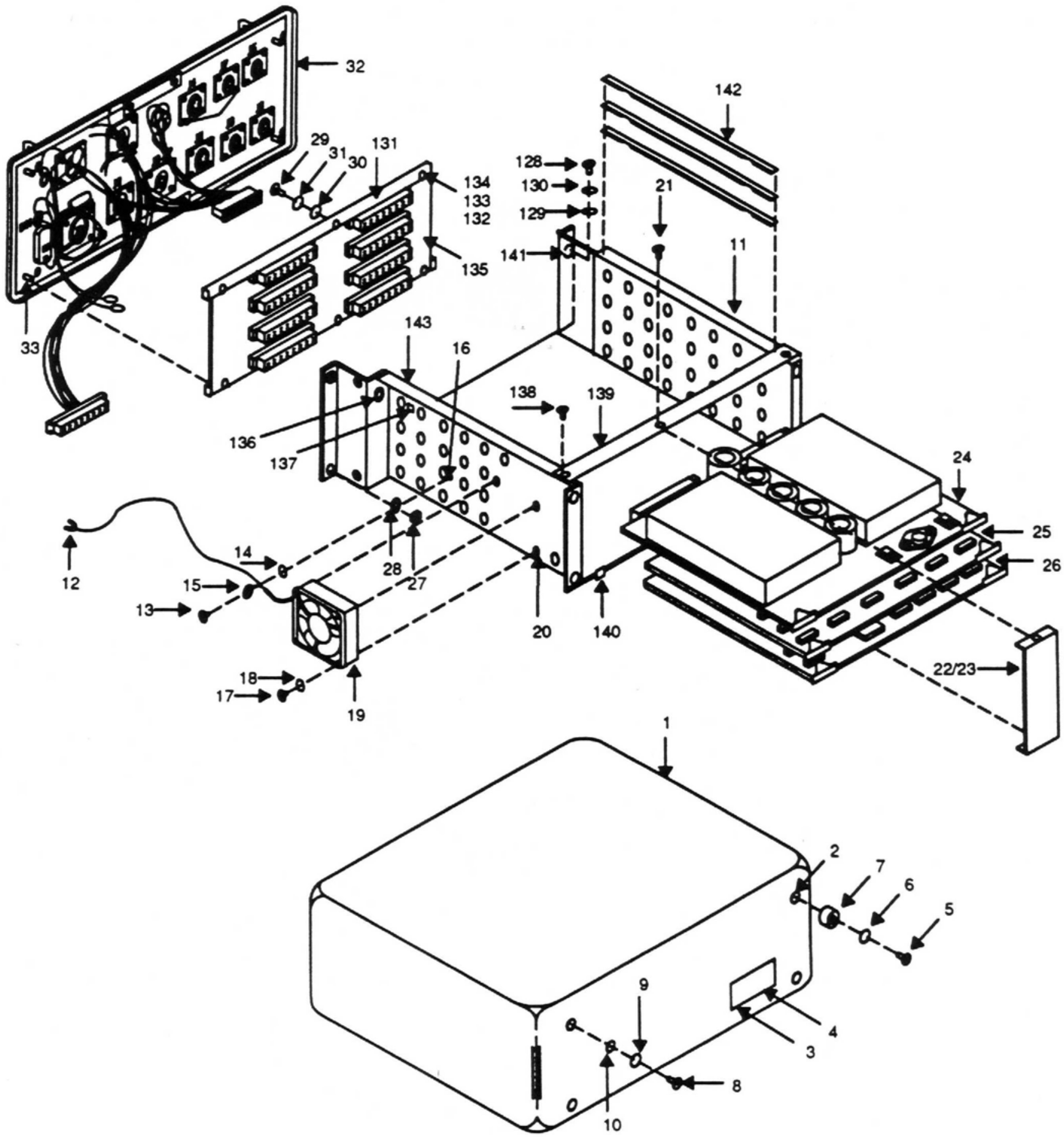
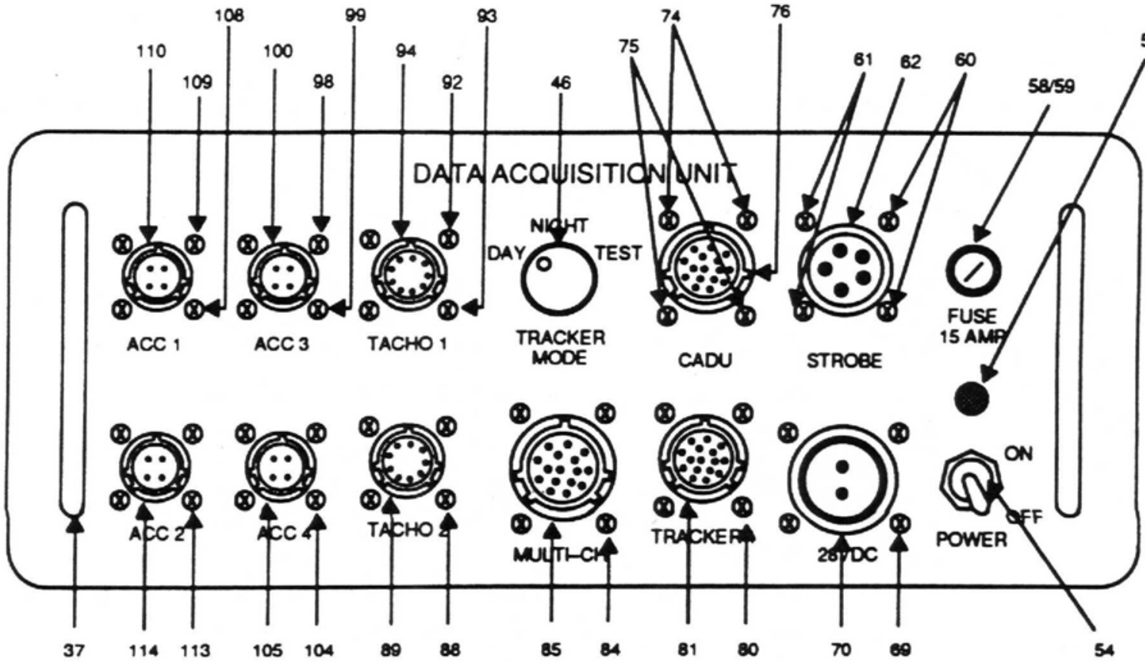
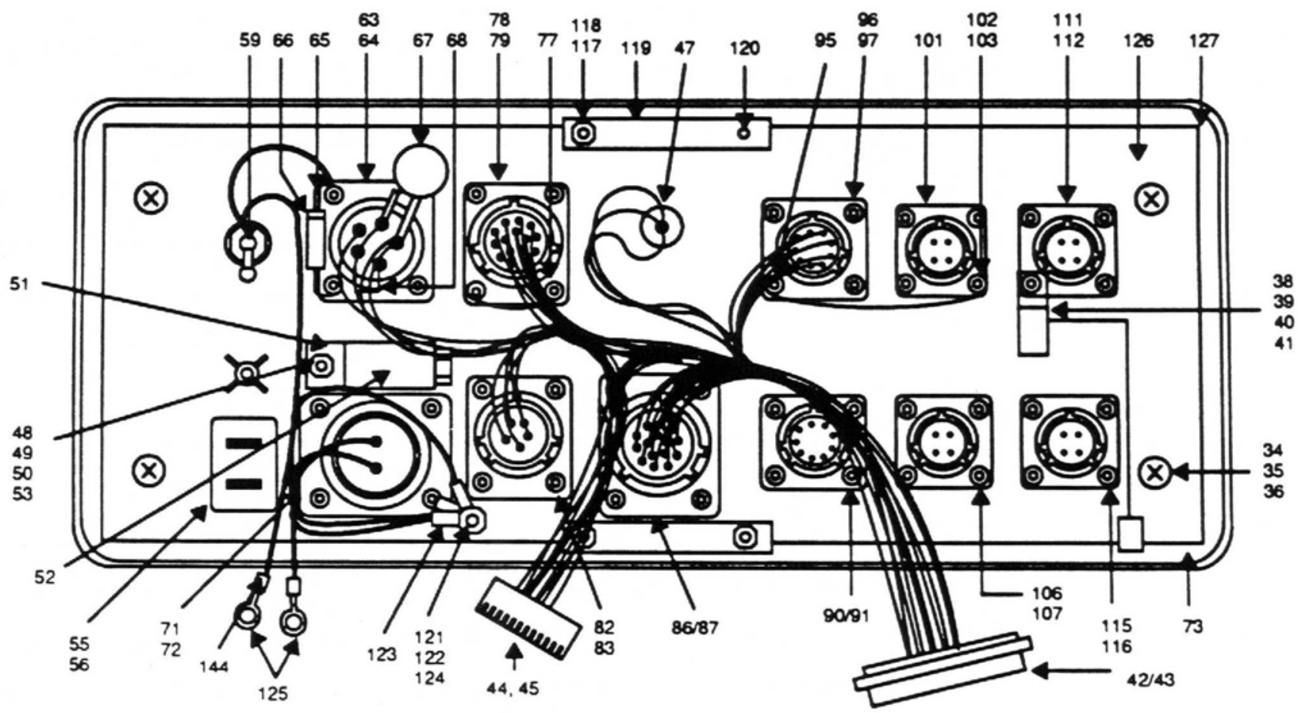


Figure 2. Data Acquisition Unit (DAU) (29328203) (Sheet 1 of 2)



FRONT PANEL



FRONT PANEL (Back View)

Figure 2. Data Acquisition Unit (DAU) (29328203) (Sheet 2 of 2)

Figure 2. Group 01 Data Acquisition Unit (DAU) (29328203)

(1). ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	PAOLL	1G3P5	29328203	Data Acquisition Unit (DAU)	1
1	XDFZZ	1G3P5	98376	.Enclosure (SI P/N 29109500)	1
2	PAFZZ	46384	F-440-1	..Nut, Plain Clinch	8
3	XDFZZ	1G3P5	29327200	.ID Plate	1
4	XDFZZ	85480	DAT-27-619-1	.Label (SI P/N 28121700)	1
5	PAFZZ	96906	MS51957-14	.Screw, Pan Head	8
6	PAFZZ	96906	MS35338-135	.Washer, Lock	8
7	XDFZZ	93106	2081W-017-BLK	.Bumper (SI P/N 28031302)	4
8	PAFZZ	96906	MS51957-28	.Screw, Pan Head	4
9	PAFZZ	96906	MS35338-136	.Washer, Lock	4
10	PAFZZ	96906	MS15795-805	.Washer, Flat	4
11	XDFFF	1G3P5	29325803	.Card Cage Assembly	1
12	XDFZZ	1G3P5	28091405	..Terminal, Lug	1
13	PAFZZ	96906	MS51957-25	..Screw, Pan Head	1
14	PAFZZ	96906	MS15795-803	..Washer, Flat	4
15	XDFZZ	14726	XR26245N-T	..Terminal Lug (SI P/N 28133400)	1
16	XDFZZ	46384	F-632-1	..Fastener	1
17	PAFZZ	96906	MS51957-22	..Screw, Pan Head	4
18	PAFZZ	96906	MS35338-135	..Washer, Lock	4
19	PAFZZ	67088	A33096-16	..Fan (SI P/N 28113202)	1
20	PAFZZ	46384	F-440-1	..Nut, Plain Clinch	4
21	PAFZZ	96906	MS24693-C25	..Screw, Flat Head	2
22	XDFZZ	1G3P5	29481200	..Bracket, PWA Hold-down	1
23	XDFZZ	46384	MS24693-C25	..Screw	2
24	PBFLL	1G3P5	29111900	..PWA, Power Supply	1
25	PBFLL	1G3P5	29356504	..PWA, Processor	1
26	PBFLL	1G3P5	29111100	..PWA, Acquisition	1
27	PAFZZ	96906	MS35649-284	..Nut, Hex	4
28	PAFZZ	96906	MS35338-137	..Washer, Lock	4
29	PAFZZ	96906	MS51957-5	..Screw, Pan Head	2
30	PAFZZ	96906	MS15795-802	..Washer, Flat	2
31	PAFZZ	96906	MS35338-134	..Washer, Lock	2
32	XDFFF	1G3P5	29325900	..Front Panel Assembly	1
33	XDFZZ	46384	FHS-832-10	…Stud	4
34	PAFZZ	96906	MS51958-62	…Screw	4
35	PAFZZ	80205	NAS620C10	...Washer, Flat	4
36	PAFZZ	96906	MS35338-138	...Washer, Lock	4
37	XDFZZ	05791	AL-7119-14	…Handle (SI P/N 28099301)	2
38	PAFZZ	96906	MS35649-244	...Nut, Hex	1
39	PAFZZ	96906	MS35338-135	...Washer, Lock	1
40	PAFZZ	96906	MS15795-803	…Washer, Flat	1
41	XDFZZ	53421	8961	...Clamp (SI P/N 28003103)	1
42	XDFZZ	00779	925486-1	...Connector (SI P/N 28034210)	1
43	XDFZZ	00779	104480-4	...Socket, Contact (SI P/N 28034211)	66
44	XDFZZ	00779	2-87631-6	...Connector (SI P/N 28091206)	1
45	XDFZZ	00779	1-87523-8	...Socket, Contact (SI P/N 28091203)	27
46	PAOZZ	96906	MS91528-1C3B	...Knob	1
47	XDFZZ	81073	50S45-01-2-03N	...Switch, Rotary (SI P/N 28115002)	1
48	PAFZZ	80205	NAS671C6	...Nut, Hex	1
49	PAFZZ	96906	MS15795-805	...Washer, Flat	2
50	PAFZZ	96906	MS35338-136	...Washer, Lock	1

Figure 2. Group 01 Data Acquisition Unit (DAU) (29328203) -- Continued

(1). ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
51	XDFZZ	1G3P5	29326000	...Bracket, Line Filter	1
52	XDFZZ	51406	51-311-310	...Filter (SI P/N 28118903)	1
53	XDFZZ	46384	FHS-632-6	...Stud	1
54	PAFZZ	1G3P5	N-1030B	...Toggle Switch Seal (SI P/N 28099500)	1
55	XDFZZ	78189	1224-02	...Washer, Star (SI P/N 28133200)	1
56	PAFZZ	13112	82601	...Switch, Toggle (SI P/N 28110600)	1
57	PAFZZ	91802	5400A5	...Light Indicator, LED (SI P/N 28110700)	1
58	PAOZZ	71400	GMA15	...Fuse (SI P/N 28107801)	1
59	XDFZZ	61935	FIO031.1383	...Fuse Holder (SI P/N 28099400)	1
60	PAFZZ	96906	MS24693-C5	...Screw, Machine	2
61	PAFZZ	96906	MS24693-C4	...Screw, Machine	2
62	PAFZZ	96906	MS3102R14S-5S	...Connector (J2)	1
63	PAFZZ	77820	10-101949-14	...Gasket (SI P/N 28132506)	1
64	XDFZZ	OA554	AT327-14	...Nutplate (SI P/N 29084803)	1
65	XDFZZ	1G3P5	756-55-12	...Terminal, Insulated (SI P/N 10575701)	2
66	XDFZZ	01121	RS11.5K5%	...Resistor (SI P/N 28108500)	1
67	XDFZZ	09214	V47ZA7	...Varistor (SI P/N 28006003)	1
68	XDFZZ	12929	TVS505	...Suppressor, Voltage (SI P/N 28126200)	1
69	PAFZZ	96906	MS24693-C4	...Screw, Machine	4
70	PAFZZ	96906	MS3102R16-11P	...Connector (J1)	1
71	XDFZZ	77820	10-101949-16	...Gasket (SI P/N 28132507)	1
72	XDFZZ	OA554	AT327-16	...Nutplate (SI P/N 29084804)	1
73	XDFZZ	98376	ZT72-190CG-5	...Cover	1
74	PAFZZ	96906	MS24693-C3	...Screw, Machine	2
75	PAFZZ	96906	MS24693-C4	...Screw, Machine	2
76	PAFZZ	96906	MS3112E14-18S	...Connector (J10)	1
77	XDFZZ	1G3P5	756-55-12	...Terminal, Insulated (SI P/N 10575701)	2
78	XDFZZ	OA554	AT327-14	...Nutplate (SI P/N 29084803)	1
79	PAFZZ	77820	10-101949-14	...Gasket (SI P/N 28132506)	1
80	PAFZZ	96906	MS24693-C3	...Screw, Machine	4
81	PAFZZ	96906	MS3112E12-10SW	...Connector (J3)	1
82	XDFZZ	OA554	AT327-12	...Nutplate (SI P/N 29084802)	1
83	PAFZZ	77820	10-101949-12	...Gasket (SI P/N 28132504)	1
84	PAFZZ	96906	MS24693-C3	...Screw	4
85	PAFZZ	96906	MS27508E16B55S	...Connector (J9)	1
86	XDFZZ	OA554	AT327-16	...Nutplate (SI P/N 29084804)	1
87	XDFZZ	1G3P5	10-101949-16	...Gasket (SI P/N 28132507)	1
88	PAFZZ	96906	MS24693-C3	...Screw, Machine	4
89	XDFZZ	96906	MS3112E10-6S	...Connector (J11)	1
90	XDFZZ	OA554	AT327-10	...Nutplate (SI P/N 29084801)	1
91	PAFZZ	77820	10-101949-10	...Gasket (SI P/N 28132503)	1
92	PAFZZ	96906	MS24693-C3	...Screw, Machine	3
93	PAFZZ	96906	MS24693-C4	...Screw, Machine	1
94	XDFZZ	96906	MS3112E10-6S	...Connector (J4)	1
95	XDFZZ	1G3P5	756-55-12	...Terminal, Insulated (SI P/N 10575701)	1
96	XDFZZ	OA554	AT327-10	...Nutplate (SI P/N 29084801)	1
97	PAFZZ	77820	10-101949-10	...Gasket (SI P/N 28132503)	1
98	PAFZZ	96906	MS24693-C3	...Screw, Machine	3
99	PAFZZ	96906	MS24693-C4	...Screw, Machine	1
100	PAFZZ	96906	MS3112E8-4S	...Connector (J7)	1
101	XDFZZ	1G3P5	756-55-12	...Terminal, Insulated (SI P/N 10575701)	1

Figure 2. Group 01 Data Acquisition Unit (DAU) (29328203) -- Continued

(1). ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
102	XDFZZ	OA554	AT327-8	...Nutplate (SI P/N 29084800)	1
103	PAFZZ	77820	10-101949-8	...Gasket (SI P/N 28132501)	1
104	PAFZZ	96906	MS24693-C3	...Screw, Machine	4
105	PAFZZ	96906	MS3112E8-4S	...Connector (J8)	1
106	XDFZZ	OA554	AT327-8	...Nutplate (SI P/N 29084800)	1
107	PAFZZ	77820	10-101949-8	...Gasket (SI P/N 28132501)	1
108	PAFZZ	96906	MS24693-C6	...Screw, Machine	1
109	PAFZZ	96906	MS24693-C3	...Screw, Machine	3
110	PAFZZ	96906	MS3112E8-4S	...Connector (J5)	1
111	XDFZZ	OA554	AT327-8	...Nutplate (SI P/N 29084800)	1
112	PAFZZ	77820	10-101949-8	...Gasket (SI P/N 28132501)	1
113	PAFZZ	96906	MS24693-C3	...Screw, Machine	4
114	PAFZZ	96906	MS3112E8-4S	...Connector (J6)	1
115	XDFZZ	OA554	AT327-8	...Nutplate (SI P/N 29084800)	1
116	PAFZZ	77820	10-101949-8	...Gasket (SI P/N 28132501)	1
117	PAFZZ	80205	NAS671C6	...Nut, Hex	4
118	PAFZZ	96906	MS35338-136	...Washer, Lock	4
119	XDFZZ	1G3P5	29110000	...Support Angle	2
120	XDFZZ	46384	FHS-623-6	...Stud	4
121	PAFZZ	80205	NAS671C6	...Nut, Hex	1
122	PAFZZ	96906	MS35338-136	...Washer, Lock	1
123	PAFZZ	96906	MS25036-102	...Terminal	3
124	XDFZZ	46384	FHS-623-6	...Stud	1
125	PAFZZ	96906	MS25036-102	...Terminal	2
126	XDFZZ	1G3P5	29321000	...Front Panel	1
127	XDFZZ	1G3P5	29084900	...Gasket	1
128	PAFZZ	96906	MS51957-27	..Screw	4
129	PAFZZ	80205	NAS620C6	..Washer, Flat	4
130	PAFZZ	96906	MS35338-136	..Washer, Lock	4
131	XDFZZ	1G3P5	29147300	..Bar Support	2
132	PAFZZ	96906	MS51957-28	..Screw, Machine	6
133	PAFZZ	80205	NAS620C6	..Washer, Flat	6
134	PAFZZ	96906	MS35338-136	..Washer, Lock	6
135	PAFZZ	1G3P5	29112800	..PWA Backplane	1
136	XDFZZ	98388	225-017-A03	..Grommet (SI P/N 10542107)	1
137	XADZZ	1G3P5	28110000	..Label, Software License	1
138	PAFZZ	96906	MS51957-28	..Screw, Machine	2
139	XDFZZ	1G3P5	29109900	..Brace	1
140	XDFZZ	46384	S0S-632-8	..Standoff	4
141	XDFZZ	46384	SO-8194-10	..Standoff	4
142	PAFZZ	18915	26-12	..Card Guide (SI P/N 28055202)	6
143	XAFZZ	1G3P5	29109800	..Card Cage	1
144	XDFZZ	1G3P5	28054101	..Wire Markers	4

END OF FIGURE

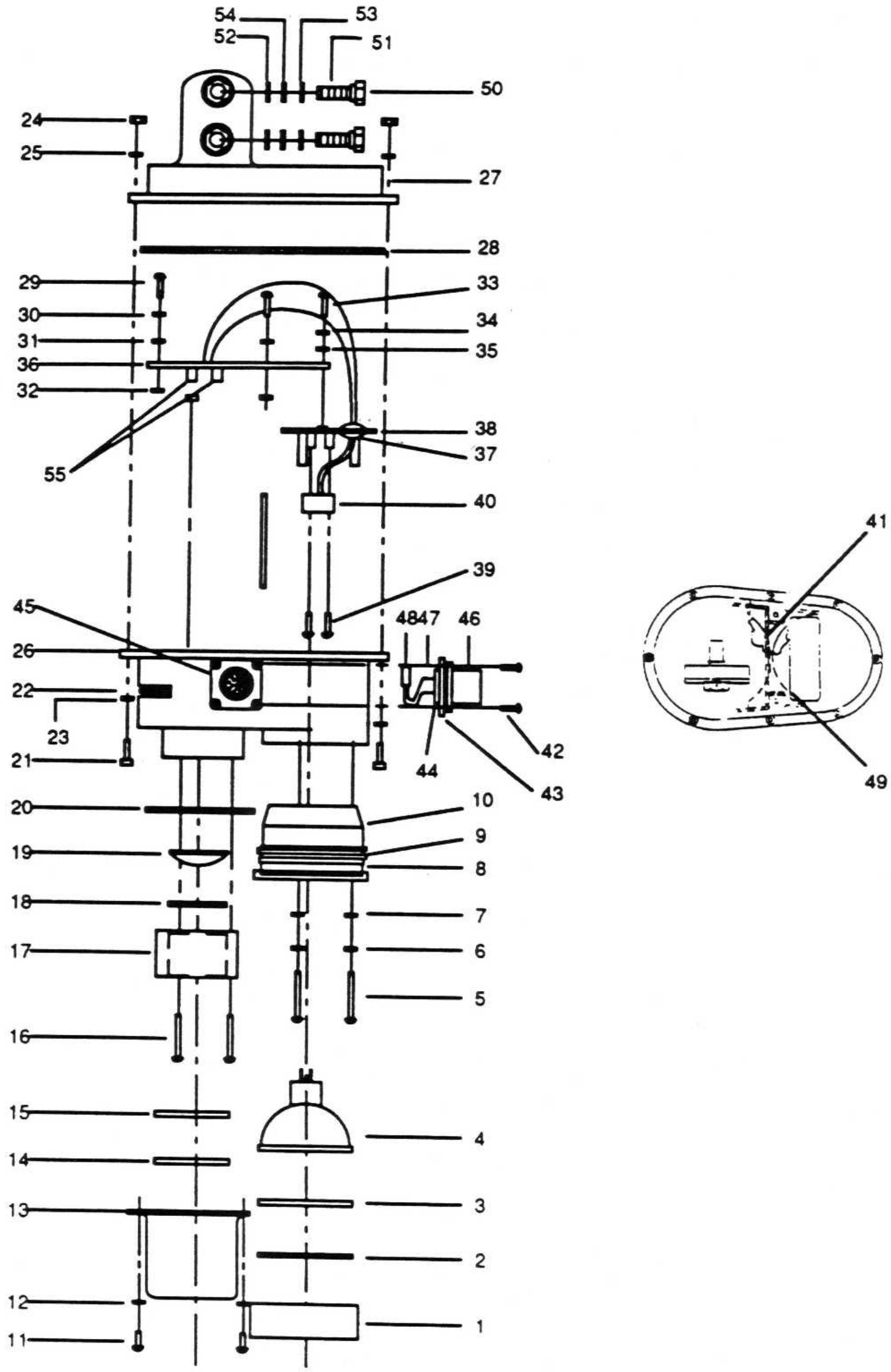


Figure 3. Universal Tracking Device (UTD) (29310700)

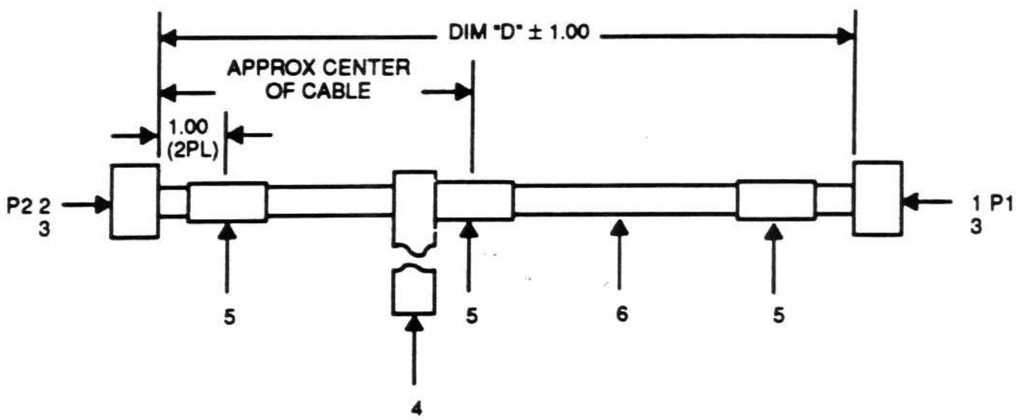
Figure 3. Group 03 Universal Tracking Device (UTD) (29310700)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	PAOFF	1G3P5	29310700	Tracking Device, Universal (UTD)	1
1	XDFZZ	1G3P5	29750100	.Face Cap, Infrared Filter	1
2	XDFZZ	06134	29491700	.O-Ring, Infrared Filter	1
3	XDFZZ	1G3P5	R-72	.Filter, IF (SI P/N 28131700)	1
4	PAFZZ	88204	1000000	.Lamp, Metal Halide (SI P/N 28127400)	1
5	PAFZZ	96906	MS51957-19	.Screw, Machine	3
6	PAFZZ	96906	MS35338-135	.Washer, Lock	3
7	PAFZZ	96906	MS15795-803	.Washer, Flat	3
8	XDFZZ	02697	2-033N103-70	.O-Ring (SI P/N 28111901)	1
9	PAFZZ	02697	2-033N103-70	.O-Ring (SI P/N 28111901)	1
10	XDFZZ	1G3P5	29310400	.Housing, Bulb	1
11	PAFZZ	96906	MS51863-11C	.Screw	9
12	PAFZZ	96906	MS15795-803	.Washer, Flat	6
13	XDFZZ	1G3P5	29310500	.Enclosure ,Lens UTD	1
14	XDFZZ	1G3P5	29311100	.Gasket, Lens	1
15	XDFZZ	04562	55.1248	.Optical Window (SI P/N 28107501)	1
16	XDFZZ	96906	MS51863-16C	.Screw	3
17	XDFZZ	1G3P5	29310600	.Retainer, Lens	1
18	PAFZZ	02697	2-024N103-70	.Packing, Preformed O-Ring (SI P/N 28111906)	1
19	XDFZZ	04562	10.0145	.Lens, Convex (SI P/N 28128500)	1
20	XDFZZ	1G3P5	2-034N103-70	.O-Ring, Lens Enclosure (SI P/N 28111902)	1
21	PAFZZ	96906	MS16995-11	.Screw, Cap Socket Hex	8
22	XDFZZ	1G3P5	29498800	.Label, Warning	1
23	PAFZZ	96906	MS15795-803	.Washer, Flat	8
24	PAFZZ	96906	MS21044-C04	.Nut, Locking	8
25	PAFZZ	96906	MS15795-803	.Washer, Flat	8
26	XDFZZ	1G3P5	29311200	.Casting, UTD Body TP	1
27	XDFZZ	1G3P5	29311400	.Base, UTD	1
28	XDFZZ	02697	4.1091D-.070W-N103-70	.O-Ring (SI P/N 28111905)	1
29	PAFZZ	96906	MS51863-12C	.Screw, Machine	3
30	PAFZZ	96906	MS35338-135	.Washer, Lock	3
31	PAFZZ	96906	MS15795-803	.Washer, Flat	3
32	XDFZZ	86928	5610-55-62	.Spacer, Nylon (SI P/N 28056705)	3
33	PAFZZ	96906	MS51957-13	.Screw, Machine	2
34	PAFZZ	96906	MS35338-135	.Washer, Lock	2
35	PAFZZ	96906	MS15795-803	.Washer, Flat	2
36	PAFZZ	1G3P5	29322500	.PWA,UTD	1
37	XDFZZ	98388	221-006-BLK	.Grommet (SI P/N 28131500)	1
38	XDFZZ	1G3P5	29310300	.Plate, Mounting	1
39	PAFZZ	96906	MS51957-17	.Screw, Machine	2
40	XDFZZ	3T059	H989	.Socket, HAL Lamp (SI P/N 28131300)	1
41	XDFZZ	1G3P5	29331200	.Baffle	1
42	PAFZZ	96906	MS51957-20	.Screw, Machine	4
43	XDFZZ	77820	10-101949-10	.Gasket, Connector (SI P/N 28132503)	1
44	XDFZZ	1G3P5	29710500	.Nutplate, Connector	1
45	XDFFF	1G3P5	29310800	.Cable Assembly	1
46	PAFZZ	96906	MS3112E10-6P	..Connector Plug	1
47	PAFZZ	00779	87631-2	..Connector Housing (SI P/N 28091213)	1
48	PAFZZ	00779	87309-9	..Contact (SI P/N 28091218)	1
49	XDFZZ	1G3P5	THT-6-428-10	.Ident Plate (SI P/N 28225901)	1
50	XDOZZ	1G3P5	29322100	.Hardware Set, UTD	1

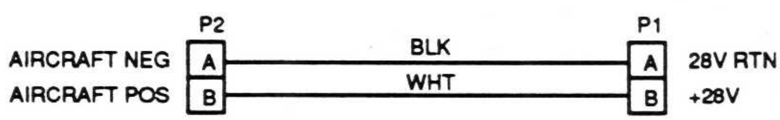
Figure 3. Group 03 Universal Tracking Device (UTD) (29310700) -- Continued

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
51	XDOZZ	1G3P5	MS51096-335	..Screw, Captive (SI P/N 29326200)	2
52	XDOZZ	97464	2000-31-ST-ZD	..Ring, Retaining (SI P/N 28132300)	2
53	PAOZZ	96906	MS35338-140	..Washer, Lock Spring	2
54	PAOZZ	88044	AN960-C516L	..Washer, Flat	2
55	PAFZZ	1G3P5	29311000	.Cap, Diode	2

END OF FIGURE



ASSEMBLY NUMBER	IDENTIFICATION				DIMENSION "D"
00	P2 TO	AIRCRAFT PWR	1G3P5 – 29104700 REV_W2	P1 TO 28VDC DAU	10 FT
01	P2 TO	AIRCRAFT PWR	1G3P5 – 29104701 REV_W2	P1 TO 28VDC DAU	15 FT
02	P2 TO	AIRCRAFT PWR	1G3P5 – 29104702 REV_W2	P1 TO 28VDC DAU	20 FT
03	P2 TO	AIRCRAFT PWR	1G3P5 – 29104703 REV_W2	P1 TO 28VDC DAU	25 FT



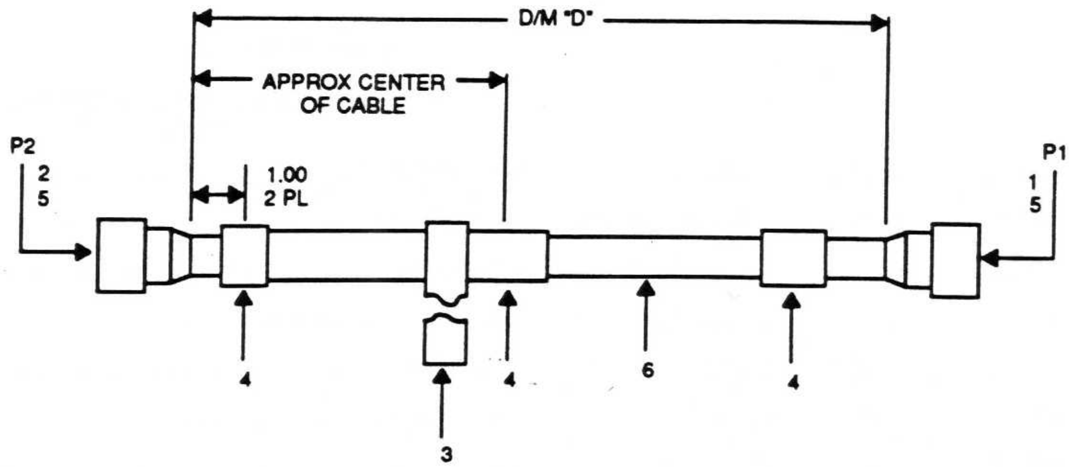
WIRE DIAGRAM

Figure 4. Cable Assembly - Aircraft Power to DAU (29104700)

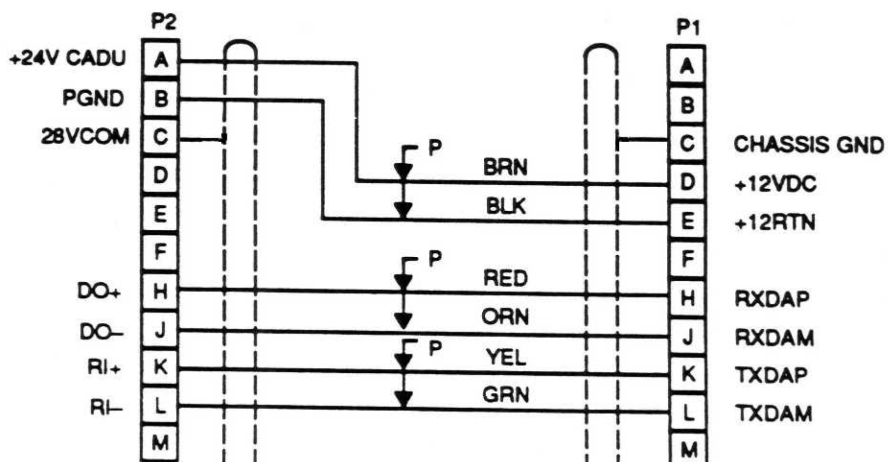
Figure 4. Group 04 Cable Assembly - Aircraft Power to DAU (29104700)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	PAOFF	1G3P5	29104700	Cable Assembly	1
1	PAFZZ	96906	MS3106F16-11S	.Connector, Plug	1
2	PAFZZ	96906	MS3106F16-11P	.Connector	1
3	PAFZZ	96906	MS3420-8A	.Bushing, Non-metallic	2
4	XDFZZ	1G3P5	28108700	.Cable Tie	1
5	XDFZZ	1G3P5	28110206	.Wire Marker	3
6	MFFZZ	92194	1933	.Cable (SI P/N 28111200)	A/R

END OF FIGURE



ASSEMBLY NUMBER	IDENTIFICATION			DIM "D"
	"A"	"B"	"C"	
00	P2 TO DAU/CADU	1G3P5- 29325600 REV	P1 TO CADU J1	60.0 + 2.0
01	P2 TO DAU/CADU	1G3P5- 29325601 REV	P1 TO CADU J1	120.0 + 3.0
02	P2 TO DAU/CADU	1G3P5- 29325602 REV_	P1 TO CADU J1	12.0 + .25



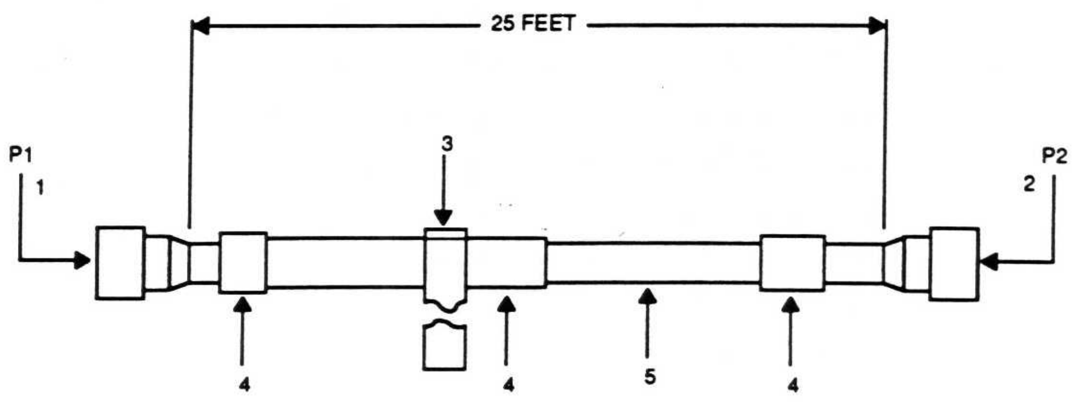
WIRING DIAGRAM

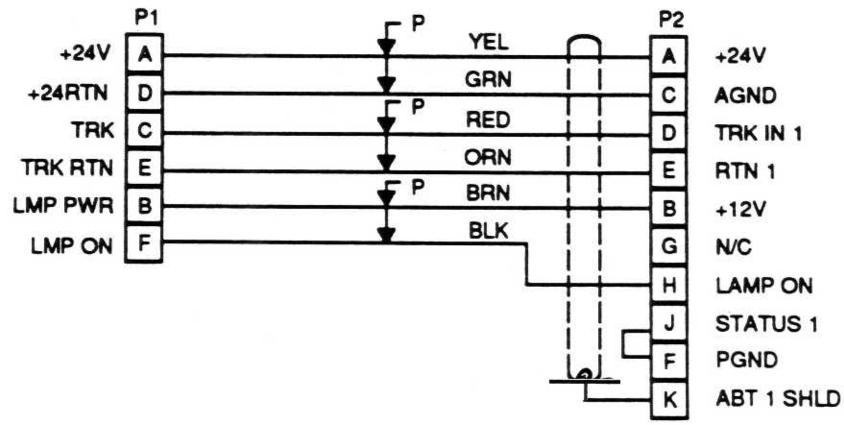
Figure 5. Cable Assembly - DAU to CADU (29325601)

Figure 5. Group 04 Cable Assembly - DAU to CADU (29325601)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	PAOFF	1G3P5	29325601	Cable Assembly	1
1	XDFZZ	96906	MS3126F14-18P	.Connector, Plug	1
2	XDFZZ	96906	MS3126F14-18SW	.Connector, Plug	1
3	XDFZZ	1G3P5	28108700	.Cable Tie	1
4	XDFZZ	1G3P5	HS095WE1NF038B	.Wire Marker (SI P/N 28110208)	3
5	PAFZZ	96906	MS3420-6	.Bushing	2
6	MFFZZ	1G3P5	28094001	.Cable	A/R

END OF FIGURE





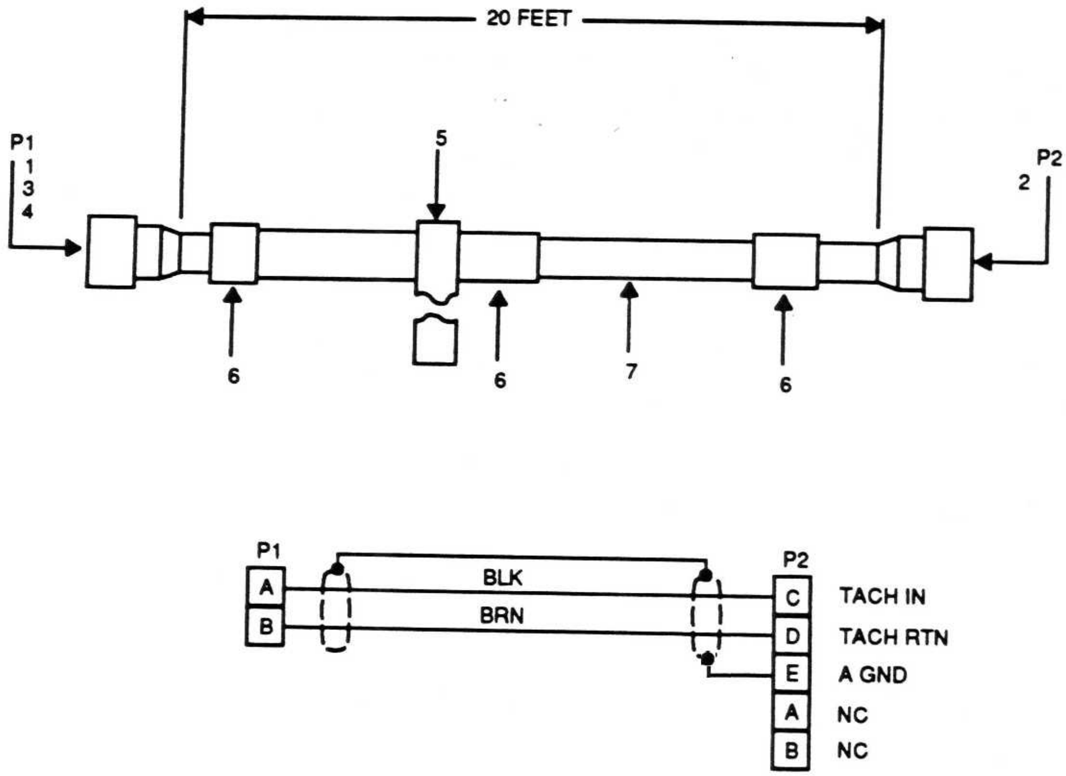
WIRING DIAGRAM

Figure 6. Cable Assembly - UTD (29325701)

Figure 6. Group 04 Cable Assembly - UTD (29325701)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	PAOFF	1G3P5	29325701	Cable Assembly	1
1	PAFZZ	96906	MS3116P10-6S	.Connector, Plug	1
2	PAFZZ	96906	MS3116P12-10PW	.Connector, Plug	1
3	XDFZZ	1G3P5	28108700	.Cable Tie	1
4	XDFZZ	1G3P5	HS095WE1NF038B	.Wire Marker (SI P/N 28110208)	3
5	MFFZZ	1G3P5	28094001	.Cable	A/R

END OF FIGURE



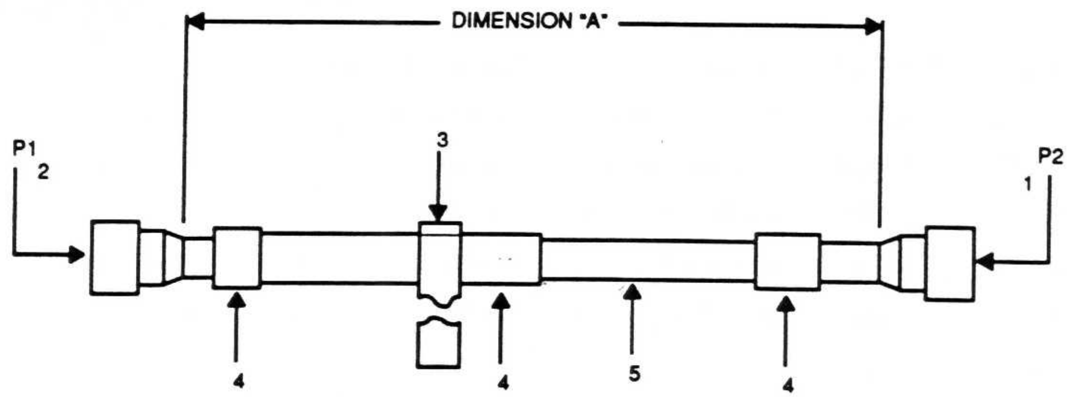
WIRING DIAGRAM

Figure 7. Cable Assembly - Magnetic RPM Sensor to DAU (29105403)

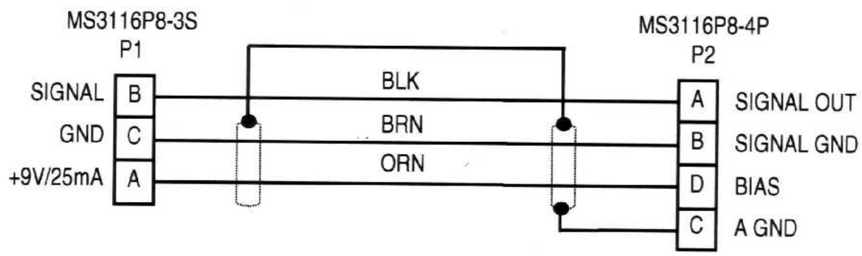
Figure 7. Group 04 Cable Assembly - Magnetic RPM Sensor to DAU (29105403)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	PAOFF	1G3P5	29105403	Cable Assembly	1
1	PAFZZ	96906	MS3106A10SL-4S	.Connector	1
2	PAFZZ	96906	MS3116P10-6P	.Connector	1
3	PAFZZ	96906	MS3420-4	.Bushing	1
4	PAFZZ	81349	M85049/41-4A	.Clamp	1
5	XDFZZ	1G3P5	28108700	.Cable Tie	1
6	XDFZZ	1G3P5	HS048WE1NF038B	.Wire Marker (SI P/N 28110203)	3
7	MFFZZ	1G3P5	28093900	.Cable	20

END OF FIGURE



PART NUMBER	"DIMENSION"
29105600	50 FEET
29105601	15 FEET
29105602	10 FEET
29105603	5 FEET
29105604	35 FEET
29105605	25 FEET



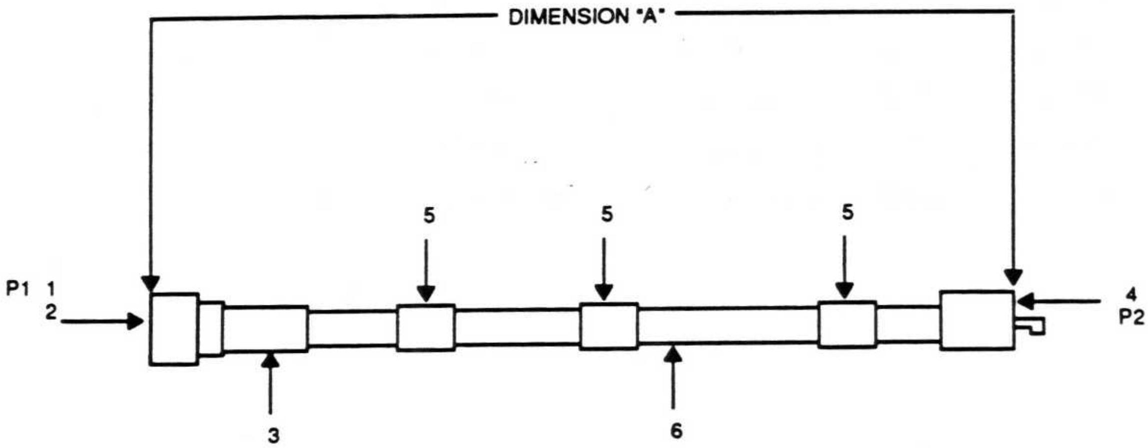
WIRING DIAGRAM

Figure 8. Cable Assembly - Accelerometer to DAU (29105600 through 29105605)

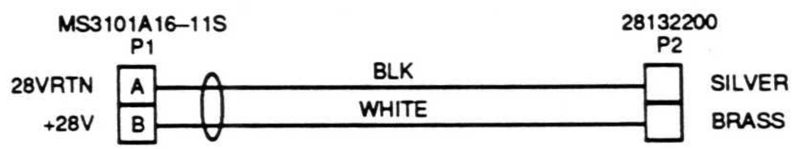
Figure 8. Group 04 Cable Assembly - Accelerometer to DAU (29105600 through 29105605)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	PAOFF	1G3P5	2910560X	Cable Assembly	1
1	PAFZZ	96906	MS3116P8-4P	.Connector	1
2	PAFZZ	96906	MS3116P8-3S	.Connector	1
3	XDFZZ	1G3P5	28108700	.Cable Tie	1
4	XDFZZ	1G3P5	28110203	.Wire Marker	3
5	MFFZZ	1G3P5	28093900	.Cable	A/R

END OF FIGURE



PART NUMBER	DIMENSION "A"
29312800	13 INCHES



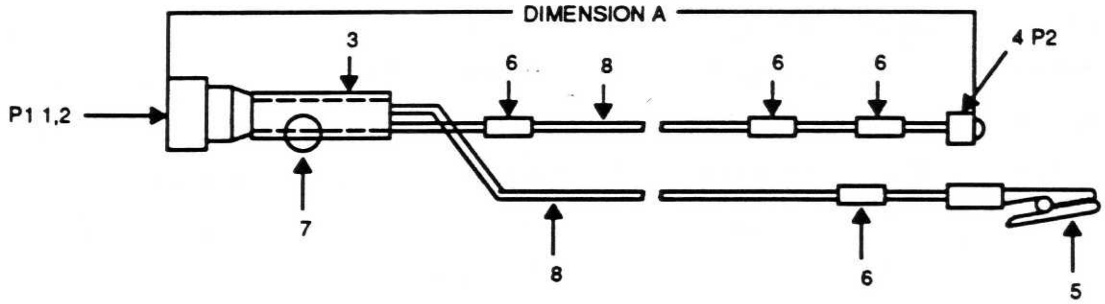
WIRING DIAGRAM

Figure 9. Cable Assembly – UH-1 DC Power (29312800)

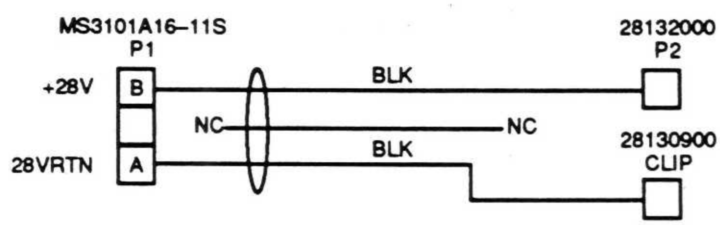
Figure 9. Group 04 Cable Assembly – UH-1 DC Power (29312800)

(1). ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	PAOFF	1G3P5	29312800	Cable Assembly	1
1	PAFZZ	96906	MS3101A16-11S	.Connector, Plug	1
2	PAFZZ	96906	MS3057-8A	.Backshell	1
3	PAFZZ	96906	MS3420-8A	.Bushing, Non-metallic	1
4	PAFZZ	1G3P5	HBL7545C	.Connector, Plug (SI P/N 28132200)	1
5	PAFZZ	1G3P5	28110206	.Wire Marker	3
6	MFFZZ	92194	1933	.Cable (SI P/N 28111200)	A/R

END OF FIGURE



PART NUMBER	DIMENSION "A"
29317100	13 INCHES



WIRING DIAGRAM

Figure 10. Cable Assembly – AH-1S DC Power (29317100)

Figure 10. Group 04 Cable Assembly – AH-1 DC Power (29317100)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	PAOFF	1G3P5	29317100	Cable Assembly	1
1	PAFZZ	96906	MS3101A16-11S	.Connector, Plug	1
2	PAFZZ	96906	MS3057-8A	.Backshell	1
3	PAFZZ	96906	MS3420-6A	.Bushing	1
4	XDFZZ	8D391	0651-03	.Connector, Lamp base (SI P/N 28132000)	1
5	PAFZZ	83330	301-103	.Clip, Alligator (SI P/N 28130900)	1
6	XDFZZ	1G3P5	28110204	.Wire Marker	4
7	PAFZZ	96906	MS3420-4A	.Bushing	1
8	MFFZZ	Sw733	8899	.Wire (SI P/N 28131000)	A/R

END OF FIGURE

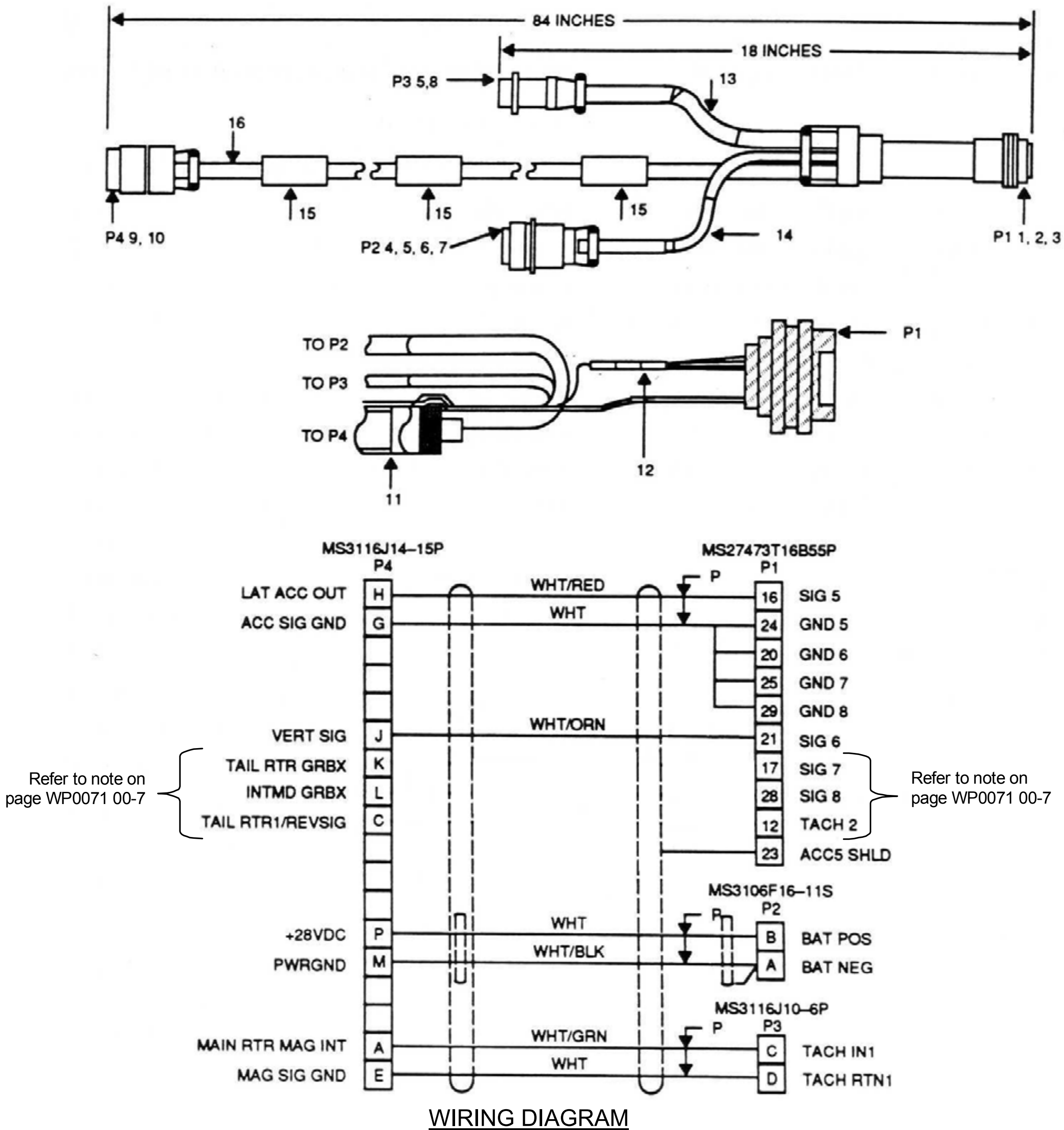
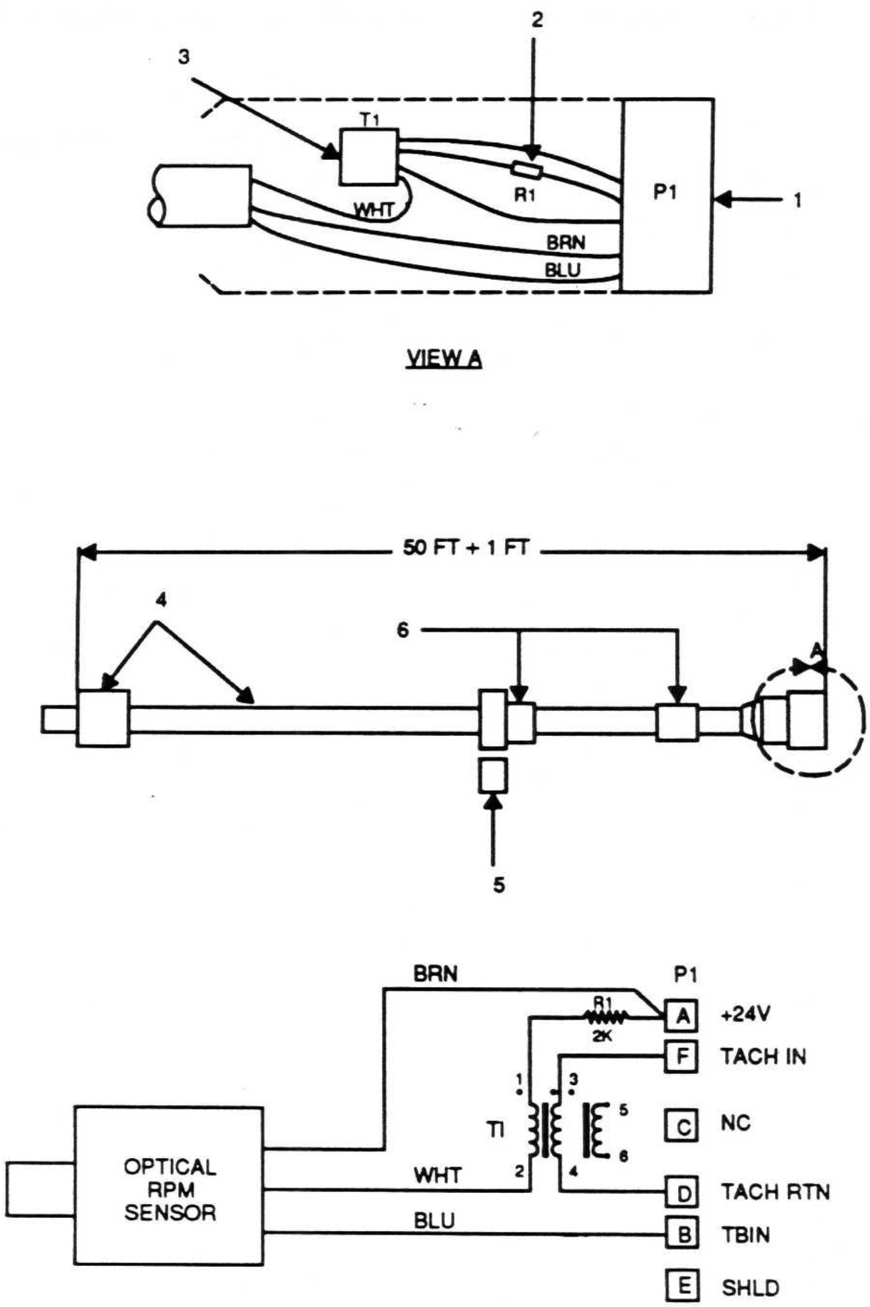


Figure 11. Cable Assembly - AH-64 to DAU (29304600)

Figure 11. Group 04 Cable Assembly - AH-64 to DAU (29304600)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	PAOFF	1G3P5	29304600	Cable Assembly	1
1	PAFZZ	96906	MS27473T16B35P	.Connector, Plug	1
2	PAFZZ	81349	M85049/17-16W06B	.Backshell	1
3	PAFZZ	96906	MS3420-12A	.Bushing, Non-metallic	1
4	PAFZZ	96906	MS3106F16-11S	.Connector, Plug, Electric	1
5	PAFZZ	96906	MS3420-4A	.Bushing, Non-metallic	2
6	PAFZZ	96906	MS3420-6A	.Bushing, Non-metallic	1
7	PAFZZ	81349	M83519/2-8	.Splice, Conductor	1
8	PAFZZ	96906	MS3116J10-6P	.Connector, Plug, Electric	1
9	PAFZZ	96906	MS3116J14-15P	.Connector, Plug, Electric	1
10	PAFZZ	96906	MS3420-8A	.Bushing, Non-metallic	1
11	XDFZZ	06090	D-104-00	.Shield Terminations (SI P/N 28125501)	1
12	XDFZZ	06090	D-110-0181	.Wire Splice (SI P/N 28126300)	1
13	XDFZZ	1G3P5	28110203	.Wire Marker	1
14	XDFZZ	1G3P5	28110204	.Wire Marker	1
15	XDFZZ	1G3P5	28110206	.Wire Marker	3
16	MFFZZ	1G3P5	28094000	.Cable	A/R

END OF FIGURE



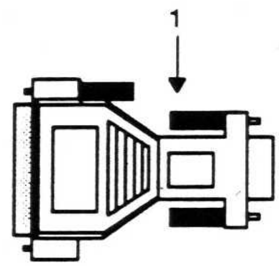
WIRING DIAGRAM

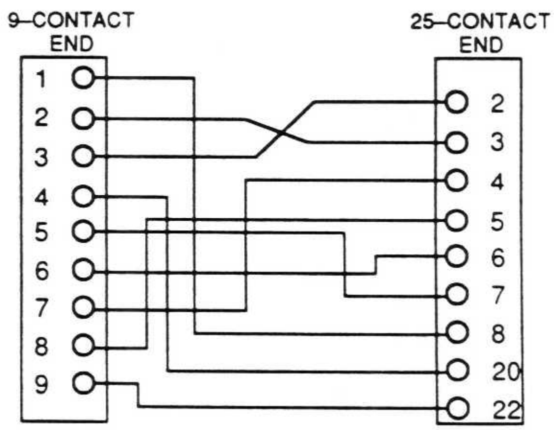
Figure 12. Optical RPM Sensor (29314700)

Figure 12. Group 04 Optical RPM Sensor (29314700)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	PAOFF	1G3P5	29314700	Cable Assembly	1
1	PAFZZ	96906	MS3116P10-6P	.Connector, Plug	1
2	XDFZZ	91637	CCF-552001F	.Resistor (SI P/N 10532537)	1
3	XDFZZ	31669	H-5460	.Transformer (SI P/N 28092800)	1
4	XDFZZ	1G3P5	28131100	.Sensor w/Cable	1
5	XDFZZ	1G3P5	28108702	.Cable Tie	1
6	XDFZZ	1G3P5	28110206	.Wire Marker	2

END OF FIGURE





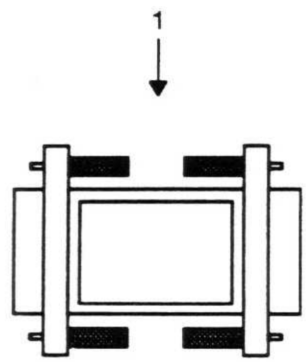
WIRING DIAGRAM

Figure 13. AT Serial Adapter (DG259MF-IBM)

Figure 13. Group 04 AT Serial Adapter (DG259MF-IBM)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
1	XDFZZ	43221	DG259MF-IBM	Adapter, AT Serial	1

END OF FIGURE



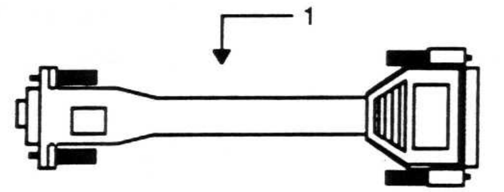
ALL PINS ARE WIRED THROUGH TO THE SAME PIN AT THE OTHER CONNECTOR.

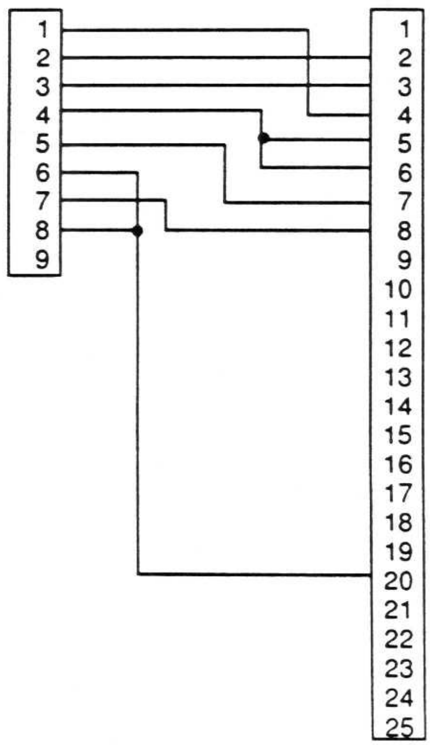
Figure 14. Gender Changer (28130800)

Figure 14. Group 04 Gender Changer (28130800)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
1	XDFZZ	1G3P5	28130800	Gender Changer	1

END OF FIGURE





WIRING DIAGRAM

Figure 15. Cable, Serial Printer (28130802)

Figure 15. Group 04 Cable, Serial Printer (28130802)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
1	XDFZZ	1G3P5	28130802	Cable, Serial Printer	1

END OF FIGURE

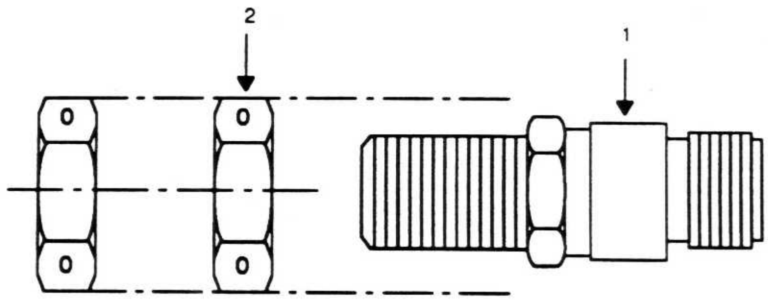


Figure 16. Magnetic Sensor Assembly (27288400)

Figure 16. Group 04 Magnetic Sensor Assembly (27288400)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	AOOOO	1G3P5	27288400	Magnetic Sensor Assembly	1
1	PAOZZ	81692	3030AN	.Sensor, Magnetic (SI P/N 28076100)	1
2	PAOZZ	96906	MS9201-07	.Nut, Hex	2

END OF FIGURE

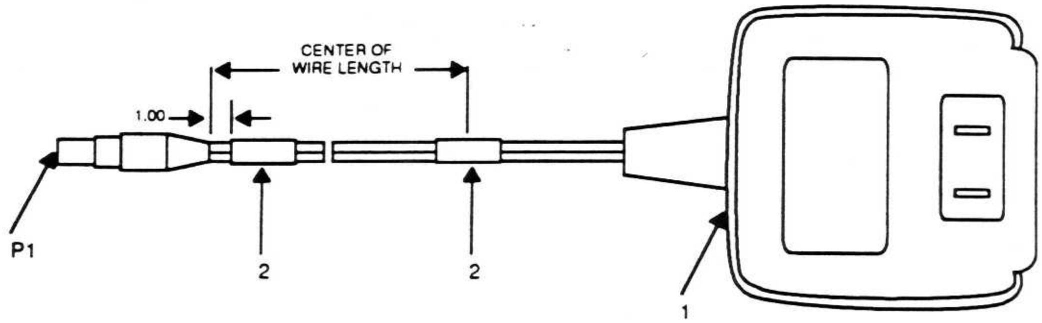


Figure 17. Battery Charger (29315000)

Figure 17. Group 04 Battery Charger (29315000)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	PAOZZ	1G3P5	29315000	Battery Charger	1
1	XDOZZ		AD1280-OP05-CP	.Power Supply (SI P/N 28118801)	1
2	XDFZZ	1G3P5	28110203	.Wire Marker	2

END OF FIGURE

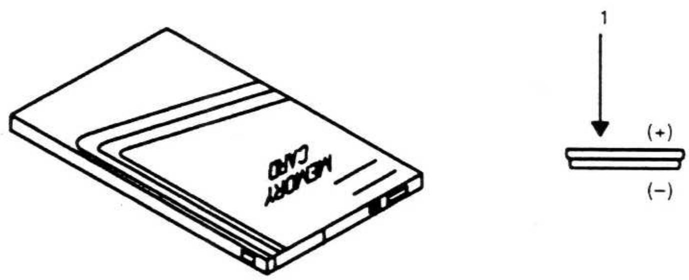
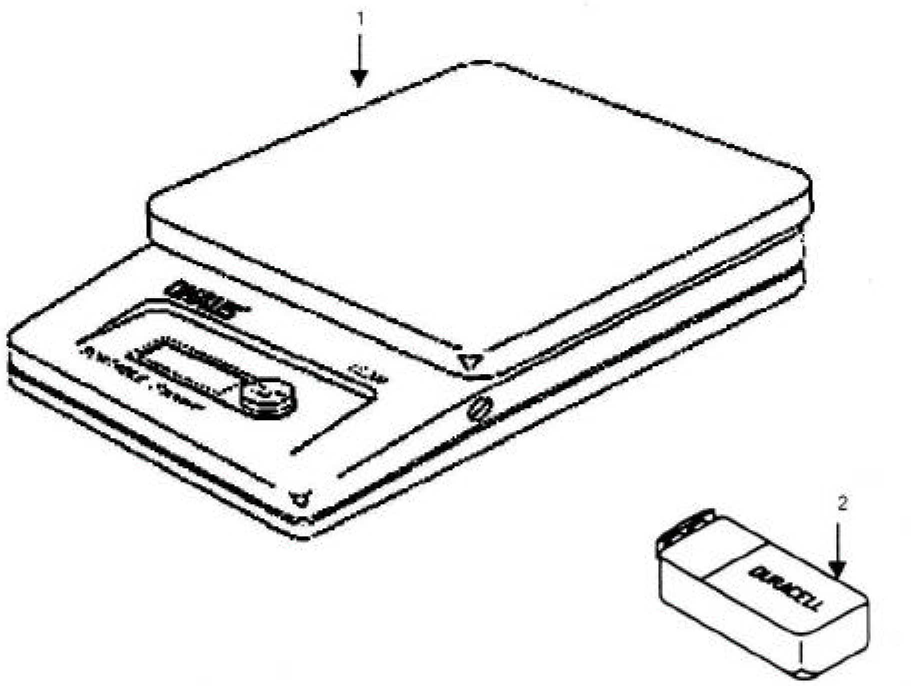


Figure 18. Credit Card Memory (CCM) Control, Recorder (28131210)

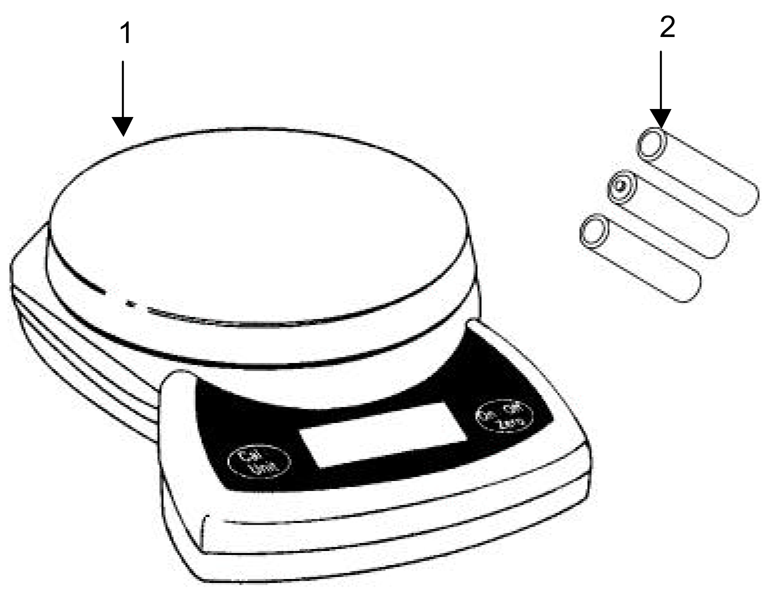
Figure 18. Group 04 Credit Card Memory (CCM) Control, Recorder (28131210)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	PAOOO	1G3P5	28131210	Credit Card Memory	1
1	PAOZZ	77542	BR2325	.Battery, Non-rechargeable	1

END OF FIGURE



(29323700)



(29323703)

Figure 19. Weighing Scale

Figure 19. Group 04 Weighing Scale

(1) ITEM NO.	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
1	XDOOO	1G3P5	29323700	Scale, Gram/Ounce	1
	XDOOO	35012	29323703	Scale, Gram/Ounce (Alternate to 29323700)	1
		85973	CS2000	Scale, Gram/Ounce (Alternate)	1
2	PAOZZ	90303	MN1604	Battery, Non-rechargeable (SI P/N 10693400) (Used with P/N 29323700)	1
	PAOZZ	90303	MN1500	Battery, Non-rechargeable (SI P/N 10693410) (Used with P/N 29323703	3

END OF FIGURE

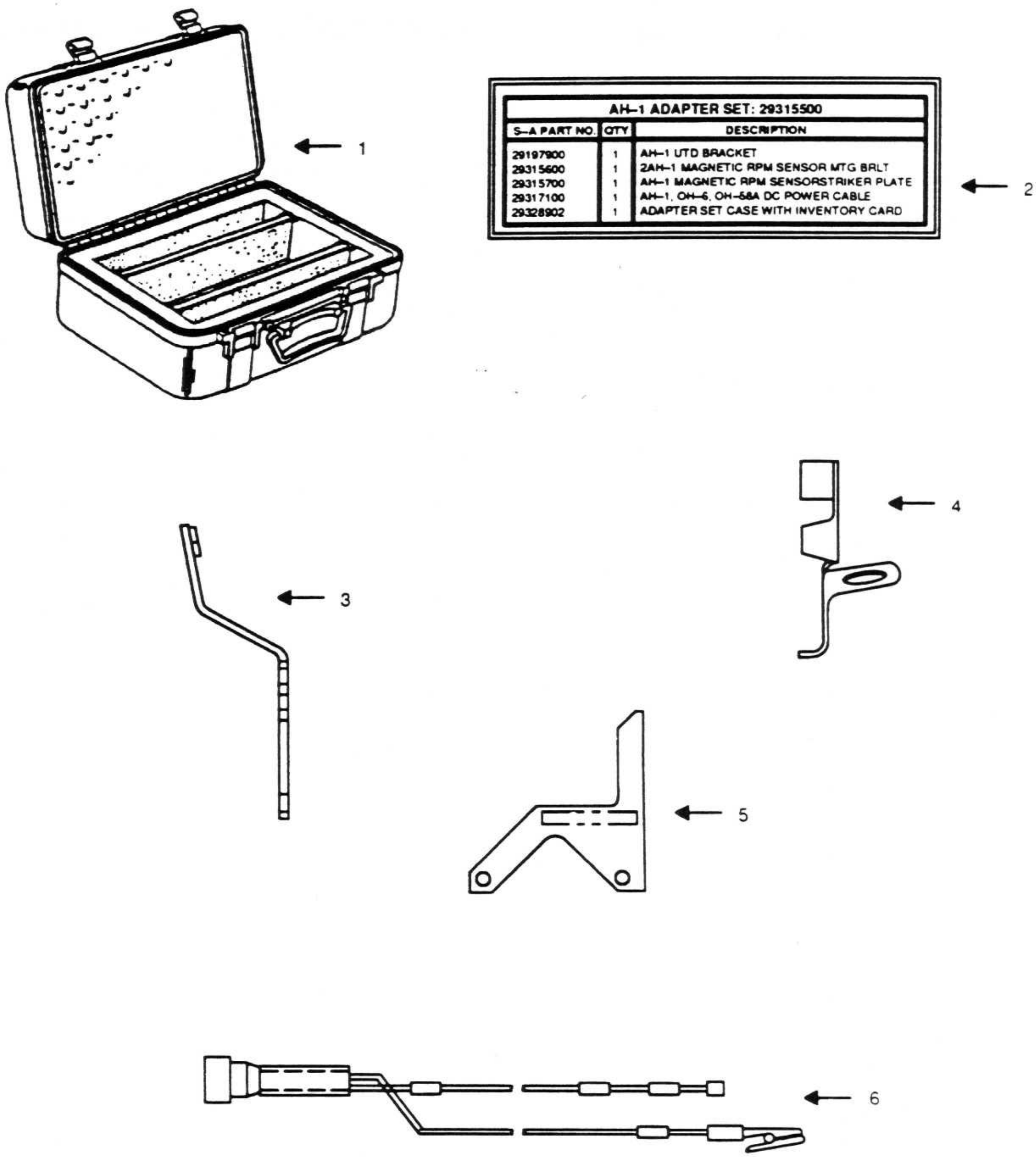


Figure 20. AH-1 Test Adapter Kit (29315500)

Figure 20. Group 05 AH-1 Test Adapter Kit (29315500)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODE (UOC)	(6) QTY
	PBOFF	1G3P5	29315500	AH-1 Test Adapter Kit	1
1	XDFZZ	1G3P5	29320100	.Case	1
2	XDFZZ	1G3P5	29321600	.Inventory Card	1
3	XDOZZ	1G3P5	29197900	.UTD Bracket	1
4	XDOZZ	1G3P5	29315600	.RPM Sensor Bracket	1
5	XDOZZ	1G3P5	29315700	.Mag RPM Plate	1
6	PAOFF	1G3P5	29317100	.DC Power Cable Assembly (See figure 10)	1

END OF FIGURE

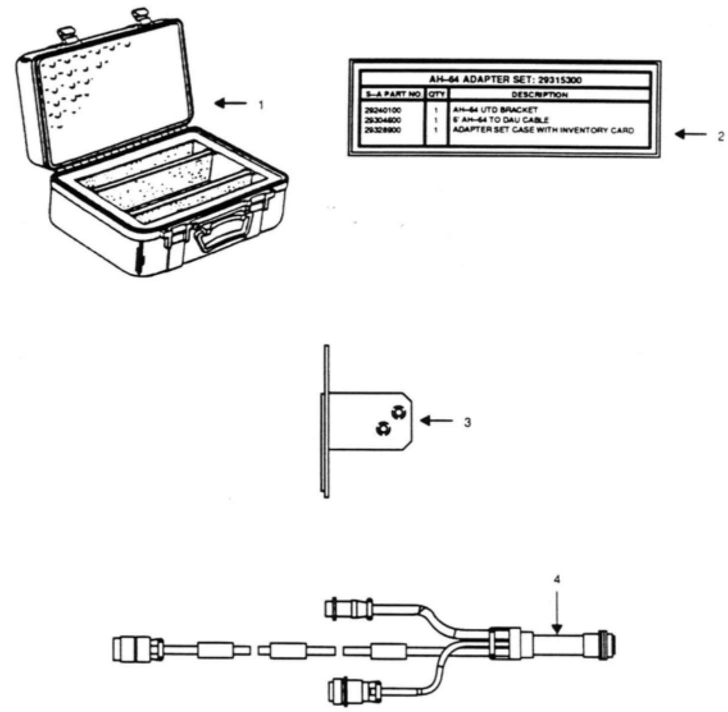


Figure 21A. AH-64A/C Test Adapter Kit (29315300)

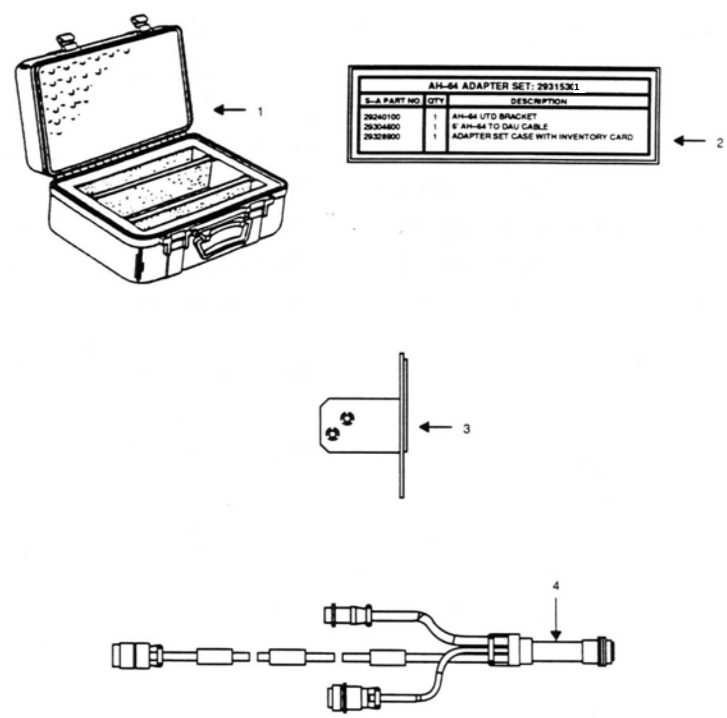


Figure 21B. AH-64D Test Adapter Kit (29315301)

Figure 21A. Group 05 AH-64A/C Test Adapter Kit (29315300)

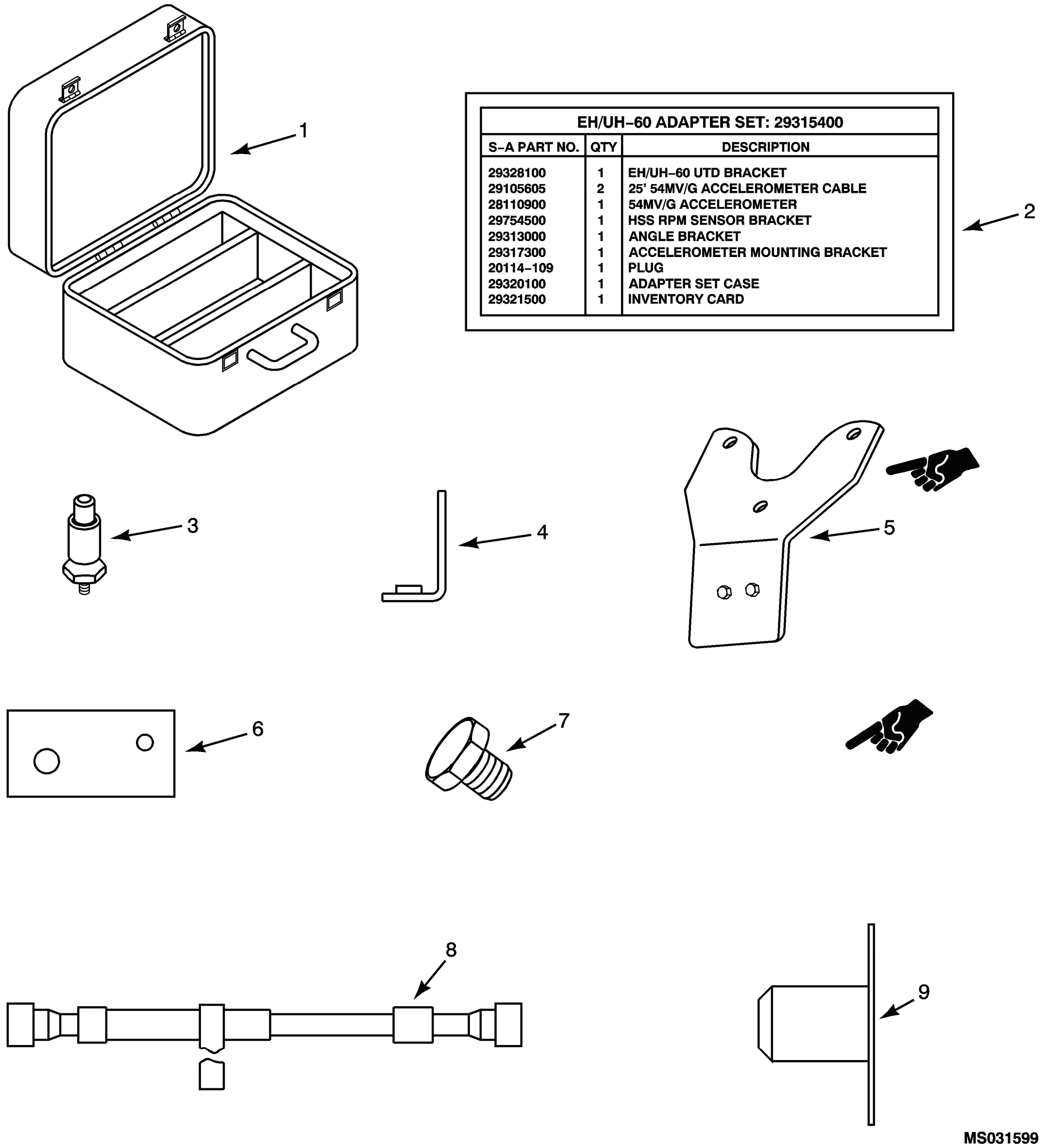
(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODE (UOC)	(6) QTY
	PBOFF	1G3P5	29315300	AH-64 Test Adapter Kit	1
1	XDFZZ	1G3P5	29320100	.Case	1
2	XDFZZ	1G3P5	29321400	.Inventory Card	1
3	XDOZZ	1G3P5	29240100	.UTD Bracket	1
4	PAOFF	1G3P5	29304600	.Cable Assembly, AH-64 to DAU	1

END OF FIGURE

Figure 21B. Group 05 AH-64D Test Adapter Kit (29315301)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODE (UOC)	(6) QTY
	PBOFF	1G3P5	29315301	AH-64D Test Adapter Kit	1
1	XDFZZ	1G3P5	29320100	.Case	1
2	XDFZZ	1G3P5	29321401	.Inventory Card	1
3	XDOZZ	1G3P5	29771400	.UTD Bracket	1
4	PAOFF	1G3P5	29304600	.Cable Assembly, AH-64 to DAU	1

END OF FIGURE



EH/UH–60 ADAPTER SET: 29315400		
S–A PART NO.	QTY	DESCRIPTION
29328100	1	EH/UH–60 UTD BRACKET
29105605	2	25' 54MV/G ACCELEROMETER CABLE
28110900	1	54MV/G ACCELEROMETER
29754500	1	HSS RPM SENSOR BRACKET
29313000	1	ANGLE BRACKET
29317300	1	ACCELEROMETER MOUNTING BRACKET
20114–109	1	PLUG
29320100	1	ADAPTER SET CASE
29321500	1	INVENTORY CARD

Figure 22. EH/UH-60 Adapter Test Kit (29315400)

Figure 22. Group 05 EH/UH-60 Adapter Test Kit (29315400)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODE (UOC)	(6) QTY
	PBOFF	1G3P5		EH/UH-60 Test Adapter Kit	1
1	XDFZZ	1G3P5	29320100	.Case	1
2	XDFZZ	1G3P5	29321500	.Inventory Card	1
3	PAOZZ	53126	991D	.Accelerometer (SI P/N 28110900)	1
4	PAOFF	1G3P5	29313000	.Angle Bracket	1
5	XDOZZ	1G3P5	29754500	.HSS RPM Sensor Bracket	1
6	XDOZZ	1G3P5	29317300	.Accelerometer Mounting Plate	1
7	PAFZZ	96906	20114-109	.Plug	1
8	PAOFF	1G3P5	29105605	.Cable Assembly (See figure 8)	2
9	XDOZZ	1G3P5	29328100	.UTD Bracket	1

END OF FIGURE

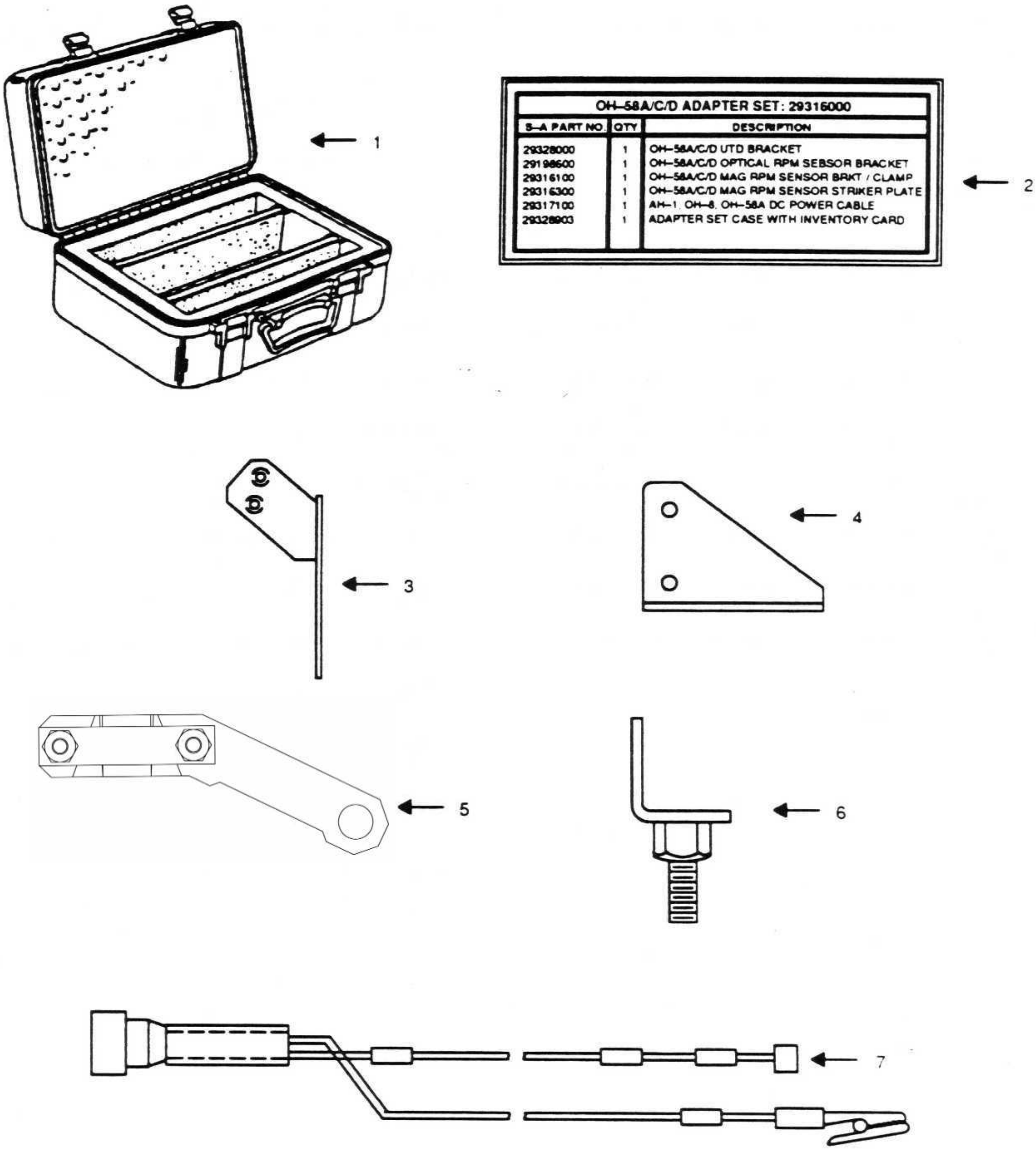


Figure 23. OH-58A/C/D Test Adapter Kit (29316000)

Figure 23. Group 05 OH-58A/C/D Test Adapter Kit (29316000)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODE (UOC)	(6) QTY
	PBOFF	1G3P5	29316000	OH-58A/C/D Test Adapter Kit	1
1	XDFZZ	1G3P5	29320100	.Case	1
2	XDFZZ	1G3P5	29321700	.Inventory Card	1
3	XDOZZ	1G3P5	29328000	.UTD Bracket	1
4	XDOZZ	1G3P5	29198600	.RPM Sensor Bracket	1
5	XDOZZ	1G3P5	29316100	.Mag Sensor Bracket	1
6	XDOZZ	1G3P5	29316300	.Mag Striker Plate	1
7	PAOFF	1G3P5	29317100	.DC Power Cable Assembly (See figure 10)	1

END OF FIGURE

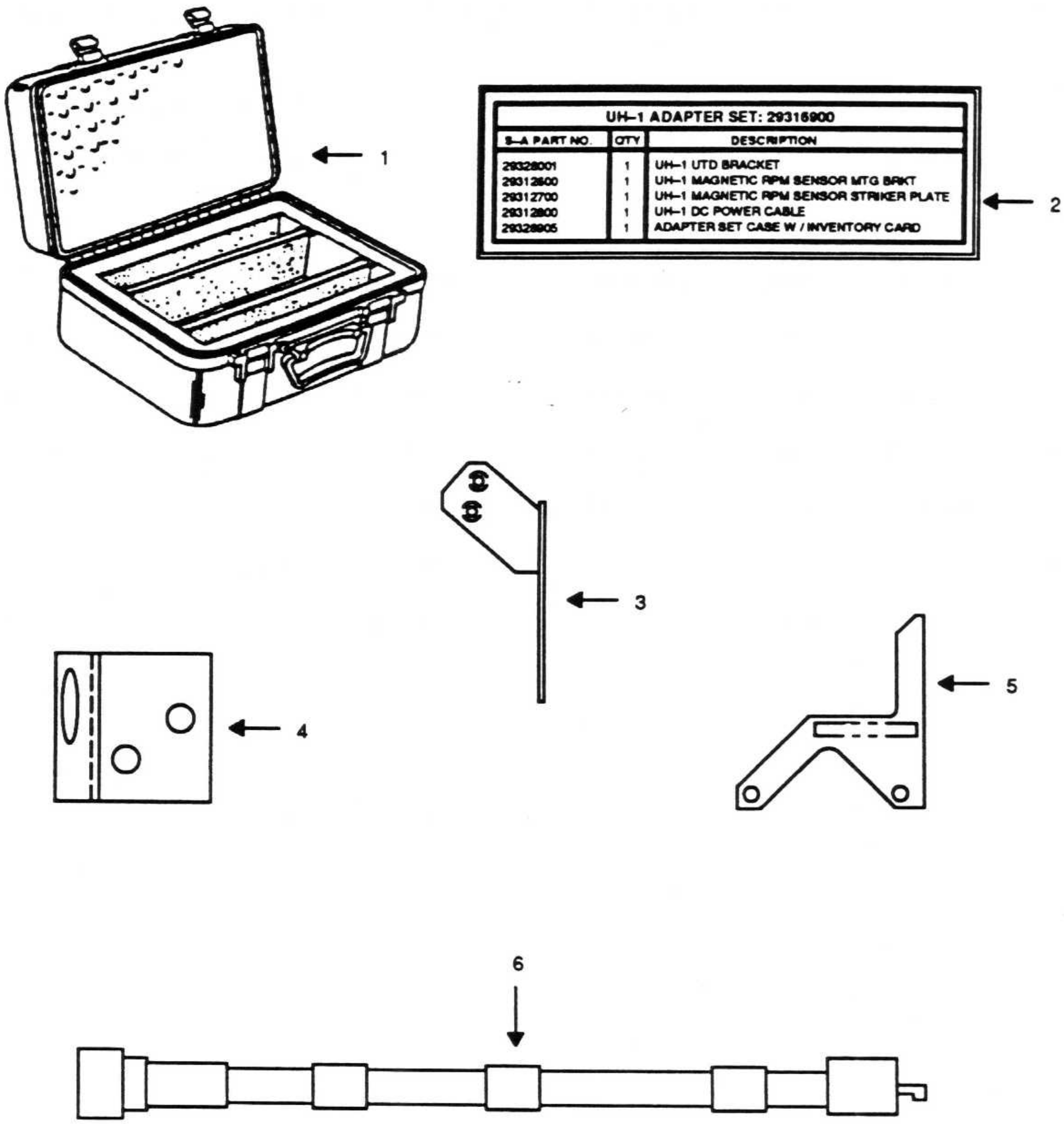
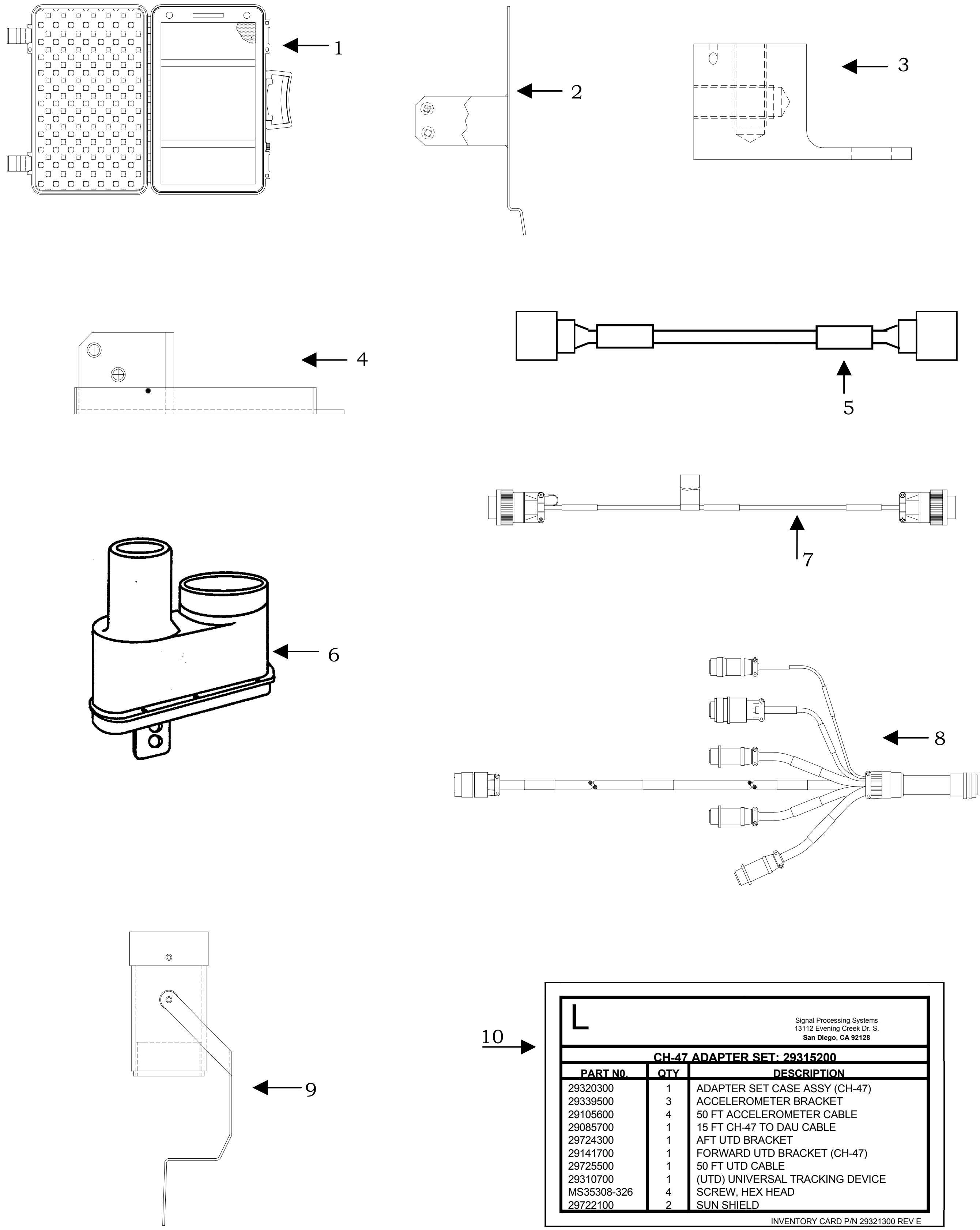


Figure 24. UH-1 Test Adapter Kit (29316900)

Figure 24. Group 05 UH-1 Test Adapter Kit (29316900)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODE (UOC)	(6) QTY
	PBOFF	1G3P5	29316900	UH-1 Test Adapter Kit	1
1	XDFZZ	1G3P5	29320100	.Case	1
2	XDFZZ	1G3P5	29321900	.Inventory Card	1
3	XDOZZ	1G3P5	29328001	.UTD Bracket	1
4	XDOZZ	1G3P5	29312600	.Mag RPM Sensor Bracket	1
5	XDOZZ	1G3P5	29312700	.Mag RPM Striker Plate	1
6	PAOFF	1G3P5	29312800	.DC Power Cable Assembly (See figure 9)	1

END OF FIGURE



CH-47 ADAPTER SET: 29315200

PART N0.	QTY	DESCRIPTION
29320300	1	ADAPTER SET CASE ASSY (CH-47)
29339500	3	ACCELEROMETER BRACKET
29105600	4	50 FT ACCELEROMETER CABLE
29085700	1	15 FT CH-47 TO DAU CABLE
29724300	1	AFT UTD BRACKET
29141700	1	FORWARD UTD BRACKET (CH-47)
29725500	1	50 FT UTD CABLE
29310700	1	(UTD) UNIVERSAL TRACKING DEVICE
MS35308-326	4	SCREW, HEX HEAD
29722100	2	SUN SHIELD

INVENTORY CARD P/N 29321300 REV E

Figure 25. CH-47 Test Adapter Kit (29315200)

Figure 25. Group 05 CH-47 Test Adapter Kit (29315200)

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODE (UOC)	(6) QTY
	PBOFF	1G3P5	29315200	CH-47 Test Adapter Kit	1
1	XDFZZ	1G3P5	29320300	.Case	1
2	XDFZZ	1G3P5	29141700	.Forward UTD Bracket	1
3	XDOZZ	1G3P5	29339500	.Accelerometer Bracket	3
4	XDOZZ	1G3P5	29724300	.Aft UTD Bracket	1
5	PAOFF	1G3P5	29105600	.50-ft. Accelerometer Cable	4
6	PAOFF	1G3P5	29310700	.Universal Tracking Device (UTD) (See figure 3)	1
7	PAOFF	1G3P5	29725500	.50-ft. UTD Cable	1
8	PAOFF	1G3P5	29085700	.15-ft. CH-47 to DAU Cable	1
9	XDFZZ	1G3P5	29722100	.Sun Shield	2
10	XDFZZ	1G3P5	29321300	.Inventory Card	1

END OF FIGURE

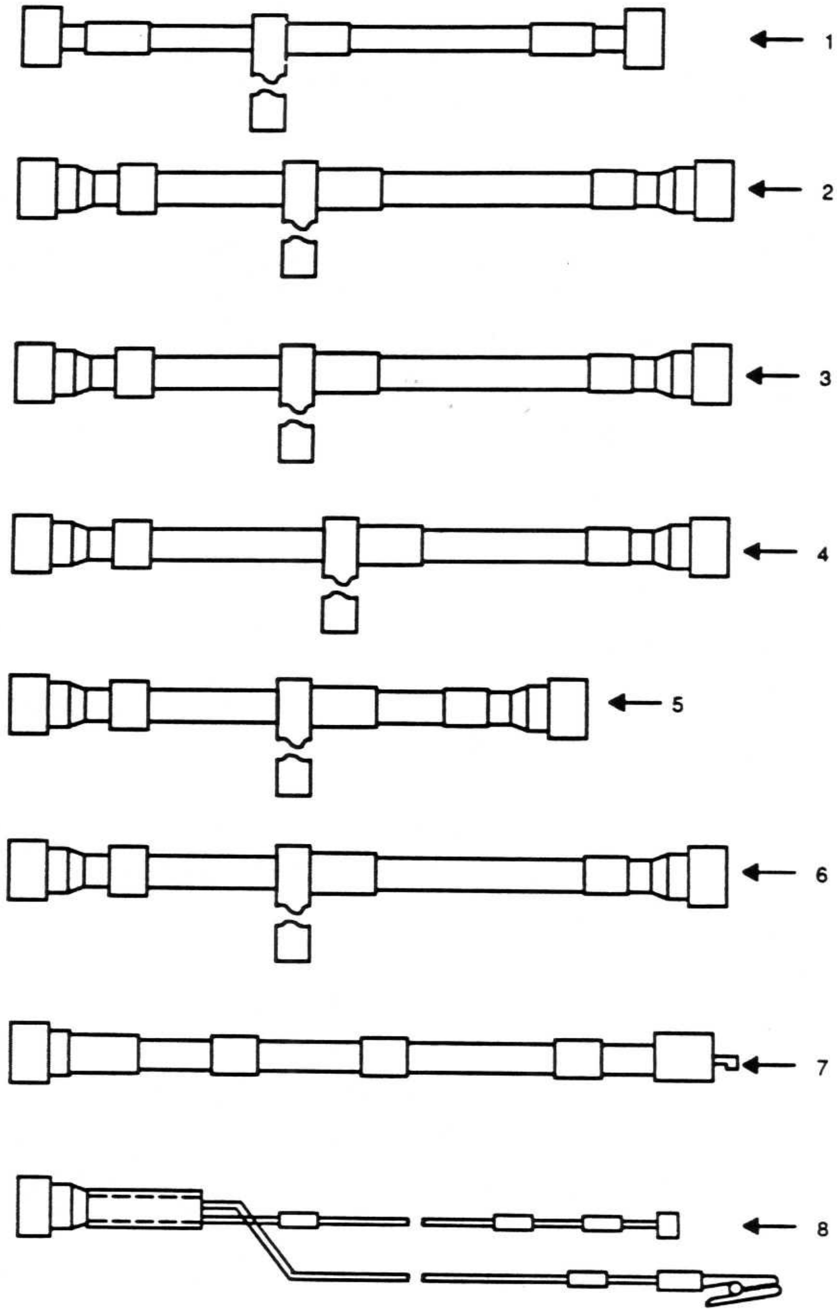


Figure 26. AVA Accessories (Sheet 1 of 2)

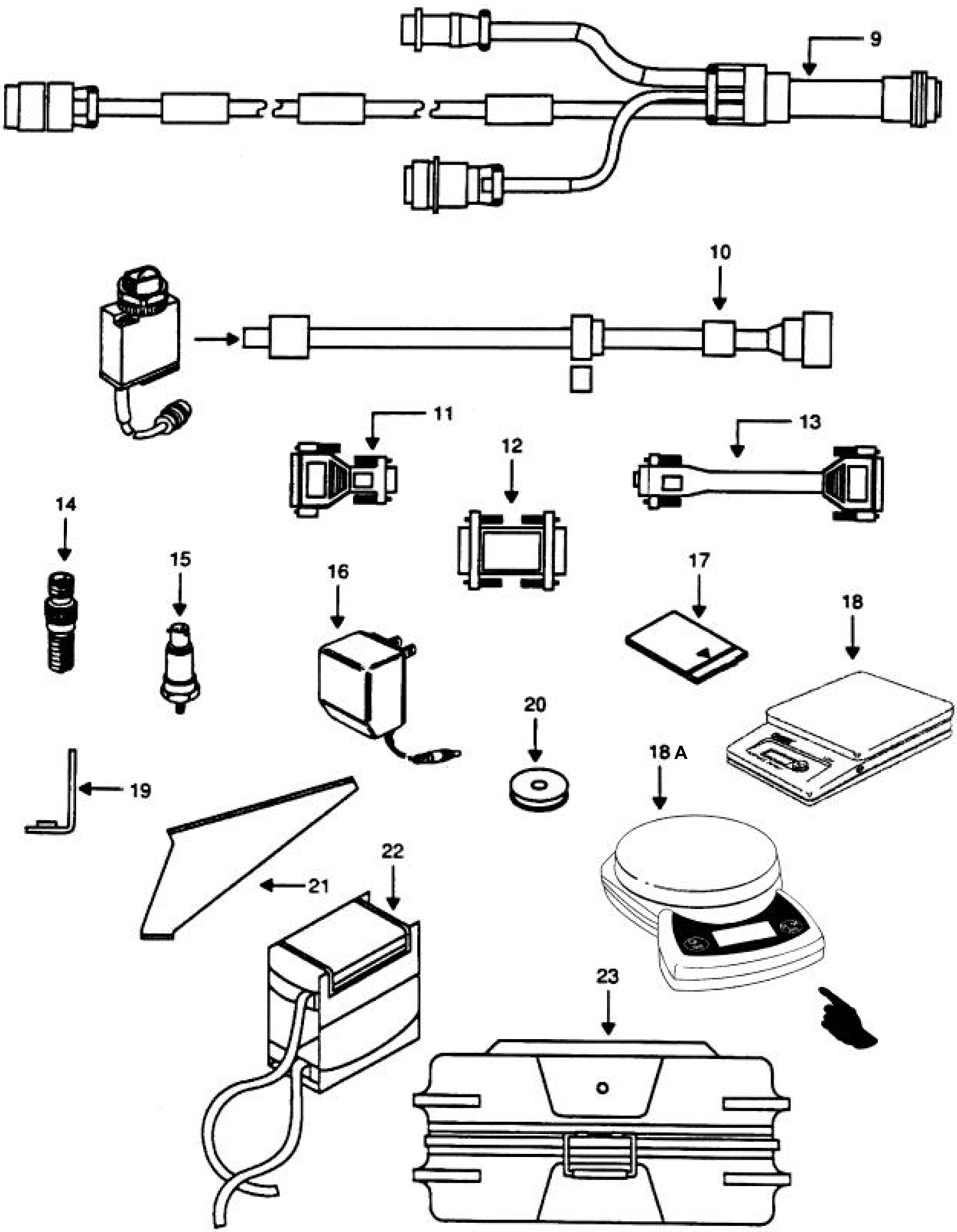


Figure 26. AVA Accessories (Sheet 2 of 2)

Figure 26. Group 06 AVA Accessories

(1) ITEM NO	(2) SMR CODE	(3) CAGE	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
	PBODD	1G3P5	29313107	Test Set, Aviation Vibration Analyzer	1
1	PAOFF	1G3P5	29104700	.Cable Assy A/C Power (see figure 4)	1
2	PAOFF	1G3P5	29325601	.Cable Assy DAU to CADU (see figure 5)	1
3	PAOFF	1G3P5	29325701	.Cable Assy DAU to UTD (see figure 6)	1
4	PAOFF	1G3P5	29105403	.Cable Assy DAU Mag RPM Sensor (see figure 7)	1
5	PAOFF	1G3P5	29105605	.25' Cable Assy 54 mV/g Accelerometer (see figure 8)	1
6	PAOFF	1G3P5	29105600	.50' Cable Assy 54 mV/g Accelerometer (see figure 8)	1
7	PAOFF	1G3P5	29312800	.Cable Assy DC Power (see figure 9)	1
8	PAOFF	1G3P5	29317100	.Cable Assy DC Power (see figure 10)	1
9	PAOFF	1G3P5	29304600	.Cable Assy DAU (see figure 11)	1
10	PAOFF	1G3P5	29314700	.Optical RPM Sensor (see figure 12)	1
11	XDFZZ	43221	DG259MF-IBM	.Adapter, AT Serial (see figure 13)	1
12	XDFZZ	1G3P5	28130800	.Gender Changer (see figure 14)	1
13	XDFZZ	1G3P5	28130802	.Cable, Serial Printer (see figure 15)	1
14	AOOOO	1G3P5	27288400	.Magnetic Sensor Assy (see figure 16)	1
15	PAOZZ	53126	28110900	.Accelerometer, 54 mV/g	2
16	PAOZZ	1G3P5	29315000	.Charger, Battery (see figure 17)	1
17	PAOZZ	1G3P5	28131220	.Credit Card Memory (see figure 18)	1
18	PAOZZ	1G3P5	29323700	.Scale, Weighing (see figure 19)	1
18A	PAOZZ	1G3P5	29323703	.Scale, Weighing (see figure 19, Alternate for Item 18)	1
19	PAOZZ	1G3P5	29313000	.Bracket, Angle	2
20	PAOZZ	1G3P5	10605000	.Tape, Reflective	1
21	XDOZZ	1G3P5	29198700	.Bracket, Optical RPM Sensor	1
22	XDOZZ	1G3P5	29086000	.Case, Carrying, Canvas	1
23	XDFZZ	1G3P5	29320800	.Case, Assy - Shipping/Storage	1

END OF FIGURE

END OF WORK PACKAGE

SPECIAL TOOLS LIST

Special tools are not required.

END OF WORK PACKAGE

CROSS-REFERENCE INDEXES
NATIONAL STOCK NUMBER INDEX

NSN	FIGURE	ITEM	NSN	FIGURE	ITEM
2510-01-392-1010	2	131	5310-00-167-0814	3	54
4140-01-347-0057	2	19	5310-00-197-4505	2	55
4920-01-384-4038	1	25	5310-00-208-3786	1	16
5305-00-054-5639	2	29	5310-00-595-6211	2	40
5305-00-054-5647	3	33	5310-00-595-6211	3	7
5305-00-054-5648	2	5	5310-00-595-6211	3	12
5305-00-054-5648	1	12	5310-00-595-6211	3	23
5305-00-054-5650	1	2	5310-00-595-6211	3	25
5305-00-054-5651	3	39	5310-00-595-6211	3	31
5305-00-054-5653	3	5	5310-00-595-6211	3	35
5305-00-054-5654	3	42	5310-00-595-6211	1	3
5305-00-054-5656	2	17	5310-00-595-6211	2	14
5305-00-054-6649	2	13	5310-00-595-6761	2	30
5305-00-054-6651	2	128	5310-00-616-8660	1	23
5305-00-054-6651	1	6	5310-00-616-8660	2	48
5305-00-056-9961	2	61	5310-00-616-8660	2	117
5305-00-056-9961	2	69	5310-00-616-8660	2	121
5305-00-056-9961	2	75	5310-00-722-5998	2	10
5305-00-056-9961	2	93	5310-00-722-5998	2	49
5305-00-056-9961	2	99	5310-00-722-5998	1	24
5305-00-056-9961	1	27	5310-00-773-7624	2	129
5305-00-059-3658	2	34	5310-00-773-7624	2	133
5305-00-066-7325	2	60	5310-00-852-0800	16	2
5305-00-068-5414	3	21	5310-00-878-7111	2	16
5305-00-068-6605	2	108	5310-00-928-2690	2	31
5305-00-225-6400	2	74	5310-00-929-6395	2	9
5305-00-225-6400	2	80	5310-00-929-6395	2	50
5305-00-225-6400	2	84	5310-00-929-6395	2	118
5305-00-225-6400	2	88	5310-00-929-6395	2	122
5305-00-225-6400	2	92	5310-00-929-6395	2	130
5305-00-225-6400	2	98	5310-00-929-6395	2	134
5305-00-225-6400	2	104	5310-00-929-6395	1	7
5305-00-225-6400	2	109	5310-00-933-8118	2	6
5305-00-225-6400	2	113	5310-00-933-8118	2	18
5305-00-969-6495	2	21	5310-00-933-8118	2	39
5305-00-969-6495	2	23	5310-00-933-8118	3	6
5305-01-004-7954	3	11	5310-00-933-8118	3	30
5305-01-419-4344	2	8	5310-00-933-8118	3	34
5305-01-419-4344	2	132	5310-00-933-8118	1	4
5305-01-419-4344	2	138	5310-00-933-8119	2	28
5306-00-852-7104	3	51	5310-00-933-8120	2	36
5307-00-446-5361	2	120	5310-00-934-9748	2	38
5307-00-446-5361	2	124	5310-00-934-9759	2	27
5307-00-446-5361	2	53	5310-00-934-9953	2	140
5307-00-987-9768	2	33	5310-00-974-6623	3	53

CROSS-REFERENCE INDEXES
NATIONAL STOCK NUMBER INDEX (Continued)

NSN	FIGURE	ITEM
5310-00-982-4999	3	24
5310-00-989-0640	2	35
5310-01-044-6569	2	2
5310-01-044-6569	2	20
5325-00-837-3052	1	8
5330-00-044-7071	2	71
5330-00-044-7071	2	87
5330-00-585-1591	2	63
5330-00-585-1591	2	79
5330-00-585-1591	1	28
5330-00-686-0978	2	103
5330-00-686-0978	2	107
5330-00-686-0978	2	112
5330-00-686-0978	2	116
5330-00-717-3750	2	91
5330-00-717-3750	2	97
5330-00-717-3750	3	43
5330-00-950-1970	2	83
5330-01-380-1963	3	14
5330-01-380-6211	1	36
5330-01-383-4953	3	20
5330-01-475-1032	3	1
5331-01-044-2309	3	9
5331-01-044-2309	3	8
5331-01-453-3468	3	2
5340-00-477-4230	2	41
5340-01-331-5884	22	4
5340-01-331-5884	26	19
5340-01-379-2647	26	21
5340-01-381-6289	1	9
5340-01-386-4432	3	50
5340-01-388-9632	1	13
5355-00-144-7107	2	46
5365-00-598-5282	7	3
5365-00-598-5287	11	3
5365-00-598-5394	4	3
5365-00-598-5394	9	3
5365-00-598-5394	11	10
5365-00-682-1427	10	7
5365-00-682-1427	11	5
5365-00-820-4535	5	5
5365-00-828-8526	10	3
5365-00-828-8526	11	6
5895-01-324-9712	26	22
5895-01-329-4862	18	
5895-01-329-4862	26	17
5905-01-037-6442	2	67
5905-01-323-4069	12	2
5905-01-380-6287	12	4
5920-01-441-1925	2	58
5930-00-583-8494	2	56
5935-00-074-2907	2	89
5935-00-074-2907	2	94
5935-00-074-8729	6	1
5935-00-321-8295	4	1
5935-00-321-8295	11	4
5935-00-415-3885	4	2
5935-00-539-2651	7	1
5935-00-731-6419	2	85
5935-00-807-9308	2	62
5935-00-812-4675	6	2
5935-00-825-8860	2	100
5935-00-825-8860	2	105
5935-00-825-8860	2	110
5935-00-825-8860	2	114
5935-00-826-1023	2	81
5935-00-893-7373	8	2
5935-00-975-0961	8	1
5935-01-007-6449	2	76
5935-01-052-9436	1	14
5935-01-068-2688	5	1
5935-01-076-9450	11	8
5935-01-081-0855	1	32
5935-01-116-3630	2	70
5935-01-118-0333	5	2
5935-01-148-1191	9	1
5935-01-148-1191	10	1
5935-01-149-2540	7	4
5935-01-165-0718	2	44
5935-01-168-0800	9	2
5935-01-168-0800	10	2
5935-01-231-8432	2	42
5935-01-245-2052	2	72
5935-01-245-2052	2	86
5935-01-325-8002	3	47
5935-01-360-6602	11	9
5935-01-423-7231	7	2
5935-01-423-7231	12	1
5935-01-447-3975	13	1
5935-01-447-3975	26	11

CROSS-REFERENCE INDEXES
NATIONAL STOCK NUMBER INDEX (Continued)

NSN	FIGURE	ITEM
5935-01-475-0970	2	82
5935-01-477-8845	2	90
5935-01-477-8845	2	96
5940-00-179-2884	11	11
5940-00-204-8966	2	123
5940-00-204-8966	2	125
5940-00-813-0698	1	34
5940-01-135-7086	11	7
5950-01-177-1304	12	3
5953-01-125-5821	3	46
5961-01-150-8675	2	68
5998-01-201-0394	2	142
5998-01-342-5872	1	15
5998-01-342-5873	2	25
5998-01-342-5874	2	24
5998-01-344-2308	2	26
5998-01-347-1519	3	36
5999-00-245-7231	10	5
5999-01-175-5185	3	48
5999-01-393-2699	2	45
5999-01-393-2699	1	33
6130-01-329-6494	17	
6130-01-329-6494	26	16
6135-00-900-2139	19	2
6135-01-186-4010	18	1
6140-01-347-3580	1	26
6145-00-378-3836	4	6
6145-00-378-3836	9	6
6145-01-004-8343	10	8
6150-01-327-4177	5	
6150-01-327-4177	26	2
6150-01-327-4178	6	
6150-01-327-4178	26	3
6150-01-327-4182	10	
6150-01-327-4182	20	6
6150-01-327-4182	23	7
6150-01-327-4182	26	8
6150-01-327-6827	4	
6150-01-327-6827	26	1
6150-01-327-6828	7	
6150-01-327-6828	26	4
6150-01-327-6829	9	
6150-01-327-6829	24	6
6150-01-327-6829	26	7
6150-01-327-6830	11	

NSN	FIGURE	ITEM
6150-01-327-6830	21	4
6150-01-327-6830	26	9
6150-01-328-1872	25	5
6150-01-328-1872	26	6
6150-01-347-0052	22	9
6150-01-347-0052	26	5
6150-01-365-3985	15	1
6150-01-365-3985	26	13
6150-01-365-5545	25	8
6150-01-369-0278	25	7
6210-01-287-9902	2	57
6210-01-348-8252	3	
6210-01-348-8252	25	6
6210-01-475-0541	3	3
6625-01-324-9818	21	
6625-01-324-9819	22	
6625-01-324-9820	20	
6625-01-324-9822	24	
6625-01-325-0573	8	
6625-01-325-3390	1	
6625-01-325-8536	23	
6625-01-327-5323	12	
6625-01-327-5323	26	10
6625-01-327-5359	16	
6625-01-364-4477	25	
6625-01-426-0666	14	1
6625-01-426-0666	26	12
6650-01-448-9639	25	9
6670-01-325-3162	19	1
6670-01-325-3162	26	18
6670-01-325-3162	26	18A
6670-01-407-4073	19	1
6680-01-328-1913	26	15
6680-01-328-1913	22	3
6695-01-325-3391	2	
7690-01-353-1700	2	4
9390-01-334-4357	26	20
9905-01-469-0497	1	5
9905-01-469-0497	2	3

END OF WORK PACKAGE

CROSS-REFERENCE INDEXES
PART NUMBER INDEX

CAGE	PART NUMBER	STOCK NUMBER	FIGURE	ITEM
67088	A33096-16	4140-01-347-0057	2	19
	AD1280-OP05-CP		17	1
05791	AL-7119-14		2	37
88044	AN960-C516L	5310-00-167-0814	3	54
OA554	AT327-10	5935-01-477-8845	2	90
OA554	AT327-10	5935-01-477-8845	2	96
OA554	AT327-12	5935-01-475-0970	2	82
OA554	AT327-14		1	29
OA554	AT327-14		2	64
OA554	AT327-14		2	78
OA554	AT327-16	5935-01-245-2052	2	72
OA554	AT327-16	5935-01-245-2052	2	86
OA554	AT327-8		2	102
OA554	AT327-8		2	106
OA554	AT327-8		2	111
OA554	AT327-8		2	115
77542	BR2325	6135-01-186-4010	18	1
91637	CCF-552001F	5905-01-323-4069	12	2
85973	CS2000	6670-01-407-4073	19	1
06090	D-104-00	5940-00-179-2884	11	11
06090	D-110-0181		11	12
85480	DAT-27-619-1	7690-01-353-1700	2	4
43221	DG259MF-IBM	5935-01-447-3975	13	1
43221	DG259MF-IBM	5935-01-447-3975	26	11
46384	F-440-1	5310-01-044-6569	2	2
46384	F-440-1	5310-01-044-6569	2	20
46384	F-632-1	5310-00-878-7111	2	16
46384	FHS-623-6	5307-00-446-5361	2	120
46384	FHS-623-6	5307-00-446-5361	2	124
46384	FHS-632-6	5307-00-446-5361	2	53
46384	FHS-832-10	5307-00-987-9768	2	33
61935	FIO031.1383		2	59
71400	GMA15	5920-01-441-1925	2	58
31669	H-5460	5950-01-177-1304	12	3
3T059	H989		3	40
1G3P5	HBL7545C		9	4
1G3P5	HS048WE1NF038B		7	6
1G3P5	HS095WE1NF038B		5	4
1G3P5	HS095WE1NF038B		6	4
OGT95	JM44LC1216HR	4920-01-384-4038	1	25
81349	M24308/26-1	5935-01-052-9436	1	14
81349	M83519/2-8	5940-01-135-7086	11	7
81349	M85049/17-16W06B		11	2
81349	M85049/41-4A	5935-01-149-2540	7	4
90303	MS1604	6135-00-900-2139	19	2
96906	MS15795-802	5310-00-595-6761	2	30
96906	MS15795-803	5310-00-595-6211	2	40
96906	MS15795-803	5310-00-595-6211	3	7
96906	MS15795-803	5310-00-595-6211	3	12
96906	MS15795-803	5310-00-595-6211	3	23
96906	MS15795-803	5310-00-595-6211	3	25

CROSS-REFERENCE INDEXES
PART NUMBER INDEX (Continued)

CAGE	PART NUMBER	STOCK NUMBER	FIGURE	ITEM
96906	MS15795-803	5310-00-595-6211	3	31
96906	MS15795-803	5310-00-595-6211	3	35
96906	MS15795-803	5310-00-595-6211	1	3
96906	MS15795-803	5310-00-595-6211	2	14
96906	MS15795-805	5310-00-722-5998	2	10
96906	MS15795-805	5310-00-722-5998	2	49
96906	MS15795-805	5310-00-722-5998	1	24
96906	MS16995-11	5305-00-068-5414	3	21
96906	MS21044-C04	5310-00-982-4999	3	24
96906	MS24693-C25	5305-00-969-6495	2	21
96906	MS24693-C25	5305-00-969-6495	2	23
96906	MS24693-C3	5305-00-225-6400	2	74
96906	MS24693-C3	5305-00-225-6400	2	80
96906	MS24693-C3	5305-00-225-6400	2	84
96906	MS24693-C3	5305-00-225-6400	2	88
96906	MS24693-C3	5305-00-225-6400	2	92
96906	MS24693-C3	5305-00-225-6400	2	98
96906	MS24693-C3	5305-00-225-6400	2	104
96906	MS24693-C3	5305-00-225-6400	2	109
96906	MS24693-C3	5305-00-225-6400	2	113
96906	MS24693-C4	5305-00-056-9961	2	61
96906	MS24693-C4	5305-00-056-9961	2	69
96906	MS24693-C4	5305-00-056-9961	2	75
96906	MS24693-C4	5305-00-056-9961	2	93
96906	MS24693-C4	5305-00-056-9961	2	99
96906	MS24693-C4	5305-00-056-9961	1	27
96906	MS24693-C5	5305-00-066-7325	2	60
96906	MS24693-C6	5305-00-068-6605	2	108
96906	MS25036-101	5940-00-813-0698	1	34
96906	MS25036-102	5940-00-204-8966	2	123
96906	MS25036-102	5940-00-204-8966	2	125
96906	MS27473T16B35P		11	1
96906	MS27508E16B55S	5935-00-731-6419	2	85
96906	MS3057-8A	5935-01-168-0800	9	2
96906	MS3057-8A	5935-01-168-0800	10	2
96906	MS3101A16-11S	5935-01-148-1191	9	1
96906	MS3101A16-11S	5935-01-148-1191	10	1
96906	MS3102R14S-5S	5935-00-807-9308	2	62
96906	MS3102R16-11P	5935-01-116-3630	2	70
96906	MS3106A10SL-4S	5935-00-539-2651	7	1
96906	MS3106F16-11P	5935-00-415-3885	4	2
96906	MS3106F16-11S	5935-00-321-8295	4	1
96906	MS3106F16-11S	5935-00-321-8295	11	4
96906	MS3112E10-6P	5953-01-125-5821	3	46
96906	MS3112E10-6S	5935-00-074-2907	2	89
96906	MS3112E10-6S	5935-00-074-2907	2	94
96906	MS3112E12-10SW	5935-00-826-1023	2	81
96906	MS3112E14-18PW		1	31

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PART NUMBER INDEX (Continued)

CAGE	PART NUMBER	STOCK NUMBER	FIGURE	ITEM
96906	MS3112E14-18S	5935-01-007-6449	2	76
96906	MS3112E8-4S	5935-00-825-8860	2	100
96906	MS3112E8-4S	5935-00-825-8860	2	105
96906	MS3112E8-4S	5935-00-825-8860	2	110
96906	MS3112E8-4S	5935-00-825-8860	2	114
96906	MS3116J10-6P	5935-01-076-9450	11	8
96906	MS3116J14-15P	5935-01-360-6602	11	9
96906	MS3116P10-6P	5935-01-423-7231	7	2
96906	MS3116P10-6P	5935-01-423-7231	12	1
96906	MS3116P10-6S	5935-00-074-8729	6	1
96906	MS3116P12-10PW	5935-00-812-4675	6	2
96906	MS3116P8-3S	5935-00-893-7373	8	2
96906	MS3116P8-4P	5935-00-975-0961	8	1
96906	MS3126F14-18P	5935-01-068-2688	5	1
96906	MS3126F14-18SW	5935-01-118-0333	5	2
96906	MS3215-4012	5325-00-837-3052	1	8
96906	MS3420-12A	5365-00-598-5287	11	3
96906	MS3420-4	5365-00-598-5282	7	3
96906	MS3420-4A	5365-00-682-1427	10	7
96906	MS3420-4A	5365-00-682-1427	11	5
96906	MS3420-6	5365-00-820-4535	5	5
96906	MS3420-6A	5365-00-828-8526	10	3
96906	MS3420-6A	5365-00-828-8526	11	6
96906	MS3420-8A	5365-00-598-5394	4	3
96906	MS3420-8A	5365-00-598-5394	9	3
96906	MS3420-8A	5365-00-598-5394	11	10
96906	MS35338-134	5310-00-928-2690	2	31
96906	MS35338-135	5310-00-933-8118	2	6
96906	MS35338-135	5310-00-933-8118	2	18
96906	MS35338-135	5310-00-933-8118	2	39
96906	MS35338-135	5310-00-933-8118	3	6
96906	MS35338-135	5310-00-933-8118	3	30
96906	MS35338-135	5310-00-933-8118	3	34
96906	MS35338-135	5310-00-933-8118	1	4
96906	MS35338-136	5310-00-929-6395	2	9
96906	MS35338-136	5310-00-929-6395	2	50
96906	MS35338-136	5310-00-929-6395	2	118
96906	MS35338-136	5310-00-929-6395	2	122
96906	MS35338-136	5310-00-929-6395	2	130
96906	MS35338-136	5310-00-929-6395	2	134
96906	MS35338-136	5310-00-929-6395	1	7
96906	MS35338-137	5310-00-933-8119	2	28
96906	MS35338-138	5310-00-933-8120	2	36
96906	MS35338-140	5310-00-974-6623	3	53
96906	MS35649-244	5310-00-934-9748	2	38
96906	MS35649-284	5310-00-934-9759	2	27
1G3P5	MS51096-335	5306-00-852-7104	3	51

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CAGE	PART NUMBER	STOCK NUMBER	FIGURE	ITEM
96906	MS51863-11C	5305-01-004-7954	3	11
96906	MS51863-12C		3	29
96906	MS51863-16C		3	16
96906	MS51957-13	5305-00-054-5647	3	33
96906	MS51957-14	5305-00-054-5648	2	5
96906	MS51957-14	5305-00-054-5648	1	12
96906	MS51957-16	5305-00-054-5650	1	2
96906	MS51957-17	5305-00-054-5651	3	39
96906	MS51957-19	5305-00-054-5653	3	5
96906	MS51957-20	5305-00-054-5654	3	42
96906	MS51957-22	5305-00-054-5656	2	17
96906	MS51957-25	5305-00-054-6649	2	13
96906	MS51957-27	5305-00-054-6651	2	128
96906	MS51957-27	5305-00-054-6651	1	6
96906	MS51957-28	5305-01-419-4344	2	8
96906	MS51957-28	5305-01-419-4344	2	132
96906	MS51957-28	5305-01-419-4344	2	138
96906	MS51957-5	5305-00-054-5639	2	29
96906	MS51958-62	5305-00-059-3658	2	34
96906	MS91528-1C3B	5355-00-144-7107	2	46
96906	MS9201-07	5310-00-852-0800	16	2
1G3P5	N-1030B		2	54
80205	NAS620C10	5310-00-989-0640	2	35
80205	NAS620C6	5310-00-773-7624	2	129
80205	NAS620C6	5310-00-773-7624	2	133
80205	NAS671C4	5310-00-208-3786	1	16
80205	NAS671C6	5310-00-616-8660	1	23
80205	NAS671C6	5310-00-616-8660	2	48
80205	NAS671C6	5310-00-616-8660	2	117
80205	NAS671C6	5310-00-616-8660	2	121
1G3P5	R-72	6210-01-475-0541	3	3
01121	RS11.5K5%		2	66
46384	S0S-632-8	5310-00-934-9953	2	140
46384	SO-8194-10		2	141
1G3P5	THT-6-428-10		3	49
12929	TVS505	5961-01-150-8675	2	68
09214	V47ZA7	5905-01-037-6442	2	67
14726	XR26245N-T		2	15
98376	ZT72-190CG-5		2	73
8D391	0651-03		10	4
04562	10.0145		3	19
88204	1000000		3	4
77820	10-101949-10	5330-00-717-3750	2	91
77820	10-101949-10	5330-00-717-3750	2	97
77820	10-101949-10	5330-00-717-3750	3	43
77820	10-101949-12	5330-00-950-1970	2	83
77820	10-101949-14	5330-00-585-1591	2	63

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PART NUMBER INDEX (Continued)

CAGE	PART NUMBER	STOCK NUMBER	FIGURE	ITEM
77820	10-101949-14	5330-00-585-1591	2	79
77820	10-101949-14	5330-00-585-1591	1	28
77820	10-101949-16	5330-00-044-7071	2	71
77820	10-101949-16	5330-00-044-7071	2	87
77820	10-101949-8	5330-00-686-0978	2	103
77820	10-101949-8	5330-00-686-0978	2	107
77820	10-101949-8	5330-00-686-0978	2	112
77820	10-101949-8	5330-00-686-0978	2	116
00779	104480-4		2	43
1G3P5	10605000	9390-01-334-4357	26	20
78189	1224-02	5310-00-197-4505	2	55
00779	1-87523-8	5999-01-393-2699	2	45
00779	1-87523-8	5999-01-393-2699	1	33
92194	1933	6145-00-378-3836	4	6
92194	1933	6145-00-378-3836	9	6
97464	2000-31-ST-ZD		3	52
	20114-109		22	7
02697	2-024N103-70		3	18
02697	2-033N103-70	5331-01-044-2309	3	9
02697	2-033N103-70	5331-01-044-2309	3	8
1G3P5	2-034N103-70	5330-01-383-4953	3	20
93106	2081W-017-BLK		2	7
98388	221-006-BLK		3	37
98388	225-017-A03		2	136
18915	26-12	5998-01-201-0394	2	142
1G3P5	27288400	6625-01-327-5359	16	
1G3P5	28054101		2	144
1G3P5	28091405		2	12
1G3P5	28093900		7	7
1G3P5	28093900		8	5
1G3P5	28094000		11	16
1G3P5	28094001		5	6
1G3P5	28094001		6	5
1G3P5	28108700		4	4
1G3P5	28108700		5	3
1G3P5	28108700		6	3
1G3P5	28108700		7	5
1G3P5	28108700		8	3
1G3P5	28108702		12	5
1G3P5	28110000		2	137
1G3P5	28110203		8	4
1G3P5	28110203		11	13
1G3P5	28110203		17	2
1G3P5	28110204		10	6
1G3P5	28110204		11	14
1G3P5	28110206		4	5
1G3P5	28110206		9	5

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PART NUMBER INDEX (Continued)

CAGE	PART NUMBER	STOCK NUMBER	FIGURE	ITEM
1G3P5	28110206		11	15
1G3P5	28110206		12	6
53126	28110900	6680-01-328-1913	26	15
1G3P5	28130800	6625-01-426-0666	14	1
1G3P5	28130800	6625-01-426-0666	26	12
1G3P5	28130802	6150-01-365-3985	15	1
1G3P5	28130802	6150-01-365-3985	26	13
1G3P5	28131100	5905-01-380-6287	12	4
1G3P5	28131210	5895-01-329-4862	18	
1G3P5	28131220	5895-01-329-4862	26	17
00779	2-87631-6	5935-01-165-0718	2	44
1G3P5	29084900		2	127
1G3P5	29085700	6150-01-365-5545	25	8
1G3P5	29086000	5895-01-324-9712	26	22
1G3P5	29104700	6150-01-327-6827	4	
1G3P5	29104700	6150-01-327-6827	26	1
1G3P5	29105403	6150-01-327-6828	7	
1G3P5	29105403	6150-01-327-6828	26	4
1G3P5	29105600	6150-01-328-1872	25	5
1G3P5	29105600	6150-01-328-1872	26	6
1G3P5	29105601	6625-01-325-0573	8	
1G3P5	29105605	6150-01-347-0052	22	9
1G3P5	29105605	6150-01-347-0052	26	5
1G3P5	29109800		2	143
1G3P5	29109900		2	139
1G3P5	29110000		2	119
1G3P5	29111100	5998-01-344-2308	2	26
1G3P5	29111900	5998-01-342-5874	2	24
1G3P5	29112800		2	135
1G3P5	29141700		25	2
1G3P5	29147300	2510-01-392-1010	2	131
1G3P5	29197900		20	3
1G395	29198600		23	4
1G3P5	29198700	5340-01-379-2647	26	21
1G3P5	29240100		21	3
1G3P5	29304600	6150-01-327-6830	11	
1G3P5	29304600	6150-01-327-6830	21	4
1G3P5	29304600	6150-01-327-6830	26	9
1G3P5	29306300		1	1
1G3P5	29306400		1	10
1G3P5	29310300		3	38
1G3P5	29310400		3	10
1G3P5	29310500		3	13
1G3P5	29310600		3	17
1G3P5	29310700	6210-01-348-8252	3	
1G3P5	29310700	6210-01-348-8252	25	6
1G3P5	29310800		3	45

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CAGE	PART NUMBER	STOCK NUMBER	FIGURE	ITEM
1G3P5	29311000		3	55
1G3P5	29311100	5330-01-380-1963	3	14
1G3P5	29311200		3	26
1G3P5	29311400		3	27
1G3PR	29312600		24	4
1G3P5	29312700		24	5
1G3P5	29312800	6150-01-327-6829	9	
1G3P5	29312800	6150-01-327-6829	24	6
1G3P5	29312800	6150-01-327-6829	26	7
1G3P5	29313000	5340-01-331-5884	22	4
1G3P5	29313000	5340-01-331-5884	26	19
1G3P5	29313107		26	
1G3P5	29314106	6625-01-325-3390	1	
1G3P5	29314700	6625-01-327-5323	12	
1G3P5	29314700	6625-01-327-5323	26	10
1G3P5	29315000	6130-01-329-6494	17	
1G3P5	29315000	6130-01-329-6494	26	16
1G3P5	29315200	6625-01-364-4477	25	
1G3P5	29315300	6625-01-324-9818	21	
1G3P5	29315400	6625-01-324-9819	22	
1G3P5	29315500	6625-01-324-9820	20	
1G3P5	29315600		20	4
1G3P5	29315700		20	5
1G3P5	29316000	6625-01-325-8536	23	
1G3P5	29316100		23	5
1G3P5	29316300		23	6
1G3P5	29316900	6625-01-324-9822	24	
1G3P5	29317100	6150-01-327-4182	10	
1G3P5	29317100	6150-01-327-4182	20	6
1G3P5	29317100	6150-01-327-4182	23	7
1G3P5	29317100	6150-01-327-4182	26	8
1G3P5	29317300		22	6
1G3P5	29320100		20	1
1G3P5	29320100		21	1
1G3P5	29320100		22	1
1G3P5	29320100		23	1
1G3P5	29320100		24	1
1G3P5	29320300		25	1
1G3P5	29320800		26	23
1G3P5	29321000		2	126
1G3P5	29321300		25	10
1G3P5	29321400		21	2
1G3P5	29321500		22	2
1G3P5	29321600		20	2
1G3P5	29321700		23	2
1G3P5	29321900		24	2
1G3P5	29322100	5340-01-386-4432	3	50

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PART NUMBER INDEX (Continued)

CAGE	PART NUMBER	STOCK NUMBER	FIGURE	ITEM
1G3P5	29322500	5998-01-347-1519	3	36
1G3P5	29323200		1	35
1G3P5	29323400		1	11
1G3P5	29323500		1	19
1G3P5	29323700	6670-01-325-3162	19	1
1G3P5	29323700	6670-01-325-3162	26	18
1G3P5	29323703	6670-01-325-3162	26	18A
1G3P5	29324000	6140-01-347-3580	1	26
1G3P5	29324100	5330-01-380-6211	1	36
1G3P5	29324200		1	30
1G3P5	29324300	5340-01-381-6289	1	9
1G3P5	29324400		1	18
1G3P5	29324501		1	17
1G3P5	29324607	5998-01-342-5872	1	15
1G3P5	29325601	6150-01-327-4177	5	
1G3P5	29325601	6150-01-327-4177	26	2
1G3P5	29325701	6150-01-327-4178	6	
1G3P5	29325701	6150-01-327-4178	26	3
1G3P5	29325803		2	11
1G3P5	29325900		2	32
1G3P5	29326000		2	51
1G3P5	29327200	9905-01-469-0497	1	5
1G3P5	29327200	9905-01-469-0497	2	3
1G3P5	29328000		23	3
1G3P5	29328001		24	3
1G3P5	29328100		22	10
1G3P5	29328203	6695-01-325-3391	2	
1G3P5	29328301		22	5
1G3P5	29329600	5340-01-388-9632	1	13
1G3P5	29331200		3	41
1G3P5	29331300		1	37
1G3P5	29339500		25	3
1G3P5	29356504	5998-01-342-5873	2	25
1G3P5	29481200		2	22
1G3P5	29491200		1	22
06134	29491700	5331-01-453-3468	3	2
1G3P5	2949880		3	22
1G3P5	29710500		3	44
1G3P5	29722100	6650-01-448-9639	25	9
1G3P5	29724300		25	4
1G3P5	29725500	6150-01-369-0278	25	7
1G3P5	29750100	5330-01-475-1032	3	1
1G3P5	29754500		23	5
83330	301-103	5999-00-245-7231	10	5
81692	3030AN		16	1
02697	4.1091D-.070W-N103-70		3	28
94222	47-60-101-50		1	20

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CAGE	PART NUMBER	STOCK NUMBER	FIGURE	ITEM
94222	47-63-101-50		1	21
81073	50S45-01-2-03N		2	47
51406	51-311-310		2	52
91802	5400A5	6210-01-287-9902	2	57
04562	55.1248		3	15
86928	5610-55-62		3	32
1G3P5	756-55-12		2	65
1G3P5	756-55-12		2	77
1G3P5	756-55-12		2	95
1G3P5	756-55-12		2	101
13112	82601	5930-00-583-8494	2	56
00779	87309-9	5999-01-175-5185	3	48
00779	87631-2	5935-01-325-8002	3	47
00779	87631-6	5935-01-081-0855	1	32
SW733	8899	6145-01-004-8343	10	8
53421	8961	5340-00-477-4230	2	41
00779	925486-1	5935-01-231-8432	2	42
1G3P5	98376		2	1
53126	991D	6680-01-328-1913	22	3

END OF WORK PACKAGE

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FIGURE	ITEM	NSN	CAGE	PART NUMBER
1		6625-01-325-3390	1G3P5	29314106
1	1		1G3P5	29306300
1	2	5305-00-054-5650	96906	MS51957-16
1	3	5310-00-595-6211	96906	MS15795-803
1	4	5310-00-933-8118	96906	MS35338-135
1	5	9905-01-469-0497	1G3P5	29327200
1	6	5305-00-054-6651	96906	MS51957-27
1	7	5310-00-929-6395	96906	MS35338-136
1	8	5325-00-837-3052	96906	MS3215-4012
1	9	5340-01-381-6289	1G3P5	29324300
1	10		1G3P5	29306400
1	11		1G3P5	29323400
1	12	5305-00-054-5648	96906	MS51957-14
1	13	5340-01-388-9632	1G3P5	29329600
1	14	5935-01-052-9436	81349	M24308/26-1
1	15	5998-01-342-5872	1G3P5	29324607
1	16	5310-00-208-3786	80205	NAS671C4
1	17		1G3P5	29324501
1	18		1G3P5	29324400
1	19		1G3P5	29323500
1	20		94222	47-60-101-50
1	21		94222	47-63-101-50
1	22		1G3P5	29491200
1	23	5310-00-616-8660	80205	NAS671C6
1	24	5310-00-722-5998	96906	MS15795-805
1	25	4920-01-384-4038	OGT95	JM44LC1216HR
1	26	6140-01-347-3580	1G3P5	29324000
1	27	5305-00-056-9961	96906	MS24693-C4
1	28	5330-00-585-1591	77820	10-101949-14
1	29		0A554	AT327-14
1	30		1G3P5	29324200
1	31		96906	MS3112E14-18PW
1	32	5935-01-081-0855	00779	87631-6
1	33	5999-01-393-2699	00779	1-87523-8
1	34	5940-00-813-0698	96906	MS25036-101
1	35		1G3P5	29323200
1	36	5330-01-380-6211	1G3P5	29324100
1	37		1G3P5	29331300
2		6695-01-325-3391	1G3P5	29328203
2	1		1G3P5	98376
2	2	5310-01-044-6569	46384	F-440-1
2	3	9905-01-469-0497	1G3P5	29327200
2	4	7690-01-353-1700	85480	DAT-27-619-1

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FIGURE	ITEM	NSN	CAGE	PART NUMBER
2	5	5305-00-054-5648	96906	MS51957-14
2	6	5310-00-933-8118	96906	MS35338-135
2	7		93106	2081W-017-BLK
2	8	5305-01-419-4344	96906	MS51957-28
2	9	5310-00-929-6395	96906	MS35338-136
2	10	5310-00-722-5998	96906	MS15795-805
2	11		1G3P5	29325803
2	12		1G3P5	28091405
2	13	5305-00-054-6649	96906	MS51957-25
2	14	5310-00-595-6211	96906	MS15795-803
2	15		14726	XR26245N-T
2	16	5310-00-878-7111	46384	F-632-1
2	17	5305-00-054-5656	96906	MS51957-22
2	18	5310-00-933-8118	96906	MS35338-135
2	19	4140-01-347-0057	67088	A33096-16
2	20	5310-01-044-6569	46384	F-440-1
2	21	5305-00-969-6495	96906	MS24693-C25
2	22		1G3P5	29481200
2	23	5305-00-969-6495	96906	MS24693-C25
2	24	5998-01-342-5874	1G3P5	29111900
2	25	5998-01-342-5873	1G3P5	29356504
2	26	5998-01-344-2308	1G3P5	29111100
2	27	5310-00-934-9759	96906	MS35649-284
2	28	5310-00-933-8119	96906	MS35338-137
2	29	5305-00-054-5639	96906	MS51957-5
2	30	5310-00-595-6761	96906	MS15795-802
2	31	5310-00-928-2690	96906	MS35338-134
2	32		1G3P5	29325900
2	33	5307-00-987-9768	46384	FHS-832-10
2	34	5305-00-059-3658	96906	MS51958-62
2	35	5310-00-989-0640	80205	AS620C10
2	36	5310-00-933-8120	9690	MS35338-138
2	37		05791	AL-7119-14
2	38	5310-00-934-9748	96906	MS35649-244
2	39	5310-00-933-8118	96906	MS35338-135
2	40	5310-00-595-6211	96906	MS15795-803
2	41	5340-00-477-4230	53421	8961
2	42	5935-01-231-8432	00779	925486-1
2	43		00779	104480-4
2	44	5935-01-165-0718	00779	2-87631-6
2	45	5999-01-393-2699	00779	1-87523-8
2	46	5355-00-144-7107	96906	MS91528-1C3B
2	47		81073	50S45-01-2-03N
2	48	5310-00-616-8660	80205	NAS671C6
2	49	5310-00-722-5998	96906	MS15795-805

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FIGURE AND ITEM NUMBER INDEX (Continued)

FIGURE	ITEM	NSN	CAGE	PART NUMBER
2	50	5310-00-929-6395	96906	MS35338-136
2	51		1G3P5	29326000
2	52		51406	51-311-310
2	53	5307-00-446-5361	46384	FHS-623-6
2	54		1G3P5	N-1030B
2	55	5310-00-197-4505	78189	1224-02
2	56	5930-00-583-8494	13112	82601
2	57	6210-01-287-9902	91802	5400A5
2	58	5920-01-441-1925	71400	GMA15
2	59		61935	FIO031.1383
2	60	5305-00-066-7325	96906	MS24693-C5
2	61	5305-00-056-9961	96906	MS24693-C4
2	62	5935-00-807-9308	96906	MS3102R14S-5S
2	63	5330-00-585-1591	77820	10-101949-14
2	64		0A554	AT327-14
2	65		1G3P5	756-55-12
2	66		01121	RS11.5K5%
2	67	5905-01-037-6442	09214	V47ZA7
2	68	5961-01-150-8675	12929	TVS505
2	69	5305-00-056-9961	96906	MS24693-C4
2	70	5935-01-116-3630	96906	MS3102R16-11P
2	71	5330-00-044-7071	77820	10-101949-16
2	72	5935-01-245-2052	0A554	AT327-16
2	73		98376	ZT72-190CG-5
2	74	5305-00-225-6400	96906	MS24693-C3
2	75	5305-00-056-9961	96906	MS24693-C4
2	76	5935-01-007-6449	96906	MS3112E14-18S
2	77		1G3P5	756-55-12
2	78		0A554	AT327-14
2	79	5330-00-585-1591	77820	10-101949-14
2	80	5305-00-225-6400	96906	MS24693-C3
2	81	5935-00-826-1023	96906	MS3112E12-10SW
2	82	5935-01-475-0970	0A554	AT327-12
2	83	5330-00-950-1970	77820	10-101949-12
2	84	5305-00-225-6400	96906	MS24693-C3
2	85	5935-00-731-6419	96906	MS27508E16B55S
2	86	5935-01-245-2052	0A554	AT327-16
2	87	5330-00-044-7071	77820	10-101949-16
2	88	5305-00-225-6400	96906	MS24693-C3
2	89	5935-00-074-2907	96906	MS3112E10-6S
2	90	5935-01-477-8845	0A554	AT327-10
2	91	5330-00-717-3750	77820	10-101949-10
2	92	5305-00-225-6400	96906	MS24693-C3
2	93	5305-00-056-9961	96906	MS24693-C4
2	94	5935-00-074-2907	96906	MS3112E10-6S

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FIGURE AND ITEM NUMBER INDEX (Continued)

FIGURE	ITEM	NSN	CAGE	PART NUMBER
2	95		1G3P5	756-55-12
2	96	5935-01-477-8845	0A554	AT327-10
2	97	5330-00-717-3750	77820	10-101949-10
2	98	5305-00-225-6400	96906	MS24693-C3
2	99	5305-00-056-9961	96906	MS24693-C4
2	100	5935-00-825-8860	96906	MS3112E8-4S
2	100		0A554	AT327-8
2	101		1G3P5	756-55-12
2	102		0A554	AT327-8
2	103	5330-00-686-0978	77820	10-101949-8
2	104	5305-00-225-6400	96906	MS24693-C3
2	105	5935-00-825-8860	96906	MS3112E8-4S
2	107	5330-00-686-0978	77820	10-101949-8
2	108	5305-00-068-6605	96906	MS24693-C6
2	109	5305-00-225-6400	96906	MS24693-C3
2	110	5935-00-825-8860	96906	MS3112E8-4S
2	111		0A554	AT327-8
2	112	5330-00-686-0978	77820	10-101949-8
2	113	5305-00-225-6400	96906	MS24693-C3
2	114	5935-00-825-8860	96906	MS3112E8-4S
2	115		0A554	AT327-8
2	116	5330-00-686-0978	77820	10-101949-8
2	117	5310-00-616-8660	80205	NAS671C6
2	118	5310-00-929-6395	96906	MS35338-136
2	119		1G3P5	29110000
2	120	5307-00-446-5361	46384	FHS-623-6
2	121	5310-00-616-8660	80205	NAS671C6
2	122	5310-00-929-6395	96906	MS35338-136
2	123	5940-00-204-8966	96906	MS25036-102
2	124	5307-00-446-5361	46384	FHS-623-6
2	125	5940-00-204-8966	96906	MS25036-102
2	126		1G3P5	29321000
2	127		1G3P5	29084900
2	128	5305-00-054-6651	96906	MS51957-27
2	129	5310-00-773-7624	80205	NAS620C6
2	130	5310-00-929-6395	96906	MS35338-136
2	131	2510-01-392-1010	1G3P5	29147300
2	132	5305-01-419-4344	96906	MS51957-28
2	133	5310-00-773-7624	80205	NAS620C6
2	134	5310-00-929-6395	96906	MS35338-136
2	135		1G3P5	29112800
2	136		98388	225-017-A03
2	137		1G3P5	28110000
2	138	5305-01-419-4344	96906	MS51957-28
2	139		1G3P5	29109900

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FIGURE AND ITEM NUMBER INDEX (Continued)

FIGURE	ITEM	NSN	CAGE	PART NUMBER
2	140	5310-00-934-9953	46384	S0S-632-8
2	141		46384	SO-8194-10
2	142	5998-01-201-0394	18915	26-12
2	143		1G3P5	29109800
2	144		1G3P5	28054101
3		6210-01-348-8252	1G3P5	29310700
3	1	5330-01-475-1032	1G3P5	29750100
3	2	5331-01-453-3468	06134	29491700
3	3	6210-01-475-0541	1G3P5	R-72
3	4		88204	1000000
3	5	5305-00-054-5653	96906	MS51957-19
3	6	5310-00-933-8118	96906	MS35338-135
3	7	5310-00-595-6211	96906	MS15795-803
3	8	5331-01-044-2309	02697	2-033N103-70
3	9	5331-01-044-2309	02697	2-033N103-70
3	10		1G3P5	29310400
3	11	5305-01-004-7954	96906	MS51863-11C
3	12	5310-00-595-6211	96906	MS15795-803
3	13		1G3P5	29310500
3	14	5330-01-380-1963	1G3P5	29311100
3	15		04562	55.1248
3	16		96906	MS51863-16C
3	17		1G3P5	29310600
3	18		02697	2-024N103-70
3	19		04562	10.0145
3	20	5330-01-383-4953	1G3P5	2-034N103-70
3	21	5305-00-068-5414	96906	MS16995-11
3	22		1G3P5	2949880
3	23	5310-00-595-6211	96906	MS15795-803
3	24	5310-00-982-4999	96906	MS21044-C04
3	25	5310-00-595-6211	96906	MS15795-803
3	26		1G3P5	29311200
3	27		1G3P5	29311400
3	28		02697	4.1091D-.070W-N103-70
3	29		96906	MS51863-12C
3	30	5310-00-933-8118	96906	MS35338-135
3	31	5310-00-595-6211	96906	MS15795-803
3	32		86928	5610-55-62
3	33	5305-00-054-5647	96906	MS51957-13
3	34	5310-00-933-8118	96906	MS35338-135
3	35	5310-00-595-6211	96906	MS15795-803
3	36	5998-01-347-1519	1G3P5	29322500
3	37		98388	221-006-BLK
3	38		1G3P5	29310300
3	39	5305-00-054-5651	96906	MS51957-17

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FIGURE AND ITEM NUMBER INDEX (Continued)

FIGURE	ITEM	NSN	CAGE	PART NUMBER
3	40		3T059	H989
3	41		1G3P5	29331200
3	42	5305-00-054-5654	96906	MS51957-20
3	43	5330-00-717-3750	77820	10-101949-10
3	44		1G3P5	29710500
3	45		1G3P5	29310800
3	46	5953-01-125-5821	96906	MS3112E10-6P
3	47	5935-01-325-8002	00779	87631-2
3	48	5999-01-175-5185	00779	87309-9
3	49		1G3P5	THT-6-428-10
3	50	5340-01-386-4432	1G3P5	29322100
3	51	5306-00-852-7104	1G3P5	MS51096-335
3	52		97464	2000-31-ST-ZD
3	53	5310-00-974-6623	96906	MS35338-140
3	54	5310-00-167-0814	0A554	AN960-C516L
3	55		1G3P5	29311000
4		6150-01-327-6827	1G3P5	29104700
4	1	5935-00-321-8295	96906	MS3106F16-11S
4	2	5935-00-415-3885	96906	MS3106F16-11P
4	3	5365-00-598-5394	96906	MS3420-8A
4	4		1G3P5	28108700
4	5		1G3P5	28110206
4	6	6145-00-378-3836	92194	1933
5		6150-01-327-4177	1G3P5	29325601
5	1	5935-01-068-2688	96906	MS3126F14-18P
5	2	5935-01-118-0333	96906	MS3126F14-18SW
5	3		1G3P5	28108700
5	4		1G3P5	HS095WE1NF038B
5	5	5365-00-820-4535	96906	MS3420-6
5	6		1G3P5	28094001
6		6150-01-327-4178	1G3P5	29325701
6	1	5935-00-074-8729	96906	MS3116P10-6S
6	2	5935-00-812-4675	96906	MS3116P12-10PW
6	3		1G3P5	28108700
6	4		1G3P5	HS095WE1NF038B
6	5		1G3P5	28094001
7		6150-01-327-6828	1G3P5	29105403
7	1	5935-00-539-2651	96906	MS3106A10SL-4S
7	2	5935-01-423-7231	96906	MS3116P10-6P
7	3	5365-00-598-5282	96906	MS3420-4
7	4	5935-01-149-2540	81349	M85049/41-4A
7	5		1G3P5	28108700
7	6		1G3P5	HS048WE1NF038B
7	7		1G3P5	28093900
8		6625-01-325-0573	1G3P5	29105601

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FIGURE	ITEM	NSN	CAGE	PART NUMBER
8	1	5935-00-975-0961	96906	MS3116P8-4P
8	2	5935-00-893-7373	96906	MS3116P8-3S
8	3		1G3P5	28108700
8	4		1G3P5	28110203
8	5		1G3P5	28093900
9		6150-01-327-6829	1G3P5	29312800
9	1	5935-01-148-1191	96906	MS3101A16-11S
9	2	5935-01-168-0800	96906	MS3057-8A
9	3	5365-00-598-5394	96906	MS3420-8A
9	4		1G3P5	HBL7545C
9	5		1G3P5	28110206
9	6	6145-00-378-3836	92194	1933
10		6150-01-327-4182	1G3P5	29317100
10	1	5935-01-148-1191	96906	MS3101A16-11S
10	2	5935-01-168-0800	96906	MS3057-8A
10	3	5365-00-828-8526	96906	MS3420-6A
10	4		8D391	0651-03
10	5	5999-00-245-7231	83330	301-103
10	6		1G3P5	28110204
10	7	5365-00-682-1427	96906	MS3420-4A
10	8	6145-01-004-8343	SW733	8899
11		6150-01-327-6830	1G3P5	29304600
11	1		96906	MS27473T16B35P
11	2		81349	M85049/17-16W06B
11	3	5365-00-598-5287	96906	MS3420-12A
11	4	5935-00-321-8295	96906	MS3106F16-11S
11	5	5365-00-682-1427	96906	MS3420-4A
11	6	5365-00-828-8526	96906	MS3420-6A
11	7	5940-01-135-7086	81349	M83519/2-8
11	8	5935-01-076-9450	96906	MS3116J10-6P
11	9	5935-01-360-6602	96906	MS3116J14-15P
11	10	5365-00-598-5394	96906	MS3420-8A
11	11	5940-00-179-2884	06090	D-104-00
11	12		06090	D-110-0181
11	13		1G3P5	28110203
11	14		1G3P5	28110204
11	15		1G3P5	28110206
11	16		1G3P5	28094000
12		6625-01-327-5323	1G3P5	29314700
12	1	5935-01-423-7231	96906	MS3116P10-6P
12	2	5905-01-323-4069	91637	CCF-552001F
12	3	5950-01-177-1304	31669	H-5460
12	4	5905-01-380-6287	1G3P5	28131100
12	5		1G3P5	28108702
12	6		1G3P5	28110206

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FIGURE AND ITEM NUMBER INDEX (Continued)

FIGURE	ITEM	NSN	CAGE	PART NUMBER
13	1	5935-01-447-3975	43221	DG259MF-IBM
14	1	6625-01-426-0666	1G3P5	28130800
15	1	6150-01-365-3985	1G3P5	28130802
16		6625-01-327-5359	1G3P5	27288400
16	1		81692	3030AN
16	2	5310-00-852-0800	96906	MS9201-07
17		6130-01-329-6494	1G3P5	29315000
17	1			AD1280-OP05-CP
17	2		1G3P5	28110203
18	1	6135-01-186-4010	77542	BR2325
18		5895-01-329-4862	1G3P5	28131210
19	1	6670-01-325-3162	1G3P5	29323700
19	1	6670-01-325-3162	1G3P5	29323703
19	1	6670-01-407-4073	85973	CS2000
19	2	6135-00-900-2139	90303	MS1604
20		6625-01-324-9820	1G3P5	29315500
20	1		1G3P5	29320100
20	2		1G3P5	29321600
20	3		1G3P5	29197900
20	4		1G3P5	29315600
20	5		1G3P5	29315700
20	6	6150-01-327-4182	1G3P5	29317100
21		6625-01-324-9818	1G3P5	29315300
21	1		1G3P5	29320100
21	2		1G3P5	29321400
21	3		1G3P5	29240100
21	4	6150-01-327-6830	1G3P5	29304600
22		6625-01-324-9819	1G3P5	29315400
22	1		1G3P5	29320100
22	2		1G3P5	29321500
22	3	6680-01-328-1913	53126	991D
22	4	5340-01-331-5884	1G3P5	29313000
22	5		1G3P5	29754500
22	6		1G3P5	29317300
22	7			20114-109
22	8	6150-01-347-0052	1G3P5	29105605
22	9		1G3P5	29328100
23		6625-01-325-8536	1G3P5	29316000
23	1		1G3P5	29320100
23	2		1G3P5	29321700
23	3		1G3P5	29328000
23	4		1G395	29198600
23	5		1G3P5	29316100
23	6		1G3P5	29316300
23	7	6150-01-327-4182	1G3P5	29317100

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FIGURE AND ITEM NUMBER INDEX (Continued)

FIGURE	ITEM	NSN	CAGE	PART NUMBER
24		6625-01-324-9822	1G3P5	29316900
24	1		1G3P5	29320100
24	2		1G3P5	29321900
24	3		1G3P5	29328001
24	4		1G3PR	29312600
24	5		1G3P5	29312700
24	6	6150-01-327-6829	1G3P5	29312800
25		6625-01-364-4477	1G3P5	29315200
25	1		1G3P5	29320300
25	2		1G3P5	29141700
25	3		1G3P5	29339500
25	4		1G3P5	29724300
25	5	6150-01-328-1872	1G3P5	29105600
25	6	6210-01-348-8252	1G3P5	29310700
25	7	6150-01-369-0278	1G3P5	29725500
25	8	6150-01-365-5545	1G3P5	29085700
25	9	6650-01-448-9639	1G3P5	29722100
25	10		1G3P5	29321300
26			1G3P5	29313107
26	1	6150-01-327-6827	1G3P5	29104700
26	2	6150-01-327-4177	1G3P5	29325601
26	3	6150-01-327-4178	1G3P5	29325701
26	4	6150-01-327-6828	1G3P5	29105403
26	5	6150-01-347-0052	1G3P5	29105605
26	6	6150-01-328-1872	1G3P5	29105600
26	7	6150-01-327-6829	1G3P5	29312800
26	8	6150-01-327-4182	1G3P5	29317100
26	9	6150-01-327-6830	1G3P5	29304600
26	10	6625-01-327-5323	1G3P5	29314700
26	11	5935-01-447-3975	43221	DG259MF-IBM
26	12	6625-01-426-0666	1G3P5	28130800
26	13	6150-01-365-3985	1G3P5	28130802
26	15	6680-01-328-1913	53126	28110900
26	16	6130-01-329-6494	1G3P5	29315000
26	17	5895-01-329-4862	1G3P5	28131220
26	18	6670-01-325-3162	1G3P5	29323700
26	19	5340-01-331-5884	1G3P5	29313000
26	20	9390-01-334-4357	1G3P5	10605000
26	21	5340-01-379-2647	1G3P5	29198700
26	22	5895-01-324-9712	1G3P5	29086000
26	23		1G3P5	29320800
26	18A	6670-01-325-3162	1G3P5	29323703

END OF WORK PACKAGE

EXPENDABLE / DURABLE ITEMS LIST

INTRODUCTION

Scope

This work package lists expendable supplies and materials you will need to operate and maintain the AVA Test Set. This listing is for information only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, Expendable/Durable Items (except Medical, Class V, Repair Parts, and Heraldic Items), or CTA 8-100, Army Medical Department Expendable/Durable Items.

Explanation of Columns in the Expendable/Durable Items List

Column (1) - Item Number. This number is assigned to the entry in the list and is referenced in the narrative instructions to identify the item (e.g., Use cleaning compound, item 5, WP 0098 00).

Column (2) - Level. This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew
O – Unit/AVUM
F - Direct Support/AVIM
H - General Support
D – Depot

Column (3) - National Stock Number (NSN). This is the NSN assigned to the items that you can use to requisition it.

Column (4) - Description. Indicates the Federal item name and; if required, a description to identity the item. The last line for each item indicates the Commercial and Government Entity Code (CAGEC) in parentheses followed by the part number.

Column (5) - Unit of Measure (U/M). This code shows the physical measurement or count of an item, such as gallon, dozen, gross, etc.

EXPENDABLE/DURABLE ITEMS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) PART NUMBER	(4) DESCRIPTION	(5) U/M
1	F	SI 28107700	Thread-lock adhesive, Item 24221	Tube
2	F	SI 28059900	Silicone Adhesive, RTV 108	Tube
3	F	SI 28140600	Permabond 910 Adhesive	Tube
4	F	Saunders 5-22	Teflon Thread Tape	Roll
5	F	Chemtronics CSP20	Lens Cleaner	Box
6	F	7930-01-064-5179	Cleaner (Spray)	Can
7	F		Lint-free cloth	
8	F		Lint-free pad	
9	F		Dry-forced air	
10	F	MS3367-4-9	Tie-wraps	

END OF WORK PACKAGE

MANUFACTURED ITEMS LIST

GENERAL

This work package contains the procedures for fabricating the manufactured items you are authorized to make.

WIRING – MANUFACTURE

FABRICATION

1. Cut a suitable length of wire from a spool of bulk wire.

NOTE

Be sure the wire you cut is the same gauge as the wire you are replacing. Identify wire by using color-coded tape, the same color as the wire you are replacing.

2. Note what type and size of connector the old wire had and match it with the new wire.
3. Measure the length of the old wire. When cutting the new wire, add 6 inches to this length.

NOTE

If splicing a wire, use heat shrink tubing over the spliced area.

4. Fasten the first connector splice to one end of the wire.

NOTE

Check new wire for continuity before installation.

5. Install the wire, following the path of the old wire as much as possible.
6. Fasten the wire in place with tape, nylon ties or shrink-wrap.
7. If wire is spliced and heat shrink tubing is used, shrink tubing using a suitable heat source.

END OF WORK PACKAGE

TORQUE LIMITS

The table below gives the standard torque values for studs, nuts, bolts, and screws. Exceptions to the following values are given in the maintenance task where appropriate.

Standard Torque Limits

THREAD DIAMETER: SCREW SIZE NO.	THREAD DIAMETER: THREADS PER INCH	STANDARD TORQUE: MAXIMUM TORQUE (inch-pounds)
Use these torques for bolts and nuts with standard threads.		
6	32	10.1 in-lbs.
8	32	17 in-lbs.
2	56	2 in-lbs.
10	24	23.8 in-lbs.

NOTE

To determine breakaway torque, thread nut onto screw or bolt until at least two threads stick out. Nut shall not make contact with a mating part. Stop the nut. Torque necessary to begin turning nut again is the breakaway torque. Do not reuse self-locking nuts that do not meet minimum breakaway torque.

END OF WORK PACKAGE

AVA APPLICATION AND PROCEDURES – H-60 SERIES
(Script File No. UH60.CMD)

This WP supersedes WP 0069 00 dated 22 December 2003

WARNING

Use extreme care when flying with UTD mounted. UTD interferes with wirestrike capabilities.

CAUTION

Never install cables where they can be damaged. Use wire bundle ties or clamps to route cabling along or through airframe instead of securing cables with fairing doors, panels or seat frames. Never bundle tie cables to flight controls.

TASK 1 - TEST EQUIPMENT INSTALLATION/CHECKOUT
TASK 2 - FLAT TRACK MAIN ROTOR ON THE GROUND
TASK 3 - BALANCE MAIN ROTOR ON THE GROUND
TASK 4 - MAIN ROTOR ROLL/VERTICAL IN-FLIGHT TUNING
TASK 5 - POST FLIGHT BALANCE AMIN ROTOR ON THE GROUND
TASK 6 - BALANCE TAIL ROTOR
TASK 7 - VIBRATION ABSORBER TUNING
TASK 8 - 120 HOUR ENGINE OUTPUT SHAFT AND OIL COOLER VIBRATION TESTING
TASK 9 - ENGINE OUTPUT SHAFT BALANCING, MULTI-DISK COUPLING (MC)
TASK 10 - IMPROVED ENGINE OUTPUT (IEO) SHAFT BALANCING, DIAPHRAGM COUPLING (DC)
TASK 11 - ISOLATING IRREGULAR/UNUSUAL VIBRATIONS

PERSONNEL REQUIRED

Four People Required:
- Tactical Transport Helicopter Repairer
- Powertrain Repairer
- Pilot
- Maintenance Test Pilot

SUPPLIES

- Lockwire, MS20995NC32 (Task 1)
- Corrosion Preventive Compound (C42)

TOOLS

- Aircraft Mechanic's Toolkit, NSN 5180-00-323-4692
- Aircraft Adapter Module, (4063) NSN 4920-01-070-7536
- Aircraft Adapter Kit, (29315400) NSN 6625-01-324-9819
- *Data Acquisition Unit (DAU) (29328203)
- *Control and Display Unit (CADU) (29314106)
- *10-ft CADU to DAU Cable (29325601)
- *Universal Tracking Device (UTD) (29310700)
- *10-ft Aircraft DC Power Cable (29104700)
- *25-ft 54 mV/g Accelerometer Cable (29105605) (2 ea)
- *54 mV/g Accelerometers (28110900) (4 ea)
- *50-ft 54 mV/g Accelerometer Cable (29105600) (2 ea)
- Pilot Heel Vertical Accelerometer Mounting Plate (29317300)
- *Accelerometer Brackets (29313000) (3 each)
- *Optical RPM Sensor (29314700)
- *Optical RPM Sensor Mounting Bracket (29198700)
- *Magnetic RPM Sensor (27288400)
- EH/UH-60A UTD Mounting Bracket (29328100)
- *Magnetic RPM Sensor Cable (29105403)
- Torque Wrench, 0-30 in-lb., NSN 5120-00-117-4832
- *25-ft UTD Cable (29325701)
- Torque Wrench, 150-750 in-lb., NSN 5120-00-821-3444
- Optical HSS RPM Sensor Mounting Bracket (29754500 or HSS-OSB-001)
- AVA Basic Kit, Rotor Track & Balance, NSN 6625-01-282-3746

*Included in AVA Basic Kit

ALSO NEEDED

- Balance Weights (as required)
- Tab Bending Tool
- Tape, Reflective (10605000)
- H-60 Series Setup File (installed in CADU)
- Washers, Flat (MS15795-810) (5 each)
- C-clamp, NSN 5120-00-180-0905
- Upper Screen Assembly (20222-043)
- Lower Screen Assembly (20222-041)
- DELETED
- DELETED

REFERENCES

- TM 1-1520-237-10
- TM 1-1520-237-23
- TM 1-1520-237-23P
- TM 1-1520-237-MTF
- TM 1-3325-724-13&P

The UH-60 Flight Plans are listed below with a brief description of their purposes. The selectable Flight Plans (see Table 1) are listed in order of appearance in the menu of the CADU and not in the order in which they are to be performed.

120HR (Task 8)
The UH-60 120 hour vibration survey is performed on the engines and oil cooler (see Task 8). This procedure measures the vibration levels of the components only, and does not offer corrective actions for out-of-tolerance conditions.

ABTUNE (Task 7)
This is a test designed for measurement and diagnosis of the UH-60 4/REV-cantilever spring cabin absorber. It consists of a sweep through a series of Nr points to measure the effectiveness of the cantilever spring cabin absorber at different rotor RPM. It should be performed when directly by the CADU or when the cabin 4p becomes excessive. The AVA evaluates the 4/REV cabin levels during each FLIGHT plan. The operator may be directed to perform ABTUNE while running main rotor diagnostics.

BOXABS (Task 7)
This is a test designed for measurement and diagnosis of the UH-60 4/REV cabin box absorber. It consists of a sweep through a series of Nr points to measure the effectiveness of the cabin box absorber at different rotor RPM. It should be performed when directed by the CADU or when the cabin 4/REV becomes excessive. The AVA evaluates the 4/REV cabin levels during each FLIGHT plan. The operator may be directed to perform ABTUNE while running main rotor diagnostics. If box absorbers are installed run the BOXABS flight plan.

ENG_1, ENG_2 (Task 9)
This is a test designed to balance the standard engine driveshafts with the multi-disk couplings for the H-60 series aircraft. It will offer corrective actions in the form of balance washers installed on the forward end of the engine output shaft.

ENG_1_DC, ENG_2_DC (Task 10)
This is a test designed to balance the new ECP-319 engine driveshafts with the diaphragm couplings for the H-60 series aircraft. It will offer corrective actions in the form of balance set screws installed in the diaphragm coupling at the forward end of the engine output shaft.

FLIGHT (Task 4)
This test is primarily designed to reduce the in-flight main rotor 1/REV vertical (A+B) and roll (A-B) to specified levels, using Pitch Change Links (PCL) and tabs only. By default hub weights are turned off. This test is designed to be performed only after the main rotor track at flat pitch 100% Nr is less than 0.5 inches and the main rotor is balanced on the ground (A-B at flat pitch 100% Nr<0.2 ips). It is not recommended to proceed to FLIGHT until these conditions are met, doing so may cause unnecessary flight time. If no recent maintenance has been performed on the rotor but the vibration levels are unacceptable, this flight plan can be used to reduce the vibration levels to within the recommended limits without performing GNDTRK and /or GNDBAL.

GNDBAL (Task 3 & 5)
This is the final ground run to be performed prior to and at the completion of the FLIGHT rotor smoothing. It makes a weight adjustment on the rotor to reduce the flat pitch main rotor 1/REV A-B. This flight plan is to be used after the final rotor smoothing flight if the in-flight PCL and/or tab adjustments have put the ground balance above the limit.

GNDTRK (Task 2)
This flight plan flat tracks the main rotor prior to balancing. It is recommended that this flight plan be used after any blade or PCL replacement and prior to any other major main rotor work. It will adjust pitch links to optimize track, without regard to balance changes. If the aircraft is already in service and the operator simply wishes to improve the vibration levels, do not perform the GNDTRK task.

PROBES (Task 11)
This flight plan is designed to acquire data from up to four accelerometers to assist in isolating irregular or unusual vibrations. This flight plan will measure data one channel at a time on DAU ACC1 through ACC4. Accelerometers may be installed anywhere on the airframe and will measure a 0 to 500 Hz spectrum (0 to 30,000 RPM).

TAIL (Task 6)
This flight plan is designed to balance the H-60 series tail rotor. It uses the optical RPM sensor on tach channel 2 and one accelerometer on ACC4. It should be performed after any rework on the tail rotor or any time a medium to high frequency vibration is felt in the aircraft.

Table 1. H-60 Series Flight Plans and Test States

FLIGHT PLAN	TEST STATES	TEST CONDITION
120HR	CKENG1 CKENG2 OILCLR	100% NR, FLAT PITCH
ABTUNE	NR96 NR97 NR98 NR99 NR100 NR101 NR102 NR103	140 KTS, 96% NR 140 KTS, 97% NR 140 KTS, 98% NR 140 KTS, 99% NR 140 KTS, 100% NR 140 KTS, 101% NR 140 KTS, 102% NR 140 KTS, 103% NR
BOXABS	98% Nr 99% Nr 100% Nr 100.5% Nr 101% Nr 102% Nr	140 KTS, 98% NR 140 KTS, 99% NR 140 KTS, 100% NR 140 KTS, 100.5% NR 140 KTS, 101% NR 140 KTS, 102% NR
ENG_1	ENG_1	High Speed Shaft Balance Multi-Disk Coupling 100% NR, FLAT PITCH #1 ENGINE ONLY
ENG_2	ENG_2	High Speed Shaft Balance Multi-Disk Coupling 100% NR, FLAT PITCH #2 ENGINE ONLY
ENG_1_DC	ENG1DC	High Speed Shaft Balance Diaphragm Coupling 100% NR, FLAT PITCH #1 ENGINE ONLY
ENG_2_DC	ENG2DC	High Speed Shaft Balance Diaphragm Coupling 100% NR, FLAT PITCH #2 ENGINE ONLY
FLIGHT	FPG100 Hover 80Kts 120Kts 140Kts	100% NR, FLAT PITCH HOVER 80 KTS, LEVEL FLIGHT 120 KTS, LEVEL FLIGHT 140 KTS, LEVEL FLIGHT
GNDBAL	FPG100	100% NR, FLAT PITCH
GNDTRK	Fpg100	100% NR, FLAT PITCH
PROBES	ACC1 ACC2 ACC3 ACC4	USED AS REQUIRED (Operator must note accelerometer location and orientation when taking data)
TAIL	FPGTL	TAIL BALANCE – FLAT PITCH, 100% NR

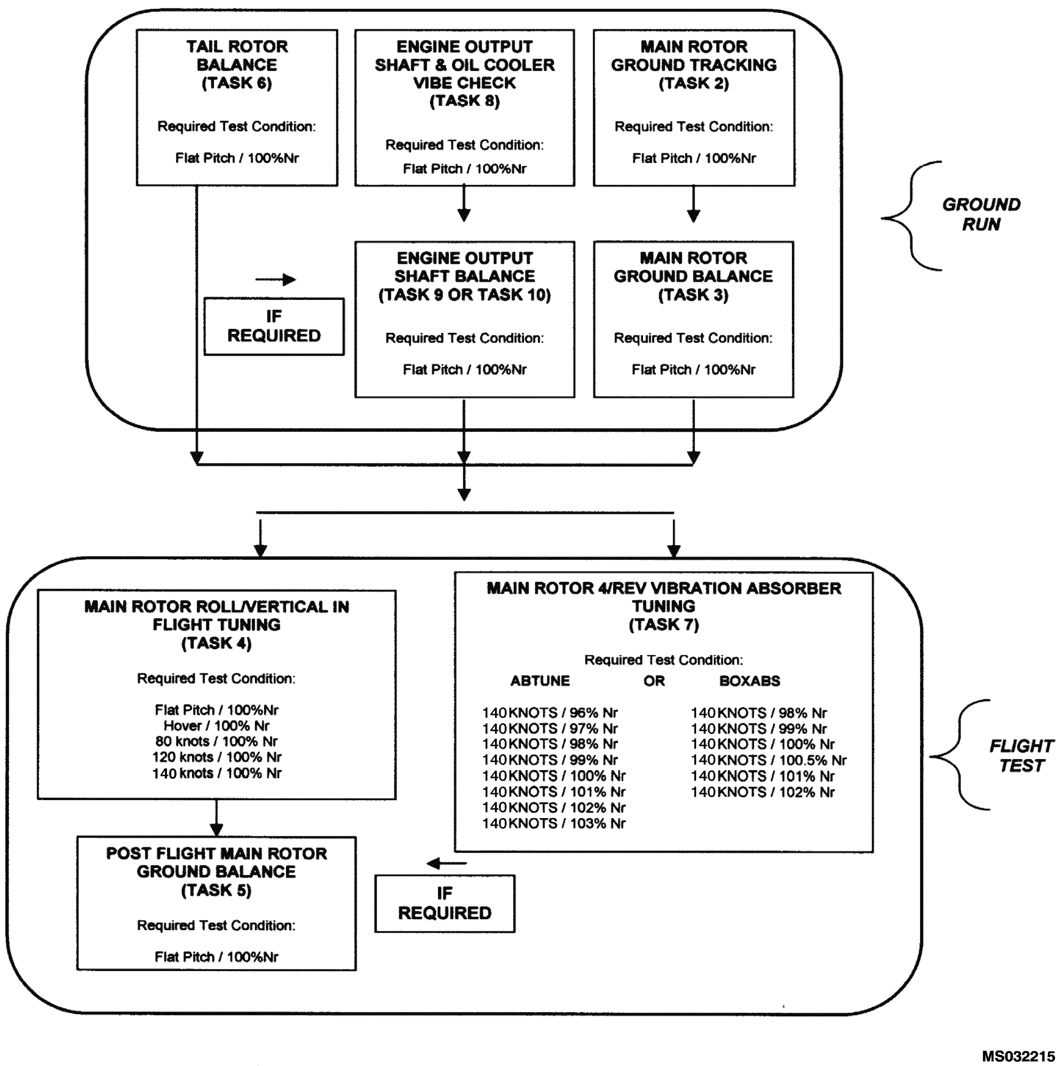
Vibration Test Sequence

This section explains the sequence in which the vibration tasks within TM 1-6625-724-13&P must be carried out. Each block in Figure 1 represents a separate vibration task. The tasks are classified as either Ground Run tasks or Flight Test tasks. All Ground Run tasks must be completed before the Flight Test tasks can be started.

The ground run vibration tasks shown on the top row of Figure 1 can be accomplished interchangeably. However, main rotor flat pitch tracking must be completed before the main rotor ground balance is done.

The flight test vibration tasks can be accomplished once the ground run tasks have been completed.

If aircraft component disassembly or replacement occurs after a vibration task has been initially completed, the vibration tasks that are affected by the component disassembly or replacement must be re-done individually.



1) Ground Run Tasks must be completed before the Flight Test Tasks can be started.
2) Main Rotor Flat Pitch Track (Task 2) must be completed before Main Rotor Ground Balance (Task 3) can be started.
3) Engine Output Shaft Balance (Task 9 or Task 10) is only required if Engine & Oil Cooler Vibe Check (Task 8) is out of limits.
4) Post Flight Ground Balance (Task 6) is only required if FPG A-B is out of limits.
5) The aircraft absorber configuration will determine what absorber flight plan will be used.

Figure 1. Vibration Test Sequence

TASK 1 – TEST EQUIPMENT INSTALLATION/CHECKOUT

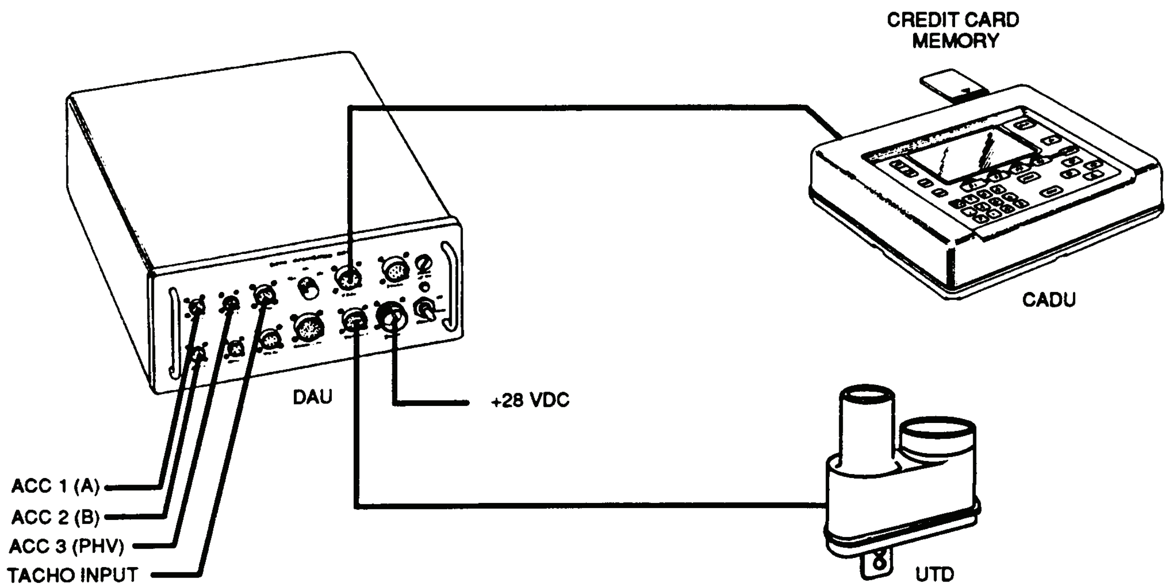


Figure 2. Typical AVA Test Setup Configuration

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA blade tracking equipment from transport case. Check for possible damaged equipment and frayed cables. Figure 2 is the typical AVA test setup configuration.

b. Install DAU in canvas carrying case.

c. Place DAU in right forward facing troop seat with connectors facing up and secure DAU using aircraft shoulder and lap belts and canvas straps. If no seats are installed, the DAU may be secured to the D-rings found on the aircraft cabin floor.

d. Connect power cable (29104700) to aircraft's 28 Vdc utility receptacle at station 293, right side, on cabin ceiling and to DAU receptacle marked 28 Vdc.

e. Place CADU in aircraft. Connect CADU to DAU cable (29325601 or 29325603) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: MAGNETIC RPM SENSOR INSTALLATION

a. Figure 3 is a typical magnetic RPM sensor installation. Remove outer jam nut from magnetic RPM sensor (27288400) and install sensor into bracket on stationary swashplate. Reinstall the outer jam nut, but do not tighten.

b. Turn motor head and line up magnetic RPM senor with senor interrupter on the rotating swashplate.

NOTE

When the magnetic RPM senor and sensor interrupter are aligned, the black blade must be over the nose of the helicopter. Figure 3 shows a typical magnetic RPM sensor installation.

c. Adjust clearance between magnetic RPM sensor and sensor interrupter to 0.022 to 0.024 inch. Tighten outer jam nut on magnetic RPM sensor until a sharp rise in torque is felt, then tighten more with 1/6 to 1/3 turn. Install lockwire.

d. Connect magnetic RPM sensor cable (29105403) to magnetic RPM sensor.

CAUTION

Be sure that magnetic RPM sensor cable cannot interfere with any moving components, as this installation is used during flight. When routing cable, make sure that there is enough slack so that when swashplate moves it will not damage cable.

e. Route magnetic RPM sensor cable down and along main gearbox, through drip pan and into cabin.

f. Connect magnetic RPM sensor cable to the DAU receptacle marked TACHO 1.

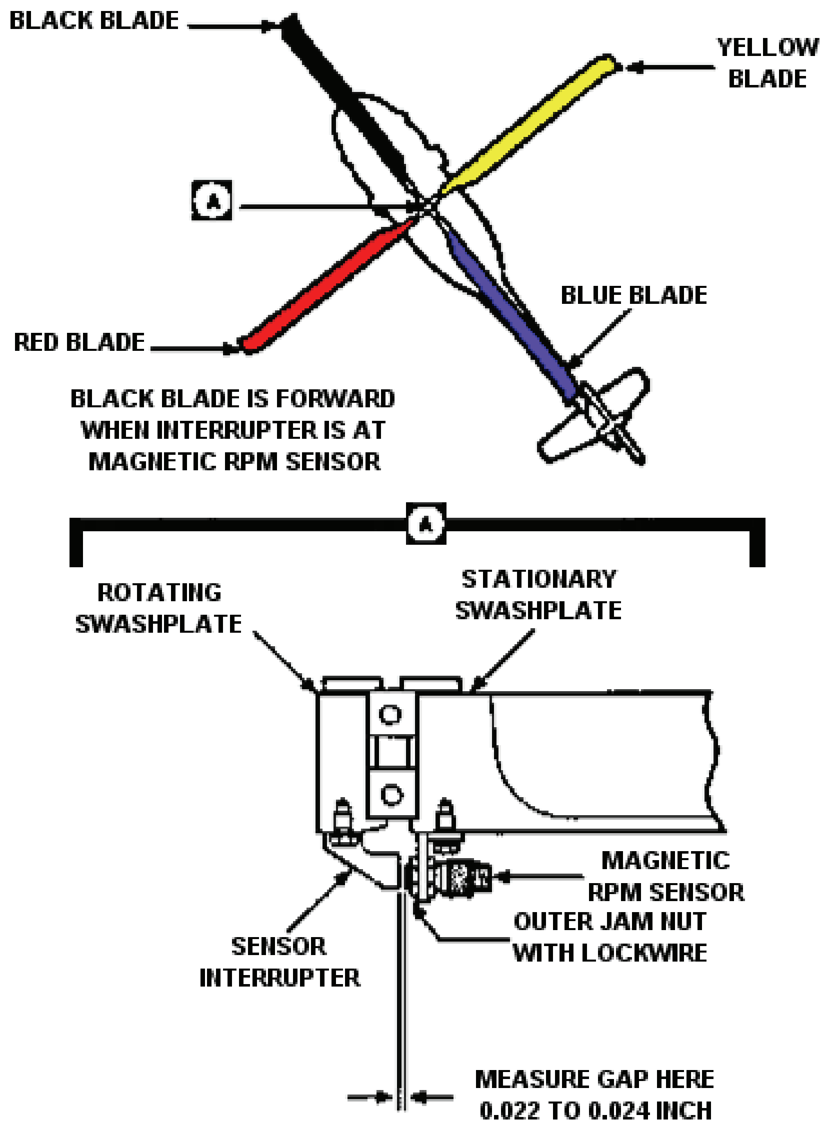


Figure 3. Magnetic RPM Sensor Installation

PROCEDURE 3: TRACKER INSTALLATION

a. Remove forward nose avionics bay access door vent screen.

b. Route UTD cable (29325701) through vent ducting, leaving one foot of cable outside of the aircraft.

c. Route remaining cable through avionics bay, along left side of cockpit center console, making sure cable is secure and does not interfere with flight controls, and connect to the DAU receptacle marked TRACKER 1.

d. Install the UTD mounting bracket (29328100) to avionics bay access door with arrow on bracket body pointing aft. Secure with screws long enough to pass through the mating fastener.

NOTE

If the UTD captive mounting bolts are lost or damaged, use NAS 1305-14 bolts of suitable length as replacements.

e. Mount UTD on bracket, ensuring that the night lens (red lens on UTD) is below the optical lens (clear lens). See Figure 4.

f. Connect the UTD cable (29325701) to UTD connector.

g. Ensure that the TRACKER MODE switch on the front of the DAU is in the DAY position.

Figure 4. Tracker Installation

PROCEDURE 4: ACCELEROMETER INSTALLATION

a. Figure 5 is a typical accelerometer installation.

b. Mount accelerometer brackets (29313000) to station 247 bulkhead behind pilot's and copilot's seats.

c. Install accelerometers (28110900) on accelerometer mounting brackets, with accelerometer facing down (see Figure 5, Configuration 1).

d. Connect accelerometer cable (29105605) from left-side (A) accelerometer to the DAU receptacle marked ACC1 and arrange armor plating adjustment cable so that it does not interfere with the accelerometer during vibration testing.

NOTE

The armor plating adjustment cables must be either moved forward or arranged so that they do not touch either the accelerometers or accelerometer cables and interfere with vibration testing.

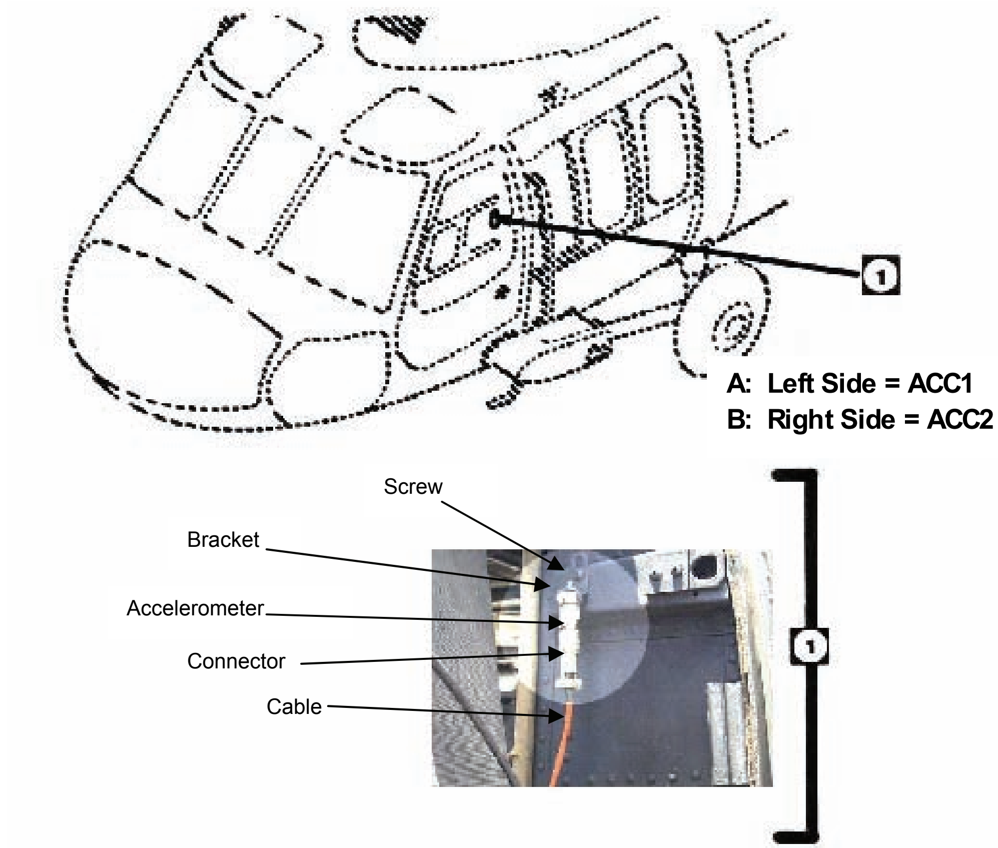


Figure 5. Typical Accelerometer Installation Configuration

e. Connect accelerometer cable (29105605) from right side (B) accelerometer to the DAU receptacle marked ACC2 and arrange armor plating adjustment cable so that it does not interfere with the accelerometer during vibration testing.

f. Install pilot heel vertical (PHV) accelerometer as follows (Figure 6):
   (1) Install accelerometer on L bracket, 2931300, and torque to 20 inch pounds.

NOTE

The pilot heel vertical (PHV) accelerometer is installed so that the connector end of the accelerometer is pointing straight up.

(2) On the right side of the cockpit center console, just aft of the pilots ICS footswitch on the floor, locate the vertical line of screws that runs up from the floor at the intersection where the console width increases (approximately STA 198, WL 215, BL 9R). Remove the second screw from the cockpit floor and attach the accelerometer and bracket with the same screw. Make sure that the accelerometer is oriented with the connector end pointing up and that the accelerometer bracket is sufficiently tight.

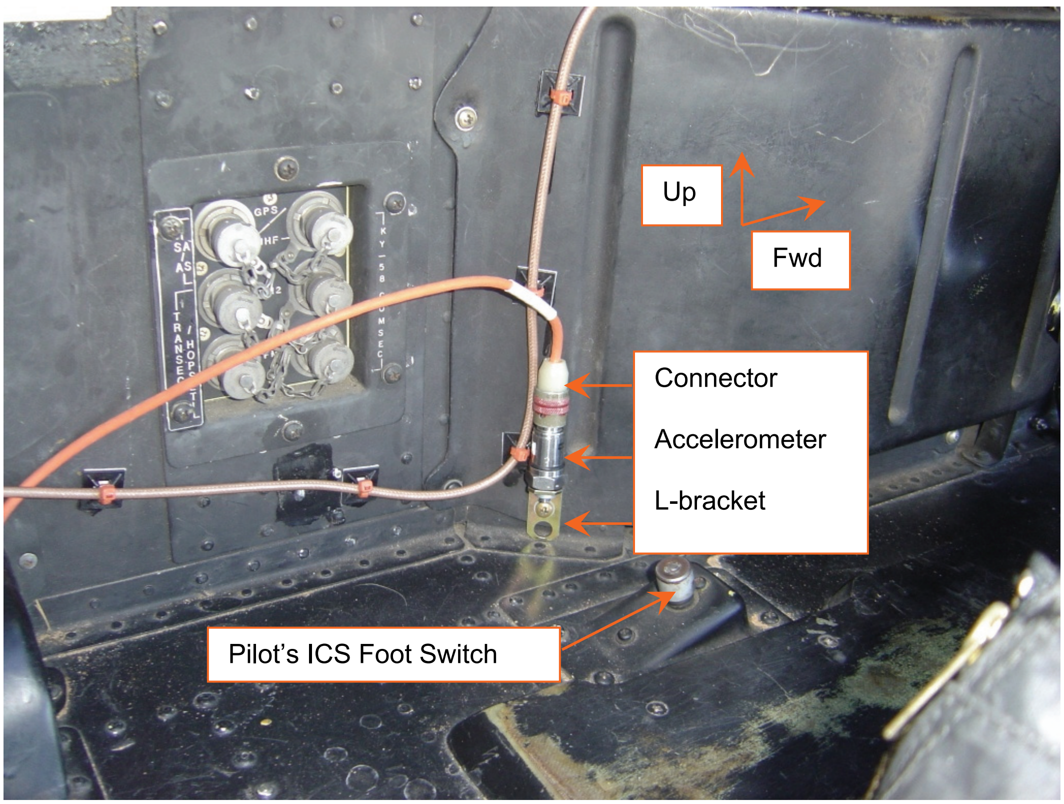


Figure 6. Pilot Heel Vertical Accelerometer Installation

g. Connect accelerometer cable (29105600) from accelerometer (PHV) to the DAU receptacle marked ACC3.

h. If tail rotor balancing is to be performed, the tail rotor balancing equipment may be installed (Task 6, Procedures 1 through 3) at this time. If not, proceed to Procedure 5.

PROCEDURE 5: NIGHT TIME TRACKING INSTRUCTIONS

NOTE

The following steps are to be taken if night time tracking is anticipated. If no flights will be performed after dusk, proceed to Procedure 6.

a. Ensure that the TRACKER MODE switch is in the NIGHT position.

b. Ensure that the underside, trailing edge of all blades is as clean as possible. This is necessary for optimum adhesion of the reflective tape.

c. Place a single, 5-ft strip of reflective tape on the underside, trailing edge of each blade as shown in Figure 7. The tape should begin 18 inches before the hub-end edge of the trim tab, and proceed toward the blade tip. Do not follow the contour of the tab. Ensure that the tap is smooth and as straight as possible.

d. If verification of the tape placement is desired, it can be viewed by holding a flashlight near your head and shining it at the rotating blades. Any misplaced sections of the tape will stand out.

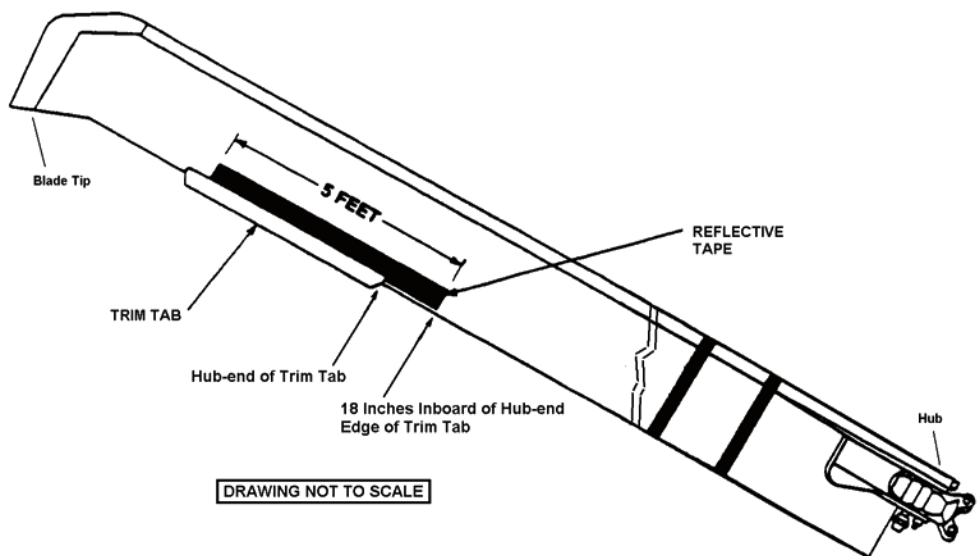


Figure 7. Placement of Reflective Tape on Rotor Blades

PROCEDURE 6: CHECKOUT

a. When aircraft electrical power has been applied, put the DAU power switch in the **ON** position. Ensure that the green light just above the switch is illuminated.

b. On the CADU press **ON**. If not already at the Main Menu, press **QUIT** as many times as required to display the Main Menu.

c. Use cursor keys to highlight Aircraft Type, then press **DO**.

d. Aircraft Types menu is displayed. Use cursor keys to highlight UH-60, and then press **DO**.

e. Main Menu is displayed and Tail Number is highlighted. Press **DO**.

f. Tail Number menu is displayed. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.

g. Main Menu is displayed and Flight Plan is highlighted. Press **DO**.

h. The Flight Plans menu is displayed. Use cursor keys to highlight the appropriate flight plan and perform the appropriate flight plan as outlined in subsequent task.

TASK 2 – FLAT TRACK MAIN ROTOR ON THE GROUND

PROCEDURE 1: PREPARATION

a. Install test equipment (refer to Task 1).

b. Operate aircraft at 100% Nr, flat pitch, and nose into the wind.

c. Turn on DAU.

d. Turn on CADU.

PROCEDURE 2: PERFORM GROUND TRACK (GNDTRK) MEASUREMENT

a. Press Quit on the CADU until all selections are undefined.

b. Use cursor keys to highlight Aircraft Type, then press **DO**.

c. Use cursor keys to highlight UH-60, and then press **DO**.

d. Tail Number is highlighted. Press **DO**.

e. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.

f. Flight Plan is highlighted. Press **DO**.

g. Use cursor keys to highlight GNDTRK. Press **DO**.

h. Enter the Measure mode by pressing **F1**. Verify that Test State FPG100 is highlighted.

i. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire track data and return to the selection menu.

j. After the measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu and perform Task 3, Balance Main Rotor on the Ground.

k. If measured values exceed manufacturer's desired levels, press the **DO** key to enter the DIAGS mode. Perform all corrections displayed on the diagnostic screen. Do not use a partial set of the adjustments. Run Procedure 2 again and verify that previously installed corrections brought aircraft ground track to within manufacturer's recommended limits.

NOTE

If a large track split on the ground has occurred due to large PCL adjustments as a result from prior maintenance and if it is determined that the rotor is too rough to continue to 100% Nr, data may be taken as low as 70% Nr. Corrections may be used from the CADU, which should reduce the track level to an acceptable level allowing 100% rotor speed on next run.

TASK 3 – BALANCE MAIN ROTOR ON THE GROUND

PROCEDURE 1: PREPARATION
Perform Task 2, Flat Track Main Rotor on the Ground.

PROCEDURE 2: PERFORM GROUND BALANCE (GNDBAL) MEASUREMENT

a. Use cursor keys to highlight Aircraft Type, then press **DO**.

b. Use cursor keys to highlight UH-60, and then press **DO**.

c. Tail Number is highlighted. Press **DO**.

d. Use cursor keys to highlight tail number used in Task 2, then press DO.

e. Flight Plan is highlighted. Press **DO**.

f. Use cursor keys to highlight GNDBAL. Press **DO**.

g. Enter the Measurement mode by pressing **F1**. Verify that Test State FPG100 is highlighted.

h. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire balance data and return to the selection menu.

i. After the measurement is completed, press **DO** on “finish”, then press **DO** on Diagnostics. If measurement is within specified limits, press **QUIT** to Main Menu.

j. If measured values exceed manufacturer’s desired levels, press the **DO** key to enter the DIAGS mode. Perform all corrections displayed on the diagnostic screen. Do not use a partial set of adjustments. Run Procedure 2 again and verify that previously installed corrections brought aircraft ground balance to within manufacturer’s recommended limits.

NOTE

Blades Yellow and Red form one pair, Blue and Black form the other. Weights should only be installed on one blade of each pair.

Maximum weight allowed on one spindle is 5 pounds.

Weight of bolt and attaching hardware is approximately 2 ounces.

Weight of balance washer (70106-08105-102) is approximately 1 ounce. Weight of balance washer (AN970-6) is approximately 1/2 ounce.

There are four locations to install balance weights: two on the upper bracket and two on the lower bracket.

The weight of the attaching hardware must be included in the total weight computation (see Figure 8).

The maximum number of balance weights that can be used per bolt is 18, with washer under bolt head removed to obtain the 5-pound maximum. If the washer under the bolt head is installed, the maximum number of balance weights per bolt is 17.

Weight should be as equal as possible. 2 lbs. or less, use trailing bolt hole. Over 2 lbs., divide weight equally among all four-bolt holes.

k. Make appropriate logbook entry on the PCL and balance weights that were changed, if any.

l. Proceed to Task 4.

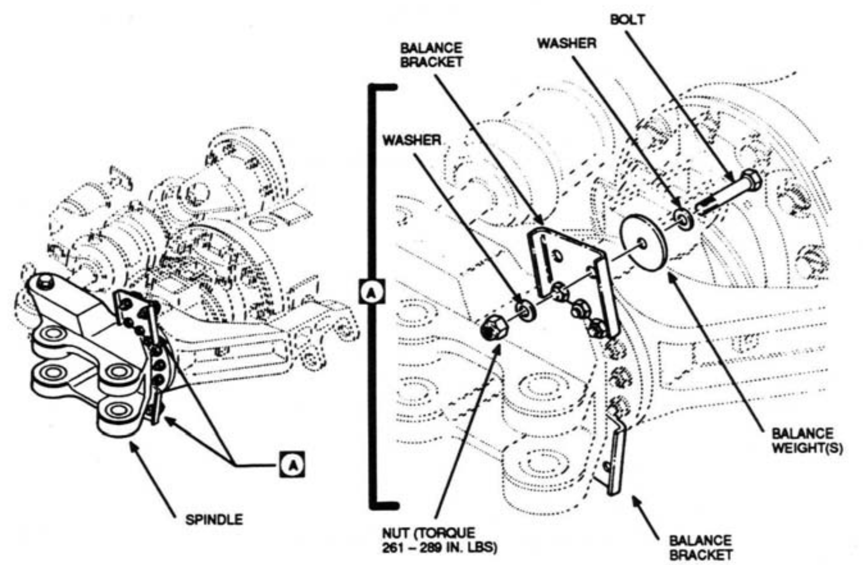


Figure 8. Balance Weight Installation (Horn Assembly 70102-08111-047)

TASK 4 – MAIN ROTOR ROLL/VERTICAL IN-FLIGHT TUNING

CAUTION

If tail rotor requires balancing, Task 6, (Balance Tail Rotor) should be accomplished before flight.

Main rotor in-flight roll/vertical tuning should be performed when any of the following occur:

- Main rotor 1/REV (258 RPM) in-flight vibration is unacceptable.
- Main rotor maintenance was done and ground flat pitch tracking was performed, see Task 2.

PROCEDURE 1: EQUIPMENT INSTALLATION

NOTE

If major maintenance has been accomplished that requires rotor smoothing, Tasks 2 & 3 should be accomplished prior to starting this task. If no maintenance has been previously accomplished then start at Task 4.

a. Install test equipment, see Task 1.

b. Turn on DAU.

c. Turn on CADU.

PROCEDURE 2: PERFORM FLIGHT MEASUREMENT

a. Press QUIT on the CADU until all selections are undefined.

b. Use cursor keys to highlight Aircraft Type, then press **DO**.

c. Use cursor keys to highlight UH-60, and then press **DO**.

d. Tail Number is highlighted. Press **DO**.

e. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.

f. Flight Plan is highlighted. Press **DO**.

g. Use cursor keys to highlight FLIGHT. Press **DO**.

h. Enter the Measure mode by pressing **F1**. Verify that Test State FPG100 is highlighted.

WARNING

If main rotor 1/REV vibration becomes objectionable, acquire data normally through the highest airspeed at which vibration can be tolerated. Do not skip test conditions, data should be taken from ground to the highest airspeed possible. After data is taken at the highest speed achieved, press QUIT then highlight “Save and Exit” and then press DO. Land the aircraft and perform corrections suggested by the CADU prior to further flight.

i. Press **DO** when the aircraft is stable at the highlight selection. Verify that the aircraft is at the required Test State (FPG100, Hover, 80 Kts, 120 Kts, or 140 Kts) and press **DO** again. Perform this operation each time a measurement is completed and another Test State is highlighted. The AVA will acquire track and vibration data at each Test State and then return to the selection menu.

j. After the last measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics.

k. The first screen indicates the status of the absorbers. If absorbers are tuned, expect to see the following message:

MAIN ROTOR 4/REV VIBRATION IS WITHIN LIMITS.

ABSORBER TUNING CAN BE CONSIDERED COMPLETE. HOWEVER IF CABIN ABSORBER IS NOT TUNED TO 100% Nr, ABSORBER TUNING IS NOT OPTIMUM. IT IS RECOMMENDED THAT CABIN ABSORBER BE TUNED TO 100% Nr FOR BEST MAIN ROTOR 4/REV VIBRATION RESULTS.

NOTE

The cabin Box Spring Absorber is tuned to 100.5%.

l. After rotor smoothing is completed and if absorbers are in need of tuning, proceed to Task 7.

m. If rotor 1/REV measurements are within specified limits, press **QUIT** to Main Menu. Remove test equipment.

NOTE

The vibration goals are: A + B at Hover, 80 Kts, 120 Kts and 140 Kts <0.25 ips. Also, the A-B goal at all points is 0.20 ips. If all goals are achieved, no adjustments are necessary and the rotor track and balance is complete.

n. If measured values exceed manufacturer's desired levels, press the **DO** key to enter the DIAGS mode. Evaluate the percentage of improvements using "View Predictions" to determine if the corrective action suggested on the "View Corrections" page is sufficient to lower vibration to acceptable levels. Perform all corrections displayed on the correction screens. Check to ensure that all screens of multiple page solutions have been performed. If alternations to these corrective actions are desired, use the EDIT ADJUSTABLES and EDIT DEFAULTS options. Do not use a partial set of the adjustments. See Procedure 3 for trim tab adjustments.

o. After corrections are installed, fly aircraft and repeat Task 4 to re-check the 1/REV vibrations through the required flight conditions.

p. If last flight does not sufficiently improve rotor vibration, trend the flight data.

   1. Press **QUIT** until the Main menu is displayed.
   2. Press **F2** "Display".
   3. Select "Trend Flights" and press **DO**.
   4. Select the appropriate accelerometer channel and test condition for the desired data to be viewed.
   5. Change the number 4 to 2 in the "# of Test" column and change "Draw Axis" from YES to No then press **DO**.
   6. View the polar chart to determine if the vibration went towards the center or away from the center.
   7. Perform corrective actions deemed necessary to correct this condition, i.e. adjustments installed backwards, incorrect blade color coding, worn components etc.

q. Perform Task 4 again until rotor vibrations are below vibration goals outlined in the note above.

PROCEDURE 3: H-60 SERIES AIRCRAFT TRIM TAB ADJUSTMENTS

NOTE

Trim tab adjustments change the vertical track of a blade.

Bending a trim tab down will cause a blade to dive with increasing airspeed.

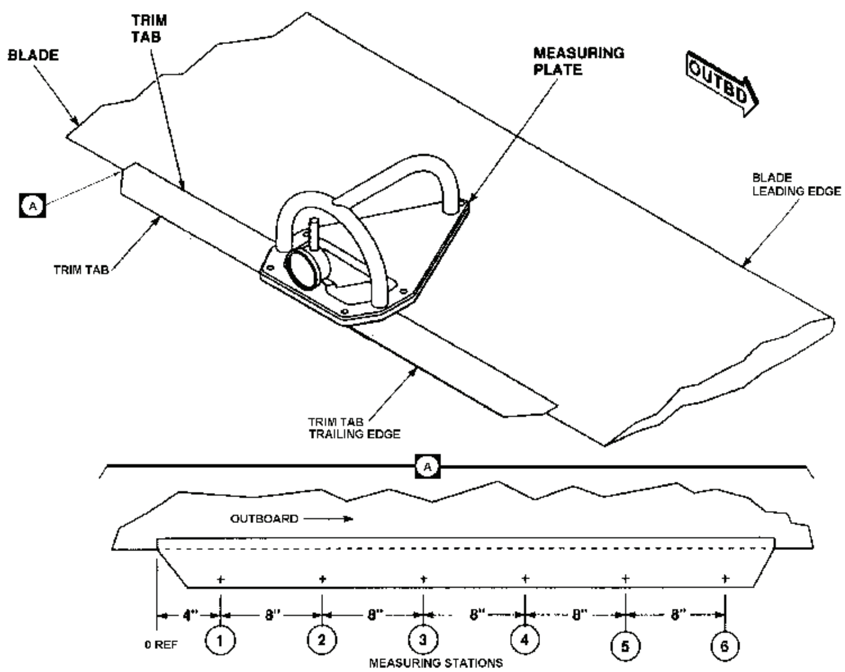
Bending a trim tab up will cause a blade to climb with increased airspeed.

The AVA will provide trim tab adjustments in MILS. The trim tab adjusting tool is scaled in thousands of an inch. One MIL equals 0.001.

a. Mark tab measurement stations as show in Figure 9. Use light colored paint or non-corrosive marker to accurately define each station on the trailing edge.

b. Set measuring plate on the blade surface, aligning the three vertical pins with the trailing edge of the trim tab (see Figure 9).

c. Measure and record the tab setting at each of the six trim tab measuring stations. Ensure that the center pin is right over the station mark.



STATION	1	2	3	4	5	6
INCHES FROM 0	4	12	20	29	36	44

Figure 9. Trim Tab Measurement

d. Remove the measuring plate and set aside for use during bending process.

NOTE

If a blade is to be tabbed up, the table correction (the number of mils recommended on the diagnostics screen of the AVA) is to be added to the initial measurement. If a blade is to be tabbed down, then the table correction (the number of mils recommended on the diagnostics screen of the AVA) is to be subtracted from the initial measurement.

e. The target measurement for one station is equal to the initial station measurement (taken above), plus/minus the table correction. Perform the same calculation for all six stations.

CAUTION

Maximum trim tab bending adjustment per flight for one station is 0.030 inch in each direction from the current setting. Do not over-bend trim tab.

Trim tabs should be bent uniformly at all six stations.

f. Place center of the trim tab-bending tool over the measuring station. See Figures 9 & 10.

g. Using a very light effort (to acquire a feel for the force needed to bend trim tab), bend tab. Check the magnitude of adjustment using the trim tab measuring plate and adjust future bending effort based on this experience. Repeat adjustment until the TARGET tab setting is obtained for that station. Perform this procedure for all six-tab stations.

h. Annotate the new trim tab measurements on the trim tab position measurement record. A sample form is shown on Figure 11, but each blade should have a measurement record in the historical forms (green book).

i. Remove tab adjustment tools and perform limited test flight. Fly the aircraft and re-check the 1/REV vibrations at the required flight conditions.

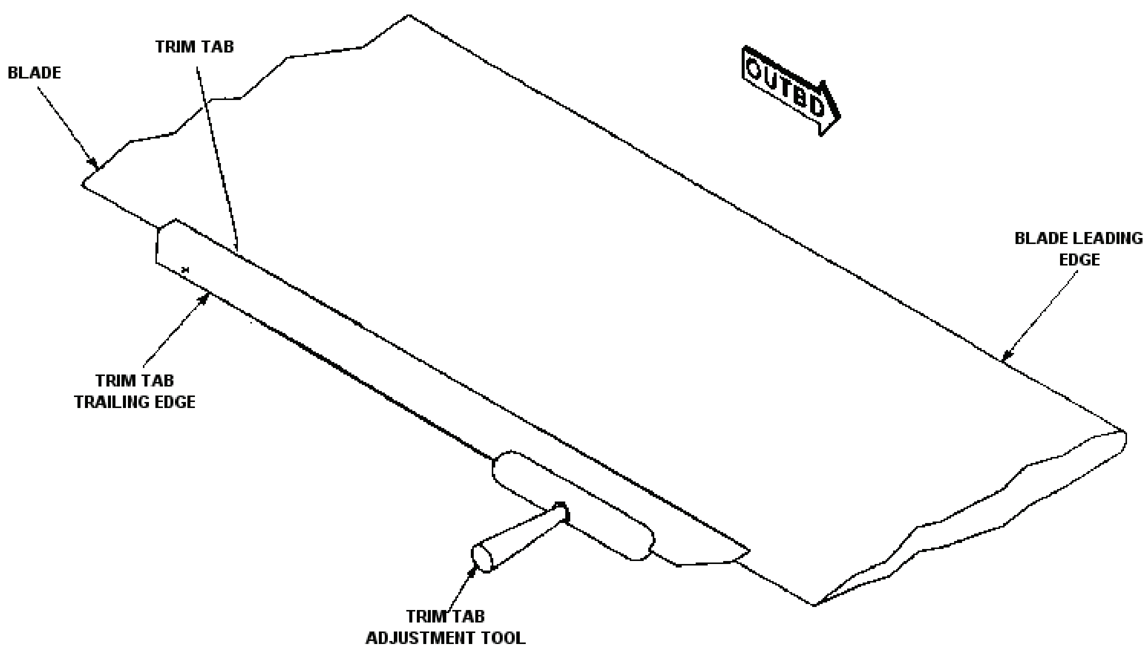


Figure 10. Trim Tab Adjustment

UH–60 TRIM TAB ADJUSTMENT SHEET

AIRCRAFT__________________

DATE__________________

Tab	Blade Info			Trim Tab Measurement Station					
Adj #	Color	S/N		1	2	3	4	5	6
1			Initial Setting						
1 MIL = 0.001 inches			Correction Value						
(+) Adjustment = Up Tab (–) Adjustment = Down Tab			Target Setting						

DATE__________________

Tab	Blade Info			Trim Tab Measurement Station					
Adj #	Color	S/N		1	2	3	4	5	6
2			Initial Setting						
1 MIL = 0.001 inches			Correction Value						
(+) Adjustment = Up Tab (–) Adjustment = Down Tab			Target Setting						

DATE__________________

Tab	Blade Info			Trim Tab Measurement Station					
Adj #	Color	S/N		1	2	3	4	5	6
3			Initial Setting						
1 MIL = 0.001 inches			Correction Value						
(+) Adjustment = Up Tab (–) Adjustment = Down Tab			Target Setting						

DATE__________________

Tab	Blade Info			Trim Tab Measurement Station					
Adj #	Color	S/N		1	2	3	4	5	6
4			Initial Setting						
1 MIL = 0.001 inches			Correction Value						
(+) Adjustment = Up Tab (–) Adjustment = Down Tab			Target Setting						

DATE__________________

Tab	Blade Info			Trim Tab Measurement Station					
Adj #	Color	S/N		1	2	3	4	5	6
5			Initial Setting						
1 MIL = 0.001 inches			Correction Value						
(+) Adjustment = Up Tab (–) Adjustment = Down Tab			Target Setting						

MS030281

Figure 11. UH-60 Trim Tab Adjustment Sheet

TASK 5 – POST FLIGHT BALANCE MAIN ROTOR ON THE GROUND

PROCEDURE 1: PREPARATION
Perform Task 4, Main Rotor Roll/Vertical IN-FLIGHT Tuning.

PROCEDURE 2: PERFORM GROUND BALANCE MEASUREMENT

a. Use cursor keys to highlight Aircraft Type, then press **DO**.

b. Use cursor keys to highlighted UH-60, then press **DO**.

c. Tail Number is highlighted. Press **DO**.

d. Use cursor keys to highlight tail number used in Task 4, then press **DO**.

e. Flight Plan is highlighted. Press **DO**.

f. Use cursor keys to highlighted GNDBAL. Press **DO**.

g. Enter the Measure mode by pressing **F1**. Verify that Test State FPG100 is highlighted.

h. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire balance data and return to the selection menu.

i. After the measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics. If the measurements are within specified limits, press **QUIT** to Main Menu.

j. If measured values exceed manufacturer's desired levels, press the **DO** key to enter the DIAGS mode. Perform all corrections displayed on the diagnostic screen. Do not use a partial set of the adjustments. Run Procedure 2 again and verify that previously installed corrections brought aircraft ground balance to within manufacturer's recommended limits.

k. Make appropriate logbook entry on the balance weights that were changed, if any. Remove track and balance equipment.

TASK 6 – BALANCE TAIL ROTOR

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA tail rotor balancing equipment from transport case. Check for possible damaged equipment and frayed cables.

b. Install DAU in canvas carrying case.

c. Place DAU in right forward facing troop seat with connectors facing up and secure DAU using aircraft shoulder and lap belts and canvas straps. If no troop seats are installed, the DAU may be secured to the D-rings found on the aircraft cabin floor.

d. Connect power cable (29104700) to aircraft's 28 Vdc utility receptacle at station 293, right side, on cabin ceiling and to DAU receptacle marked 28 Vdc.

e. Locate CADU in aircraft. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: ACCELEROMETER INSTALLATION

a. Remove screw from left side of pylon at bottom of tail gearbox aft fairing, see Figure 12.

b. Mount UH-60 accelerometer bracket (29313000) on pylon with pylon screw 90 degrees to leading edge of pylon.

c. Install accelerometer (28110900) on accelerometer bracket. Ensure connector is facing down and to the rear.

d. Connect accelerometer cable (29105600) to accelerometer.

e. Run cable down left side of pylon. Secure cable to extended steps on pylon and continue routing cable through the tie-down ring located on right side of tail cone.

f. Connect accelerometer cable to the DAU receptacle marked ACC4.

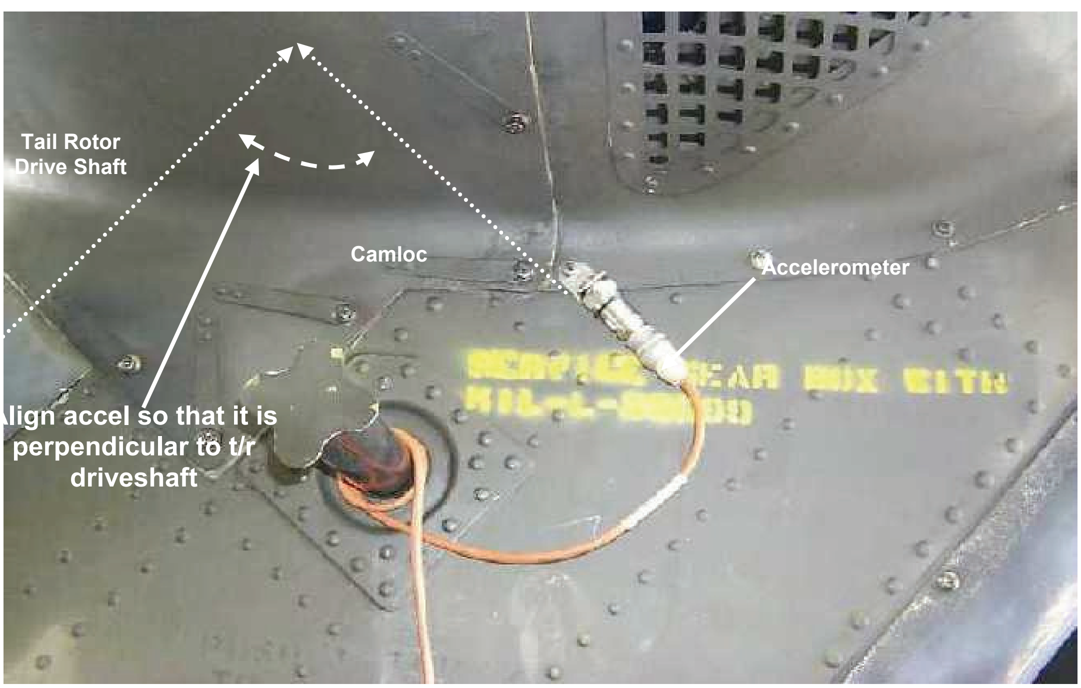


Figure 12. Tail Rotor Accelerometer Placement

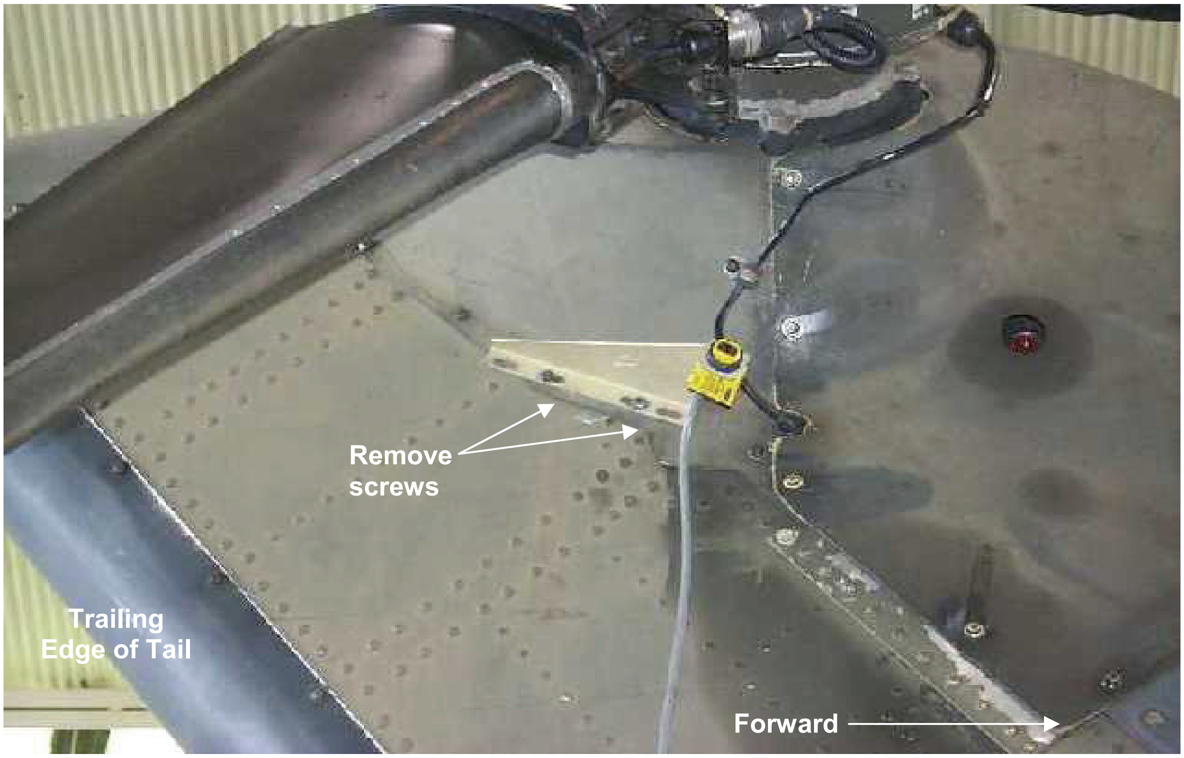


Figure 13. Optical RPM Sensor Mounting Bracket

PROCEDURE 3: OPTICAL RPM SENSOR INSTALLATION

a. Remove screws identified by Figure 13 from the right side of the tail rotor.

b. Remove outer jam nut on optical RPM sensor (29314700) and install on tail rotor bracket (29198700). The body of the optical RPM sensor should be resting against the bracket. Reinstall the outer jam nut but do not tighten.

c. Mount bracket on tail using the panel screws. The optical RPM sensor and bracket will be slightly upside-down with the arrow on the bracket pointing aft and up when installed correctly.

d. Hand-tighten jam nut on optical RPM sensor.

e. Route optical RPM sensor cable along the tail pylon (same as the accelerometer cable, Task 6, Procedure 2.e) and connect it to the DAU receptacle marked TACHO2.

NOTE

If there is any tape remaining from previous balance routines, this must be completely removed to ensure a clean and accurate tachometer signal to DAU.

f. Place a 4-inch strip of reflective tape on the inside of the target (TGT) tail rotor blade, Figure 14, at the same approximate location as the beam of the optical sensor.

g. Turn on DAU.

h. Turn on CADU.

i. Apply 28 Vdc power to the DAU.

j. Rotate the tail rotor until the target blade passes in front of the optical RPM sensor. A red LED on the back of the sensor will light if the sensor picks up a return from the reflective tape.

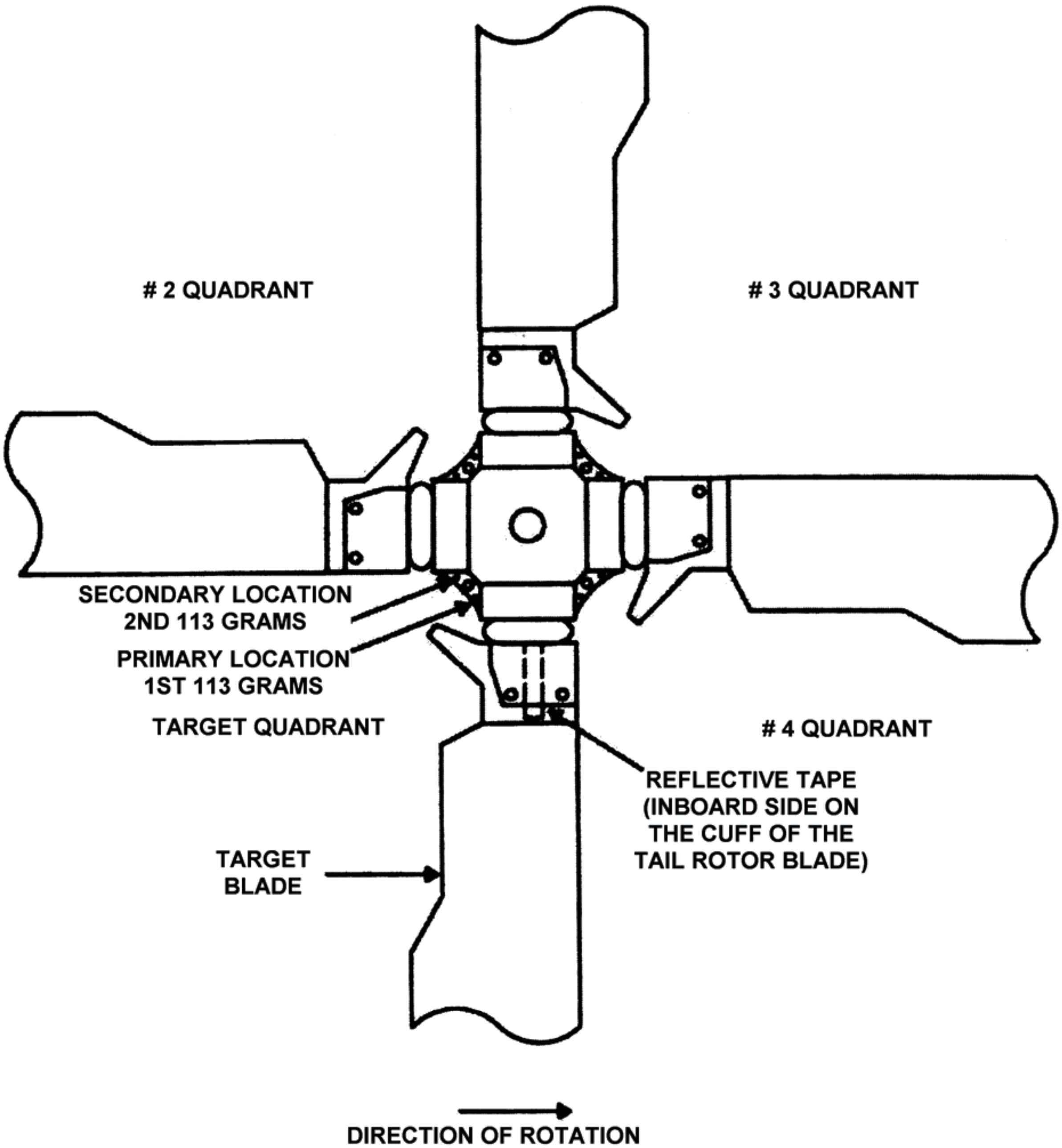


Figure 14. Tail Rotor (Right Side)

PROCEDURE 4: PERFORM TAIL MEASUREMENT

a. Position aircraft so that nose is pointed towards the wind.

b. Operate aircraft at 100% Nr, flat pitch.

c. Turn on DAU.

d. Turn on CADU.

e. Press **QUIT** on the CADU until all selections are undefined.

f. Use cursor keys to highlight Aircraft Type, and then press **DO**.

g. Use cursor keys to highlight UH-60, and then press **DO**.

h. Tail Number is highlighted. Press **DO**.

i. Use cursor keys to highlight a tail number or enter a new one (up to seven characters), then press **DO**.

j. Flight Plan is highlighted. Press **DO**.

k. Use cursor keys to highlight TAIL. Press **DO**.

l. Enter the Measure mode by pressing **F1**. Verify that Test State FPGTL is highlighted.

m. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire balance data and return to the selection menu.

n. After the measurement is completed, press **DOES** on Finish, then press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu.

o. If measured values exceed manufacturer's desired levels, press the **DO** key to enter the DIAGS mode. Perform all corrections displayed on the diagnostic screen as outlined in Procedure 5. If alternations of these corrective actions are desired, use the Edit Adjustables option and turn off adjustments not wanted. Do not use a partial set of the adjustments.

PROCEDURE 5: CORRECTING TAIL ROTOR BALANCE

NOTE

If adding weight, weigh attaching hardware using a gram scale and add the balance weights as required to attain predetermined weight. Heaviest total weight is 113.5 grams (4 oz.) per bolt hole or a maximum of 227 grams (8 oz.) per quadrant. Ensure screw has at least 1-1/2 threads exposed beyond nut.

If removing weight, place all existing weights (only from quadrant being adjusted) and attaching hardware on gram scale and remove balance washers as required to attain predetermined weight.

Ensure AN960C416 washers are between balance washers and retention plate to prevent contact between balance washers and radius on retention plate.

Correction display refers to the quadrants as TARGET (the quadrant that follows the blade with the tape on it), 2, 3 and 4, in direction of blade rotation.

a. Install attaching bolt, washers, nut and balance weights to assigned quadrant as shown in Figure 14. Install half of the weights under the bolt head and the remaining weights under the nut.

b. Torque nut from 90 to 100 inch-pounds.

c. Repeat Task 6 and verify results.

d. Make appropriate logbook entry indicating that tail rotor balance was completed and is within limits.

e. Remove test equipment.

TASK 7 - VIBRATION ABSORBER TUNING

The following procedures provide instructions for the testing and tuning of the vibration absorbers. This procedure can be accomplished in conjunction with the Main Rotor Diagnostics.

- Cabin and nose absorber will be tuned whenever any cabin or nose absorber maintenance has been performed.
- Cabin and nose absorber tuning will be checked when a test flight reveals that 4/REV vertical vibration in cockpit exceeds limits, or if vibration causes pilot or copilot discomfort.

PROCEDURE 1: PREPARATION

a. Install test equipment as per task 1 procedures 1, 2, and 4 steps f-h.

PROCEDURE 2: ACCELEROMETER INSTALLATION (FWD CABIN)

a. Lower cabin soundproofing to gain access to the cabin vibration absorber (TM 1-1520-237-23-series).

b. Attach accelerometer (28110900) to mounting plate (29317300), see figure 15. Add washers (MS15795-810) as necessary between accelerometer and mounting plate to prevent the accelerometer stud from extending beyond the plate.

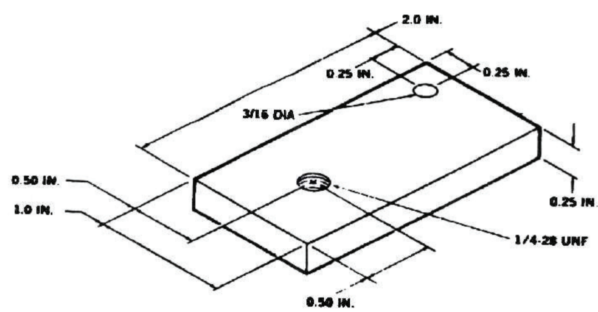


Figure 15. Pilot Heel/Cabin Vertical Accelerometer Mounting Plate (P/N 29317300)

CAUTION

To prevent damaging the overhead frames, the portion of the C-clamp that actually touches the airframe should be padded.

c. Clamp plate horizontally to the overhead frame at station 308, buttline 0, just forward of the absorber location using C-Clamp (NSN 5120-00-180-0905). See figure 16.

d. Connect accelerometer cable (29105600) to the accelerometer and to DAU receptacle marked ACC4.

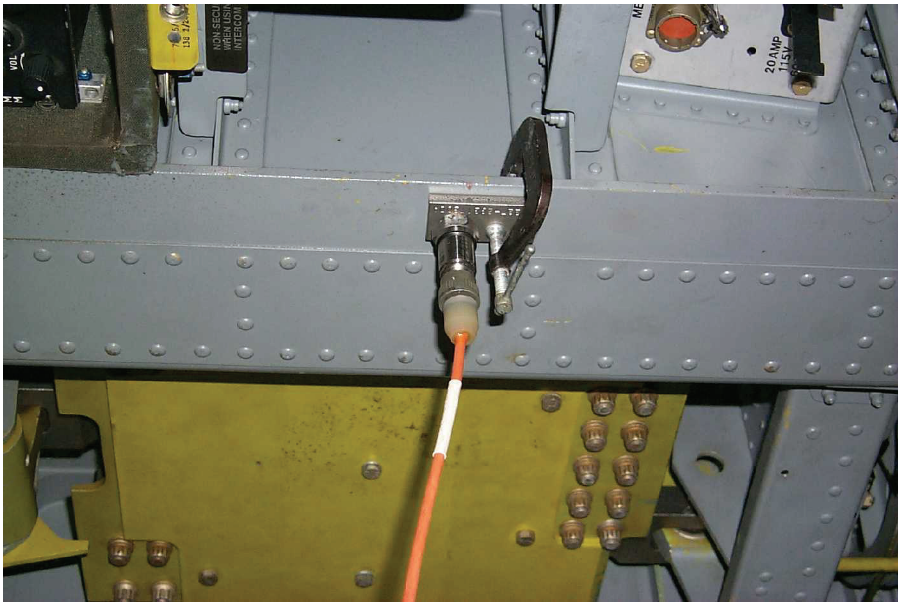


Figure 16. ABTUNE/BOXABS Tuning Accel. Installation (View looking up)

PROCEDURE 3: IN-FLIGHT CHECK OF 4/REV VIBRATIONS AND TUNE NOSE ABSORBER

- Nose absorber is tuned to an ips range instead of a specific Nr.
- Tuning weight on nose absorber is adjusted based on ips reading from pilot heel vertical (PHV) accelerometer.
- The cabin absorber must be tuned to 100% Nr at 145 knots before tuning the nose absorber.
- Prior to tuning the nose absorber, make sure the cabin absorber is not blocked.

NOTE

The goal for pilot heel vertical (PHV) 4/REV vibration is between 0.3 ips and 0.6 ips, with 0.5 ips being the target. If the level drops below 0.3 ips, nose absorber may interfere with cabin absorber tuning and actually degrade cabin and cockpit 4/REV vibration. The goal for cockpit (A+B) 4/REV vibration is below 0.4 IPS; otherwise absorber tuning must be performed.

a. Perform task 4, procedure 2 (Acquire data in the FLIGHT plan).

NOTE

Test States of 120K and 145K must be measured for the in-flight vibration absorber test to be completed

b. After the measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics.

c. If nose absorber is above limits the CADU will display the ips value and then suggest a weight change to bring the ips level within the range of 0.3 to 0.6 ips.

NOTE

If aircraft is equipped with CANTILEVER SPRING type absorbers, insure that all hardware and bushings are within limits outlined in TM 1-1520-237-5, WP 0219 and WP 0221 prior to making any weight adjustments.

d. If pilot heel vertical measurements are outside of recommended range, perform nose absorber weight adjustments according to TM 1-1520-237-23-2 (Chapter 2, Airframe Maintenance AVUM).

e. Repeat FLIGHT plan and perform adjustments until no further adjustments are required to tune Nose Absorber.

f. If the cabin absorber requires tuning and the aircraft is equipped with CANTILEVER SPRING type absorbers, proceed to procedure 4.

   If the cabin absorber requires tuning and the aircraft is equipped with BOX FRAME type absorbers, proceed to procedure 5.

g. If Nose/Cabin absorbers are within limits remove AVA test equipment and return the aircraft to a flight-ready condition.

PROCEDURE 4: TUNE CABIN ABSORBER (Cantilever Spring Type)

NOTE

Refer to procedures in TM 1-1520-237-MTF (Vibration Absorber Check and Tuning) when performing cabin absorber tuning.

NOTE

This flight plan does have a diagnostic routine in the AVA. Once all data has been measured, perform the correct diagnostic actions (refer to figure 17a for main rotor 4/REV vibration check and tuning procedure and the AVA for tuning weight adjustments)

a. If cabin absorber is a BOX FRAME type absorber go to procedure 5.

b. Turn on DAU.

c. Turn on CADU.

d. Press **QUIT** on the CADU until all selections are undefined.

e. Use cursor keys to highlight Aircraft Type, and then press **DO**.

f. Use cursor keys to highlight UH-60, and then press **DO**.

g. Tail Number is highlighted. Press **DO**.

h. Use cursor keys to highlight a tail number or enter a new tail number (up to seven characters), then press **DO**.

i. Flight Plan is highlighted. Press **DO**.

j. Use cursor keys to highlight ABTUNE. Press **DO**.

k. Enter the Measure mode by pressing **F1**.

l. Stabilize the aircraft at 145 Kts, 96% Nr, and level flight.

m. Use cursor keys to highlight NR96. Press **DO** twice.

n. When the measurement is completed, the ABTUNE display indicates: NR96 done.

NOTE

The aircraft may be flown in Engine Control Unit (ECU) LOCKOUT only when ECU LOCKOUT procedures in TM 1-1520-237-MTF are followed.

o. Repeat steps (l) through (n) for the remaining Test States (97% Nr, 98% Nr, 99% Nr, 100% Nr, 101% Nr, 102% Nr and 103%Nr). For the Test States above 100% Nr (101% Nr, 102% Nr and 103% Nr) the aircraft must be operated in ECU or DEC lockout.

p. After all measurements are completed press **DO** on Finish.

q. Press **F3** to select Diagnostics.

r. Check the message displayed regarding absorber tuning. If the absorber is tuned correctly (tuned to 100%), press **QUIT** to return to the Main Menu. If the absorber is not tuned correctly (tuned to 100%), follow the AVA diagnostics per figure 17a, Cabin Absorber Flowchart.

NOTE

If aircraft is equipped with CANTILEVER SPRING type absorbers, insure that all hardware and bushings are within limits outlined in TM 1-1520-237-5, WP 0219 and WP 0221 prior to making any weight adjustments.

s. If the cabin absorber needs tuning, a weight adjustment will be displayed. Perform the recommended weight adjustment according to TM 1-1520-237-23-2 (Chapter 2, Airframe Maintenance AVUM).

t. Repeat task 7 procedure 4 steps (a) through (s) and perform adjustments until the cabin absorber is tuned.

u. When the cabin absorber is tuned correctly (tuned to 100%), perform the FLIGHT plan (task 4) to check cockpit main rotor 4/REV vibration and nose absorber tuning.

v. Make appropriate logbook entry when all main rotor 4/REV work is done.

w. Remove AVA test equipment and return aircraft to a flight-ready condition.

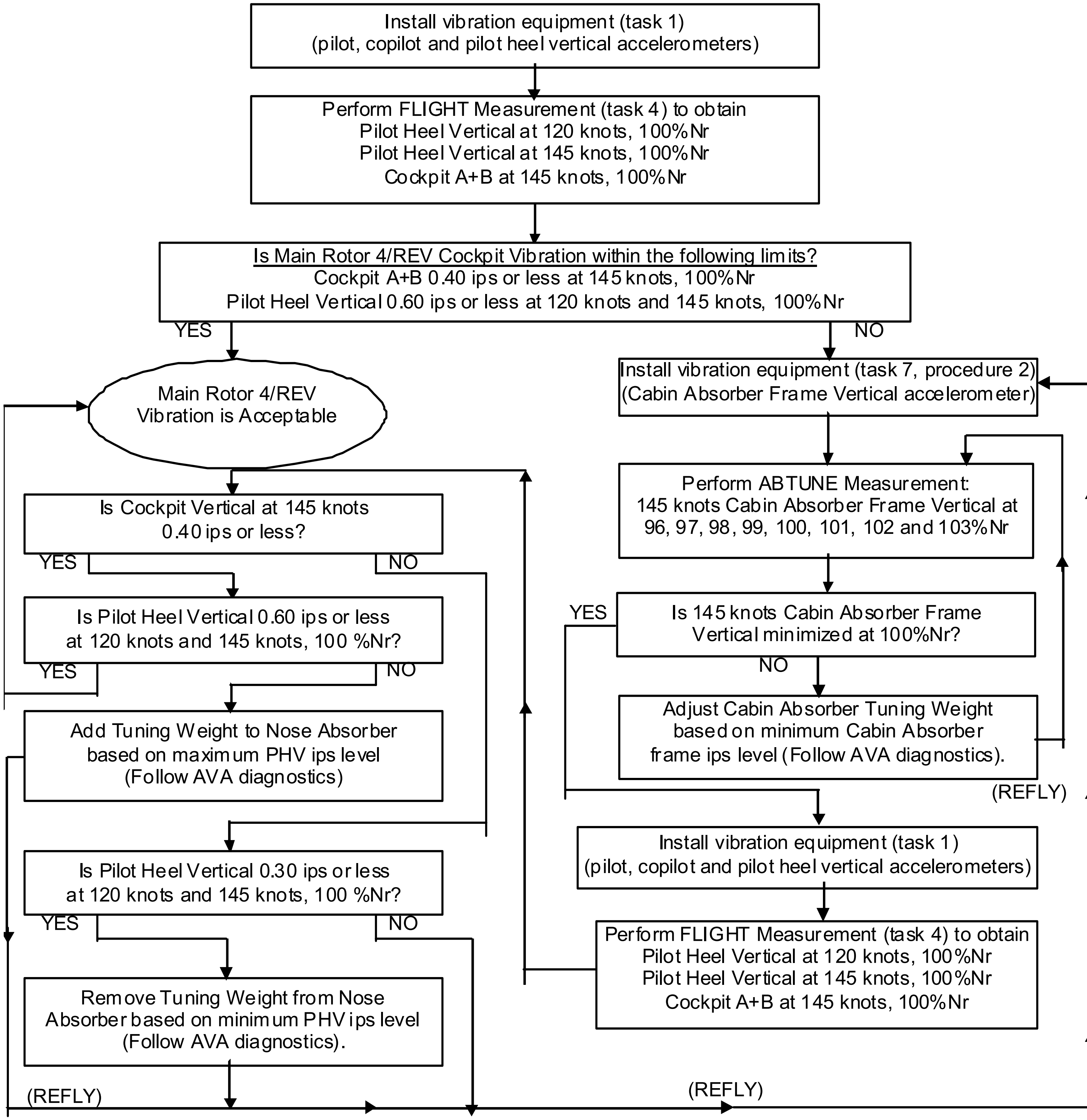


Figure 17a. UH-60 Cantilever Spring Absorber Main Rotor 4/REV Vibration Check And Tuning Procedure

PROCEDURE 5: TUNE CABIN ABSORBER (Box Frame Type)

NOTE

This flight plan does not have a diagnostic routine in the AVA. Once all data has been measured, perform the correct diagnostic actions (refer to figure 17b for main rotor 4/REV vibration check and tuning procedure and table 2 for tuning weight adjustments).

a. If cabin absorber is a CANTILEVER SPRING type absorber go to procedure 4.

b. Turn on DAU.

c. Turn on CADU.

d. Press **QUIT** on the CADU until all selections are undefined.

e. Use cursor keys to highlight Aircraft Type, and then press **DO**.

f. Use cursor keys to highlight UH-60, and then press **DO**.

g. Tail Number is highlighted. Press **DO**.

h. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.

i. Flight Plan is highlighted. Press **DO**.

j. Use cursor keys to highlight BOXABS. Press **DO**.

k. Enter the Measure mode by pressing **F1**.

l. Stabilize the aircraft at 145 Kts, 98% Nr, and level flight.

m. Use cursor keys to highlight 98% Nr. Press **DO** twice.

n. When the measurement is completed, the BOXABS display indicates: 98% Nr done.

NOTE

100.5% flight condition is achieved by using the increase/decrease switch to maximum without going into ECU lockout. The aircraft may be flown in Engine Control Unit (ECU) LOCKOUT only when ECU LOCKOUT procedures in TM 1-1520-237-MTF are followed

o. Repeat steps (l) through (n) for the remaining Test States (99% Nr, 100% Nr, 100.5% Nr, 101% Nr and 102% Nr). For the Test States above 100% Nr (101% Nr and 102% Nr) the aircraft must be operated in ECU or DEC lockout.

p. After all measurements are completed press **DO** on Finish.

q. Press **F2** to select Display menu. Select the Summary Display option and press **DO** twice.

r. Using figure 17b, Box Absorber Flowchart, determine whether cabin box frame absorber requires adjustment.

s. If the cabin absorber needs tuning, use table 2 to determine the weight adjustment. Perform the recommended weight adjustment according to TM 1-1520-237-23-2 (Chapter 2, Airframe Maintenance AVUM).

t. Repeat task 7 procedure 5 steps (a) through (s) and perform adjustments until the cabin absorber is tuned.

u. When the cabin absorber is tuned correctly (tuned to 100.5%), perform the FLIGHT plan (task 4) to check cockpit main rotor 4/REV vibration and nose absorber tuning.

v. Make appropriate logbook entry when all main rotor 4/REV work is done.

w. Remove AVA test equipment and return the aircraft to a flight-ready condition.

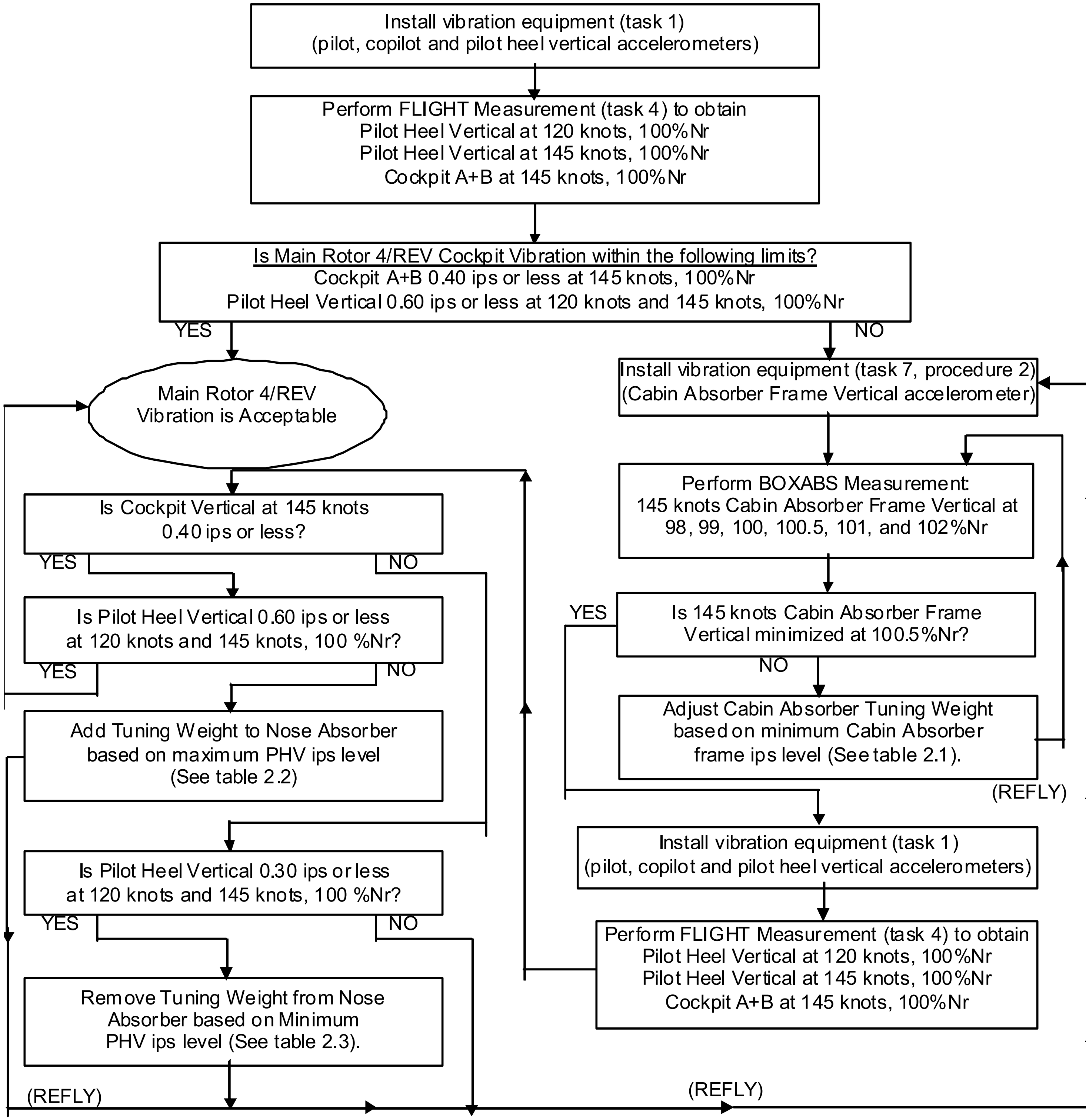


Figure 17b. UH-60 Box Frame Absorber Main Rotor 4/REV Vibration Check And Tuning Procedure

Table 2. UH-60 Box Frame Absorber Tuning Weight Adjustments

TABLE 2.1	
Cabin Absorber (PN 70219-02159-041)	
Minimum Cabin Frame ips at:	Weight Change (lb.)
98%Nr	Remove 1.75
99%Nr	Remove 1.05
100%Nr	Remove 0.35
100.5%Nr	No Change
101%Nr	Add 0.35
102%Nr	Add 1.05
TABLE 2.2	
Nose Absorber (PN 70219-01041-041)	
Maximum Pilot Heel Vertical (ips)	Weight Change (lb.)
0.61-0.75	Add 0.70
0.76-0.90	Add 1.05
TABLE 2.3	
Minimum Pilot Heel Vertical (ips)	Weight Change (lb.)
0.00-0.15	Remove 0.70
0.16-0.30	Remove 0.35

Box Frame Absorber Tuning Weights: (applicable to both cabin and nose absorber)	
78286-70219-01045-101	0.35 lb.
78286-70219-01045-102	0.70 lb.
78286-70219-01045-103	1.40 lb.
78286-70219-01045-104	3.40 lb.
78286-70219-01045-105	7.80 lb.
78286-70219-01045-106	3.20 lb.

TASK 8 – 120 HOUR ENGINE OUTPUT SHAFT AND OIL COOLER VIBRATION TESTING

NOTE

This procedure may be utilized to check condition of engine output shaft and oil cooler balance regardless of engine output shaft configurations.

The following procedures provide instructions for the balance testing and balancing of the engine output shafts and vibration testing of the oil cooler for the UH-60 helicopters using the AVA equipment.

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA vibration test equipment from transport case. Check for possible damaged equipment and frayed cables.

b. Install DAU in canvas carrying case.

c. Place DAU on right troop seat with connectors facing up and secure DAU using aircraft shoulder and lap belts and canvas strap D-rings. If no troop seats are installed, the DAU may be secured to the D-rings found on the aircraft cabin floor.

d. Connect power cable (29104700) to aircraft's 28 Vdc utility receptacle at station 293, right side, on cabin ceiling and to DAU receptacle marked 28 Vdc.

e. Place CADU in aircraft. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: ACCELEROMETER INSTALLATION

a. On each input module, remove one nut at rear and down from lifting ring. (Not required on aircraft modified with accelerometer block installed). See Figures 18 and 19.

b. Install accelerometer (28110900) on accelerometer bracket, or block if installed. Mount accelerometer bracket to input module with accelerometer vertical to input module (connector end facing up). Reinstall nut and TORQUE TO 260 – 289 INCH-POUNDS. Do this for both modules.

c. Connect accelerometer cables to accelerometers and route cables over top of input module, under cowl, under forward edge of engine air inlet (if installed), through tiedown ring, and in window. Do this for both modules.

d. Connect accelerometer cable from left input module (No. 1) to the DAU receptacle marked ACC1, and accelerometer cable from right input module (No.2) to the DAU receptacle marked ACC2.

Figure 18. No. 1 Input Module Accelerometer Installation (ACC1)

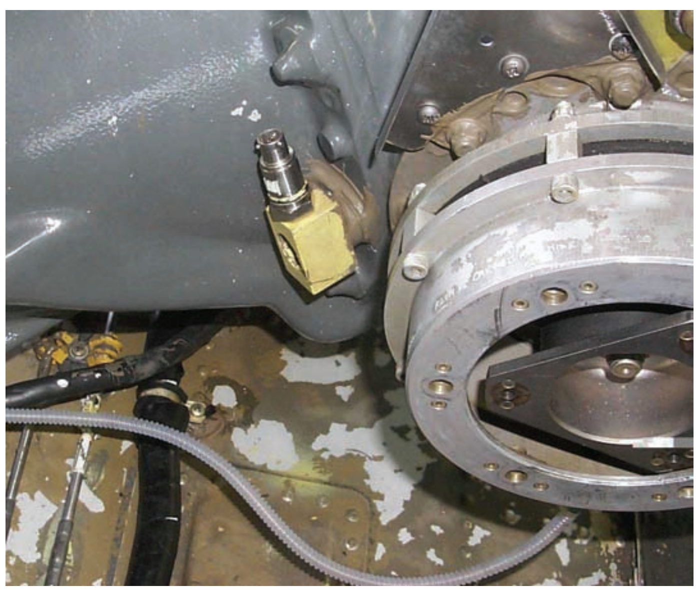


Figure 19. No. 2 Input Module Accelerometer Installation (ACC2)

e. If the oil cooler vibration levels are to be tested, perform the following:

1. Open oil cooler access doors.

2. Wash axial fan with water if dirt is evident in the fan inlet flange area.

NOTE

Make sure that accelerometer, connector, and cable do not rest against hoses.

3. Install fore-aft accelerometer in bracket (P/N 70361-03016-101) on oil cooler fan housing with the connector end facing forward. See Figure 20.

4. With masking tape, label the cabin end of the cable of the Fore-Aft accelerometer 3.

NOTE

Make sure the cable has adequate clearance from any moving or hot parts.

5. Route the accelerometer cable through the oil cooler compartment and into the cabin. Secure the cable tightly at several places in the oil cooler compartment with tiedown straps, item 282, Appendix D, of TM 1-1520-237-23.

6. In the cabin, connect accelerometer cable labeled 3 to the DAU receptacle marked ACC3. (See Figure 2).

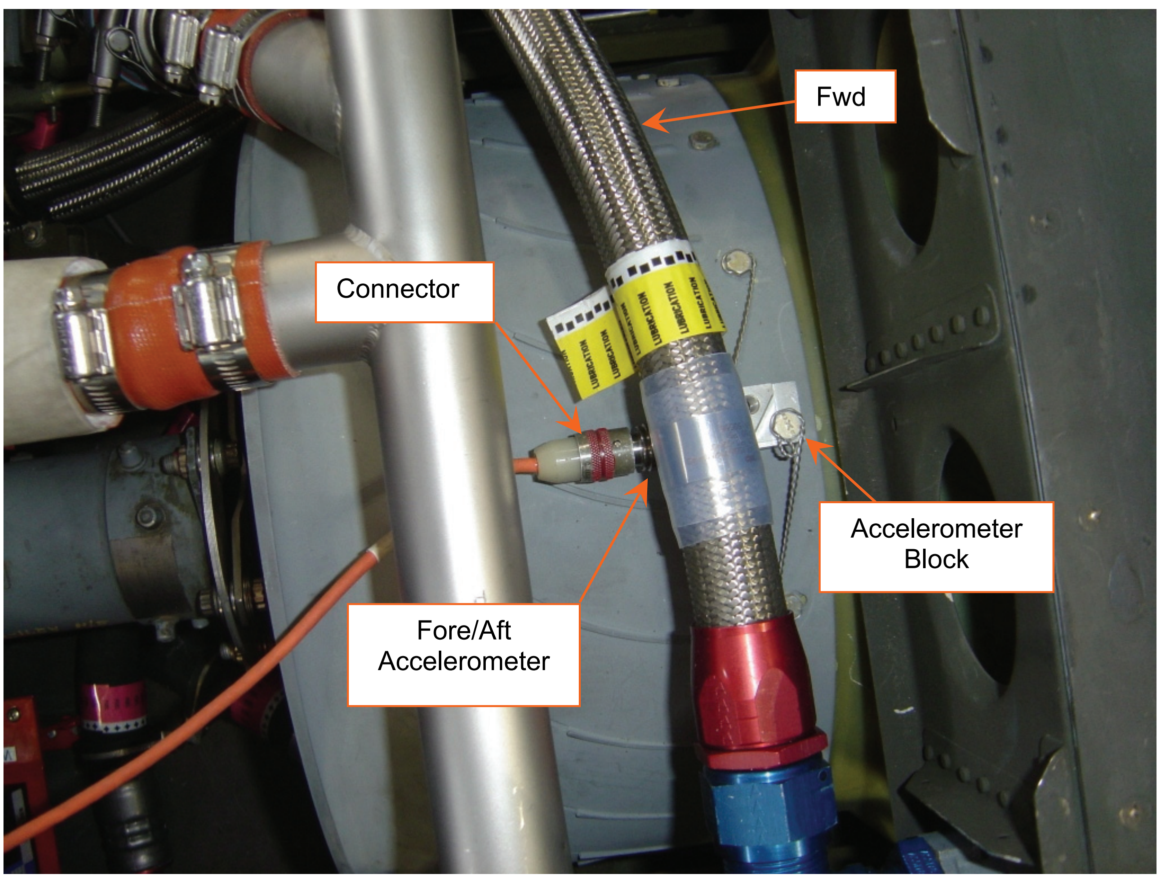


Figure 20. Oil Cooler Fan Accelerometer Installation

PROCEDURE 3: ENGINE OUTPUT SHAFTS AND OIL COOLER TESTING

NOTE

Make sure the UH-60 Aircraft Type software version is 7.5e or higher. Software versions prior to 7.5e are not programmed to perform Improved Engine Output (IEO) Shaft (ECP-319) balance procedure or single accelerometer Oil Cooler Fan check.

NOTE

No. 2 engine must not be running during the No. 1 engine output shaft vibration level check. No. 1 engine must be run at 100% for five minutes prior to the measurement being taken.

a. Start and run No. 1 engine at 100% Nr, flat pitch.

b. Turn on DAU.

c. Turn on CADU.

d. Press **QUIT** on the CADU until all selections are undefined.

e. Use cursor keys to highlight Aircraft type, then press **DO**.

f. Use cursor keys to highlight UH-60, and 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 characters), then press **DO**.

i. Flight Plan is highlighted. Press **DO**.

j. Use cursor keys to highlight 120HR. Press **DO**.

k. Enter the Measure mode by pressing **F1**. Verify that Test State CKENG1 is highlighted.

l. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire No. 1 engine vibration data and return to the selection menu.

m. Shut down No. 1 engine and start and run No. 2 engine at 100% Nr, flat pitch.

NOTE

No. 1 engine must not be running during the No. 2 engine output shaft vibration level check. No. 2 engine must be run at 100% for five minutes prior to a measurement being taken.

n. Verify that Test State CKENG2 is highlighted.

o. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire No. 2 engine vibration data and return to the selection menu.

p. Verify that Test State OILCLR is highlighted.

q. Press **DO** to begin oil cooler vibration testing. Verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire oil cooler vibration data.

r. After the measurement is complete, press **DO** on Finish, then press **DO** on “Main Menu”.

s. Shut down No. 2 engine.

t. Enter the Display mode by pressing **F2**.

u. The Display mode menu is displayed. Use cursor keys to highlight Summary Displays, and then press **DO**.

v. The Select Summary Display menu is displayed. Use cursor keys to highlight Engine 1 drive shaft, then press **DO**.

w. PEAK VIBRATION for Engine 1 drive shaft is displayed. Record the value.

x. Press **QUIT**.

y. The Select Summary Display menu is displayed. Use cursor keys to highlight Engine 2 drive shaft, then press **DO**.

z. PEAK VIBRATION for Engine 2 drive shaft is displayed. Record the value.

aa. Press **QUIT**.

bb. The Select Summary Display menu is displayed. Use cursor keys to highlight Oil Cooler Shaft F/A, then press **DO**.

cc. PEAK VIBRATION for F/A Oil Cooler Shaft is displayed. Record the value.

dd. Press **QUIT**.

ee. The Select Summary Display menu is displayed.

ff. For UH-60L helicopters and EH/UH-60A helicopters with the standard multi-disk coupling shaft installed, vibration levels shall be 0.50 ips or less. If vibration levels are within this range, engine output shaft is balanced. Remove the accelerometers, cables and brackets from the input modules. If vibration level is between 0.50 ips and 2.0 ips, balance engine output shaft in accordance with Task 9. If vibration level is greater than 2.0 ips, proceed to Task 9, Engine output shaft balancing, multi-disk coupling (MC), Procedure 1: check balance, multi-disk coupling (MC).

gg. For UH-60M helicopters, UH-60L helicopters and EH/UH-60A helicopters with Improved Engine Output (IEO) Shaft Diaphragm Coupling (ECP-319) installed, vibration levels shall be 0.50 ips or less. If vibration levels are within this range, engine output shaft is balanced. Remove the accelerometers, cables, and brackets from the input modules. If vibration level is between 0.50 ips and 2.0 ips, balance engine output shaft in accordance with Task 10. If vibration level is greater than 2.0 ips, proceed to Task 10, Engine output shaft balancing, diaphram coupling (DC), Procedure 1: Check balance, Diaphram coupling (DC).

hh. If fore-aft oil cooler vibration is greater than 1.0 ips, perform Procedure 4: Oil Cooler Vibration Adjustments.

PROCEDURE 4: OIL COOLER VIBRATION ADJUSTMENTS
The following procedure provides adjustments to reduce vibrations associated with the oil cooler assembly. This procedure should be performed when Procedure 3: Engine Output Shafts and Oil Cooler Testing indicates that an oil cooler shaft fore-aft vibration level of greater than 1.0 ips is present.

a. Ensure proper hardware is installed and flexible coupling, both in front of as well as behind oil cooler assembly, are shimmed properly (refer to TM 1-1520-237-23). Shim if necessary. Re-check vibration levels.

NOTE

The intent is to change the relationship between the oil cooler fan, drive shaft and adapter and the Section II Tail Rotor Drive Shaft.

b. Re-index Section II Tail Rotor Drive Shaft, Station 410, 120 degrees clockwise.

c. Re-check vibration levels. If level is above 1.0 ips, re-index drive shaft 120 degrees clockwise.

d. Re-check vibration levels. If a reading above 1.0 ips occurs, index drive shaft to the position that results in the lowest vibration level.

e. Ensure that viscous damper is shimmed so that no axial pre-load exists in the tail rotor drive shaft or the oil cooler assembly. Adjust if necessary. Re-check vibration levels.

f. Check oil cooler drive shaft runout, refer to TM 1-1520-237-23. If runout is over the 0.010-inch limit, adjust drive shaft. Re-check vibration levels.

g. If vibration levels remain above 1.0 ips, replace oil cooler.

h. If drive shat or oil cooler drive shaft was re-indexed, reinstall spline wear indication system, refer to TM 1-1520-237-23.

TASK 9 – ENGINE OUTPUT SHAFT BALANCING, MULTI-DISK COUPLING (MC)

NOTE

Proceed to Task 10 to perform Improved Engine Output Shaft/Diaphragm Coupling Balance (DC).

The following procedures provide instructions for the balancing of the engine output shafts of the H-60 Series helicopters with shaft balance assembly installed using the AVA equipment.

PROCEDURE 1: CHECK BALANCE, MULTI-DISK COUPLING (MC)

a. Perform Task 8, Procedures 1 and 2: Equipment Installation (omit oil cooler connection if oil cooler assembly is not to be tested).

NOTE

Make sure all cables are secure on helicopter using tiedown straps per Appendix D of TM 1-1520-237-23.

NOTE

Make sure AVA equipment software version 7.5 or higher is installed.

b. Perform Task 8, Procedure 3: Engine Output Shafts and Oil Cooler Testing (disregard all references to the oil cooler if the oil cooler assembly is not to be tested).

c. The vibration level of an engine output shaft shall be 0.50 ips or less. If the vibration level is within this range, the engine output shaft is balanced. Remove the accelerometers, cables and brackets from the input modules. If the vibration levels is between 0.50 ips and 2.0 ips, balance the engine output shaft in accordance with the following procedure. If the vibration level is greater than 2.0 ips and there are balance washers installed on the coupling, remove the balance washers and repeat the balance check in Step b. If the vibration level with no balance weights installed is still greater than 2.0 ips, remove and inspect the shaft and multi-disk coupling.. If no problems are found, re-install the shaft rotated one bolt hole from previous installation. Repeat the balance check procedure in Step b. The remove, inspect, and re-install rotated one bolt hole may be performed two times. If after two iterations of rotating the shaft, the vibration levels are still greater than 2.0 ips, replace the output shaft using procedures in TM 1-1520-237-23.

PROCEDURE 2: OPTICAL TACHOMETER SENSOR INSTALLATION, MULTI-DISK COUPLING (MC)

a. Turn off all electrical power.

b. Open engine cowling.

c. Remove engine air inlet (refer to TM 1-1520-237-23).

d. Remove crotch assembly from engine (refer to TM 1-1520-237-23).

NOTE

Prior to installing engine air inlet screen, area must be inspected for cleanliness and foreign objects.

e. Install engine upper screen assembly (202225-043) and lower screen assembly (20222-041) using clamp from air inlet. Torque nut on clamp to 60-70 inch-pounds.

CAUTION

If bleed air plug is not properly installed into the bleed air tube, the plug may be blown free striking the aircraft, M/R blades or personnel.

f. Plug bleed-air tube with bleed-air tube plug (20114-109). Install plug using existing coupling and sleeve. Torque clamp to 43-47 inch-pounds.

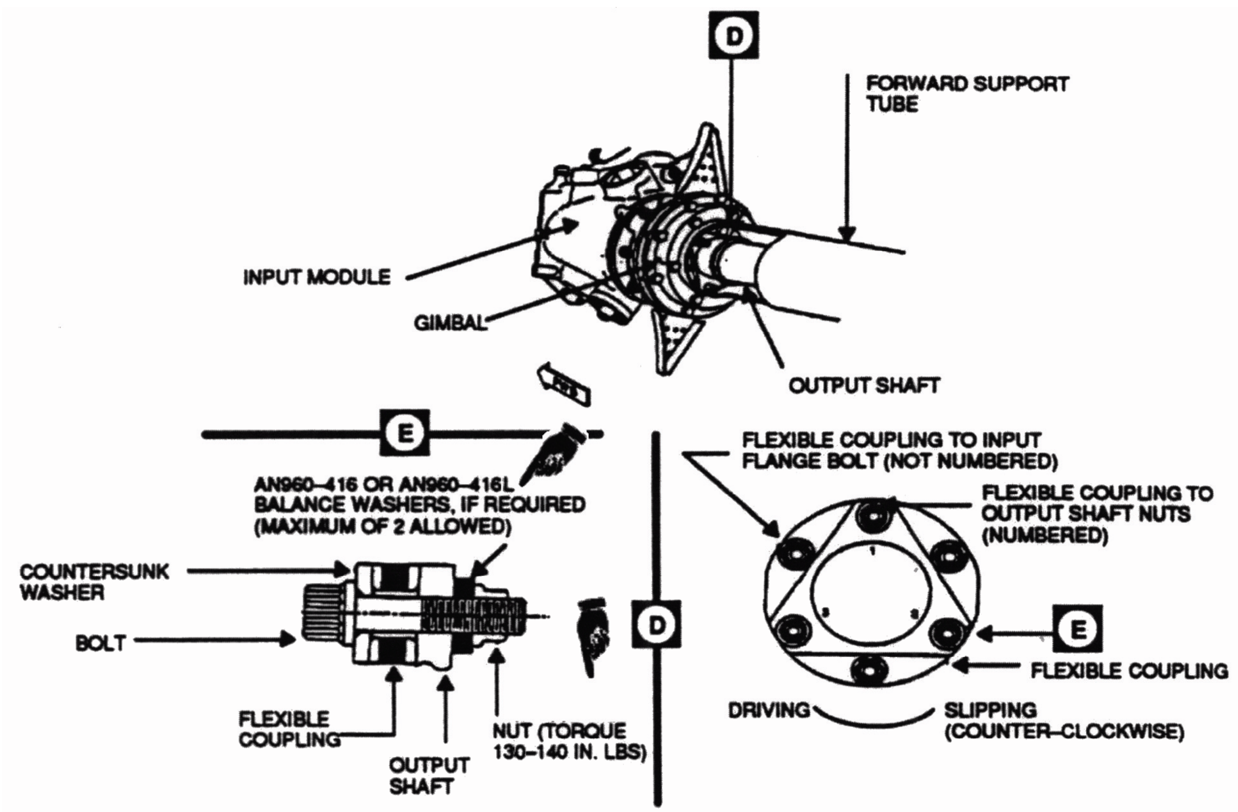


Figure 21. Engine Output Shaft Balance Bolt Configuration

g. Locate the three bolts, which connect engine output shaft to the flexible coupling. Pick one bolt and label it No. 1 using a black grease pencil (See Figure 21).
h. Rotate engine output shaft in freewheeling direction to next bolt (whichever is applicable). Label this bolt No. 2. Repeat rotation and label last bolt No. 3.
i. Rotate engine output shaft until No. 1 bolt appears in center of engine support tube access hole.

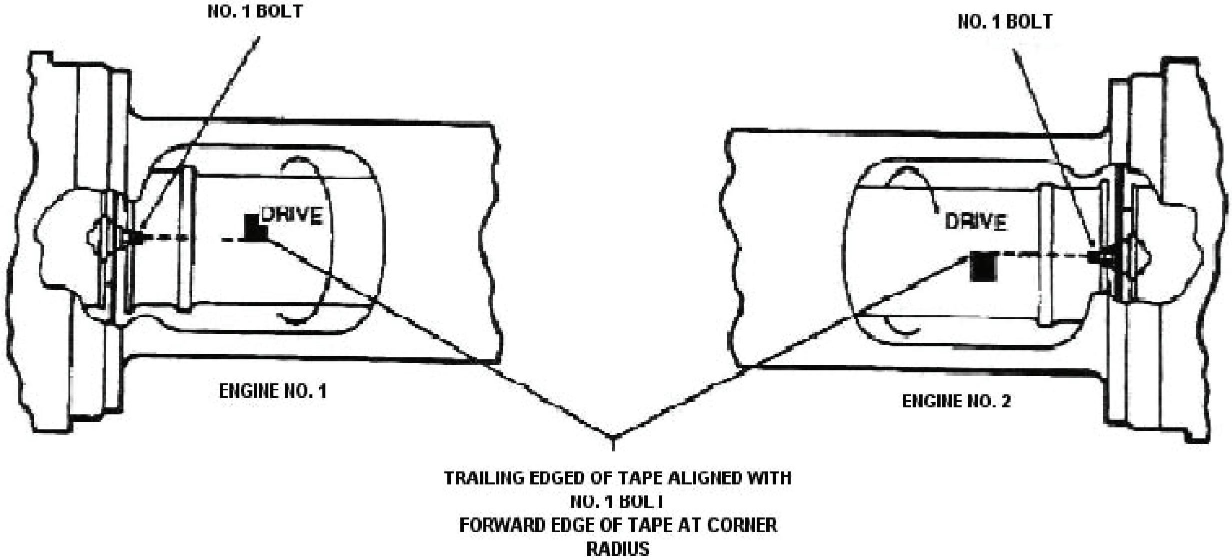


Figure 22. Engine Output Shaft Connecting Bolt and Reflective Tape Location

j. Using shop towel (Item 323, Appendix D of TM 1-1520-237-23) dampened with dry cleaning solvent (Item 68, Appendix D of TM 1-1520-237-23). Clean an area on engine output shaft at least 2 inches wide by 3 inches lone (see Figure 22).

NOTE

Measurement failure during Engine Output Shaft Balance can result if reflective tape is dirty. Do not use fingers to rub reflective tape. Keep reflective tape clean.

NOTE

Reflective tape is installed in a different location on each engine output shaft. Refer to Figure 22 for location of reflective tape.

k. Install one rectangular piece of reflective tape, 1 inch by 2 inch, on the engine output shaft (see Figure 22). Rub tape with clean, wooden spatula (Item 281, Appendix D of TM 1-1520-237-23) or the plastic backing that was removed from the reflective tape.

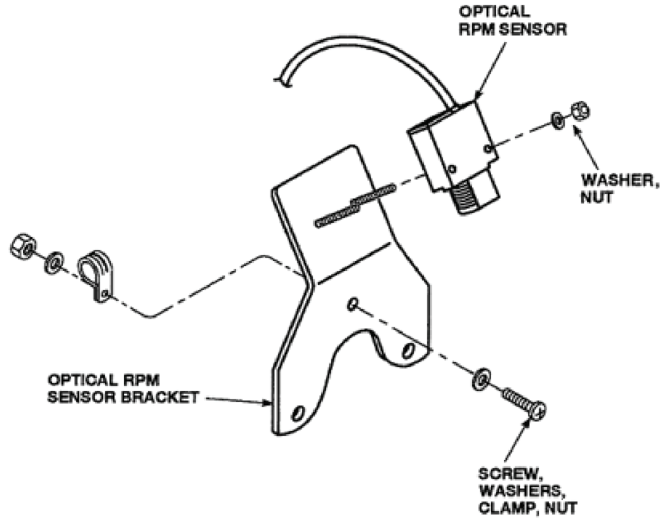


Figure 23. Engine Output Shaft Balance Optical RPM Sensor and Bracket Assembly

l. If Optical RPM sensor (P/N 29134700) is not installed on optical RPM sensor bracket (P/N 29754500 or HSS-OSB-001) install as follows (Figure 23):

CAUTION

Do not over-tighten the nuts/screws that attach the optical sensor to the output shaft optical sensor bracket. Optical sensor housing is plastic and will be broken if the nuts are over-tightened.

Attach optical sensor to bracket using two screws, MS 35206-221 or equivalent, four washers, AN960C4 or equivalent, and two nuts, MS21044C04 or equivalent. Torque nuts until snug. Do not over-tighten.

Attach optical sensor cable to opposite side of bracket relative to side where optical sensor is attached. Optical sensor cable could block the optical sensor line of sight and cause a measurement error if attached to same side of bracket where optical sensor is attached.

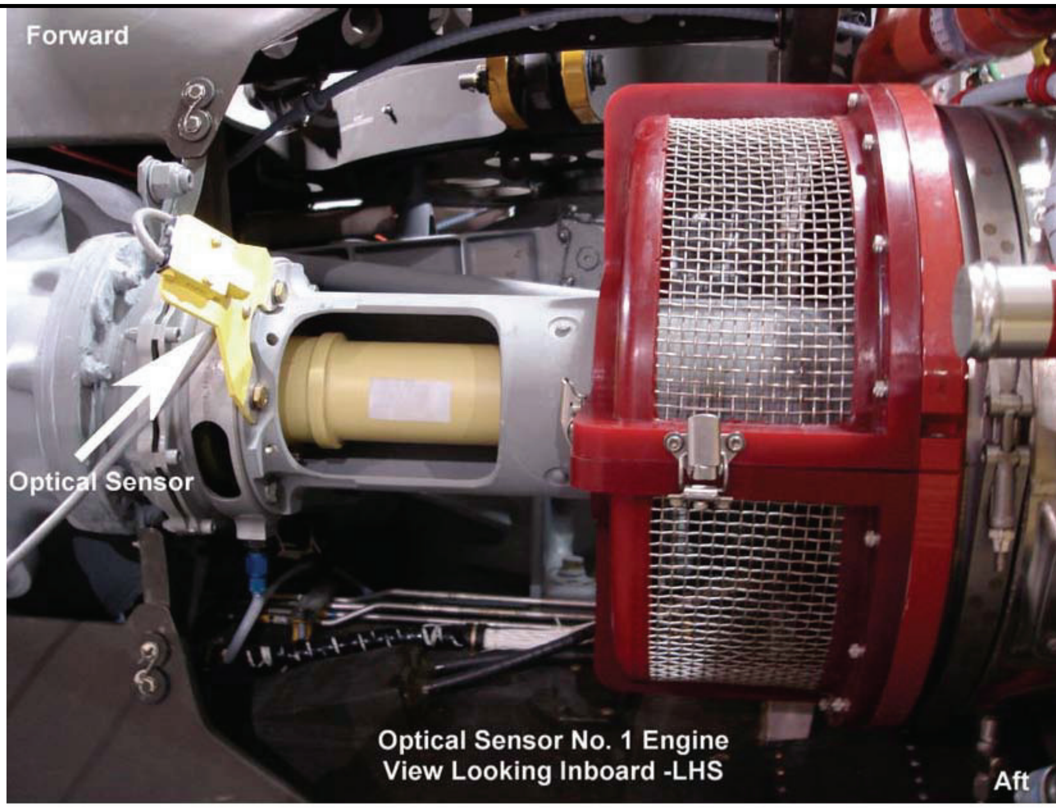


Figure 24. No. 1 Engine Output Shaft Optical Tachometer Sensor Installation

m. Install assemble bracket on to aft side of the input module gimbal housing with AN5-6A bolt and MS9320-11 washer (2 places) as shown in Figure 24. Optical sensor bracket for the No. 1 side is mounted in the 10 o'clock position (aft looking forward) and bracket for the No. 2 side is mounted in the 2 o'clock position (aft looking forward). Bracket is mounted so that the optical sensor line of sight is down and aft through the support tube hole onto the shaft. Torque Mounting bracket and bolts to 185 inch-pounds. Keep the original gimbal housing AN5C5A bolts for re-installation after balancing is complete.

n. Route 20-foot long cables through tiedown ring and in gunner's/crew-chief's window. Secure cables with tiedown straps (Item 282, Appendix D of TM 1-1520-237-23).

CAUTION

Damage to cables will result if cables contact engine output shaft. Make sure cables are secured and do not contact engine output shaft.

NOTE

Route the 20-foot long cable over top of input module when checking balance of engine output shaft.

o. Connect optical RPM sensor cable to the DAU receptacle marked TACHO 1 (if balancing ENG 1) or TACHO 2 (if balancing ENG 2).

p. Check area around engine for foreign objects.

PROCEDURE 3: PERFORM MEASUREMENTS, MULTI-DISK COUPLING (MC)

NOTE

Tape placement may be verified by applying aircraft power, then rotating the shaft by hand until the tape passes beneath the sensor. A red LED will illuminate on the back of the sensor if a return signal from the tape is present.

NOTE

No. 2 engine must not be running during the No. 1 engine output shaft vibration level check. No. 1 engine must be run at 100% Nr for five minutes prior to the measurement being taken.

a. Place the DAU power switch in the ON position.

b. Turn on the CADU.

c. Apply 28 Vdc power to the DAU.

d. Press **QUIT** until all the selections on the Main Menu are undefined.

e. Start and run No. 1 engine at 100% Nr, flat pitch.

f. Use cursor keys to highlight Aircraft Type, and then press **DO**.

g. Use cursor keys to highlight UH-60, and then press **DO**.

h. Tail Number is highlighted. Press **DO**.

i. Use cursor keys to highlight a tail number or enter a new one (up to seven digits), then press **DO**.

j. Flight plan is highlighted. Press **DO**.

k. Use cursor keys to highlight ENG 1. Press **DO**.

l. Enter the Measure mode by pressing **F1**. Verify that Test State ENG_1 is highlighted.

m. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire vibration data and return to the selection menu.

n. After the measurement is completed, press **DO** on Finish, then press **DO** on Main Menu.

NOTE

No. 1 engine must not be running during the No. 2 engine output shaft vibration level check. No. 2 engine must be run at 100% for five minutes prior to the measurement being taken.

o. Shut down No. 1 engine. Start and run No. 2 engine at 100% Nr, flat pitch.

p. Use cursor keys to highlight Flight Plan. Press **DO**.

q. Use cursor keys to highlight ENG_2. Press **DO**.

r. Enter the Measure mode by pressing **F1**. Verify that Test State ENG_2 is highlighted.

s. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire vibration data.

t. Shut down the No. 2 engine.

PROCEDURE 4: CORRECTING SHAFT BALANCE, MULTI-DISK COUPLING (MC)

a. After the measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu. Proceed to Step “d”.
b. If measured values exceed manufacturer’s desired levels on engine 2, press the **DO** key to enter the DIAGS mode. Perform all corrections displayed on the Corrections screen. If alterations of these corrective actions are desired, use the EDIT ADJUSTABLES option and turn of adjustment not wanted. Do not use a partial set of the adjustments.
c. After No. 2 engine corrections are installed or recorded, press **QUIT** two times to return to Main Menu.
d. Use cursor keys to highlight Flight Plan. Press **DO**.
e. Use cursor keys to highlight ENG 1. Press **DO**.
f. Use cursor keys to highlight Flight ID. Press **DO** two times.
g. Run diagnostics on No. 1 engine by pressing **F3**. If measurements are within specified limits, press **QUIT** to Main Menu.
h. If measured values exceed manufacturer’s desired levels, press the **DO** key to enter the DIAGS mode. Perform all corrections displayed on the Corrections screen. If alteration of these corrective actions are desired, use the EDIT ADJUSTABLES option and turn off adjustments no wanted. Do not use a partial set of the adjustments.
i. Repeat test to verify that vibration levels are within specifications.
j. Return to a flight-ready condition.

NOTE

When balancing an aircraft with the balance bolt configuration, the following guidelines must be observed when installing balance washers:

AN960-416 and AN960-416L washers are used as balance washers.

Balance washers are installed under the nut on the bolts that connect the engine output shaft to the flexible coupling. See Figure 21.

The maximum number of balance washers that can be added to any one balance bolt is two.

Do not remove bolts securing flexible coupling to output shaft. If balance washers must be added, remove nut only.

Only one nut should be removed at any time. If balance washers are added or removed on two different balance bolts, the nut on the first balance bolt adjusted must be installed and torqued before removing next nut.

Torque balance bolts IAW TM 1-1520-237-23. Refer to TM 1-1520-237-23 for the proper torque stabilization procedures.

Re-indexing of the input module flange, 120 degrees (one bolt hole), is permissible if the balance cannot be brought below 0.5 ips with balance washers only. Refer to TM 1-1520-237-23 for proper maintenance procedures.

TASK 10 – IMPROVED ENGINE OUTPUT (IEO) SHAFT BALANCING, DIAPHRAGM COUPLING (DC)

The following procedures provide instructions for the balancing of the engine output shafts of the H-60m Series helicopters with Improved Engine Output (IEO) assembly (ECP-319) installed using the AVA equipment.

PROCEDURE 1: CHECK BALANCE, DIAPHRAGM COUPLING (DC)

a. Perform Task 8, Procedures 1 and 2: Equipment Installation (omit oil cooler connection if oil cooler assembly is not to be tested).

NOTE

Make sure all cables are secure on helicopter using tiedown straps per Appendix D of TM 1-1520-237-23.

NOTE

Make sure the UH-60 Aircraft Type software version is 7.5e or higher. Software versions prior to 7.5e are not programmed to perform Improved Engine Output (IEO) Shaft (ECP-319) balance procedure.

b. Perform Task 8, Procedure 3: Engine Output Shafts and Oil Cooler Testing (disregard all references to the oil cooler if the oil cooler assembly is not to be tested.

c. The vibration level of an engine output shaft shall be 0.50 ips or less. If the vibration level is within this range, the engine output shaft is balanced. Remove the accelerometers, cables and brackets from the input modules. If the vibration levels are between 0.50 ips and 2.0 ips, balance the engine output shaft in accordance with the following procedure. If the vibration level is greater than 2.0 ips and there are balance setscrews installed on the coupling, remove the balance setscrews and repeat the balance check in Step b. If the vibration level with no balance setscrews installed is still greater than 2.0 ips, remove and inspect the shaft and diaphragm coupling.. If no problems are found, re-install the shaft rotated one bolt hole from previous installation. Repeat the balance check procedure in Step b. The remove, inspect, and re-install rotated one bolt hole may be performed five times. If after five iterations of rotating the shaft, the vibration levels are still greater than 2.0 ips, replace the output shaft using procedures in TM 1-1520-237-23.

PROCEDURE 2: OPTICAL TACHOMETER SENSOR INSTALLATION, DIAPHRAGM COUPLING (DC)

a. Turn off all electrical power.
b. Open engine cowling.
c. Remove engine air inlet (refer to TM 1-1520-237-23).
d. Remove crotch assembly from engine (refer to TM 1-1520-237-23).

NOTE

Prior to installing engine air inlet screen, area must be inspected for cleanliness and foreign objects.

e. Install engine upper screen assembly (20222-043) and lower screen assembly (20222-041) using clamp from air inlet. Torque nut on clamp to 60-70 inch-pounds.

f. Plug bleed-air tube with bleed-air tube plug (20114-109). Install plug using existing coupling and sleeve. Torque clamp to 43-47 inch-pounds.

g. Locate the twelve setscrew locations on the aft end of the diaphragm coupling. Identify the pairs of setscrew holes located between the bolts securing the output shaft to the diaphragm coupling. Select a pair of adjacent setscrew locations. Determine a center point between them and label it as No. 1 using a black grease pencil. The trailing setscrew location (in the direction of drive) is referred to as the “A” location and the leading setscrew location is referred to as the “B” location. See Figure 25.

h. Rotate engine output shaft in freewheeling direction to next pair of setscrew locations. Label the center point No. 2 and the setscrew locations as done previously. Repeat rotation, labeling center points through No. 6.

i. Rotate engine output shaft until No. 1 location appears in center of engine support tube access hole.

j. Using shop towel (Item 323, Appendix D of TM 1-1520-237-23), dampened with dry cleaning solvent (Item 68, Appendix D of TM 1-1520-237-23), clean an area on the engine output shaft at least 2 inches wide by 3 inches long. See Figure 25.

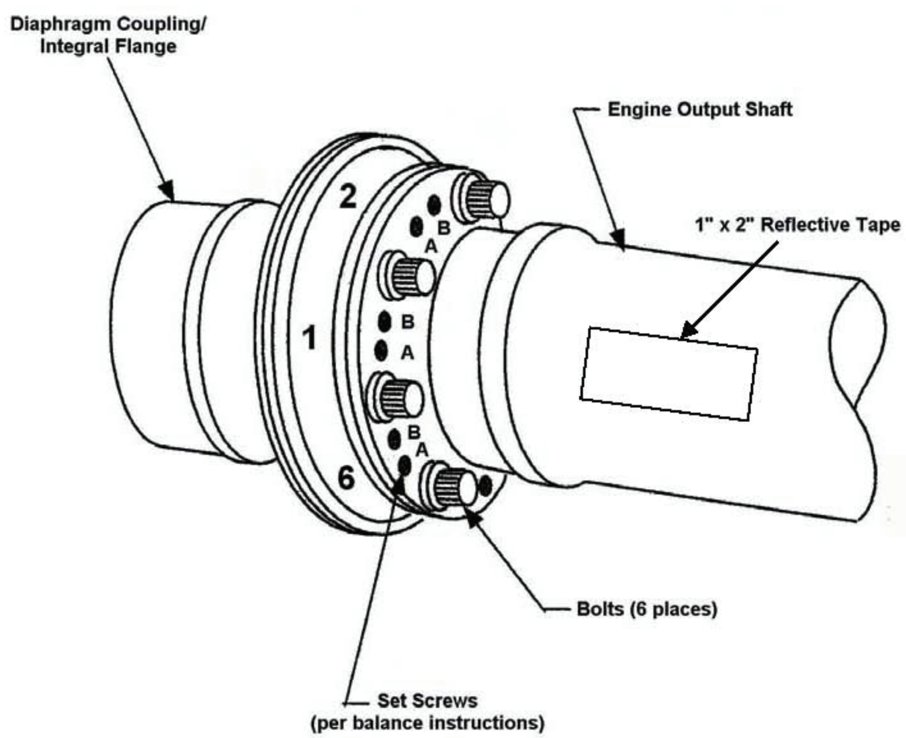


Figure 25. Improved Engine Output (IEO) Shaft/Diaphragm Coupling and Balance Weight Locations

k. Install one piece of reflective tape, 1 inch by 2 inch rectangle, on the engine output shaft at the No. 1 location on a point centerline between the 2 setscrew holes and 1 inch aft of balance ring flange (see Figure 25). Rub tape with clean, wooden spatula, (Item 281, Appendix D of TM 1-1520-237-23) or the plastic backing that was removed from the reflective tape. Do not use fingers.

NOTE

Measurement failure during Engine Output Shaft Balance can result if reflective tape is dirty. Do not use fingers to rub reflective tape. Keep reflective tape clean.

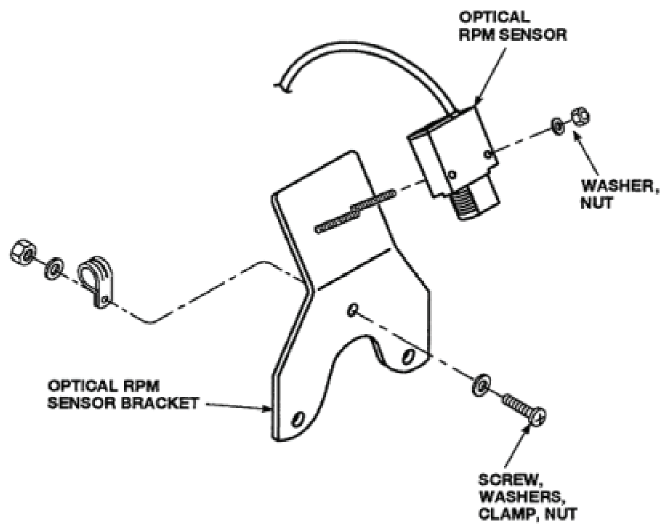


Figure 26: Engine Output Shaft Balance Optical RPM Sensor and Bracket Assembly

l. If optical RPM sensor (P/N 29134700) is not installed on optical RPM sensor bracket (P/N 29754500 or HSS-OSB-001) install as follows (see Figure 26):

CAUTION

Do not over-tighten the nuts/screws that attach the optical sensor to the output shaft optical sensor bracket. Optical sensor housing is plastic and will be broken if the nuts are over-tightened.

1. Attach optical sensor to bracket using two screws (MS35206-221 or equivalent), four washers (AN960C4 or equivalent), and two nuts (MS21044C04 or equivalent). Torque nuts until snug. Do not over-tighten (optical sensor housing is plastic and will be broken if nuts are over-tightened).

   Attach optical sensor cable to opposite side of bracket relative to side where optical sensor is attached. Optical sensor cable could block the optical sensor line of sight and cause a measurement error if attached to same side of bracket where optical sensor is attached.

m. Install assembled bracket on to aft side of the input module gimbal housing with AN5-6A bolt and MS9320-11 washer (2 places) as shown in Figure 27. Optical sensor bracket for the No. 1 side is mounted in the 10 o'clock position (aft looking forward), and bracket for the No. 2 side is mounted in the 2 o'clock position (aft looking forward). Bracket is mounted so that the optical sensor line of sight is down and aft through the support tube hole onto the shaft. Torque mounting bracket and bolts to 185 inch-pounds. Keep original gimbal housing AN5C5A bolts for reinstallation after balancing is complete.

n. Route 20-foot long cables through tiedown ring and in gunner's/crew-chief's window. Secure cables with tiedown straps,(Item 282, Appendix D of TM 1-1520-237-23).

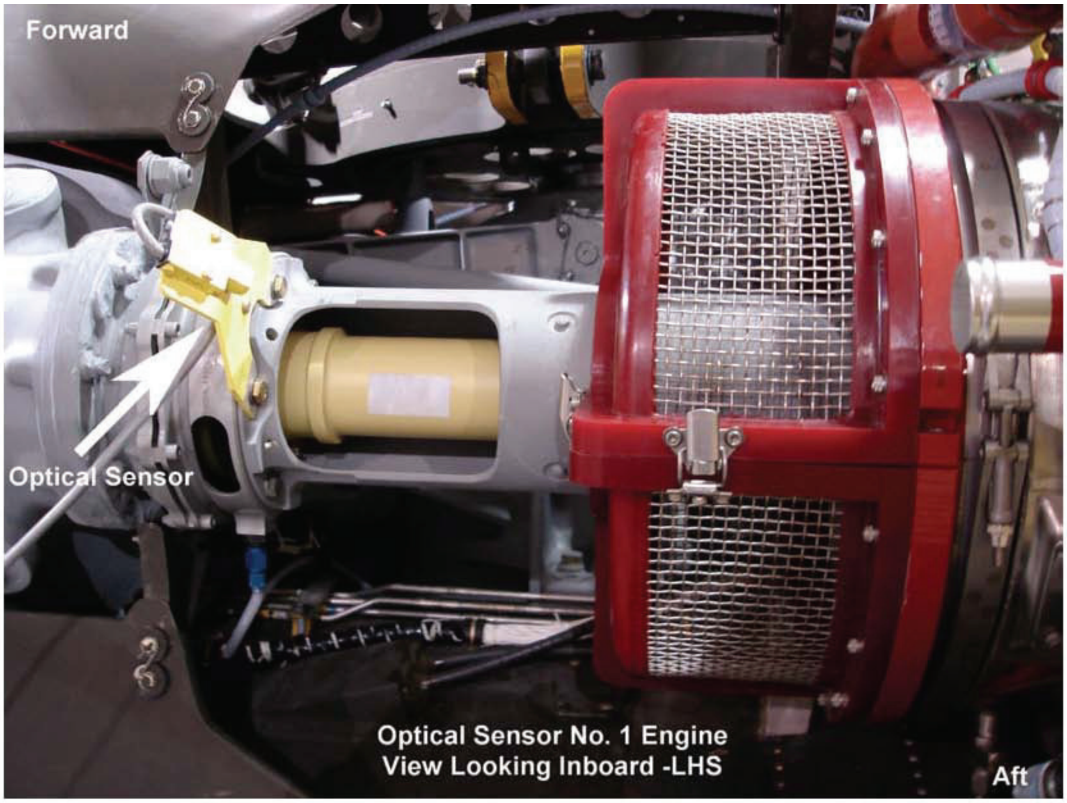


Figure 27. No. 1 Engine Improved Engine Output (IEO) Shaft Optical Tachometer Sensor Installation

CAUTION

Damage to cables will result if cables contact engine output shaft. Make sure cables are secured and do not contact engine output shaft.

NOTE

Route 20-foot long cable over top of input module when checking balance of engine output shaft

o. Connect optical RPM sensor cable to the DAU receptacle marked TACHO 1 (if balancing ENG_1_DC) or TACHO 2 (if balancing ENG_2_DC).

p. Check area around engine for foreign objects.

PROCEDURE 3: PERFORM MEASUREMENTS, DIAPHRAGM COUPLING (MC)

NOTE

Tape placement may be verified by applying aircraft power, then rotating the shaft by hand until the tape passes beneath the sensor. A red LED will illuminate on the back of the sensor if a return signal from the tape is present.

NOTE

No. 2 engine must not be running during the No. 1 engine output shaft vibration level check. No. 1 engine must be run at 100% Nr for five minutes prior to the measurement being taken.

NOTE

Make sure AVA equipment software version 7.5e or higher is installed. Prior version 7.5e software is not programmed to perform Improved Engine Output (IEO) Shaft (ECP-319) balance procedure.

a. Place the DAU power switch in the ON position.

b. Turn on the CADU.

c. Apply 28 Vdc power to the DAU.

d. Press **QUIT** until all the selections on the Main Menu are undefined.

e. Start and run No. 1 engine at 100% Nr, flat pitch.

f. Use cursor keys to highlight Aircraft Type, and then press **DO**.

g. Use cursor keys to highlight UH-60, and then press **DO**.

h. Tail Number is highlighted. Press **DO**.

i. Use cursor keys to highlight a tail number or enter a new one (up to seven digits), then press **DO**.

j. Flight plan is highlighted. Press **DO**.

k. Use cursor keys to highlight ENG_1_DC. Press **DO**.

l. Enter the Measure mode by pressing F1. Verify that Test State ENG_1_DC is highlighted.

m. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire vibration data and return to the selection menu.

n. After the measurement is completed, press **DO** on Finish, then press **DO** on Main Menu.

NOTE

No. 1 engine must not be running during the No. 2 engine output shaft vibration level check. No. 2 engine must be run at 100% for five minutes prior to the measurement being taken.

o. Shut down No. 1 engine. Start and run No. 2 engine at 100% Nr, flat pitch.

p. Use cursor keys to highlight Flight Plan. Press **DO**.

q. Use cursor keys to highlight ENG_2_DC. Press **DO**.

r. Enter the Measure mode by pressing **F1**. Verify that Test State ENG_2_DC is highlighted.

s. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire vibration data.

t. Shut down the No. 2 engine.

PROCEDURE 4: CORRECTING SHAFT BALANCE DIAPHRAGM COUPLING (MC)

a. After the measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu. Proceed to Step "j".

WARNING

FLIGHT SAFETY ITEM

Only 70361-08700-101, Titanium and PL565A428H4, Steel setscrews are used as balance weight. Verification of proper balance weight hardware is a critical characteristic.

CAUTION

Balance weight/setscrews may **NOT** be reused after balance of the Diaphragm Coupling is achieved. When installing balance weight/setscrew verify the presence of the self-locking feature of the setscrew identified as a "Poly-Lock" green patch in the screw threads. See Table 3. Make sure of the presence of run-on torque when installing balance weight/setscrew. Discard balance weight/setscrews than exhibit no run-on torque.

CAUTION

When performing balance weight adjustments, do not remove the bolts securing the diaphragm coupling to engine output shaft.

NOTE

When balancing an aircraft with the Improved Engine Output Shaft/Diaphragm Coupling and 6-location, 12point balance weight/setscrew configuration, the following guidelines must be observed when installing balance weights.

Only 70361-08700-101, Titanium and PL565A428H4 Steel setscrews are used as balance weight. Prior to installing balance weight/setscrews in the diaphragm coupling, verify the presence of a green "Poly-Lock" patch on the threads. (See Table 3).

Re-indexing of the Input Module Flange, between 60 (one bolt hole) and 180 degrees (three bolt holes) is permissible if the balance cannot be brought below 0.5 IPS with balance setscrews only. Refer to TM 1-1520-237-23 for proper maintenance procedures.

70361-08700-101, Titanium setscrews can be readily identified by the internal wrench size of 0.096 inch used to install or remove them. PL565A428H4 Steel setscrews can be readily identified by the internal wrench size of 0.125 inch used to install or remove them.

If a balance weight becomes stuck or seized into the diaphragm coupling, it may be necessary to add a balance weight of equal type to the other side of the coupling 180 degrees apart to offset.

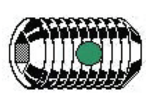
The maximum number of balance weights in any combination that can be added to a Diaphragm Coupling is 6. If the presence of a stuck setscrew is encountered, the total setscrew population remains 6 to include stuck or seized balance weight/setscrew and offset if required, on the Diaphragm Coupling.

Balance weight may be installed in 6 pairs of (12 ea) locations between the bolts that connect the engine output shaft to the diaphragm coupling. See Figure 28. For each pair of setscrew holes, it is recommended to use the leading hole for installation of Titanium setscrews and the lagging hole for installation of steel setscrews.

Torque balance weight/setscrews to 30 inch-pounds (includes prevailing run-on torque). A torque stabilization procedure does not apply to this application when installing or removing balance weight. Titanium setscrews may not sit flush when properly installed.

Table 3. Improved Engine Output (IEO) Shaft Balance Weight/Setscrew Identification

STEEL SETSCREW
PL565A428H4



THREAD =	1/4" - 28
LENGTH =	0.250"
CADMIUM PLATED	
WT Grams =	**0.953**
INTERNAL WRENCHING SIZE =	**0.125"**
SELF LOCKING FEATURE =	GREEN "POLY-LOCK"

TITANIUM SETSCREW
70361-08700-101

THREAD =	1/4" - 28
LENGTH =	0.250"
"Hi-Kote" COATING	
WT Grams =	**0.560**
INTERNAL WRENCHING SIZE =	**0.096"**
SELF LOCKING FEATURE =	GREEN "POLY-LOCK"

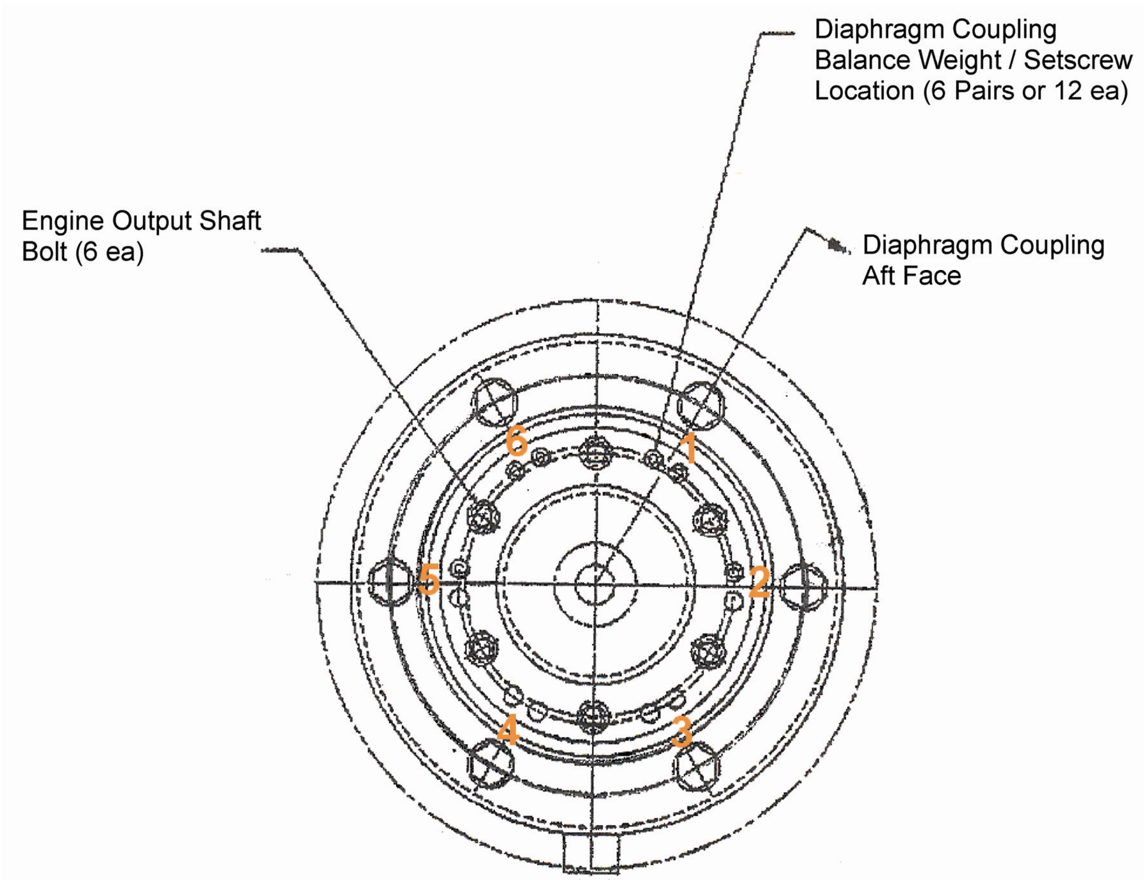
**GREEN PRIMER ON TIP*

NOTE

Do not use a partial set of the adjustments.

b. If measured values exceed manufacturer's desired levels on engine 2, press the **DO** key to enter the DIAGS mode. The first screen to appear will be titled ENTER CURRENT CONFIGURATION. Use this screen and the CADU number pad to enter the current setscrew configuration for the shaft being balanced. Use the CADU's up and down arrows to move between columns. Take note to enter the light (i.e. titanium) and heavy (i.e. steel) setscrews in their respective columns. Each location should have a maximum of two setscrews installed. Press the **DO** key to confirm the current configuration and proceed to the diagnostics screen. View the recommended corrections. Note that two pages of corrections may be available, one for a heavy setscrew adjustment and/or one for a light setscrew adjustment. The number of available pages is displayed in the upper right hand corner of the screen. Perform all corrections displayed on the Corrections screen. If alterations of the proposed corrective actions are desired, use the EDIT ADJUSTABLES option and turn off adjustment not wanted.

1. If required, select the balance weight/setscrew(s) displayed from the Corrections screen. 70361-08700-101, Titanium Setscrew can be identified by the flat gray color, internal wrenching size of 0.096 inch and the presence of green primer on the contact point to prevent dissimilar metals reaction. PL565A428H4 Steel setscrews can be identified by the cadmium plating, internal wrench size of 0.125 inch and the lack of primer on the contact point. See Table 3.



2. Locate the IEO Shaft Diaphragm Coupling for No. 2 engine and balance weight locations. See Figure 28. Identify the hole location(s) from the Corrections screen. It is recommended to apply a single setscrew adjustment to the A-location; subsequent balance corrections can utilize the B-location. If two setscrews of different weight are required in the same location, the order in which the locations are filled (i.e. A=heavy-B=light, A=light-B=heavy) does not matter.

CAUTION

Do not use more than the specified torque when installing setscrews. Excessive torque may cause setscrews to seize, making them very difficult to remove.

3. Select balance weight/setscrew from the previous step and engage threads to install. With the correct internal wrench, rotate the weight/setscrew until it bottoms in the threaded hole. Ensure the presence of run-on torque. Using a torque wrench and correct size torque adapter, torque the balance weight/setscrew to 30 inch-pounds of torque (includes prevailing run-on torque).

4. If a balance weight/setscrew becomes stuck or seized it is permissible to leave it in place and if required by the Corrections screen, install another of the same type 180 degrees across the coupling to offset the stuck or seized balance weight/setscrew. If required, use the EDIT ADJUSTABLES option and turn off adjustments not wanted to remove the stuck or seized balance weight from the correction. Only 6 of the 12 holes may have a balance weight/setscrews installed for balance, seized or offsets at any time.

c. After No. 2 engine corrections are installed or recorded, press QUIT twice to return to Main Menu.

d. Use cursor keys to highlight Flight Plan. Press **DO**.

e. Use cursor keys to highlight ENG_1_DC. Press **DO**.

f. Use cursor keys to highlight Flight ID. Press **DO** two times.

g. Run diagnostics on No. 1 engine by pressing **F3**. If measurements are within specified limits, press **QUIT** to Main Menu.

NOTE

Do not use a partial set of the adjustments.

h. If measured values exceed manufacturer's desired levels on engine 1, press the **DO** key to enter the DIAGS mode. The first screen to appear will be titled ENTER CURRENT CONFIGURATION. Use this screen and the CADU number pad to enter the current setscrew configuration for the shaft being balanced. Use the CADU's up and down arrows to move between columns. Take note to enter the light (i.e. titanium) and heavy (i.e. steel) setscrews in their respective columns. Each location should have a maximum of two setscrews installed. Press the **DO** key to confirm the current configuration and proceed to the diagnostics screen. View the recommended corrections. Note that two pages of corrections may be available, one for a heavy setscrew adjustment and/or one for a light setscrew adjustment. The number of available pages is displayed in the upper right hand corner of the screen. Perform all corrections displayed on the Corrections screen. If alterations of the proposed corrective actions are desired, use the EDIT ADJUSTABLES option and turn off adjustment not wanted.

1. If required, select the balance weight/setscrew(s) displayed from the Corrections screen. 70361-08700-101, Titanium Setscrew can be identified by the flat gray color, internal wrenching size of 0.096 inch and the presence of green primer on the contact point to prevent dissimilar metals reaction. PL565A428H4 Steel setscrews can be identified by the cadmium plating, internal wrench size of 0.125 inch and the lack of primer on the contact point. See Table 3.

2. Locate the IEO Shaft Diaphragm Coupling for No. 1 engine and balance weight locations. See Figure 28. Identify the hole location(s) from the Corrections screen. It is recommended to apply a single setscrew adjustment to the A-location; subsequent balance corrections can utilize the B-location. If two setscrews of different weight are required in the same location, the order in which the locations are filled (i.e. A=heavy- B=light, A=light-B=heavy) does not matter.

CAUTION

Do not use more than the specified torque when installing setscrews. Excessive torque may cause setscrews to seize, making them very difficult to remove.

3. Select a balance weight/setscrew from the previous step and engage threads to install. With the correct internal wrench, rotate the weight/setscrew until it bottoms in the threaded hole. Ensure the presence of run-on torque. Using a torque wrench and correct size torque adapter, torque the balance weight/setscrew to 30 inch-pounds of torque (includes prevailing run-on torque).

4. If a balance weight/setscrew becomes stuck or seized it is permissible to leave it in place and if required by the Corrections screen, install another of the same type 180 degrees across the coupling to offset the stuck or seized balance weight/setscrew. If required, use the EDIT ADJUSTABLES option and turn off adjustments not wanted to remove the stuck or seized balance weight from the correction. Only 6 of the 12 holes may have a balance weight/setscrews installed for balance, seized or offsets at any time.

i. After No. 1 engine corrections are installed or recorded, press **QUIT** twice to return to Main Menu.

NOTE

If balance adjustments were performed to either the No. 1 or No. 2 high speed shaft repeat Task 10 to verify that the vibration levels are within limits.

j. Remove equipment installations in reverse order of installation.

k. Return aircraft to a flight-ready condition.

TASK 11 – ISOLATING IRREGULAR/UNUSUAL VIBRATIONS

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA equipment from transport case. Check for possible damaged equipment and frayed cables.

b. Install DAU in canvas carrying case.

c. Select a balance weight/setscrew from the previous step and engage threads to install. With the correct internal wrench, rotate the weight/setscrew until it bottoms in the threaded hole. Ensure the presence of run-on torque. Using a torque wrench and correct size torque adapter, torque the balance weight/setscrew to 30 inch-pounds of torque (includes prevailing run-on torque).

d. Connect power cable (29104700) to aircraft's 28 Vdc utility receptacle at station 293, right side, on cabin ceiling and to DAU receptacle marked 28 Vdc.

e. Place CADU in aircraft. Connect CADU to DAU cable (29325601) to CADU to DAU receptacle marked CADU.

PROCEDURE 2: ACCELEROMETER INSTALLTION

NOTE

Data can be acquired from up to four accelerometers to assist in isolating irregular or unusual vibrations.

a. Mount/install accelerometer (28110900) (found in the basic kit) anywhere on the airframe that an irregular or unusual vibration is detected.

b. Connect accelerometer cables (found in the basic kit) from accelerometer to the DAU receptacle marked ACC1, ACC2, ACC3, and/or ACC4.

PROCEDURE 3: PERFORM PROBES MEASUREMENTS

a. Operate aircraft at desired flight condition. This should be the RPM or airspeed at which the vibration is strongest.

b. Turn on DAU.

c. Turn on CADU.

d. Press **QUIT** on the CADU until all selections are undefined.

e. Use cursor keys to highlight Aircraft Type, then press **DO**.

f. Use cursor keys to highlight UH-60, and then press **DO**.

g. Tail Number is highlighted. Press **DO**.

h. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.

i. Flight Plan is highlighted. Press **DO**. If balance adjustments were performed to either the No. 1 or No. 2 high speed shaft repeat Task 10 to verify than the vibration levels are within limits.

j. Use cursor keys to highlight PROBES. Press **DO**.

k. Enter the Measure mode by pressing **F1**. Verify than Test State ACC1 is highlighted.

l. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State (ACC1, ACC2, ACC3, or ACC4) and 0press **DO** again. The flight plan will measure data on one channel at a time. Perform this operation each time a measurement is completed and another Test State is highlighted. The AVA will acquire vibration data at each selected Test State and then return to the selection menu.

m. After the last measurement is completed, press **DO** on Finish, then press **DO** on Main Menu.

n. Enter the Display mode by pressing **F2**. Select One Test State and then press **DO**. Review each of the spectrums measured for any unusual vibrations.

o. Make appropriate logbook entry if necessary and remove test equipment.

END OF WORK PACKAGE

AVA APPLICATION AND PROCEDURES – AH-1S

(Script File No. AH1SS_R.CMD, AH1S_R.CMD, AH1SSM_R.CMD and AH1SM_R.CMD)

WARNING

Use extreme care when flying with UTD mounted. UTD interferes with wire strike capabilities.

CAUTION

Never install cables where they can be damaged. Use wire bundle ties or clamps to route cabling along or through airframe instead of securing cables with fairing doors, panels, or seat frames. Never bundle tie cables to flight controls.

TASK 1 - TEST EQUIPMENT INSTALLATION/CHECKOUT
TASK 2 - FLAT TRACK MAIN ROTOR ON THE GROUND
TASK 3 - BALANCE MAIN ROTOR-INITIAL
TASK 4 - TRACK MAIN ROTOR IN FLIGHT
TASK 5 - BALANCE TAIL ROTOR
TASK 6 - ISOLATING IRREGULAR/UNUSUAL VIBRATIONS

PERSONNEL REQUIRED

Three People Required:
- Pilot
- Aircraft Mechanic
- Inspector/Supervisor

SUPPLIES

- Lockwire MS20995NC32 (task 1)
- Reflective Tape (10605000) for tail rotor balancing and main rotor tracking/balancing at night (task 1)
- Tie-Wrap (NSN 5975-00-074-2072)
- Fastener, Clamp (209075178-1)
- Nut, Self-locking (NSN 5310-00-807-1475)
- Nut, Castellated (NSN 5310-00-871-8738)
- Pin, Cotter (NSN 5315-00-234-1864)

TOOLS

- Aircraft Mechanic's Toolkit, NSN 5180-00-323-4692
- Aircraft Adapter Kit (29315500) NSN 6625-01-324-9820
- *Data Acquisition Unit (DAU) (29328203)
- *Control and Display Unit (CADU) (29314106)
- *10-ft CADU to DAU Cable (29325601)
- *Universal Tracking Device (UTD) (29310700)
- *25-ft UTD Cable (29325701)
- AH-1S UTD Mounting Bracket (29197900)
- Torque Wrench (0-150 ¼ inch drive,
- 700-1500 in-lbs.½ inch drive)
- 10-ft AH-1S Power Cable (29104700)
- AH-1S Power Cable Adapter (29317100)
- *Magnetic RPM Sensor (27288400)
- *Magnetic RPM Sensor Cable (29105403)
- Magnetic RPM Sensor Bracket (29315600)
- *25-ft 54mV/g Accelerometer Cable (29105605)
- *50-ft 54mV/g Accelerometer Cable (29105600)
- *54mV/g Accelerometer (28110900) (2 each)
- *Accelerometer Mounting Bracket (29313000) (2 each)
- Striker Plate (29315700)
- *Optical RPM Sensor Mounting Bracket (29198700)
- *Optical RPM Sensor (29314700)
- AVA Basic Kit, Rotor Track and Balance NSN 6625-01-282-3746

*Included in AVA Basic Kit

ALSO NEEDED

- Balance Weights (as required)
- AH-1 Script File, See table 2 (installed in CADU)

REFERENCES

- TM 1-1520-236-10
- TM 1-1520-236-23
- TM 1-1520-236-MTF
- TM 1-6625-724-13&P

The AH-1 (series) Flight Plans are listed below with a brief description of their purpose. The selectable Flight Plans (table 1) are listed in order of appearance in the menu on the CADU and not in the order in which they are to be performed.

FLIGHT

This flight plan is primarily designed to reduce the in flight vertical vibrations using all adjustments. It is optimized to focus on the 120K/135K area. It is to be used after the GNDTRK and INITIAL flight plans when smoothing an aircraft after component change, or for "tuning up" an aircraft that is already in service.

GNDTRK

This flight plan is designed to get the rotor into a flyable track prior to hovering. It consists of one measurement (Fpg100), and will recommend pitch link adjustments to correct track. It should be the first test that is performed after any component change or major rework on the rotor.

INITIAL

This flight plan is performed after the GNDTRK, and will balance the rotor prior to flight. Diagnostics may provide pitch link, weight, and sweep adjustments to perform this goal. This test may be performed first if the status of the rotor components is known (i.e., the same pitch links and blades were reinstalled during a phase).

PROBES

This flight plan is designed to acquire data from up to four accelerometers to assist in isolating irregular or unusual vibrations. The flight plan will measure data one channel at a time on DAU ACC1 through ACC4. These accelerometers may be installed anywhere on the airframe and will measure a 0 to 500 Hz spectrum (0 to 30,000 RPM).

TAIL

This flight plan is designed to balance the AH1(series) tail rotor. It uses the optical RPM sensor on TACHO 2 and one accelerometer on ACC4. It should be performed after any rework on the tail rotor or anytime a medium to high frequency vibration is felt in the aircraft.

Table 1. AH1 Flight Plans and Test States

Flight Plan	Test States	Test Condition
FLIGHT	FPG100 Hover 100K 120K 135K CLIMB L/DOWN	6600 RPM N2 (100%, N2) Hover - O.G.E. 100 Kts, Level Flight 120 Kts, Level Flight 135 Kts, Level Flight 60 Kts Climb, 1000 Ft/min L/Down: 60 Kts at 1000 Ft/Min
GNDTRK	Fpg100	
INITIAL	IDLE FPG100 Hover	Flat pitch, 70%, N1 6600 RPM N2 (100%, N2) Hover - O.G.E.
PROBES	ACC1 ACC2 ACC3 ACC4	Used as required
TAIL	FPGTL	Tail Balance - Flat Pitch, 100% N2

There may be four AH-1 aircraft types in the CADU. Refer to table 2 to ensure proper software is utilized.

Table 2. AH1 Software

Aircraft File	Description
AH1S	AH-1 Cobra with Kaman 747 rotor blades installed
AH1SS	AH-1 Cobra with Kaman 747 rotor blades and stainless steel pitch links installed
AH1SM	AH-1 Cobra with 540 metal rotor blades installed
AH1SSM	AH-1 Cobra with 540 metal rotor blade and stainless steel pitch links installed

TASK 1 - TEST EQUIPMENT INSTALLATION/CHECKOUT

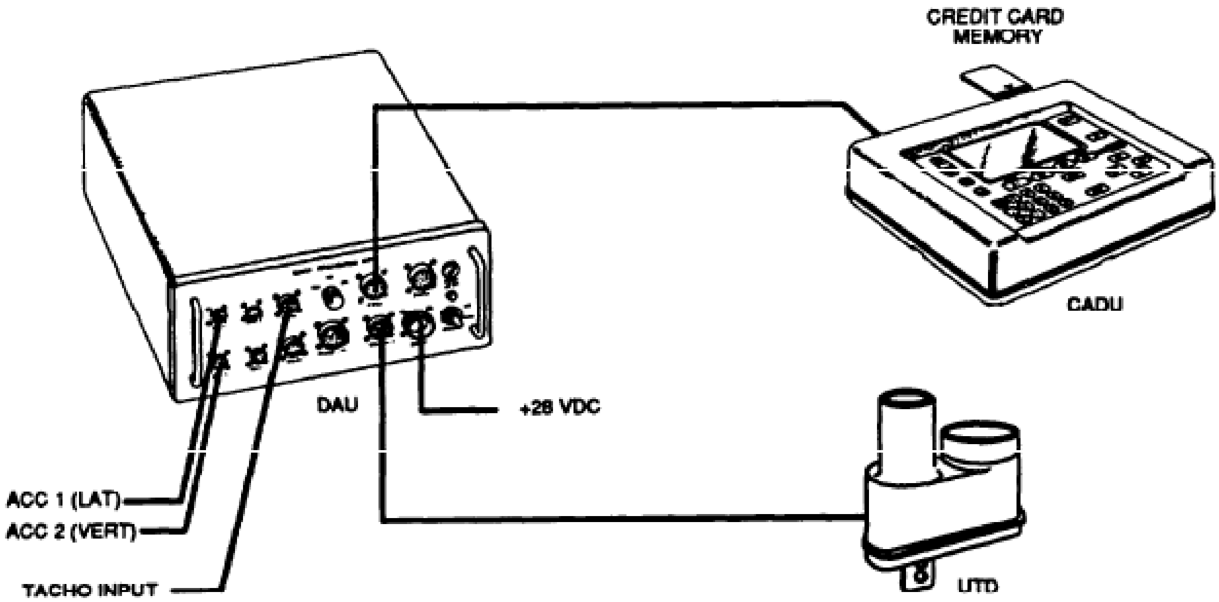


Figure 1. Typical AVA Test Setup Configuration

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA blade tracking equipment from transport case. Check for possible damaged equipment and frayed cables. Figure 1 is the typical AVA test setup configuration.

b. Install DAU in canvas carrying case.

c. Place DAU behind the pilot's seat with the connectors facing up and secure DAU using canvas straps and D-rings.

d. Remove hood assembly from one of the pilot's console lights. Remove the bulb. Plug AH-1S power cable adapter (29317100), see figure 2 into lamp socket. Ensure that the lamp intensity is set to full intensity (clockwise).

e. Connect grounding clip to a screw head or any non-painted metal surface, which will provide an adequate path to aircraft ground.

f. Connect power cable (29104700) to the AH-1S power cable adapter (29317100) and to the DAU receptacle marked 28 Vdc.

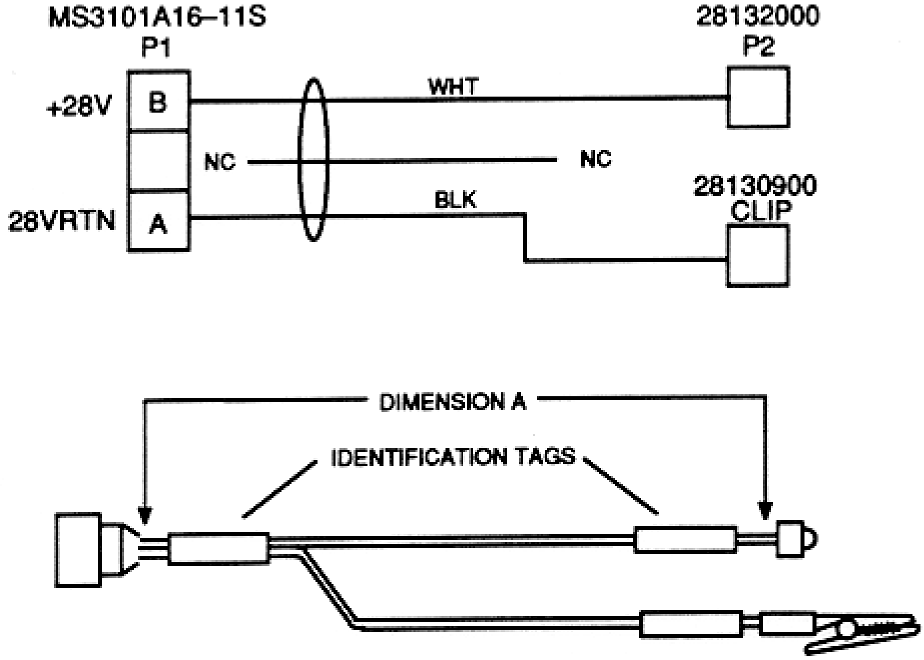
g. Place CADU in front seat. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: MAGNETIC RPM SENSOR INSTALLATION

NOTE

The lateral pitch-horn bolt should be installed with its head to the front-right (toward the centerline of the aircraft) and the nut at the left-rear (outboard).

a. Remove the cotter pin, nut, and washer from the left lateral pitch-horn bolt on the fixed swashplate.



PART NUMBER	DIMENSION "A"
29317100	13 INCHES

Figure 2. DC Power Cable Adapter Assembly (PN 29317100)

b. Place the magnetic RPM sensor bracket (29315600 REV D) on the bolt. The two posts must straddle the pitch horn to prevent it from rotating. Brackets marked with revisions earlier than revision D are not to be used.

c. Replace nut (do not use washer), and torque to 770-950 in-lbs. Install new cotter pin.

d. Install magnetic RPM sensor (27288400) into bracket, with the connector away from the mast. Use a jam nut on each side of the bracket, leaving them loose and with the top of the sensor extending as little as possible. Nuts will be adjusted later.

e. Remove the nuts and washers from two studs, see figure 3, of the twelve studs located on the outer ring of the rotating swashplate.

f. Turn main rotor head so that the WHITE blade is at 11:00 o'clock and place the single magnetic interrupter (29315700) with pointed flange down, at the left-front of the swashplate.

g. Replace nuts, and torque nuts to 100-140 in-lbs.

h. Turn the main rotor head slowly to lineup the single magnetic interrupter with the magnetic RPM sensor.

i. Adjust clearance between magnetic RPM sensor and sensor interrupter to a 0.060-inch, ±0.010 inch, clearance and tighten the jam nut. Install lockwire.

j. Connect magnetic RPM sensor cable (29105403) to magnetic RPM sensor.

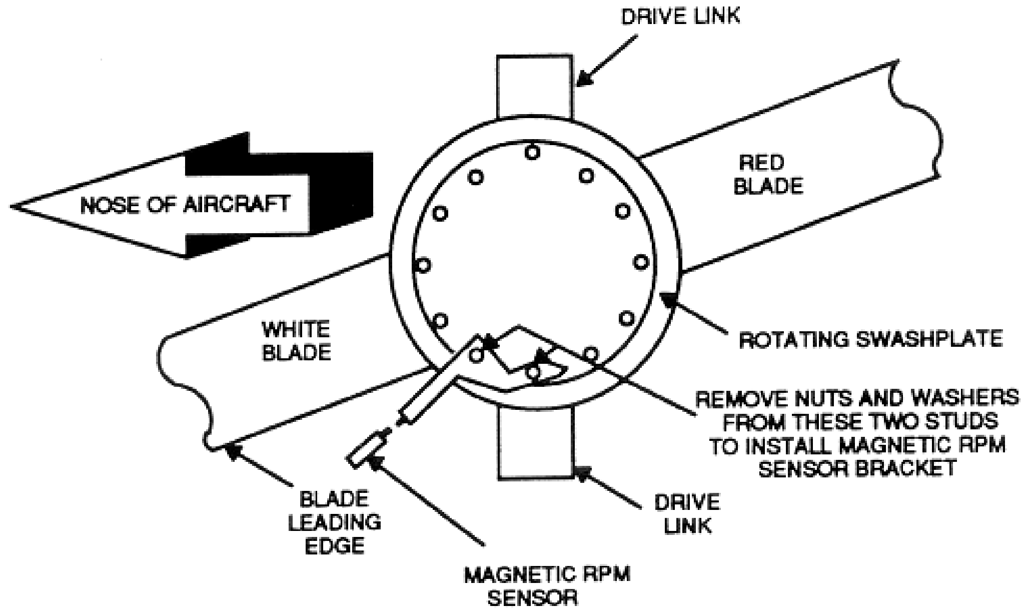


Figure 3. Magnetic RPM Sensor Installation

k. Tie-wrap the magnetic RPM sensor cable to existing hydraulic tubes and supports with enough slack to allow full swashplate movement.

CAUTION

Be sure that magnetic RPM sensor cable cannot interfere with any moving components, as this installation is used during flight. When routing cable, make sure that there is enough slack so that when the swashplate moves it will not damage cable.

l. Route the cable out of the swashplate access door. Secure it with enough slack to allow for fully extended left front control rod, but not enough for the cable to become entangled with any moving components. The cable may be routed through the hydraulic compartment and into the back of the cockpit.

m. Connect magnetic RPM sensor cable to the DAU receptacle marked TACHO 1.

PROCEDURE 3: ACCELEROMETER INSTALLATION

NOTE

The lateral accelerometer must be mounted to the bulkhead, not to a shock-mounted component.

LATERAL ACCELEROMETER

a. Install lateral accelerometer (28110900) on accelerometer mounting bracket (29313000), then connect accelerometer cable (29105605) to lateral accelerometer. Mount accelerometer bracket (29313000) to the pilot's compartment aft bulkhead (rear canopy bulkhead), with the connector pointing to the right of the helicopter (to your left when you are facing the bulkhead), see figure 4.

b. Connect accelerometer cable (29105605) from lateral accelerometer to the DAU receptacle marked ACC1.

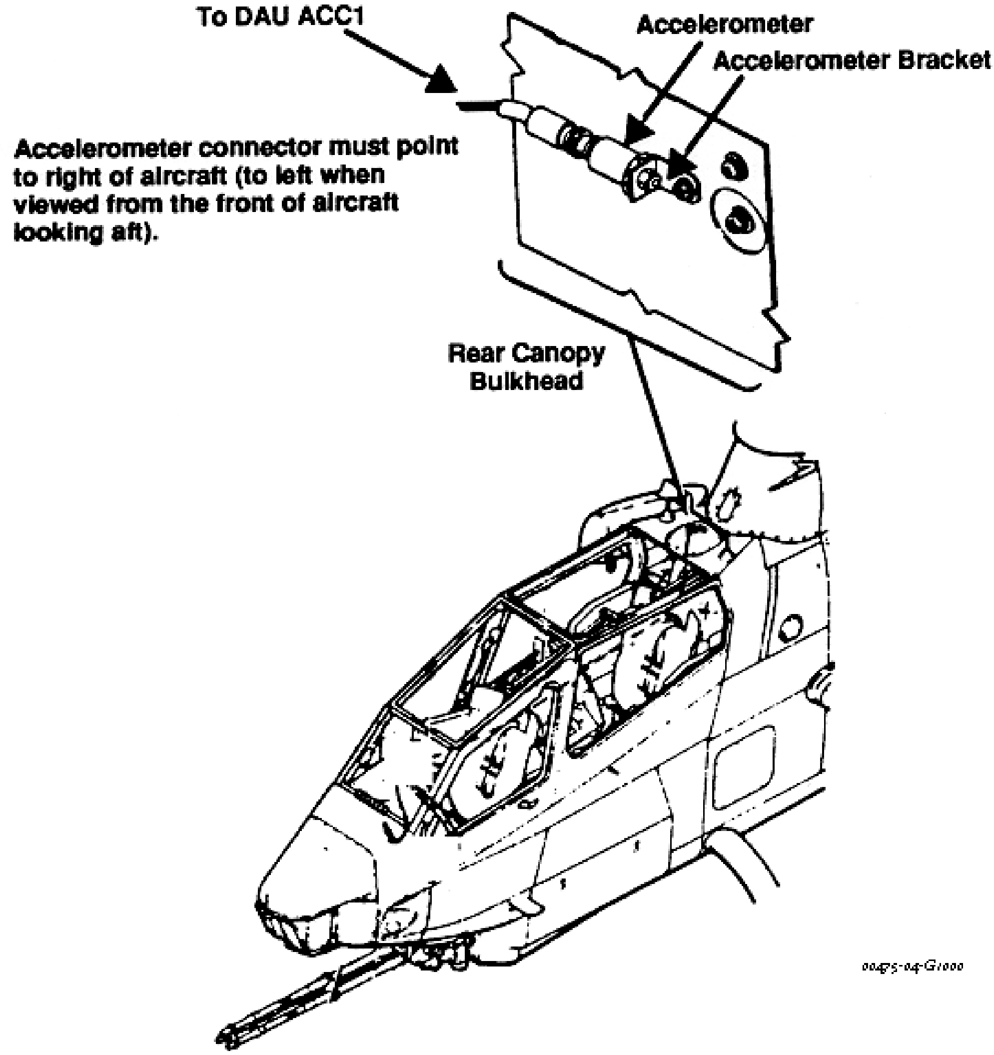


Figure 4. Lateral Accelerometer Installation on Rear Canopy Bulkhead

VERTICAL ACCELEROMETER

a. Install vertical accelerometer (28110900) on accelerometer mounting bracket (29313000), then connect accelerometer cable (29105600) to vertical accelerometer. Mount accelerometer bracket on the right side of the front cockpit. Mount on screw just forward of co-pilot's canopy removal system and fire mechanism's retainer bracket, see figure 5.

b. Connect accelerometer cable (29105600) from vertical accelerometer to the DAU receptacle marked ACC2.

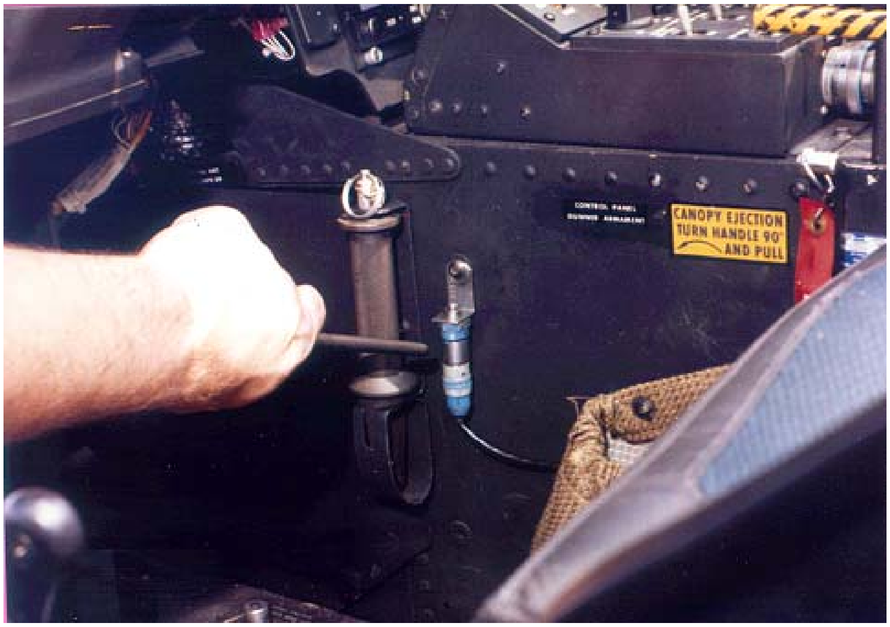


Figure 5. Vertical Accelerometer Installation Near Canopy Removal Arm and Fire Mechanism

PROCEDURE 4: TRACKER INSTALLATION

a. Remove the four airframe screws, and install UTD mounting bracket (29197900) on aircraft, see figure 6.

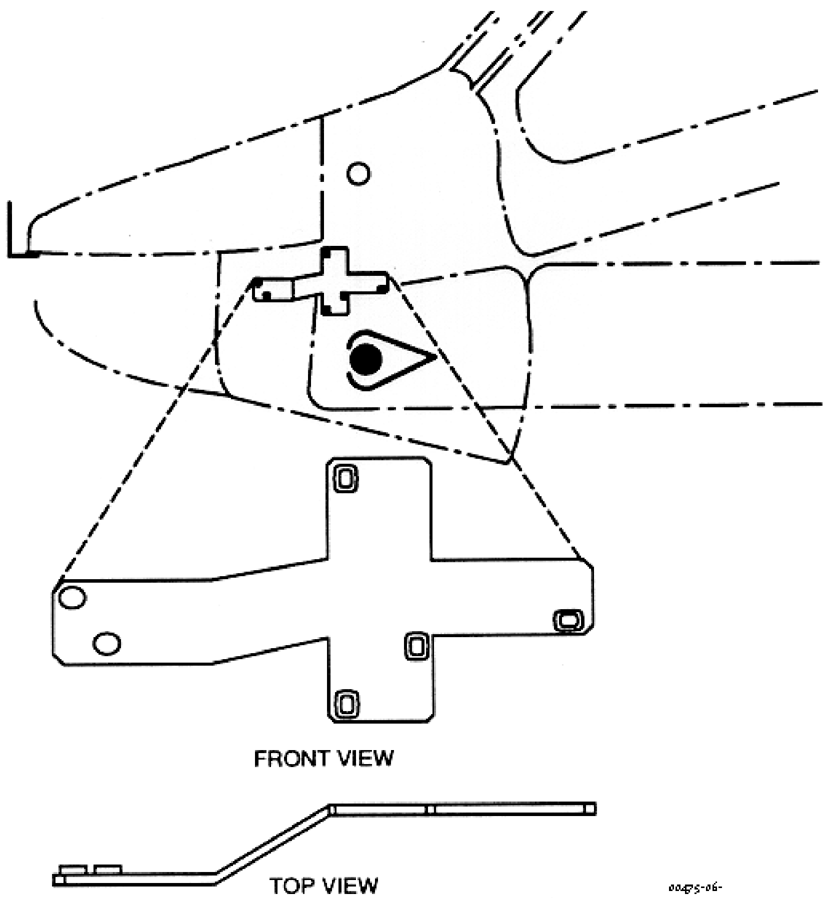


Figure 6. UTD Mounting Bracket

b. Secure UTD mounting bracket with screws long enough to pass through the mating fastener and extend a minimum of two threads.

NOTE

It may be necessary to replace the four aircraft screws with longer screws in order to mount the UTD mounting bracket.

If the UTD captive mounting bolts are lost or damaged, use NAS1305-14 bolts of suitable length as temporary replacements.

c. Mount UTD (29310700) on bracket, ensuring that the night (red) lens on UTD is below the optical (clear) lens.
d. Connect the UTD cable (29325701) to UTD connector and connect to the DAU receptacle marked TRACKER 1.
e. Ensure that the TRACKER MODE switch on the front of the DAU is in the DAY position.

PROCEDURE 5: NIGHT TIME TRACKING INSTRUCTIONS

NOTE

The following steps are to be taken if nighttime tracking is anticipated. If no flights will be performed after dusk, proceed directly to task 2.

a. Ensure that the TRACKER MODE switch on the front of the DAU is in the NIGHT position.
b. Ensure that the underside, trailing edge of all blades is as clean as possible. This is necessary for optimum adhesion of the reflective tape.
c. Place a single, 4-ft strip of reflective tape on the underside, trailing edge of each blade as shown in figure 7. Ensure that the tape is smooth and as straight as possible using the edge of the blade as a reference.
d. If verification of the tape placement is desired, it can be viewed by holding a flashlight near your head and shining it at the rotating blades. Any misplaced sections of the tape will stand out.

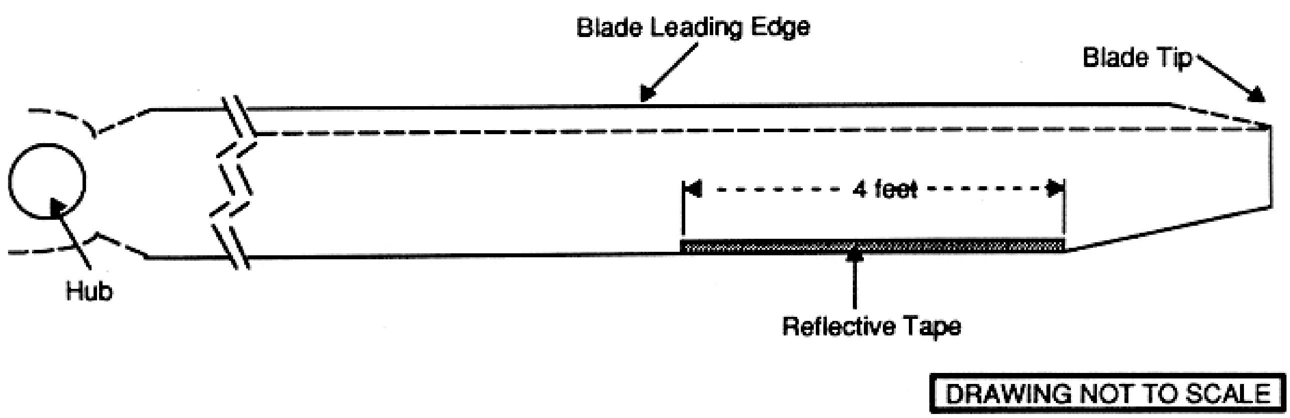


Figure 7. Placement of Reflective Tape on Rotor Blades

TASK 2 - FLAT TRACK MAIN ROTOR ON THE GROUND

PROCEDURE 1: PREPARATION

a. Install test equipment (refer to task 1).
b. Operate aircraft at IDLE (70% N1).
c. Turn on DAU.
d. Turn on CADU.

PROCEDURE 2: PERFORM GROUND TRACK (GNDTRK) MEASUREMENT

a. Press **QUIT** on the CADU until all selections are undefined.
b. Use cursor keys to highlight Aircraft Type, then press **DO**.
c. Use cursor keys to highlight aircraft type based on table 2, then press **DO**.
d. Tail Number is highlighted. Press **DO**.
e. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.
f. Flight Plan is highlighted. Press **DO**.
g. Use cursor keys to highlight GNDTRK. Press **DO**.
h. Enter the Measure mode by pressing **F1**. Verify that Test State Fpg100 is highlighted.
i. Press **DO** when the aircraft is stable at the highlighted selection. Re-verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire track and vibration data and return to the selection menu.

j. After the measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu and perform task 3, Balance Main Rotor on the Ground.
k. If measured values exceed specifications, press **DO** to calculate a solution. Evaluate the improvements obtainable through recommended corrections. Perform corrections as shown.
l. After corrections are installed, take the measurements again to verify improvements.
m. Perform task 3, Balance Main Rotor.

TASK 3 - BALANCE MAIN ROTOR - INITIAL

PROCEDURE 1: PREPARATION

Perform task 2, Flat Track Main Rotor on the Ground.

PROCEDURE 2: PERFORM INITIAL MEASUREMENT

a. Use cursor keys to highlight Aircraft Type, then press **DO**.
b. Use cursor keys to highlight aircraft type based on table 2, then press **DO**.
c. Tail Number is highlighted. Press **DO**.
d. Use cursor keys to highlight a tail number used in task 2, then press **DO**.
e. Flight Plan is highlighted. Press **DO**.
f. Use cursor keys to highlight INITIAL. Press **DO**.
g. Enter the Measure mode by pressing **F1**. Verify that Test State IDLE is highlighted.
h. Press **DO** when the aircraft is stable at the highlighted selection. Re-verify that the aircraft is at the required Test State (IDLE, FPG100, or Hover) and press **DO** again. Perform this operation each time a measurement is completed and another Test State is highlighted. The AVA will acquire track and vibration data at each Test State and then return to the selection menu.
i. After the 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 perform task 4, Track Main Rotor In Flight.
j. If measured values exceed specifications, press **DO** to calculate a solution. Evaluate the improvements obtainable through recommended corrections. Perform all corrections as shown, ensuring that you display all screens of a multiple screen solution.
k. Do not use a partial set of adjustments. If changes to the recommended corrections are desired, use the Edit Adjustables and Edit Defaults options. The AVA will calculate a new set of corrections, use view predictions to compare the new set of adjustments to the default solution to ensure the vibration is being reduced. Use all of the new corrections.
l. After corrections are installed, take the measurements again to verify improvements.
m. After more than one measurement has been taken, trend flights to verify if the hover lateral vibration is being reduced.

PROCEDURE 3: PITCH LINK ADJUSTMENTS

NOTE

When adjusting the pitch link on the AH-1SS, turn as shown in figure 8 and count flats/turn at the specified location.

a. Turn barrel the specified amount displayed on the CADU.
b. Verify corrections by completing another ground run at 100% Nr, flat pitch.
c. Make appropriate logbook entry on the pitch control links and balance weighs that were changed, if any.

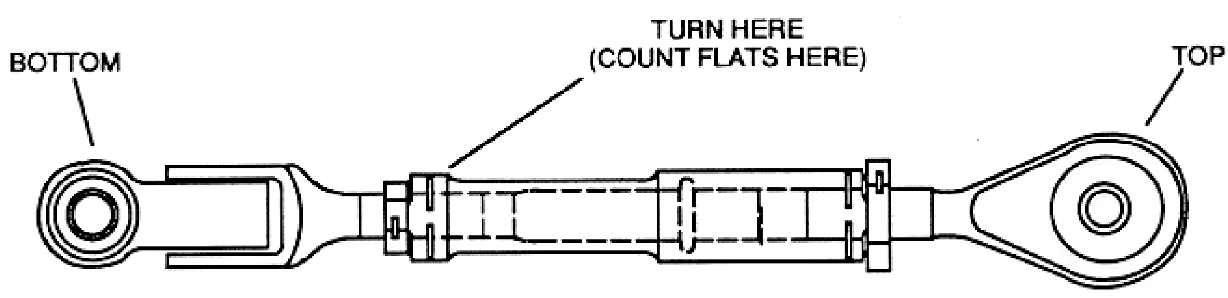


Figure 8. Pitch Link

TASK 4 - TRACK MAIN ROTOR IN FIGHT

CAUTION

If tail rotor requires balancing, task 5 (Balance Tail Rotor) should be accomplished before flight.

Main rotor in-flight vertical tracking should be performed when any of the following occurs:

- 1/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 adjustments. See task 2.

PROCEDURE 1: EQUIPMENT INSTALLATION

NOTE

Aircraft ground track and balance specified requirements (tasks 2 and 3) are to be completed prior to performing in-flight Test States.

a. Install test equipment (refer to task 1).
b. Turn on DAU.
c. Turn on CADU.

PROCEDURE 2: PERFORM FLIGHT MEASUREMENTS

a. Press **QUIT** on the CADU until all selections are undefined.
b. Use cursor keys to highlight Aircraft Type, then press **DO**.
c. Use cursor keys to highlight aircraft type based on table 2, then press **DO**.
d. Tail Number is highlighted. Press **DO**.
e. Use cursor keys to highlight a tail number or enter a new tail number (up to seven characters), then press **DO**.
f. Flight Plan is highlighted. Press **DO**.
g. Use cursor keys to highlight FLIGHT. Press **DO**.
h. Enter the Measure mode by pressing **F1**. Verify that Test State FPG100 is highlighted.

WARNING

If main rotor 1/REV vibration becomes objectionable, acquire data normally through the highest airspeed at which vibration can be tolerated. Do not skip test conditions, data should be taken from ground to the highest airspeed possible. After data is taken at the highest speed achieved, press QUIT then highlight "Save and Exit" and then press DO. Land the aircraft and perform corrections suggested by the CADU prior to further flight.

i. Press **DO** when the aircraft is stable at the highlighted selection. Re-verify that the aircraft is at the required Test State (FPG100, Hover, 100K, 120K, 135K, CLIMB, or L/DOWN) and press **DO** again. Perform this operation each time a measurement is completed and another Test State is highlighted. The AVA will acquire track and vibration data at each Test State and then return to the selection menu.
j. After the 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 go to step o.
k. If measured values exceed specifications, press **DO** to calculate a solution. Evaluate the improvements obtainable through recommended corrections. Perform corrections as shown, ensuring that you display all screens of a multiple screen solution.

l. Do not use a partial set of adjustments. If changes to the recommended corrections are desired, use the Edit Adjustables and Edit Defaults options. The AVA will calculate a new set of corrections, use view predictions to compare the new set of adjustments to the default solution to ensure the vibration is being reduced. Use all of the new corrections.

m. After corrections are installed, fly the aircraft and repeat task 4, procedure 2 to re-check the 1/REV vibrations through the required flight conditions.

n. After more than one measurement has been taken, trend flights to verify if the vertical vibrations are being reduced.

o. Remove test equipment and make appropriate log entries.

TASK 5 - BALANCE TAIL ROTOR

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA tail rotor balancing equipment from transport case. Check for possible damaged equipment and frayed cables.

b. Install DAU in canvas carrying case.

c. Place DAU behind the pilot seat with the connectors faring up and secure DAU using canvas straps and D-rings.

d. Remove hood assembly from one of the pilot's console lights. Remove the bulb. Plug AH-1S power cable adapter (29317100), figure 2, into lamp socket. Ensure that the lamp intensity is set to full intensity (clockwise).

e. Connect grounding clip to a screw head or any non-painted metal surface, which will provide an adequate path to aircraft ground.

f. Connect power cable (29104700) to the AH-1S power cable adapter (29317100) and to the DAU receptacle marked 28 Vdc.

g. Place CADU in front seat. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: ACCELEROMETER INSTALLATION

a. Install accelerometer (28110900) on accelerometer mounting bracket (29313000).

b. Mount accelerometer mounting bracket on bottom screw of the 90-degree gearbox fairing, see figure 9. Ensure that the accelerometer is on the opposite side from the tail rotor and is installed perpendicular to the tail rotor drive shaft (approximately 4:30 position).

c. Connect accelerometer cable (29105606) to accelerometer.

d. Wrap cable around tailskid using clamp fastener (209075178-1) and pass into cockpit. Connect accelerometer cable to the DAU receptacle marked ACC4.

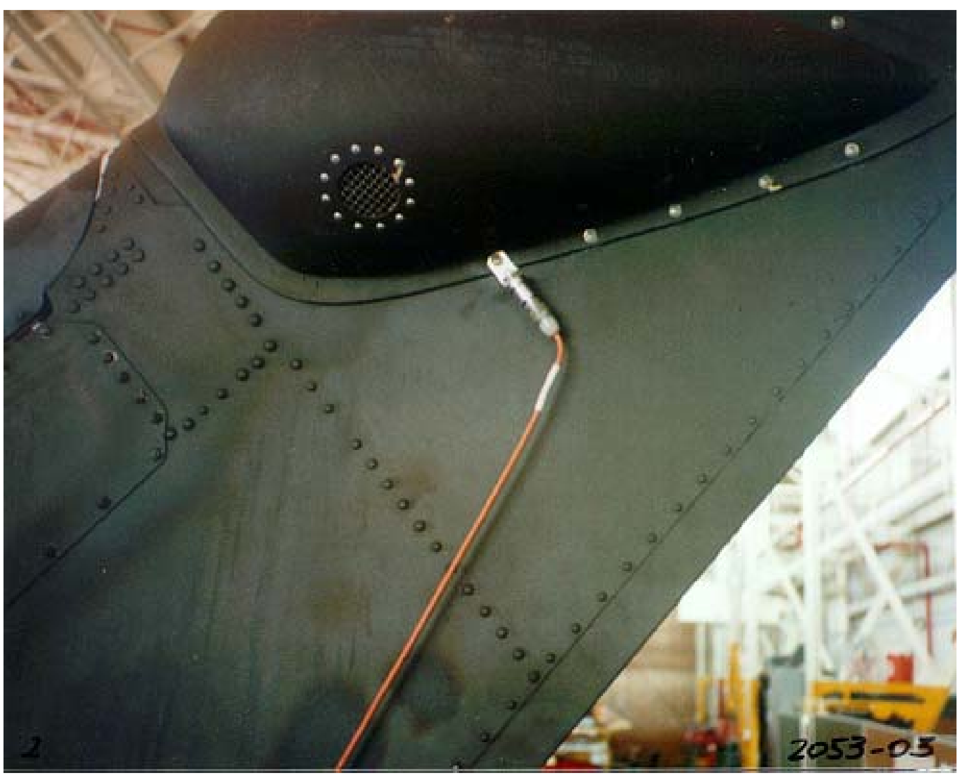


Figure 9. Accelerometer Mounting Bracket

PROCEDURE 3: OPTICAL RPM SENSOR INSTALLATION

a. Remove the two screws from the center of the 90-degree tail rotor gearbox fairing on the side of the tail rotor.

NOTE

Ensure arrow on optical RPM sensor mounting bracket is pointing aft.

b. Mount optical RPM sensor mounting bracket (29198700) over the holes on the tail rotor gearbox fairing, figure 10, with arrow on bracket body pointing aft. Secure the bracket with screws long enough to pass through the mating fasteners and extend a minimum of two threads.

c. Mount optical RPM sensor (29314700) to the bracket, figure 10, and secure with a jam nut.

d. Route the optical RPM sensor cable the same as the accelerometer cable (procedure 2).

e. Connect the optical RPM sensor cable to the DAU receptacle marked TACHO 2.

NOTE

If there is any tape remaining from previous balance routines, it must be completely removed to ensure a clear and accurate tachometer signal to the DAU.

f. Place a single, 3-inch strip of reflective tape on the inside of one of the tail rotor blades parallel to the spanwise axis of the tail rotor blade at the approximate location as the beam of the optical interrupter, see figure 10. This becomes the target (TGT) blade.

g. Proper alignment of the tape can be verified by applying AC power to the DAU and rotating the tail rotor until the taped blade passes in front of the optical RPM sensor. A red LED on the back of the sensor will light if the sensor picks up a return from the reflective tape.

PROCEDURE 4: PERFORM TAIL MEASUREMENT

a. Operate aircraft at 100% Nr, flat pitch.

b. Turn on DAU.

c. Turn on CADU.

d. Press **QUIT** on the CADU until all selections are undefined.

e. Use cursor keys to highlight Aircraft Type, then press **DO**.

f. Use cursor keys to highlight aircraft type based on table 2, 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**.

k. Enter the Measure mode by pressing **F1**. Verify that Test State FPGTL is highlighted.

l. Press **DO** when the aircraft is stable at the highlighted selection. Re-verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire balance data and return to the selections menu.

m. After the measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu and go to step r.

n. If measured values exceed specifications, press **DO** to calculate a solution. Evaluate the improvements obtainable through recommended corrections. Perform all corrections as shown, ensuring that you display all screens of a multiple screen solution.

o. Do not use a partial set of adjustments. If changes to the recommended corrections are desired, use the Edit Adjustables and Edit Defaults options. The AVA will calculate a new set of corrections, use view predictions to compare the new set of adjustments to the default solution to ensure the vibration is being reduced. Use all of the new corrections.

p. After corrections are installed, repeat task 5, procedure 4 to re-check the vibration.

q. After more than one measurement has been taken, trend flights to verify if the tail vibration is being reduced.

r. Remove test equipment and make appropriate log entries.

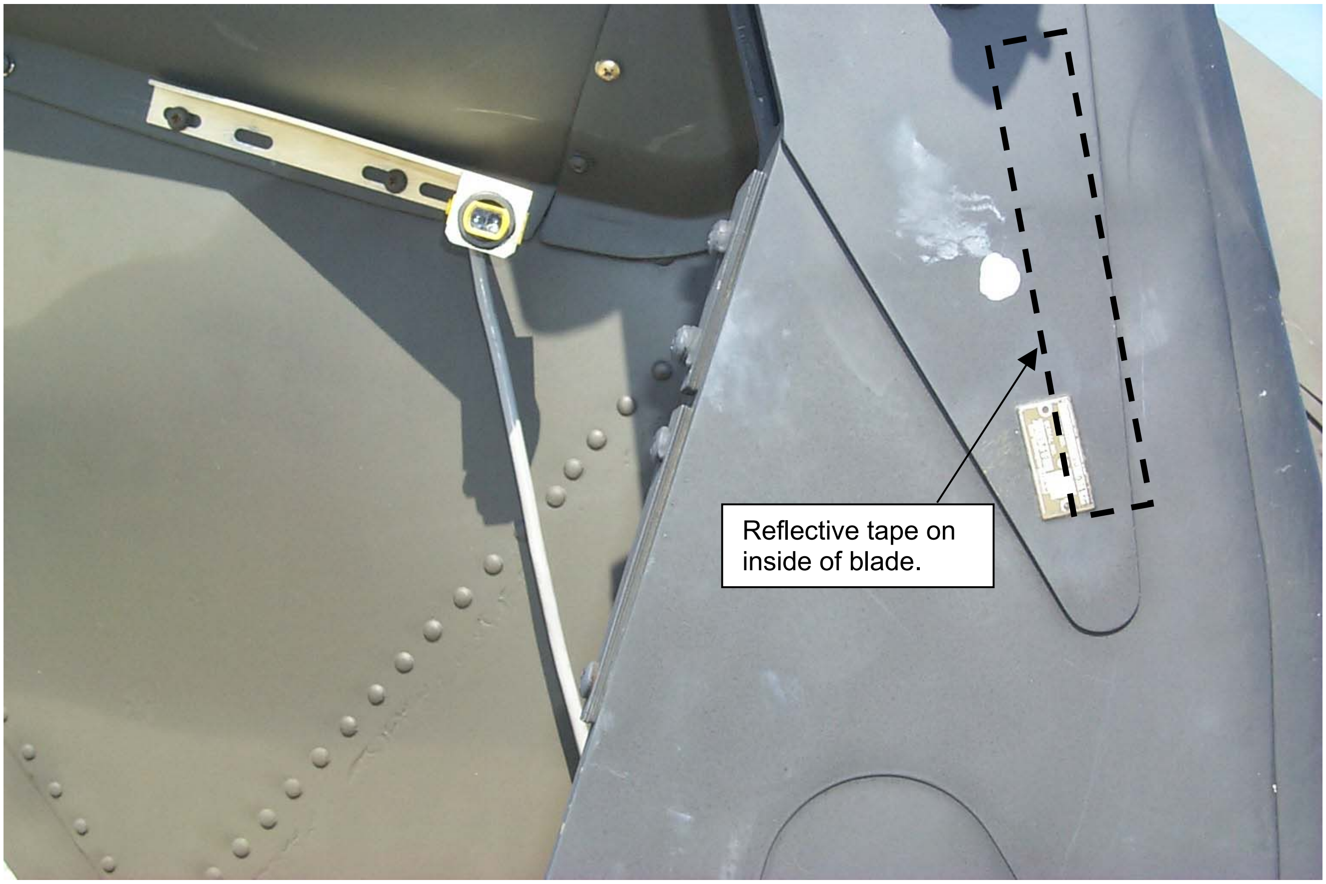


Figure 10. Optical RPM Sensor Mounting Bracket (Right-Hand Side)

TASK 6 - ISOLATING IRREGULAR/UNUSUAL VIBRATIONS

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA equipment from transport case. Check for possible damaged equipment and frayed cables.

b. Install DAU in canvas carrying case.

c. Place DAU behind the pilot seat with the connectors facing up and secure DAU using canvas straps and D-rings.

d. Remove hood assembly from one of the pilot's console lights. Remove the bulb. Plug AH-1S power cable adapter (29317100), figure 2 into lamp socket. Ensure that the lamp intensity is set to full intensity (clockwise).

e. Connect the grounding clip to a screw head or any non-painted metal surface, which will provide an adequate path to aircraft ground.

f. Connect power cable (29317100) to DAU receptacle marked 28 Vdc.

g. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: ACCELEROMETER INSTALLATION

NOTE

Data can be acquired from up to four accelerometers to assist in isolating irregular or unusual vibrations.

a. Mount/install accelerometer (28110900) anywhere on the airframe that an irregular or unusual vibration is detected.

b. Connect accelerometer cable (29105605) from accelerometer to the DAU receptacle marked ACC1, ACC2, ACC3, or ACC4. The flight plan will measure data on one channel at a time.

PROCEDURE 3: PERFORM PROBES MEASUREMENTS

a. Operate aircraft at desired flight condition. This should be the RPM or airspeed at which the vibration is strongest.

b. Turn on DAU.

c. Turn on CADU.

d. Press **QUIT** on the CADU until all selections are undefined.

e. Use cursor keys to highlight Aircraft Type, then press **DO**.

f. Use cursor keys to highlight aircraft type based on table 2, then press **DO**.

g. Tail Number is highlighted. Press **DO**.

h. Use cursor keys to highlight a tail number or enter a new tail number (up to seven characters), then press **DO**.

i. Flight Plan is highlighted. Press **DO**.

j. Use cursor keys to highlight PROBES. Press **DO**.

k. Enter the Measure mode by pressing **F1**. Verify that the desired Test State (ACC1, ACC2, ACC3 or ACC4) is highlighted.

l. Press **DO** when the aircraft is stable at desired condition. Re-verify that the aircraft is at the desired condition (ACC1, ACC2, ACC3, or ACC4) and press **DO** again. The flight plan will measure data on one channel at a time. Perform this operation each time a measurement is completed and another Test State to be measured is highlighted. The AVA will acquire vibration data at each selected Test State and then return to the selection menu.

m. After the last measurement is completed, press **DO** on Finish, then press **DO** on Main Menu.

n. Enter the Display mode by pressing **F2**. Select One Test State, and press **DO**. Review each of the spectrums measured for any unusual vibrations.

NOTE

By comparing the spectrums gathered, the source of an unusual vibration may be located.

o. Make corrections and repeat task 6.

p. Make appropriate logbook entry and remove test equipment.

END OF WORK PACKAGE

AVA APPLICATION AND PROCEDURES – AH-64A/D

(Script Files No. AH64.CMD and AH64D2.CMD)

This WP supersedes WP 0071 00 dated 22 December 2003

WARNING

Use extreme care when flying with UTD mounted. UTD interferes with wirestrike capabilities.

CAUTION

Never install cables where they can be damaged. Use wire bundle ties or clamps to route cabling along or through airframe instead of securing cables with fairing doors, panels or seat frames. Never bundle tie cables to flight controls.

TASK 1 - INSTALL TEST EQUIPMENT
TASK 2 - TRACK AND BALANCE MAIN ROTOR ON THE GROUND
TASK 3 - TRACK AND BALANCE MAIN ROTOR IN FLIGHT
TASK 4 - BALANCE TAIL ROTOR
TASK 5 - ISOLATE IRREGULAR VIBRATIONS

PERSONNEL REQUIRED

Four People Required:

- Attack Helicopter Repairer
- Inspector/Supervisor
- Pilot
- Maintenance Test Pilot

TOOLS

- Aircraft Adapter Kit, (29315300) AH64A
- Aircraft Adapter Kit, (29315301) AH64D
- Aircraft Mechanic's Toolkit, NSN 5180-00-323-4692
- Accessories Kit, Rotor Track and Balance, NSN 4920-01-328-8013
- *Data Acquisition Unit (DAU) in canvas carrying case (29328203)
- *Control and Display Unit (CADU) (29314106)
- *10-ft CADU to DAU Cable (29325601)
- *Universal Tracking Device (UTD) (29310700)
- *Optical RPM Sensor Mounting Bracket (29198700)
- *50-ft 54 mV/g Accelerometer Cable (29105600)
- 25-ft UTD Cable (29325701)
- UTD Mounting Bracket, AH-64A (29240100) AH-64D (29771400)
- 6-ft AH-64-to-DAU Cable (29304600)
- *AH-64 Aircraft Setup File (installed in CADU)
- *25-ft 54 mV/g Accelerometer Cable (29105605)
- *Optical RPM Sensor (29314700)
- *Magnetic RPM Sensor Cable (29105403)
- AVA Basic Kit, Rotor Track & Balance, NSN 6625-01-282-3746

*Included in AVA Basic Kit

ALSO NEEDED

- M/R Counterbalance Weights NSN 3040-01-181-9400
- Bundle Ties
- M/R Counterbalance Weights NSN 3040-01-181-9401
- T/R Counterbalance Weights, NSN 3040-01-170-7470
- T/R Counterbalance Weights, NSN 3040-01-170-7471
- T/R Counterbalance Weights, NSN 3040-01-170-7472
- Trim Tab Bender
- Wrench, Torque 1/2 Drive NSN 5120-00-270-3121
- Adapter, Socket Wrench, 3/8", 1/2" Drive, NSN 5120-00-240-8702
- Crowfoot Attachment 1-5/16", 1/2" Drive, NSN 5120-01-428-8240/NSN 5120-00-184-8409
- Lockwire, MS20995NC32
- Wrench, Open End 1-1/4" & 1-5/16", NSN 5120-00-277-2321

REFERENCES

- TM 1-1520-238-23
- TM 1-1520-238-MTF
- TM 1-1520-238-T-4
- TM 1-6625-724-13&P
- TM 1-1520-LONGBOW/APACHE

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.

A typical track and balance mission from start to finish includes the following:

- Phase main rotor blades as per applicable maintenance manual. For AH-64A refer to TM 1-1520-238-23, or for AH-64D refer to the Longbow IETM, TM 1-1520-LONGBOW/APACHE.

NOTE

Phasing the main rotor blades is an important starting point for track and balance and if not performed correctly, it will not allow track and balance to be completed in a timely manner.

- Install the Aviation Vibration Analyzer, refer to Task 1 of this document.
- Perform preparation for main rotor track and balance, Task 1, Procedure 2.

NOTE

Tail rotor balance will be accomplished prior to in-flight track and balance. The tail rotor balance procedure is performed during ground run operations. If the tail rotor is wired, take the measurements during the same ground runs used for main rotor ground track and balance.

NOTE

If it is anticipated that the rotor track and balance has not been disturbed (i.e., track and balance is being performed to verify that nothing has changed), and if ground track is within 1.5 inch high to low blade and ground balance is 0.2 ips or less, proceed directly to flight. If flight measurements are significantly above limits, perform GROUND test plan. If flight states require only fine-tuning adjustments, skip GROUND test plan.

- Perform tail rotor balancing if required, Task 4.
- Perform GROUND track and balance, Task 2.
- Perform FLIGHT track and balance, Task 3.

The AH-64 Flight Plans are listed below with a brief description of their purpose. Table 1 (AH-64A) and Table 2 (AH-64D) show the Test States that comprise each Flight Plan. The selectable Flight Plans are listed in order of appearance in the menu on the CADU and not in the order in which they are to be performed. The AH64NB_R.CMD (AH-64A) and AH64D2_R.CMD (AH-64D) script files are used when the Signal Processing Unit (SPU) and permanently installed vibration detection system is by-passed.

FLIGHT

Minimizes main rotor lateral vibration during ground/hover and vertical vibration at 60, 80, 100, 120 and 140 Knots. Secondary emphasis is placed on minimizing ground, hover and forward flight track spread. As default, the diagnostics will use pitch links to influence ground/hover lateral vibration/track and forward flight vertical vibration/track. Trim tabs are used to influence forward flight vertical vibration/track. Weights must be manually turned on using (Edit Adjustables) to influence ground/hover lateral vibration and forward flight vertical vibration. Success depends upon having a good GROUND track and balance starting point.

GROUND

Minimizes both main rotor track and lateral vibration at 100% (101% for AH-64D) Nr flat pitch (full down collective) using main rotor pitch links and weights. Weights are turned OFF as default and must be manually turned on (Edit Adjustables) as necessary to achieve good ground balance. If the aircraft is already in service and the operator desires to improve the vibration levels do not perform the GROUND task.

PROBES

Acquires data from up to four accelerometers (in addition to the two on-board track and balance accelerometers) to assist in isolating irregular or unusual vibrations.

tail

Minimizes tail rotor vibration on the ground with main rotor at 100% (101% for AH-64D) Nr flat pitch using tail rotor blade tip weights. Also requires installation of the accelerometer, accelerometer cable, and optical rpm sensor with accompanying blade reflective tape. For this measurement, the tail rotor accelerometer is connected to DAU receptacle “ACC4” and the optical tachometer cable to DAU receptacle “TACHO2”.

tail70

Same as **tail**, but for flat pitch on ground at 70% Nr. This flight plan should be used for tail rotor balance whenever tail rotor vibration levels preclude safe rotor operation at 100% (101% for AH-64D) Nr. The AVA will give a correction based on sensitivity coefficients for the 70% condition. Further iteration at 70% may be necessary until 100% (101% for AH-64D) can be safely achieved; however, it is not necessary to minimize vibration at 70% before attempting 100% (101% for AH-64D).

GENERAL GUIDELINES

The last page of this work package gives general guidelines for AH-64 track and balance for the GROUND and FLIGHT flight plans in a single page. It is intended as a refresher for the experienced user who has previously read and understood the detailed contents, which follow. The inexperienced operator should read and understand the more detailed text of the main body of this document before relying on the brief general guidelines contained at the end of this work package.

Table 1. AH-64A Test Plans and Test States

Flight Plan	Test States	Test Condition	Measurements Taken
GROUND	Fpg100	100% NR, flat pitch	Track, Lat Vib
FLIGHT	FPG100	100% NR, flat pitch	Track, Lat Vib, Vert Vib
	Hover	Hover	Track, Lat Vib, Vert Vib
	60 Kts	60 Kts, Level Flight	Track, Lat Vib, Vert Vib
	80 Kts	80 Kts, Level Flight	Track, Lat Vib, Vert Vib
	100 Kts	100 Kts, Level Flight	Track, Lat Vib, Vert Vib
	120 Kts	120 Kts, Level Flight	Track, Lat Vib, Vert Vib
	140 Kts	140 Kts, Level Flight	Track, Lat Vib, Vert Vib
tail	Fpgtl	100% NR, flat pitch	Tail in-plane vib
tail70	IDLETL	70% NR, flat pitch	Tail in-plane vib
PROBES	ACC1	As required to acquire 400 point asynchronous power spectrum	Accel channel 1
	ACC2		Accel channel 2
	ACC3		Accel channel 3
	ACC4		Accel channel 4
	VIBLAT		On-board T&B lateral accel (pilot)
	VIBVRT		On-board T&B vertical accel (CPG)

Table 2. AH-64D Test Plans and Test States

Flight Plan	Test States	Test Condition	Measurements Taken
GROUND	Fpg101	101% NR, flat pitch	Track, Lat Vib
FLIGHT	FPG101	101% NR, flat pitch	Track, Lat Vib, Vert Vib
	Hover	Hover	Track, Lat Vib, Vert Vib
	60KTA	60 Kts, Level Flight	Track, Lat Vib, Vert Vib
	80KTA	80 Kts, Level Flight	Track, Lat Vib, Vert Vib
	100KTA	100 Kts, Level Flight	Track, Lat Vib, Vert Vib
	120KTA	120 Kts Level Flight	Track, Lat Vib, Vert Vib
	140KTA	140 Kts, Level Flight	Track, Lat Vib, Vert Vib
tail	Fpgtl	101% NR, flat pitch	Tail in-plane vib
tail70	Tlidl	70% NR, flat pitch	Tail in-plane vib
PROBES	ACC1	As required to acquire 400 point asynchronous power spectrum	Accel channel 1
	ACC2		Accel channel 2
	ACC3		Accel channel 3
	ACC4		Accel channel 4
	LATP		On-board T&B lateral accel (pilot)
	VERTP		On-board T&B vertical accel (CPG)

TASK 1 – TEST EQUIPMENT INSTALLATION/CHECKOUT

PROCEDURE 1: AIRCRAFT PREPARATION – Main Rotor

a. Ensure that blade static phasing has been accomplished as per applicable maintenance manual.

b. Check accelerometer type. Select appropriate “AIRCRAFT TYPE” (AH64, AH64NB, AH64D, or AH64D2) from main screen on CADU. Select manager option (**F4**), then select SETUP and select ACCELEROMETER. For AH64 and AH64D script files, verify accelerometer channels 5-14 are defined as “AH64 Acc”. For AH-64NB and AH64D2 script files verify, accelerometers 1-14 are set to “Wil M991”, or to the type that is being used for the external wiring of accelerometers.

c. Ensure that the black paint on the underside of each main rotor blade is uninterrupted from the leading edge to the trailing edge along the blade span from the start of the swept tip to tab pocket 10 (i.e., no shiny leading edge visible on the blade bottom). If not, touch up with flat black spray paint, being careful to avoid runs and not over paint.

NOTE

Track measurements may be in error if the color contrast of the blade is not consistent in the area that the tracker sees the blade. Those errors may not be obvious from the measured track numbers, but they will degrade the effectiveness of the AVA-computed corrections.

d. Ensure that blades have been correctly and visibly marked as 1 through 4. Blade one is over the nose when the double interrupter is over the magnetic pick-up. Blade 2 will be on the right, Blade 3 Aft and Blade 4 on aircraft left as viewed from the pilot’s seat. Ensure that blade tab pockets have been visibly numbered from 0 through 10.

e. Ensure magnetic pickup gap is between 0.030 to 0.070 inches. Check the interrupters to ensure that they are not deformed.

f. If new blades have been installed or if previously tracked blades have been installed in different positions, zero out all trim tabs (pockets 0 through 12) and remove all balance weights.

g. If blades are installed which have been previously tracked together in the same positions, measure and record trim tab settings. If the trim tabs are bent in a uniform direction, don’t adjust tabs before flying. If the trim tabs are bent in opposing directions, zero the trim tabs for all blade pockets (0-12). If trim tabs in pockets 0-3 are not 0, this should be noted for possible future trouble-shooting.

h. If a FM antenna is installed, it should be removed before running aircraft for balance to prevent damage to antenna. The antenna should be installed when balance is complete.

PROCEDURE 2: EQUIPMENT INSTALLATION (SPU INTERFACE)

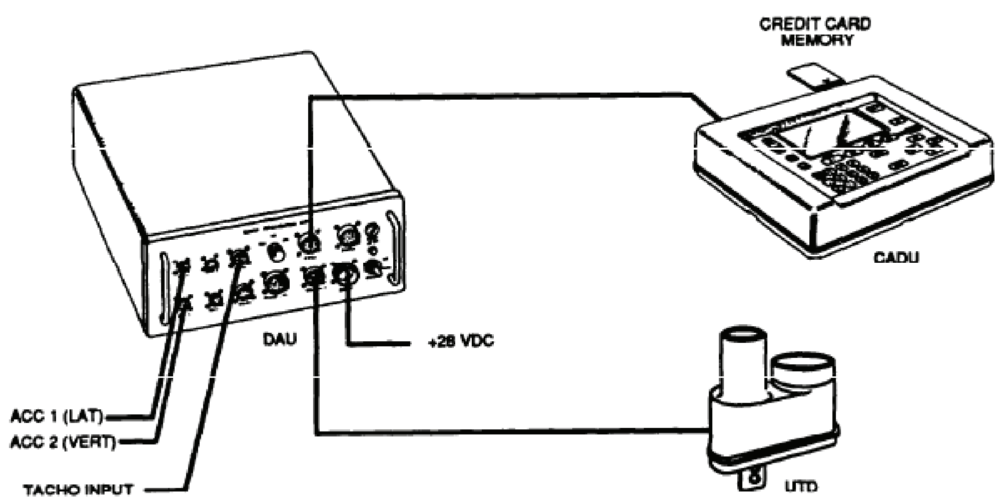


Figure 1. Typical AVA Test Setup Configuration

NOTE

It is strongly recommended that the AVA diagnostic solutions for the main rotor be made, using the externally mounted accelerometers, along with AH64NB/AH64D2 script files. Errors due to faulty on-board accelerometers, faulty SPU's, and/or poor SPU/AVA interface can make the track and balance exercise ineffective.

NOTE

For main rotor track and balance, if the external wiring of accelerometers method has been used, (Task 1, Procedure 3) ensure that the lateral accelerometer at the pilot station and the vertical accelerometer at the CPG station have been properly oriented. Improper orientation will cause the CADU to suggest improper adjustments. The lateral accelerometer should be oriented identically to the on-board lateral accelerometer, with the connector and cable pointing to the pilot's right. The vertical accelerometer should be oriented identically to the on-board one with the connector pointing down. See Figures 3 and 4. Also ensure that the lateral accelerometer in the pilot station has been connected to DAU receptacle ACC1 and the vertical accelerometer has been connected to ACC2. Improper connection of accelerometers will cause the CADU to suggest improper adjustments causing the rotor to become rougher.

a. Remove AVA blade tracking equipment from transport case. Check for possible damaged equipment and frayed cables.
b. Install DAU in the canvas carrying case.
c. On AH-64D helicopters remove soundproofing that covers the interior opening of the fuselage through hole located to the left of the CPG seat.
d. On AH-64D helicopters remove the 5L90 cover plate located on the outside of the aircraft below the CPG window and aft of the UTD mounting point.
e. Route the UTD cable (29325701) through fuselage hole. Connect the UTD cable (29325701) to DAU connector labeled TRACKER 1.
f. Place DAU on the left outboard side of the copilot's armor plate oriented such that the on/off switch is forward, with connectors facing up and secure DAU using canvas straps and D-rings. See Figure 2.

NOTE

In order to prevent possible false indications on the AH-64 tail rotor gearbox indicator, the AVA AH-64 umbilical cable part number 29304600 should be modified. Perform a continuity check on the connections between pins 17, 28 and 12 on P1 to pins K, L and C on P4, respectively. If there is continuity, the cable must be modified using the following procedure: remove two screws from connector P4 (MS3116J14) backshell clamp. Unscrew backshell and pull back the backshell and sleeve to expose wire connections. Desolder the wires from pins C, K and L and apply heat shrink tubing to wire ends. Replace sleeve, backshell and clamp. With a permanent marker, strike out the revision letter located on the cable ID tag immediately after the part number. Mark tag with the letter "D". Cable ID tag should read: "29304600 D".

g. Connect AH-64 DAU cable (29304600) to the SPU AH-64A. For the AH-64D connect the AH-64 DAU cable to the blade tracking test port located at the upper right hand section of the co-pilot's SSU mount.

NOTE

For AH-64D main rotor track and balance, ensure that the FCR select switch on the Blade Tracking Test Port is in the TRACK position.

h. Route AH-64 to DAU cable under the copilot's seat and around to the DAU.
i. Connect AH-64 to DAU cable terminations to the DAU receptacles marked MULT-CH, TACHO 1, and 28 Vdc.
j. Place CADU in aircraft. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

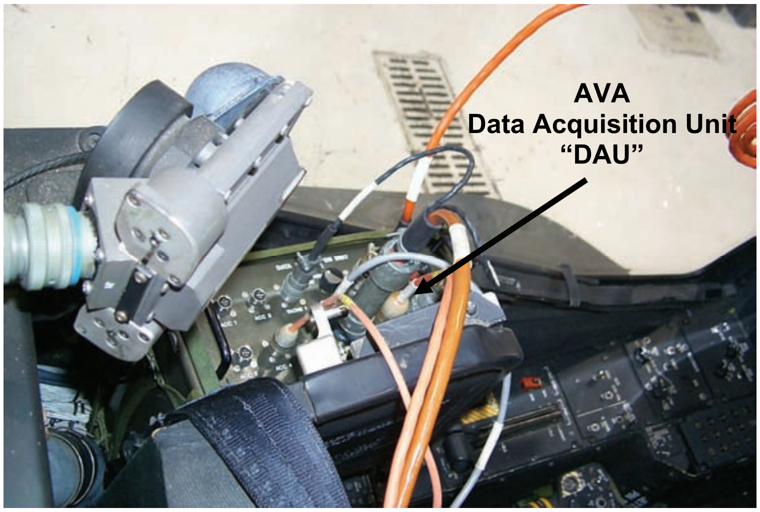


Figure 2. DAU installation at CPG station

PROCEDURE 3: EQUIPMENT INSTALLATION (SPU BYPASS)

NOTE

This step provides instructions for bypassing the SPU. This is done if the SPU is defective. If no SPU error is suspected, proceed to Procedure 4.

a. Locate the lateral permanently installed accelerometer above and to the rear of the pilot's head and remove it. Install accelerometer (28110900). See Figure 3.
b. Connect accelerometer cable (29105605) (found in the basic kit) to the lateral accelerometer and connect to the DAU receptacle marked ACC1.
c. Install accelerometer (28110900) on accelerometer mounting bracket (29313000). Orient the accelerometer vertically, with the connector facing down. For the AH-64A mount the bracket on the right-hand bulkhead panel, near the gunner's right knee, third screw down, see Figure 4. For the AH-64D remove the forward avionics control head from the copilot/gunners right hand console and mount the vertical accelerometer near the on board accelerometer, see Figure 4.
d. Connect accelerometer cable (29105605) to the vertical accelerometer, and connect to the DAU receptacle marked ACC 2.

CAUTION

Do not secure disconnected tachometer cable in next procedure to any moving components, which may interfere with flight controls.

NOTE

If magnetic sensor is operational through SPU interface it is not necessary to disconnect the aircraft wiring and interface may be used without externally wiring this sensor.

e. Disconnect the existing cable from the magnetic rpm sensor, and secure cable with a tie wrap to a convenient location.

f. Connect magnetic rpm sensor cable (29105403) to the magnetic rpm sensor. Route the cable along wire bundle above R200 panel forward, and secure to cable with wire ties. Go across the front of the transmission upper pylon and secure cable to wire bundle above L200. Route cable out of forward upper pylon ventilation air intake panel out side the aircraft. Route cable down left side of the aircraft, securing to left upper hand hold and into emergency air vent. Route cable under transparent barrier to DAU.

g. For AH-64D route cable outside the aircraft. Secure cable to existing handholds, and clamp as necessary. Pass cable into forward cockpit through 5L90 access panel.

h. Connect magnetic rpm sensor cable to the DAU receptacle marked TACHO 1.

Figure 3. Lateral Accelerometer Installation (SPU/External Wiring)

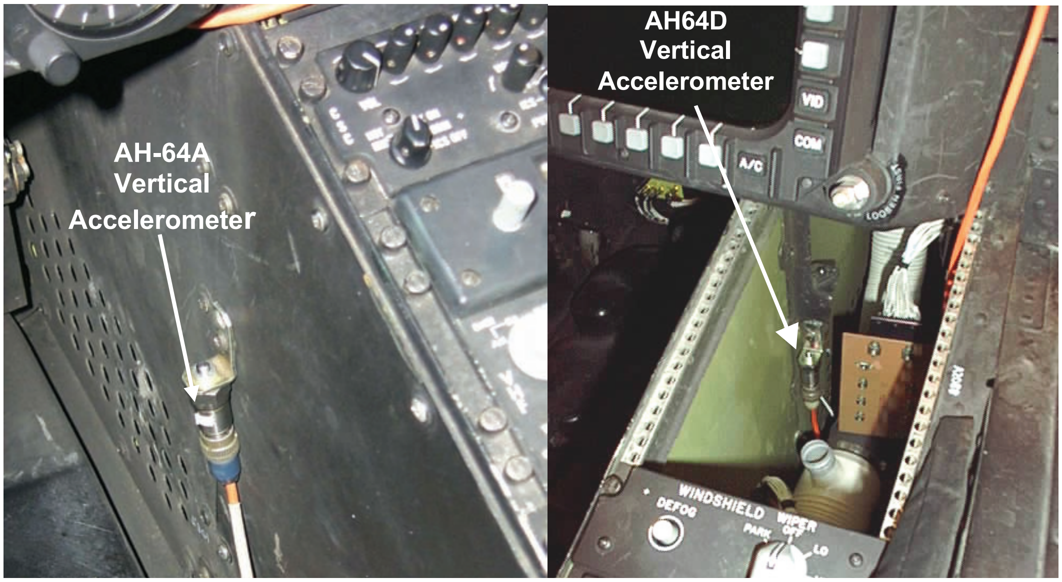


Figure 4. Vertical Accelerometer Installation (External Wiring)

PROCEDURE 4: TRACKER INSTALLATION

NOTE

It may be necessary to replace the four aircraft screws with longer screws in order to mount the UTD mounting bracket.

a. For the AH-64A aircraft performing the following tasks:

1. Remove the four outboard aircraft screws located at the top and all the way forward on the right-hand Forward Avionics Bay (FAB), near the forward edge of copilot's canopy, Figure 5, and install UTD mounting bracket (29240100) on the FAB with the airframe screw holes on the leading edge.
2. Secure UTD mounting bracket to outboard edge of the FAB with screws long enough to pass through the mating fastener and extend a minimum of two threads.

NOTE

If the UTD captive mounting bolts are lost or damaged, use NAS1305-14 bolts as replacements.

3. Mount UTD on inboard side of bracket, ensuring that the night lens (red lens on UTD) is below the optical lens (clear lens). See Figure 5.
4. Connect the UTD cable (29325701) to UTD connector.
5. Route cable through aft lower corner of the R40 panel, under the instrument panel and alongside right hand cockpit fuselage wall, continue routing of cable behind CPG's seat and around to DAU.
6. Secure loose cable between R40 access panel and UTD to fuselage with cable clamps. See Figure 5.
7. Coil up excess cable and store in map case.
8. Connect UTD cable to DAU receptacle marked TRACKER 1.
9. Ensure that the TRACKER MODE switch on the front of the DAU is in the DAY position.

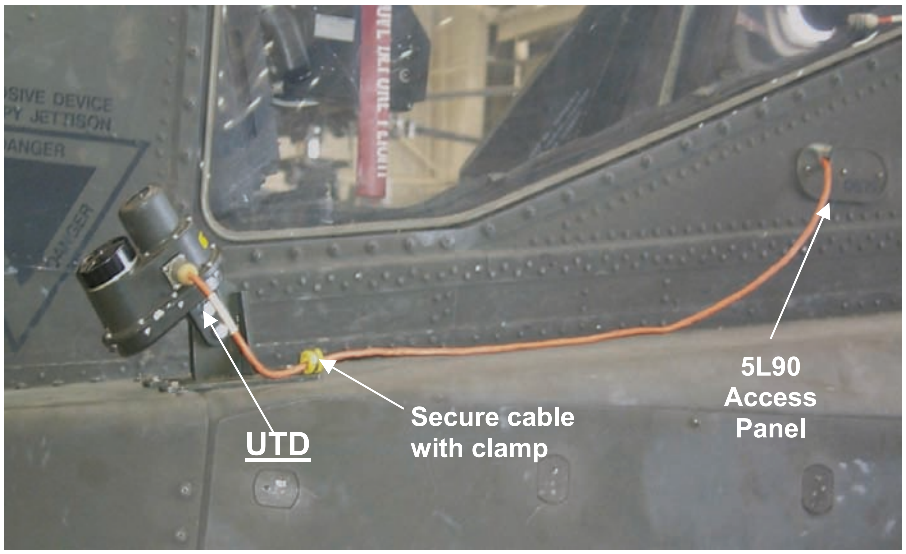
b. For the AH64D aircraft performing the following tasks:

1. Remove the four aircraft screws located on the left side Improved Extended Forward Avionics Bay (IEFAB) near forward edge, two at nose fairing joint and two at approximately six inches aft, see Figure 5.
2. Secure UTD mounting bracket to the left side IEFAB with screws long enough to pass through the mating fastener and extend a minimum of two threads.

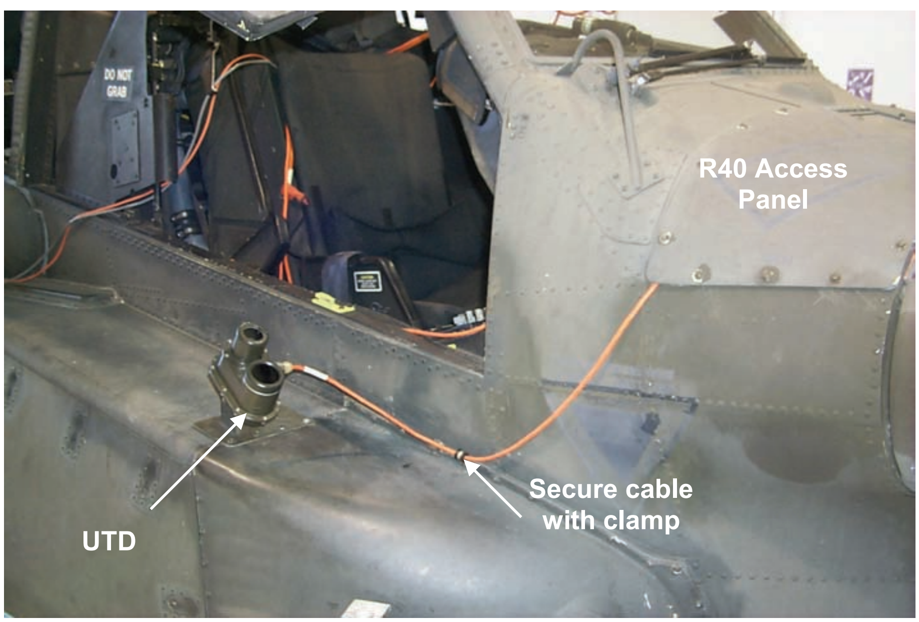
NOTE

If the UTD captive mounting bolts are lost or damaged, use NAS1305-14 bolts as replacements.

3. Mount UTD on bracket, ensuring the arrow is pointing in direction of rotor rotation. See Figure 5.
4. Connect the UTD cable (29325701) to the UTD.
5. Pull excess slack from cable and store behind CPG's seat.
6. Place a cable clamp around cable and secure cable to mounting bracket attachment screw. See Figure 5.
7. Rotate the 5L90 cover plate 180 degrees from its original position and reinstall with the UTD cable routed through the cover plate notch (notch opening upward).
8. Ensure that the TRACKER MODE switch on the front of the DAU is in the DAY position.



AH-64D UTD Mounting Bracket



AH-64A UTD Mounting Bracket

Figure 5. UTD Mounting Brackets

PROCEDURE 5: NIGHTTIME TRACKING INSTRUCTIONS

NOTE

The following steps are to be taken if nighttime tracking is required. If no flights will be performed after dusk, proceed directly to Task 2.

a. Ensure that the TRACKER MODE switch on the front of the DAU is in the NIGHT position.

b. Ensure that the underside, trailing edge of all blades is as clean as possible. This is necessary for optimum adhesion of the reflective tape.

c. Place a single, 5-ft strip of reflective tape on the underside, trailing edge (on the trim tab) of each blade from tab pocket 0 to tab pocket 5 as shown in Figure 6. Ensure that the tape is smooth and as straight as possible using the edge of the blade as a reference.

d. If verification of the reflective tape placement is desired, it can be viewed by holding a flashlight alongside your head and shining it at the rotating blades. Any sections that do not return the light evenly across the tape should be replaced.

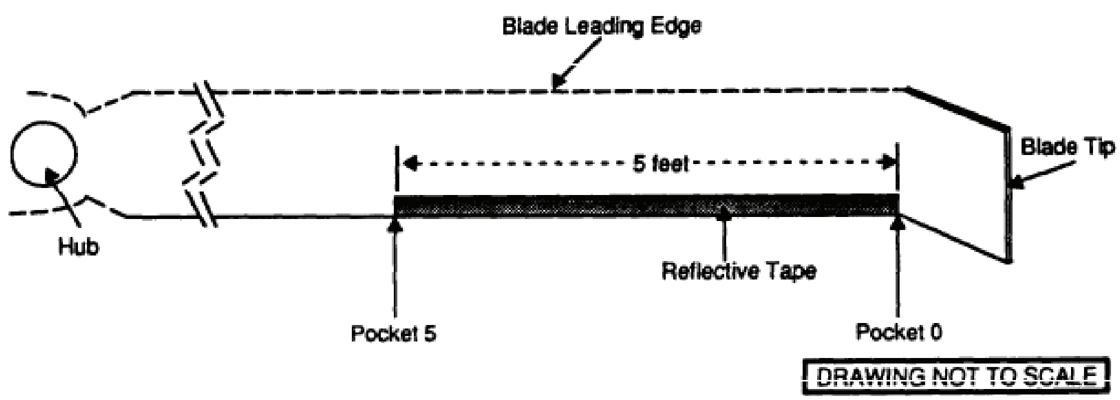


Figure 6. Placement of Reflective Tape on Rotor Blades

PROCEDURE 6: SCRIPT FILE SELECTION

Available AH-64 script files are as follows:

Aircraft Type	With on-board accels	With external accels (SPU Bypass)
AH-64A	AH64_R.CMD	AH64NB_R.CMD
AH-64D	AH64D_R.CMD	AH64D2_R.CMD

TASK 2 – TRACK AND BALANCE MAIN ROTOR ON GROUND

The purpose of main rotor adjustments made at flat pitch (full down collective) and 100% (101% for AH-64D) Nr is to establish a good starting point for forward flight track and balance and should normally be accomplished prior to initiating FLIGHT track and balance. Flight Plan GROUND will provide both weight and pitch link corrections for this purpose.

NOTE

If it is anticipated that the rotor track and balance has not been disturbed (i.e., track and balance is being performed to verify that nothing has changed), and if ground track is within 1.5 inches between high to low blade and ground balance is 0.2 ips or less, proceed directly to flight. If flight measurements are significantly above limits, perform GROUND test plan. If flight states require only fine-tuning adjustments, skip GROUND test plan.

NOTE

Tail rotor balance should be accomplished before any in-flight checks are performed. The tail rotor balance procedure can be performed during a main rotor ground run.

Ground Track and Balance Limits

The AVA will show the following limits for ground track and lateral vibration:

Track:	0.25 inch between high blade to low blade
Lateral Vibration:	0.20 ips

NOTE

It should be possible to achieve ground balance below 0.1 ips and it is encouraged to do so. Ground track significantly below 0.25 inch is not justified.

PROCEDURE 1: PERFORM GROUND MEASUREMENT

a. Operate aircraft.

NOTE

If vibration is too severe to bring rotor speed up to full operating rpm, hold rotor speed steady at the highest rotor speed that can be safely sustained for the first AVA measurement.

b. Power up DAU.

c. Wait approximately 10 seconds and power up CADU.

d. Press **QUIT** on CADU until the Main Menu appears.

e. Cursor up to highlight "Aircraft Type" and press **DO**. Cursor to highlight the appropriate aircraft type (AH64_R or AH64D_R for on-board accelerometers or AH64NB_R or AH64D2_R for externally mounted accelerometers) and press **DO**.

f. On the Main Menu, cursor to highlight tail number and press **DO**. Select tail number from the list, or highlight NEW and press **DO** to input a new tail number, (up to 7 digits) using the number keypad. When done, press **DO**.

NOTE

Ground measurements are to be taken with the collective stick in full down position.

NOTE

If tail rotor balance is also required, it can be performed during the same ground run as main rotor ground track and balance (Task 4). Main rotor ground track and balance and tail rotor balance are separate flight plans and require separate and independent measurements.

g. On the Main Menu, verify that aircraft type and tail number are as desired. Highlight Flight Plan and press **DO**. Move cursor to GROUND and press **DO**.

h. Press **F1** to initiate measurement mode to acquire main rotor track and vibration data.

i. On the measurement screen, press **F4** to toggle from LIMITS OFF to LIMITS ON. This will present a list of any measurements that exceed ground limits following completion of data taking.

j. Verify that Fpg100 is highlighted for the AH-64A or that Fpg101 is highlighted for the AH-64D. Press **DO**. When the asterisk appears on the message bar, verify that the rotor is steady at the desired speed and press **DO**. The system will begin taking measurements. Once the measurement is complete, the Pilot Transition screen will appear while data is being processed.

NOTE

If the tracker is facing into the sun, a tracker error may result. If so, re-orient the aircraft so that the tracker is pointing away from the sun, and retake the measurement.

k. If LIMITS ON is being used, the limits screen will appear following the pilot transition/data-processing screen. Review the information, then press **QUIT** to exit the limits screen.

l. Highlight FINISH and press **DO** to exit the measurement mode following a successful measurement.

m. Highlight Diagnostics to calculate corrections, or Main Menu to set up for a tail rotor measurement or display GROUND results.

PROCEDURE 2: PERFORM GROUND DIAGNOSTICS

WARNING

Total blade balance weight is not to exceed 1017 grams, nine -3 weights, on a single blade.

NOTE

AVA moves are changes to the adjustable components and are to be added to or subtracted from whatever the component is currently set.

a. On the Main Menu, ensure that the Flight Plan and Flight ID correspond to the one for which diagnostics are desired. Press **F3** DIAGS.

b. Examine the limits screen:

   1. If any measurements are above limits, do Procedure 2.1.

   2. If measurements are within limits, press the UP cursor to view measured values:

(a) If ground lateral is 0.2 ips or below and track spread is 0.25 inches or less, press **QUIT** to return to the Main Menu. If tail rotor balance is known to be acceptable or previously balanced initiate Task 3 FLIGHT track and balance.

(b) If ground lateral is above 0.15 ips, further reduction should be easy and is encouraged. Press **DO** to execute Diagnostics. Perform Procedure 2.2.

NOTE

Hub weights are defaulted to OFF and must be turned on via Edit Adjustables, when needed.

NOTE

Pitch link moves affect lateral vibration, but weight moves do not affect track. Turning weights on and off will not affect the magnitudes of the pitch link moves suggested. Turning pitch links on and off, on the other hand, will affect the weight moves suggested since pitch link adjustments also affect lateral vibration. Therefore never ignore any undesirable pitch link move, but turn the unwanted adjustment off, re-compute the corrections and re-examine the predictions. If this is not done, the corrections will in most cases be less than optimum, and the predictions will, in all cases, be in error.

PROCEDURE 2.1: PITCH LINK ONLY ADJUSTMENTS

NOTE

To prevent a large autorotation adjustment later during track and balance, the track can be adjusted to any one blade (i.e. designated target) by using the EDIT ADJUSTABLES function from the AVA diagnostic menu, toggling off the desired blade (target) to be adjusted to, and pressing **DO**. For example, if flat pitch torque is less than 15%, adjust blades up to the highest blade by toggling off highest blade and obtaining a solution. If the torque is 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 the lowest blade by toggling off lowest blade and obtaining a solution.

a. Press **DO** to calculate adjustments.

b. Examine the pitch link adjustments given.

1. If pitch link moves are 1 flat or more, record the indicated pitch link adjustments, go to Procedure 3.

2. If pitch link moves are less than 1 flat, or if no pitch link adjustments are given, press **QUIT**. Select View Predictions and press **DO**.

   (a) If measured track is less than 0.25 inch, do Procedure 2.2.

   (b) If measured track is 0.25 inch or greater and if predicted lateral is 0.1 ips or greater, do Procedure 2.3.

   (c) If measured track is 0.25 inch or greater and if predicted lateral is less than 0.1 ips, record the pitch link adjustments and do Procedure 3.

PROCEDURE 2.2 WEIGHT-ONLY ADJUSTMENT

a. Press **QUIT**. Cursor to highlight Edit Adjustables. Press **DO**.
b. Turn OFF all 4 pitch links and turn ON blades 1 and 2 weights. Press **DO**.
c. Record the weight adjustments. Perform Procedure 3.

PROCEDURE 2.3 WEIGHT AND PITCH LINK ADJUSTMENT

a. Press **QUIT**. Cursor to highlight Edit Adjustables. Press **DO**.
b. Turn ON blades 1 and 2 weights. Press **DO**.
c. Record the weight and pitch link adjustments, go to Procedure 3.

PROCEDURE 3: APPLY ADJUSTMENTS, VERIFIY/REPEAT

a. Apply recorded AVA solution, making weight and/or pitch link adjustments. For the AH-64A, follow the instructions in Procedure 4 for pitch links adjustments and weight changes refer to TM 1-1520-238-23, and for the AH-64D refer to IETM TM 1-1520-LONGBOW/APACHE.
b. Repeat the ground measurement and make additional adjustments as necessary until track is below 0.25 inch and lateral vibration is 0.20 ips (recommended 0.10 ips) or less.

PROCEDURE 4: MAIN ROTOR PITCH LINK ADJUSTMENTS

a. Mark barrel and upper rod end jam nut with a single vertical line for reference.
b. Cut lockwire securing jam nuts to barrel of pitch link to be adjusted.
c. Loosen upper jam nut while holding barrel of pitch link.
d. Loosen lower jam nut while holding barrel of pitch link.

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 directions will lower the blade.

NOTE

Shortening the pitch link moves the blade down, lengthening it moves the blade up.

e. Turn barrel the specified amount displayed on the CADU (“+” means lengthen, “-“ means shorten).
f. Tighten jam nuts and torque to 900 INCH-POUNDS.
g. Safety jam nuts with lockwire.
h. Verify corrections by completing another ground run at the specified test conditions.
i. Make appropriate logbook entry on the pitch control links, if any.

HELPFUL HINTS

1. Blade weights are turned off as a default and must be manually turned on (Edit Adjustables) when needed.
2. Pitch link adjustments will target reduction of track spread exclusively. They will effect lateral vibration, but that effect will not drive the solution.
3. As long as ground lateral is at or below 0.6 ips, do not attempt to make weight adjustments together with pitch link adjustments until track spread has been reduced to levels which require no more than ½ flat pitch link moves. This will minimize the chances for compounding errors. If ground lateral is above 0.6 ips, make a weight adjustment for the first move along with the pitch link adjustments to minimize the chance of damaging vibrations on the second run-up, but don't be surprised if some of that weight move needs to be removed on the next run.
4. Ground track and balance works efficiently when the AVA adjustments are used. For an aircraft in good mechanical condition, two sets of ground adjustments, (pitch links only), (pitch links and weights only or weights only), should be sufficient to drive track below 0.25 inch and lateral below 0.1 ips.
5. If weight adjustments are to be made, don't ignore any of the pitch link adjustments. If pitch link adjustments are ignored weight adjustment will no longer be correct. If certain pitch link adjustment is not desired, turn it off (Edit Adjustables) and have the AVA recompute the weight and pitch link solution.
6. If the AVA calls for > 1017 grams on a given blade, go ahead and install nine -3 weights on that blade and take a new measurement, before removing and/or swapping blades. If the aircraft is more sensitive than the script file sensitivities, nine -3 weights may be enough or even too much.
7. If you have one or more pitch link adjustments or 3 flats or more combined with one or more 1/2 flat adjustments, turn off the blades which are calling for the 1/2 flat adjustment and turn off the blade which had no adjustment and recompute the AVA solution. In this way, the number of pitch link adjustments are minimized until track has settled to the fine-tuning 1/2 flat level.

TROUBLESHOOTING

1. Track spread not reducing:

   Check for droop stop sticking. Droop stop sticking can affect blade track.
2. If lateral vibration is not getting better or is increasing:
   a. Check to ensure that the lateral accelerometer is mounted in the correct orientation (connector coming off to pilot's right). If mounted with the connector incorrectly coming off to the pilot's left, the AVA hub weight adjustments will drive the vibration in the wrong direction (i.e., away from polar chart center).
   b. Check to ensure that the lateral accelerometer is wired to DAU port ACC1. If the vertical accelerometer is wired to the lateral accelerometer channel (i.e., vertical accelerometer cable connected to ACC1), the lateral measurement will be in error and the adjustment will correspondingly be in error.

TASK 3 - TRACK AND BALANCE MAIN ROTOR IN FLIGHT

Main rotor FLIGHT track and balance should be performed when any of the following occurs:

a. In-flight vertical vibration is unacceptable.
b. Changes have been made to the track of one or more main rotor blades as a result of performing ground tracking.
c. Repairs have been made to one or more main rotor blades.
d. One or more main rotor blades have been removed and reinstalled or replaced.
e. In accordance with IETM instructions TM 1-1520-LONGBOW/APACHE (AH-64D) or TM 1-1520-238-23 (AH-64A).

WARNING

Vibration levels (vertical or lateral) of 1.2 ips and above may cause aircraft damage. Avoid flying the aircraft with these levels.

WARNING

Avoid flying the aircraft with track spreads (high to low blade) of 3 inches or more.

Flight Track and Vibration Limits

The AVA will show the following flight track and vibration limits:

Lateral Vibration on Ground:	0.20 ips
Lateral Vibration in Hover:	0.20 ips
Vertical Vibration in Forward Flight:	0.30 ips
Ground and Hover Track:	1.5 inch high blade to low blade
Forward Flight Track:	2.0 inch high blade to low blade

NOTE

It should be possible to obtain aircraft vibration within these limits with a reasonable number of adjustment sets (i.e., flights). Inability to do so may be a symptom of a maintenance problem or a problem with AVA equipment/installation.

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Install test equipment (refer to Task 1).
b. Turn DAU ON.
c. Turn CADU ON.

PROCEDURE 2: PERFORM FORWARD FLIGHT MEASUREMENT

a. Press **QUIT** until the Main Menu appears.
b. Verify that aircraft type and tail number are as desired. Highlight Flight Plan and press **DO**. FLIGHT is highlighted. Press **DO**.
c. Press **F1** Measure.

NOTE

Selection will stay selected as long as measurements are occurring in the current flight ID. Once the measurement screen is exited, LIMITS will reset to OFF.

d. On the measurement screen, press **F4** to toggle from LIMITS OFF to LIMITS ON.

e. On the measurement screen, highlight the desired flight condition (FPG100 for AH-64A or FPG101 for AH-64D, Hover, 60, 80, 100, 120, or 140 Knots). Press **DO**. Verify that the aircraft is steady in selected condition and press **DO** to initiate measurement.

f. The next screen will indicate that measurement is in progress.

g. Following successful measurement, the limits screen will appear to display all measurements that exceed limits. This information can be useful in determining whether or not to proceed to the next flight condition. Use the up cursor to display all measurements relative to limits.

h. Press **QUIT** to exit the limits screen and return to the measurement screen. The next Test State will be highlighted. Press **DO** twice to start measurement and repeat until all flight conditions have been obtained, or until vibration and/or track precludes advancing to the next higher speed.

WARNING

If main rotor 1/REV vibration becomes objectionable, acquire data normally through the highest airspeed at which vibration can be tolerated. Do not skip test conditions, data should be taken from ground to the highest airspeed possible. After data is taken at the highest airspeed achieved, press QUIT then highlight Save and Exit and then press DO. Land the aircraft and perform corrections suggested by the CADU prior to further flight.

NOTE

Autorotation RPM verification should be done as soon as the aircraft is capable of a forward airspeed of 80 to 100 knots. Autorotation adjustments may disturb track and balance.

NOTE

If any Test State has a “failed” or “partial” message next to the prompt or 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.

NOTE

If the tracker is pointed towards the sun, the AVA may give a tracker error and may indicate “partial” next to the measurement condition. Re-orient the aircraft away from the sun, and repeat the measurement for that condition.

NOTE

Prior to initiating diagnostics, it may be helpful to review the measured data so that the diagnostic solution can be better interpreted and adjusted (see Procedure 3 below).

g. Exit measurement mode:

1. If measurements have been acquired for all seven flight conditions, the measurement screen will automatically exit. Highlight Finish and press **DO**. Highlight Diagnostics and press **DO**.
2. If all seven conditions have not been completed and no additional data is to be taken, press **QUIT** to exit the measurement screen. Highlight Save and Exit and press **DO**. On the Main Menu, verify that the flight ID corresponds to the flight for which a solution is desired and press **F3** DIAGS.

BEFORE ENTERING DIAGNOSTICS:

a. Before entering diagnostics it may be beneficial to view the in flight vertical reading on the polar plot and the 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 7 illustrates a polar plot display of the flight vertical vibration readings from the AVA.

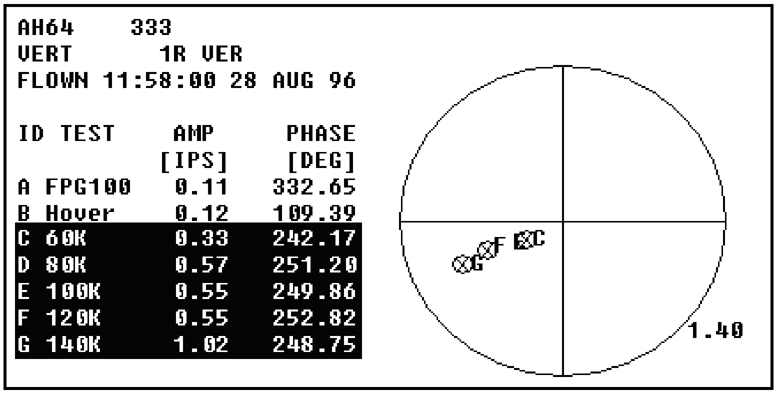
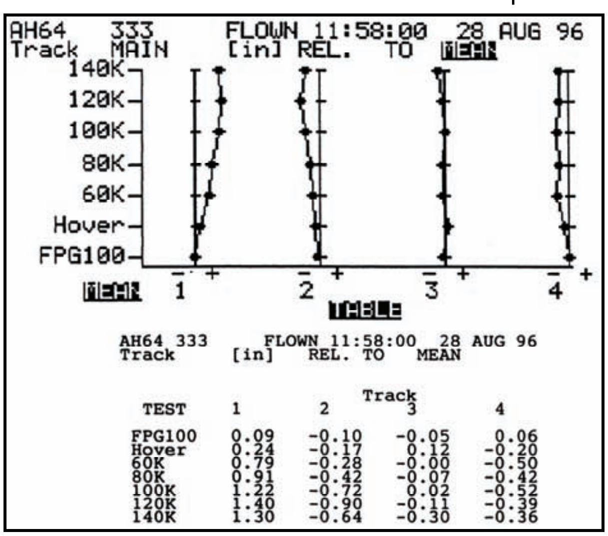


Figure 7. Polar Plot Display

b. By viewing the Figure 7 and the AH-64 coefficient polar chart for vertical vibration at the end of this work package, this clearly shows that blade 1, blade 3, or both will require adjusting to move the vibration points towards the center. To move the vibration points towards center for this example would require blade 1 to be tabbed down (or pitch linked down) or blade 3 to be tabbed up (or pitch linked up). To verify this further it helps to view the track data. Figure 8 illustrates the track trend for this example from the AVA.



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

Figure 8. AVA Track Trend

c. 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 9.

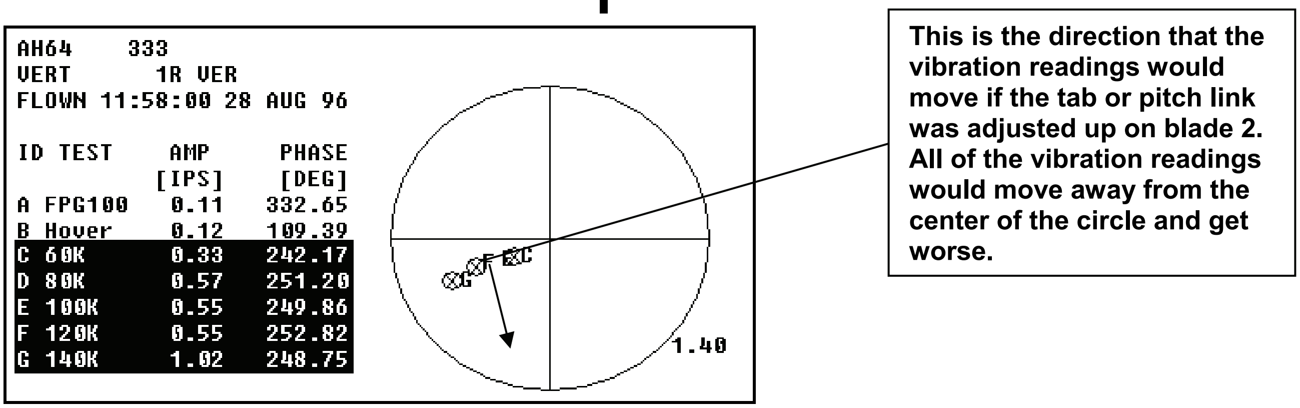


Figure 9. Polar Chart

d. As the caption says in Figure 9, 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 at the end of this section).

e. 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 is time to enter Diagnostics.

WARNING

Total blade balance weight is not to exceed 1017 grams, nine -3 weights, on a single blade.

WARNING

Total blade trim tab bends are not to exceed +\- 5 degrees in any pocket. Tabs should be bent uniformly at all locations suggested by the AVA diagnostics.

NOTE

AVA moves are changes to the adjustable components and, as such, are to be added or subtracted to whatever the component is currently set to. For example, when the AVA calls for 1 degree down in pockets 4-10, that 1 degree is to be made to any bend already existing in those pockets.

NOTE

If any blade shows a 6-10 or 8-10 tab adjustment of 2 degrees or more, it is recommended to Edit Adjustables to turn off the 2 degree or greater 6-10 or 8-10 tab region and turn on the next larger tab region for that blade, then recompute the adjustment. For example, if the AVA solution calls for a 2 degree bend in pockets 6-10 on Blade 1, use Edit Adjustables to turn off the Blade 1 6-10 tab and turn on Blade 1 4-10 tab and recompute the adjustments.

f. The Limits Screen is the first screen to appear when entering diagnostics. Examine the limits screen:
  1. If the display indicates that the maximum vertical vibration for any forward flight condition is 0.6 ips or greater, perform Procedure 3.1.
  2. If the display indicates that the maximum vertical vibration for any forward flight condition is less than 0.6 ips, perform Procedure 3.2.
  3. If the display indicates that only track is above specified limits, perform Procedure 3.2.
  4. If measurements are within specified limits, press the up cursor to view measurements. If no further adjustments are desired, terminate track and balance maintenance. If further fine-tuning is desired, perform Procedure 3.2.

PROCEDURE 3.1: Maximum Vertical ≥ 0.6 ips

a. Press **DO** to calculate and display adjustments.
b. Note the recommended adjustments, then press **QUIT**.
c. View Predictions is selected, press **DO**.
d. Examine the vibration predictions:
  1. If the display indicates predicted hover and ground lateral is within specified limits, perform Procedure 3.1.1.
  2. If the display indicates predicted hover or ground lateral are above specified limits, do Procedure 3.1.2.

PROCEDURE 3.1.1: Maximum Vertical ≥ 0.6 ips AND predicted lateral in limits.

a. Press **QUIT**.
b. Use the cursor to select View Corrections, and then press **DO**.
c. Record the recommended adjustments. Add any required autorotation rpm adjustments to any AVA recommended pitch link adjustments.
d. Do Procedure 4.

PROCEDURE 3.1.2 : Maximum Vertical ≥ 0.6 ips AND predicted lateral above limits.

a. Press **QUIT**.
b. Use the cursor to select Edit Adjustables, and then press **DO**.
c. Turn blades 1 and 2 hub weights to ON (Y).
d. Push **DO** to calculate and display adjustments.
e. Record the recommended adjustments. Add any required autorotation rpm adjustments to any AVA recommended pitch link adjustments.
f. Do Procedure 4.

PROCEDURE 3.2: Vertical < 0.6 ips.

a. Press **DO** to calculate and display adjustments.
b. Make note of the adjustments given, then press **QUIT**.
c. View Predictions is selected, press **DO**.
d. Examine the measured vibrations:
  1. If the display indicates that measured Hover and Ground lateral vibration are both within limits, do Procedure 3.2.1.
  2. If the display indicates that either measured Hover or measured Ground lateral vibration is above limits, do Procedure 3.2.2.

PROCEDURE 3.2.1: Vertical < 0.6 ips AND measured lateral in limits.

a. Press **QUIT**.
b. Use the cursor keys to select View Corrections, and then press **DO**.
c. Examines the default corrections given:
  1. If only pitch link moves are given, do Procedure 3.2.1.1.
  2. If pitch link and tab moves are given, do Procedure 3.2.1.2.
  3. If only tab moves are given, record the recommended adjustments. Do Procedure 4.

PROCEDURE 3.2.1.1: Vertical < 0.6 ips AND lateral in limits AND only P/L have been given.

a. Press **QUIT**.
b. Use the cursor to select View Predictions, press **DO**.
c. Examine and make note of the predicted vibration levels for the pitch link only moves. Press **QUIT**.
d. Use the cursor to select Edit Adjustables, press **DO**.
e. Turn off all four pitch links.
f. Turn on all four 8-10 tabs.
g. Press **DO** to calculate and display 8-10 tab adjustments.

NOTE

If any blade shows an 8-10 tab adjustment of 2 degrees or more, it is recommended to Edit Adjustables to turn off the 2 degree or greater 8-10 tab region and turn on the 6-10 tab region for that blade, then recompute the adjustment.

h. Note the tab adjustments given. Press **QUIT**.
i. Select View Predictions and examine and make note of the predicted vibration levels for the tab only solution.
j. Compare the predictions of the tab only solution to those of the pitch link only solution. Select either the pitch link only or the tab only solution, based on the effectiveness (predictions) as well as the simplicity of the adjustment set.
k. Record the selected adjustments set. Add any required autorotation pitch link adjustments to the adjustment set.
l. Do Procedure 4.

PROCEDURE 3.2.1.2: Vertical < 0.6 ips AND lateral in limits AND P/L and tabs have been given.

a. Press **QUIT**.
b. Select View Predictions and examine and note the predicted vibration levels for the pitch link and tab solution.
c. Use the cursor to select Edit Adjustables, press **DO**.
d. Turn all four pitch links from Y to N (No or off).
e. Press **DO** to calculate and display tab adjustments.

NOTE

If any blade shows a 6-10 or 8-10 tab adjustment of 2 degrees or more, it is recommended to Edit Adjustables to turn off the 2 degree or greater 6-10 or 8-10 tab region and turn on the next larger tab region for that blade, then recompute the adjustment. For example, if the AVA solution calls for a 2 degree bend in pockets 6-10 on Blade 1, use Edit Adjustables to turn off the Blade 1 6-10 tab and turn on Blade 1 4-10 tab and recompute the adjustments.

f. Press **QUIT**. Select View Predictions and examine and note the predicted vibration levels for the pitch link and tab solution.
g. Compare the predictions of the tab only solution to those of the pitch link and tab solution. Select either the pitch link and tab or the tab only solution, based on the effectiveness (predictions) as well as the simplicity of the adjustment set.
h. Record the selected adjustment set. Add any required autorotation pitch link adjustments to the adjustment set.

i. Do Procedure 4.

PROCEDURE 3.2.2: Vertical < 0.6 ips AND measured lateral above limits.

a. Press **QUIT**.
b. Use the cursor to select Edit Adjustables, and then press **DO**.
c. Turn Blades 1 and 2 weights ON.
d. Turn all four pitch links OFF.
e. Press **DO** to calculate and display weight and tab adjustments. Note the adjustments given.
f. Press **QUIT**.
g. View Predictions is selected, press **DO**.
h. Examine the predicted hover and ground lateral vibration:
   1. If predicted hover or ground lateral are above limits, do Procedure 3.2.2.1.
   2. If predicted hover and ground lateral are in limits, record the AVA-recommended weight and tab adjustments, add any pitch link moves required for autorotation rpm adjustment to the adjustment set, and do Procedure 3.

PROCEDURE 3.2.2.1: Vertical < 0.6 ips AND measured lateral above limits, AND predicted lateral with weights and tabs above limits.

a. Press **QUIT**.
b. Use the cursor to select Edit Adjustables, and then press **DO**.
c. Turn ON all 4 pitch links.
d. Press **DO** to calculate and display adjustments.
e. Make note of the adjustments given.

NOTE

If any pitch link move is greater than 1 1/2 flats, it is recommended that the solution that includes pitch link adjustments not be used. Instead, use the weight and tab solution of Procedure 3.2.2.2 (This procedure did not exist).

f. Press **QUIT**.
g. View Predictions is selected, press **DO**.
h. Make note of the predicted vibration levels – both lateral and vertical.
i. Compare the predictions for the weight and tab adjustment set, with the predictions for the weight, tab, and pitch link adjustment set.
   1. If the predicted vibration levels (both lateral and vertical) for the weight and tab solution are nearly as low as, or are lower than the weight, pitch link and tab solution, record the weight and tab adjustments.
   2. If the predicted vibration levels (both lateral and vertical) for the weight, tab and pitch link solution are significantly better than the weight and tab only solution, record the weight, pitch link and tab adjustments.
j. Add any pitch link moves required for autorotation rpm adjustment to the adjustment set.
k. Do Procedure 4.

PROCEDURE 4: Verify/Repeat

a. Make the recorded AVA-recommended adjustments. For AH-64A, perform pitch link adjustments according to the instructions in Task 2, Procedure 4 and perform trim tab adjustments according to Procedure 5 below. For the AH-64D, perform pitch link and trim tab adjustments as per the Longbow IETM, TM 1-1520-LONGBOW/APACHE.
b. Perform limited test flight, including autorotational RPM check per TM 1-1520-238-MTF. Repeat diagnostics/ corrections as necessary until all vibrations are within limits.

NOTE

If trim tab pockets are not marked or to verify tab pocket marking, for AH-64A refer to TM 1-1520-238-23 and AH-64D to IETM TM 1-1520-LONGBOW/APACHE.

PROCEDURE 5: TRIM TAB ADJUSTMENT

a. The tab bend corrections called out on the diagnostics display will refer to the start point of a continuous bend. Example: If the AVA recommends 1 degree up at pocket 4-10, the bend should start at pocket 4 and continue through pocket 10.

CAUTION

Place tab adjustment tool in the center of the tab bend pocket that is to be bent. See Figure 10.

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. See Figure 11.

Do not make bends in opposite directions in adjacent pockets. It is preferable to remove an upward bend (reset to zero degrees) if the adjacent pocket requires a downward bend.

Any noticeable deformity (kinks or sharp edges caused by the tab bending tool) is cause for rejection of the blade.

It is preferable to make two 1 - degree bends in adjacent stations rather than one 2 - degree bend in one station.

b. Perform tab adjustments on blades and pockets called out in the AVA diagnostics.

c. Remove tab adjustment tools and perform limited test flight as prescribed by Procedure 4 above.

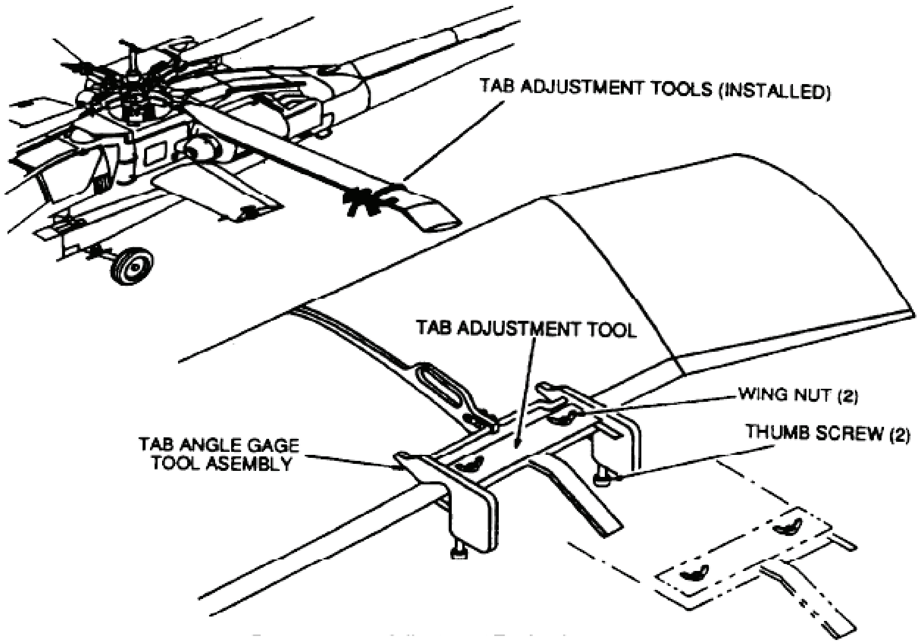


Figure 10. Tab Adjustment Tools-Installed

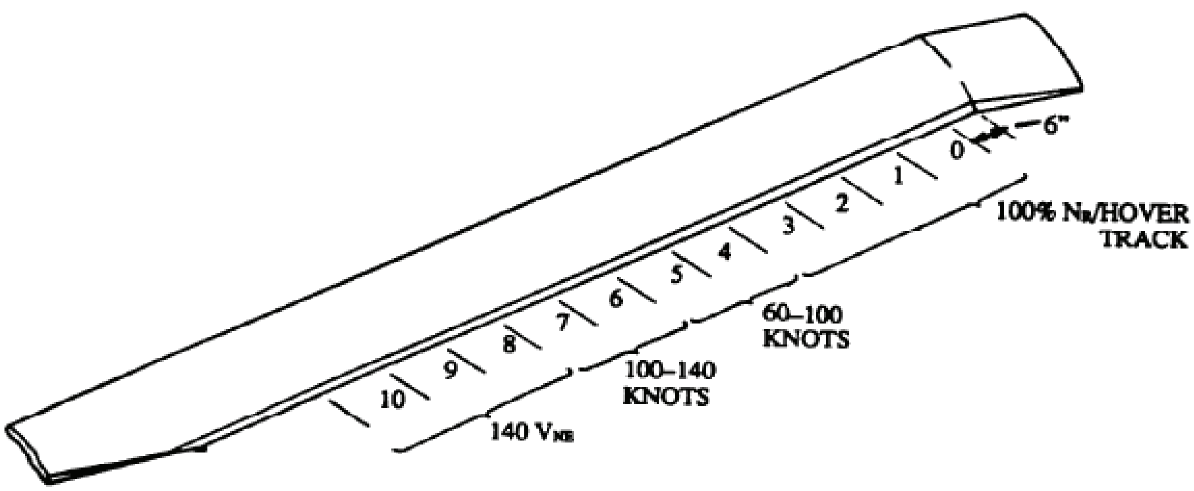


Figure 11. Blade Tip Adjustment Areas (Pockets)

HELPFUL HINTS

General

For each set of FLIGHT measurements, evaluate several solutions using Edit Adjustables, and select the solution that is the best compromise between minimum number of adjustments, reasonable magnitudes of adjustments, and most significant reduction in vibration levels.

If there is only one measurement above limits, with all others well below limits, the AVA may have a hard time compromising the good levels for the single bad one. In these cases, Resolve To Limits may help.

Track height should be given only minor consideration during the track and balance process. It is recommended to keep an eye on track and perhaps use it as a delineating factor when choosing between two otherwise comparably effective solutions, but to not use track for picking adjustments. If the AVA adjustment set is not manipulated too erratically, track will remain under sufficient control. This is because minimizing vibration requires only two blades. The third blade is used to control track with little compromise to vibration. The AVA will always use the third blade to minimize track spread, as needed. The only mechanism available for having a severely out-of-track condition while having vibrations in limits is the split tip path plane in which two opposite blades are flying in one plane and the other 2 opposite blades are flying in another plane. It is possible to end up with this configuration if one manipulates or restricts the adjustables too severely, however, the AVA will itself never drive the rotor to this configuration.

In a perfect world, zero track height would correspond to zero vertical vibration. However, in the real world, each blade (including lead lag links and pitch cases and pitch links, etc.) is far from identical to the other. Therefore, in the real world, perfect track usually does not mean zero vibration. The more mismatched the blades, the larger the track spread may have to be to obtain minimum vertical vibration.

Hub Weights

Hub weights are turned off as a default and must be manually turned on (i.e., Edit Adjustables) if needed.
If the ground lateral and hover lateral points on the polar chart need to be brought closer together, hub weights will not be effective. A hub weight adjustment will essentially move the two points around the polar chart without significantly changing the distance between them. This is evidenced by the closeness of the sensitivities both in magnitude and phase angle, for the two conditions. Therefore, if both the ground and hover lateral points need to be brought closer together on the polar chart, pitch link adjustments are generally required.

The sensitivities of vertical vibration in forward flight to hub weight changes are included in the sensitivity matrix in the script file. Due to the relative weighting of the vibration measurements, which more heavily weights the total of all vertical vibrations as compared to the total of the two lateral vibrations, the hub weight solutions will often be rendered less effective for reducing lateral vibration, since weights will be more effective in reducing vertical vibration. For these reasons, it is important to get hover and ground lateral under control early in the track and balance process, when potentially pitch link, weight and tab adjustments are being called for. The AVA will generally not be effective in coming up with a weight-only solution to minimize lateral.

Pitch Links

The AVA may give large pitch link adjustments (2 flats or more) and use a corresponding tab adjustment to counter it. Usually, these are uncalled for and are not recommended. If the AVA is giving pitch link moves of 2 flats or more, it is recommended to try other combinations of adjustments (including no pitch links at all) to try to come up with a more reasonable solution. Rarely would such relatively large pitch link moves be justified as long as ground and hover track spreads are reasonably small.

Tabs

Tabs are triggered by blade track height. When the blade relative track height changes 0.5 inches or more from its hover value at a given speed, a particular tab region is turned on, depending on that speed. The correlation between speed and tab region is as follows:

4-10 tab: Track exceeds 0.5-inch difference from hover at 60-80 knots

6-10 tab: Track exceeds 0.5-inch difference from hover at 100-120 knots

8-10 tab: Track exceeds 0.5-inch difference from hover at 140 knots

It is recommended to avoid tab bends of 2 degrees or more, if possible. If a 6-10 or 8-10 tab is triggered, but the adjustment calls for a 2 degree or more bend in that region, turn off the 6-10 or 8-10 tab and turn on the corresponding 4-10 or 6-10 tab. This distributes a smaller move over a larger span and will serve the same purpose without requiring excessive tab bending. A 4-10 tab bend of 2 degrees or more cannot be avoided in this manner. However, a 4-10 bend in excess of 3 degrees is potentially an indication of some other problem. If this happens, check to see if there is any bend in pockets 0-3. If so, they should be zeroed and a new measurement set taken. If there is no bend in 0-3 and the large 4-10 bend is required, make a 1/2 degree bend in 0-10 instead, take a new measurement and go from there. If a large 4-10 is still called for, another 1/2 degree can be put in 0-10 instead, but do not exceed 1 degree total in pockets 0-3.

TROUBLESHOOTING

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 140K) 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, 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 key (this will make the polar chart easier to read), and then press **DO**.

This will display the vibration trend from the latest flight with previous flights on a polar chart. This process is displayed in Figure 12.

The AVA's goal is to give corrections that will drive the vibration levels towards the center of the polar chart. The question when viewing the polar chart is, did the vibration levels move towards the center of the chart or go through the center of the chart. In some cases the vibration trend will go through the center of the chart and overshoot to the other side as Figure 12 shows. 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.

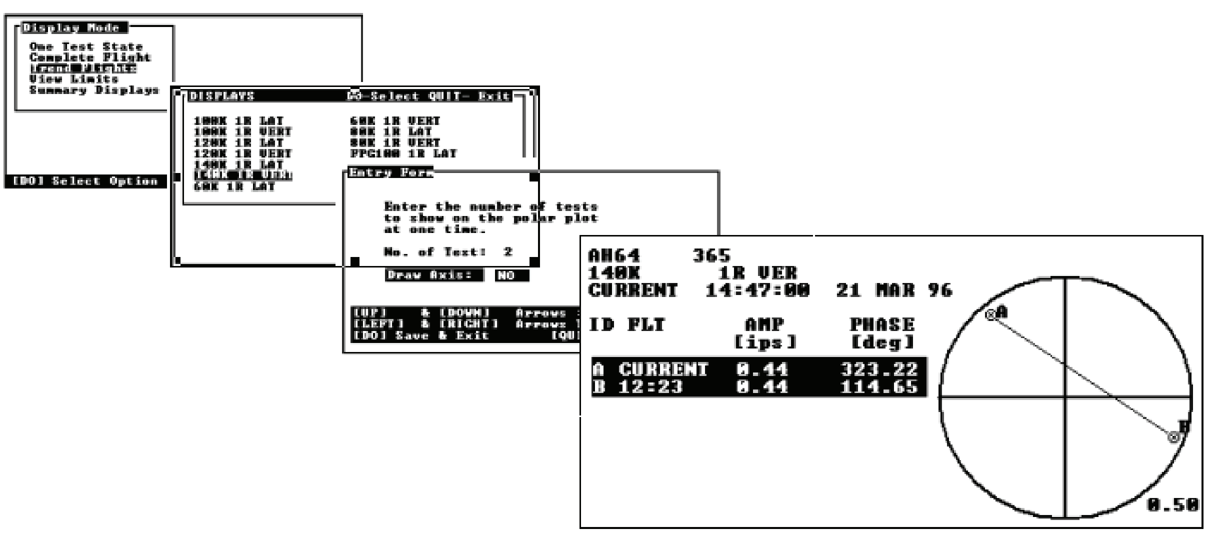


Figure 12. AVA Vibration Trend

If the vertical vibration is increasing and moving away from center, check the orientation of the vertical accelerometer. If the vertical accelerometer is mounted upside down (connector coming off to the top), all tab and pitch link adjustments will drive vertical vibration in the wrong direction (i.e., increasing).

If the AVA solutions are not effectively reducing the vibration levels flight-to-flight, ensure that the vertical and lateral accelerometers are wired into correct DAU channels. If the vertical accelerometer is wired to the lateral channel (ACC1) and the lateral accelerometer is wired to the vertical channel (ACC2), the AVA solutions will be completely erroneous.

For tachometer errors, check:

a. The blade tracking test port switch is in the track position for the AH-64D.
b. The tachometer connector on the AH-64 to DAU cable is connected to the TACHO 1 DAU port.
c. The tabs on the double and single interrupters are properly bent and that the gap between them and the mag pick-up is adjusted to a gap of 0.030 to 0.070 inch.
d. The wiring between the mag pick-up and the SPU. The weak link in that wiring is the splice that is approximately 6 inches below the mag pick-up connection.

TASK 4 – BALANCE TAIL ROTOR

NOTE

Tail rotor balance will 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, take the measurements during the same ground runs used for main rotor ground track and balance.

Tail Rotor Balance Limit

The tail rotor vibration limit displayed by the AVA is 0.15 ips. Tail rotor balance below 0.1 ips should be readily achievable, and is encouraged.

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA tail rotor balancing equipment from transport case. Check for possible damaged equipment and frayed cables.
b. Installed DAU in canvas carrying case.
c. Place DAU on the outboard side of the co-pilot's left armor plate with connectors facing up and secure DAU using canvas straps and D-rings.
d. Locate CADU in aircraft. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: OPTICAL RPM SENSOR INSTALLATION

a. Remove the two airframe screws located on the bottom and in the center on the tail rotor gearbox airframe panel. See Figure 13, item 1.
b. Mount optical rpm sensor mounting bracket (29198700) on tail with arrow on the bracket facing aft. See Figure 13, item 3. Secure the bracket with screws long enough to pass through the mating fastener and extend a minimum of two threads.
c. Mount the optical rpm sensor (29314700) to the bracket.
d. Connect the optical rpm sensor to the optical rpm sensor bracket and route the cable down the tail and forward to the DAU. Ensure cables are not pinched in CPG's door.
e. Connect the optical rpm sensor cable to the DAU receptacle marked TACHO 2.

NOTE

If there is any tape remaining from previous balance routines, this must be completely removed to ensure a clean and accurate tachometer signal to the DAU. Never apply new tape on top of existing tape. See Figure 13.

f. Place a single, 8-inch strip of reflective tape on either outboard blade, Figure 13, item 2, aligning the tape in line with the optical sensor. (The tape should be placed spanwise along the center of the blade.)
   1. Verify that the red LED on the back of the optical tachometer sensor is operating. Energize the aircraft's bus and ensure that DAU has power. With optical tachometer sensor in place rotate tail rotor so that blade with reflective tape is in front of the optical sensor. With tape in front of sensor. The red LED on back of sensor should be illuminated. A sensor with a pulsating LED indicates that the signal is strong.
   2. After installation of the reflective tape, wipe the tape with alcohol, contact cleaner, etc. This will ensure maximum reflectivity as oils from your fingers can reduce reflection.

NOTE

The blade with the reflective tape will be referred to in the AVA diagnostics as the No. 1 outboard blade, rotate the blades in the direction of rotation and the next blade is No. 1 inboard, and the next blade is No. 2 outboard and the next blade is No. 2 inboard. See Figure 13.

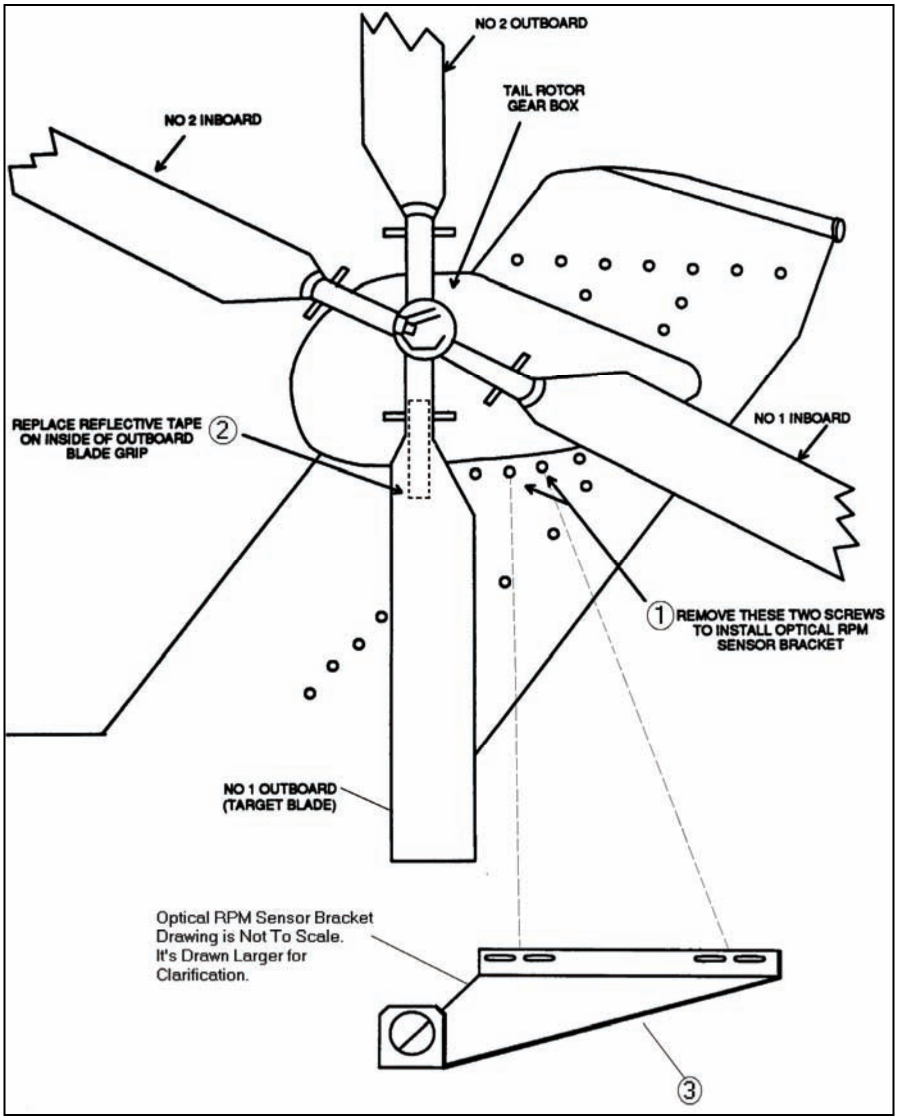


Figure 13. Locations for Installing Optical RPM Sensor Bracket and Reflective Tape

PROCEDURE 3: ACCELEROMETER INSTALLATION

a. Install accelerometer (28110900) on accelerometer mounting bracket (29313000).

b. Remove the screw directly above the tail gearbox support strut airframe mount. See Figure 14.

c. Mount the accelerometer with bracket to the tail pylon using the screw previously removed. Ensure that the bracket is oriented so that the accelerometer will be vertical using the support strut as a reference with the connector facing up. See Figure 14.

d. Connect accelerometer cable (29105600) to accelerometer and secure accelerometer cable to support strut, ensuring cable is not pulled taut.

e. Route the cables down the tail pylon and forward to the DAU. See Figure 15.

f. Connect accelerometer cable to the DAU receptacle marked ACC4.

g. Ensure cables are not pinched in CPG's door.

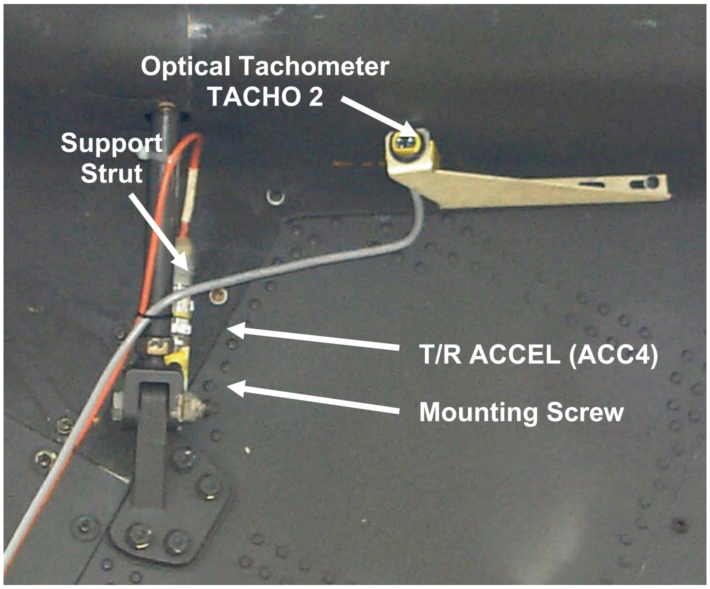


Figure 14. Tail Accelerometer & Optical Tachometer Installation

Figure 15. Tail Accelerometer Cable Routing

PROCEDURE 4: PERFORM TAIL ROTOR BALANCE MEASUREMENT

NOTE

To achieve an accurate measurement, ensure tail rotor pedals are centered (flat pitch) during ground run.

NOTE

If severe vibration prevents obtaining 100% (101% for AH-64D) Nr rotor speed, use the tail70 flight plan and take the measurement at 70% Nr. The AVA diagnostic solution for tail70 incorporates coefficients specifically for the 70% Nr condition. Repeat balance measurement/ correction at 70% Nr until 100% (101% for AH-64D) Nr can be safely achieved. Completion of tail70 does not eliminate the requirement for the balance at 100% (101% for AH-64D) Nr.

a. Operate the aircraft at full operating rpm, with the main rotor at flat pitch (full down collective).

b. Turn on DAU.

c. Turn on CADU.

d. Press **QUIT** until the Main Menu appears. Highlight Aircraft Type and press **DO**. Highlight the appropriate script file (described under Main Rotor Track and Balance section) and press **DO**.

NOTE

If main rotor measurements are not being done at the same time, the tail rotor measurement is independent of the main rotor accelerometer configuration. If tail rotor balance is to be performed at the same time as main rotor ground track and balance, utilize whichever script file is being used relative to “SPU interface” or “external wiring” for the main rotor work.

e. Tail number is highlighted. Press **DO**. Use cursor keys to highlight an existing tail number or enter the numbers from the keypad and press **DO**.

f. Flight Plan is highlighted. Press **DO**. Highlight tail and press **DO**.

g. Initiate measurement mode by pressing **F1** MEASURE.

h. fpgtl is highlighted. Press **DO** to initiate measurement, then **DO** again when the aircraft is steady at the desired condition. AVA will indicate Measuring and will display the rotor speed. Verify that the aircraft is at required Test State.

i. Once the measurement has been successfully acquired, the AVA will exit the measurement screen automatically. Press **DO** on Finish.

j. Highlight Diagnostics, and then press **DO**.

PROCEDURE 5: PERFORM TAIL ROTOR BALANCE DIAGNOSTICS

WARNING

Ensure proper blade weight retaining hardware is installed in the tail rotor blades.

WARNING

NEVER remove ALL of the weight from the tail rotor blade tips in an attempt to "zero out" the balance for a new starting point. Doing so may cause severe tail rotor vibration and result in aircraft damage. In addition to being used for dynamic rotor balance, tail rotor tip weights serve the important purpose of maintaining the design static spanwise mass moment of the blade and were initially installed by the manufacturer. Efforts should be made to make the minimum disturbance to those weights over the course of tail rotor dynamic balance maintenance exercises.

NOTE

AVA moves are changes to the adjustable tip weights and, as such, are to be added to or subtracted from whatever weights are currently in the blade tips.

NOTE

The diagnostic solution given for each set of measurements is independent of all other measurements that have been previously performed. The AVA does not maintain any history of adjustments. It therefore makes no assumptions regarding what adjustments were made during previous runs.

a. Examine the Limits screen. If measurements are within limits, press the UP cursor to display the measured magnitude. If tail rotor balance is above 0.10 ips and it is desired to reduce it further, press **QUIT** to return to the first limits screen, then continue with this procedure (do step b). If it is not desired to reduce balance to below 0.10 ips, press **QUIT** to terminate tail rotor balance procedures.
b. Press **DO** to calculate the adjustment.

NOTE

The total weight move called for by the AVA for a given blade should be equally split between the forward and aft weight pockets, with 1/2 the weight adjustment made to the forward pocket and 1/2 the weight adjustment made to the aft pocket.

NOTE

The addition of weight to a blade has the equivalent effect on vibration as removal of the same amount of weight from its opposite blade.

NOTE

A weight change to an outboard blade is 50% more effective than an equal weight change to an inboard blade.

c. Recall the measured balance:
   1. If the measurement is less than 0.7 ips, record and make the AVA-recommended adjustments. Do Procedure 6.
   2. If the measurement is 0.7 ips or greater, Do Procedure 5.1.

PROCEDURE 5.1 Tail Balance ≥ 0.70 ips

a. For balance greater than or equal to 0.7 ips, reduce the AVA-recommended adjustments by 1/2 for both inboard and outboard blades. This will prevent adjustment overshooting for high imbalance.
b. Perform Procedure 6.

PROCEDURE 6: VERIFY/REPEAT
Repeat tail measurement to determine whether or not the corrections had the desired affect. Repeat diagnostics/ corrections as necessary until vibration is within limits.

COMPARING MOVES BETWEEN RUNS
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 plans (tail and tail70) 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**.

This will display the vibration trend from the latest reading with previous readings on a polar chart. This process is displayed in Figure 16.

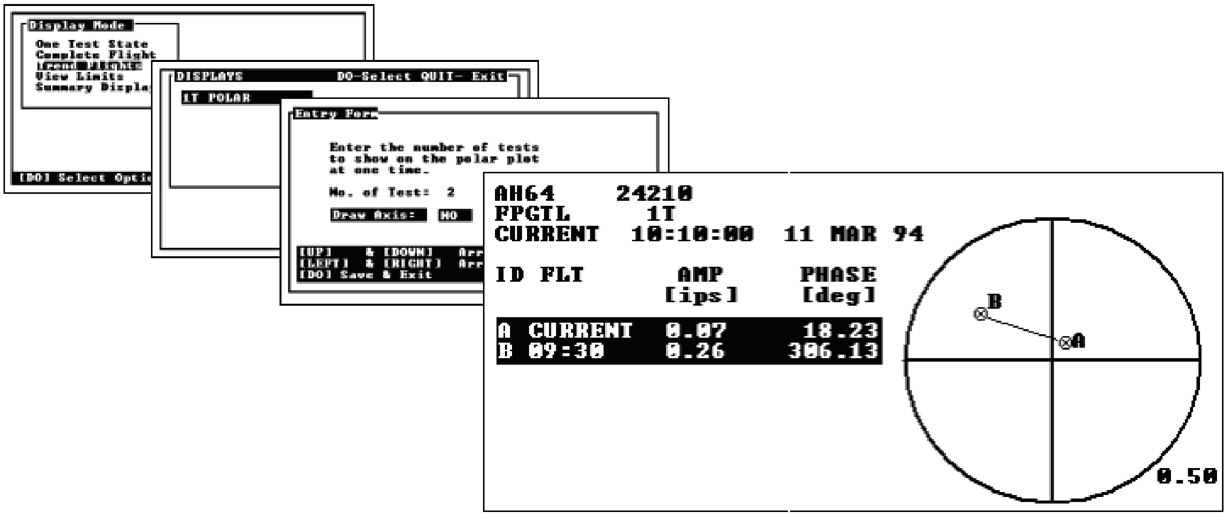


Figure 16. Vibration Trend Polar Chart

The AVA's goal is to give corrections that will drive the 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, did the vibration levels move towards the center of the chart or 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 tail rotor is responding to the moves in a normal manner, but the amount of the move was too much. If the vibration does not move towards center, something was done wrong. If the vibration trend shows vibration levels moving in a direction other than towards center, you should stop and try to determine what went wrong. If it cannot be determined what went wrong than it is recommended to make another adjustment, according to the AVA, but try to make as few moves as possible (usually 1) to reduce the vibration levels. The phase information is very important and these polar charts should be used to verify the reaction of the aircraft. 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).

HELPFUL HINTS for flight plans "tail" or "tail70"

a. If the AVA calls for a large move on one blade (i.e., more than 8 grams) with a 1 gram move on another blade, turn off the 1-gram blade and see if the predicted vibration with the one-blade move is below 0.1 ips. If so, make only the large move to the one blade.

b. Most of the optical rpm sensor brackets will cause the sensor to view the blade on the blade shank, rather than on the blade proper. Therefore, the amount of reflective tape required is usually only 6-8 inches running along the shank itself. Avoid excessively long tape applications. Apply tape according to Figure 13.

c. The horizontal stabilator is a good indicator for determining the magnitude of tail rotor out-of-balance. Keep an eye on the stabilator during the first run-up and use it as a gauge as to whether or not it is safe to run all the way up to 100% (101% for AH-64D). The vertical tail whip antenna is also a good indicator. Excessive vibration can cause the whip antenna to break off. If severe out-of-balance is suspected, remove the whip antenna prior to first run-up.

d. The AH-64 tail rotor sensitivity is measurably non-linear. This means that the sensitivity at 1.0 ips is measurably different than the sensitivity at 0.3 ips. Measured data indicates that the aircraft is roughly 1/3 more sensitive when vibration levels are in excess of 0.7 ips than for levels below that point. However, the AVA will not allow programming for this non-linearity (i.e., the script file can contain only one set of sensitivities). The AVA is programmed with the sensitivity of the aircraft for tail imbalance below 0.7 ips. If a tail measurement at 100% (101% for AH-64D) Nr is in excess of 0.7 ips, cut the AVA-recommended adjustment in half for both blades until the measured levels drop below 0.7 ips. Once below 0.7 ips use the AVA solution. If over-shooting still persists, the solution can be adjusted, but be careful to ratio the inboard blade adjustment and the outboard blade adjustment by the same amount. Do not change them by the same number of grams. For the tail70 flight plan, do not adjust the AVA-recommended moves, regardless of ips level, unless a clear over-shoot at 70% has already occurred.

e. If a weight adjustment is not split evenly between the two tip pockets, this will change the resulting phase angle, by which, the vibration measurement will change. Large moves in excess of 10 grams can significantly alter the result and cause the vibration trend to not go directly through center and therefore not go directly to zero. Split all moves as evenly as possible (only 1 gram difference allowed) between pockets.

TROUBLESHOOTING

a. If vibration increases after an adjustment, it is important to view the polar chart and plot the vibration trend between the current measurement and the prior one (Display Trend Flights). If the move was made correctly, it is possible that the vibration did in fact increase, but went through the polar chart center to the other side of the chart. It is important to distinguish an increase due to an overshoot from an increase due to an incorrect move for which the measurement went away from center.

1. If the vibration moves away from center, the adjustment was not made to the correct blade or blades. A correctly made adjustment will never cause the vibration to move away from the center of the polar chart.
2. If the vibration shot through center, and the adjustment was made correctly, the aircraft is significantly more sensitive than the script file coefficients reflect. Cut the AVA solution in half for both blades to prevent overshooting on the subsequent run. Return to full AVA moves if subsequent undershooting is evident.

b. For tachometer errors, ensure that the gray optical rpm sensor cable is connected to the DAU “TACHO2” port. Follow the line of sight of the sensor to the blade to ensure that the optical beam is hitting the reflective tape.

1. Verify that the red LED on the back of the optical tachometer sensor is operating with the DAU turned on and supplied power. With optical tachometer sensor in place rotate tail rotor so that blade with reflective tape is in front of the optical sensor. With tape in front of sensor red LED on back of sensor should be illuminated. A sensor with a pulsating LED indicates that the signal is strong.
2. After installation of the reflective tape, wipe the tape with alcohol, contact cleaner etc. This will ensure maximum reflectivity as oils from your fingers can reduce reflection.
3. Some sensors have not had the gain adjustment set to maximum. To set the gain to maximum, remove the clear plastic cover from the back of the sensor. Using a small screwdriver, turn the “gain” adjustment clockwise until a click is heard. If no click can be heard or felt then turn the screw 15 turns clockwise.

TASK 5 – ISOLATE IRREGULAR VIBRATIONS

There are two main sources of vibration in helicopters. The rotors produce low frequency vibrations, 200-5000 rpm or 3 to 80 cycles per second (Hz), at multiples of rotor revolution, and the drive train-transmission produces mid, 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 don't indicate a safety of flight problem, but not always. Irregular "Hi-Freq" vibrations usually indicate an impending failure of some drive train component and so are a safety concern. Figure 17 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 1/REV and tail rotor 1/REV.

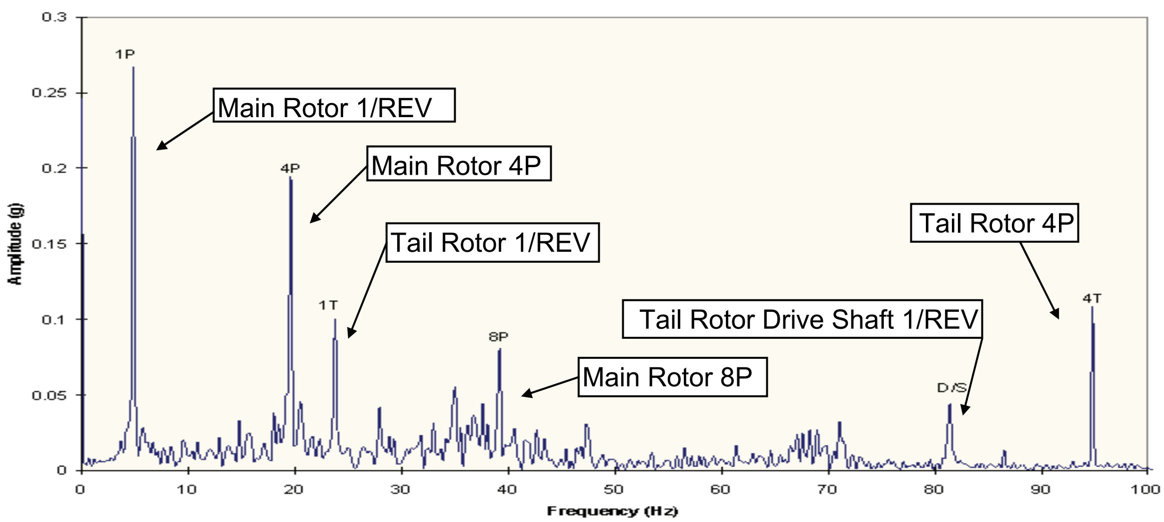


Figure 17. Spectrum Example

The AVA is capable of acquiring accelerometer measurements and generating vibration spectra from those measurements. This measurement mode is referred to as "PROBES". A vibration spectrum is a plot of vibration magnitude, usually in inches per second (ips) or in g's, versus frequency, usually in Hz or revolutions per minute (rpm). In general, the frequency of a response generated by a rotating component (e.g. rotors, fans, compressors, engines, etc.) is equal to the frequency or an integer multiple of the frequency of rotation of the component which is causing the vibration. In this way, the rotating component causing an abnormal response can be identified.

SPECTRUMS

What is a spectrum? If an accelerometer is mounted at a particular location 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 are generated by the rotors. Mid frequency vibrations are generated by drive-shafts, generators, pumps, oil cooler blowers, and engines. High frequency vibrations are generated by gear meshing and fan, turbine and compressor blade passage. The AVA allows the collection of spectrums at appropriate location by mounting an accelerometer on the airframe and use the PROBES flight plan or the FFT Aircraft Type. The "PROBES" flight plan allows vibration data to be taken on accelerometers 1 through 4 for one flight plan, and the range is from 0 to 30,000 rpm (0 to 500 Hz). This range is usually sufficient to trouble shoot most of the vibration problems on the AH-64 series. The FFT Aircraft Type has many different ranges, but it only allows measurements to be taken on ACC1. The only reason that the FFT Aircraft Type needs to be utilized is if it is known that the source in question is above 30,000 rpm (500 Hz). This data can be used for troubleshooting "Hi-Freq" vibration problems. However, there currently are no set limits on what is good and what is bad. That will be discussed further in this section.

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 tach signal. The spectrum displayed is an average of 16 spectra taken consecutively after measure is pressed and shows the vibration amplitudes induced at the measuring point by the forces from each rotating part.

MID-FREQ VIBRATIONS (DRIVE TRAIN INDUCED VIBRATION)

Most vibrations above 60 to 80 Hz will be called a "Hi-Freq" vibration by a pilot. When a "Hi-Freq" is felt the pilot knows something is not right, and it is time to turn the aircraft in for maintenance. The drive train has numerous rotating parts that produce vibration at many different frequencies. Locating the faulty 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 of the rotating parts of the AH-64. 1/REV (rotational speed of the component) vibrations are associated with balance. Indexing a shaft at its mounting flange will change its balance. 2/REV (twice the rotational speed) vibrations are associated with the alignment of shafts. An increase in several harmonics of a shaft (e.g. 1/REV, 2/REV, 3/REV, and 4/REV) at the same time is an indication of bearing wear. One method of troubleshooting "Hi-Freq" problems can be accomplished by taking data at identical locations on a known good aircraft and the aircraft under test and comparing the differences. If there is a problem, comparing these two displays can show which component is the cause.

PROCEDURE 1: ACCELEROMETER INSTALLATION

NOTE

The AVA is capable of acquiring vibration data from six accelerometers: four via DAU ports ACC1 through ACC4 and two from the on-board track and lateral accelerometers via the multi-channel connection. For the externally wired aircraft type, ACC1 and ACC2 are the track and balance lateral and vertical accelerometers. ACC3 and ACC4 are available for installation at any desired location on the aircraft. The on-board track and balance accelerometers are also available for vibration spectrum analysis.

NOTE

Vibration measurements need be taken only for the operating condition of the aircraft during which the irregular vibration is sensed.

NOTE

If only the track and balance accelerometers are to be used for spectrum analysis, skip to Procedure 2.

a. Install an accelerometer(s) (28110900) anywhere on the airframe that an irregular vibration is detected, on or near the vibrating component, using an accelerometer L-bracket from the AVA kit.
b. Connect accelerometer cable (29105600 or 29105601) to the accelerometer and to the DAU receptacle labeled ACC1, ACC2, ACC3 and/or ACC4.

PROCEDURE 2: PROBES MEASUREMENT

a. On the CADU, select Flight Plan PROBES within the current aircraft type and tail number by pressing **QUIT** until the Main Menu appears, using the cursor to highlight Flight Plan, pressing **DO**, using the cursor to highlight PROBES, and pressing **DO**.
b. Establish the operating condition during which the adverse vibration is sensed. Press **F1** MEASURE. The following measurements are available:

AH-64A	AH-64D
ACC1	ACC1
ACC2	ACC2
ACC3	ACC3
ACC4	ACC4
LAT	LATP
VERT	VERTP

NOTE

LAT/VERT (AH-64A), LATP/VERTP (AH-64D) are the on-board track and balance accelerometers.

c. Use the cursor keys to highlight the desired accelerometer. Press **DO** twice to initiate measurement. Once the measurement is complete, highlight another accelerometer for measurement acquisition, if desired, and press **DO** again.

d. If all accelerometer measurements have been made, the measurement screen will automatically exit. Press **DO** on Finish to return to the Main Menu.

e. If all accelerometer channels have not been used, press **QUIT** to exit the measurement mode, highlight Save and Exit and press **DO** to return to the Main Menu.

PROCEDURE 3: DISPLAY MEASUREMENTS

Enter the Display mode by pressing **F2**. Highlight One Test State and press **DO**. Select the desired accelerometer channel and frequency range (0 to 100 Hz or 0 to 500 Hz) and press **DO**.

PROCEDURE 4: INTERPRET THE DATA

Look for the highest response in the spectrum and identify the source component by matching the frequency of that response with one of the frequencies in Table 3.

Table 3. AH-64 Frequency Data

AH-64A 100% Nr Frequency (Hz)	AH-64D 101% Nr Frequency (Hz)	Source
4.8	4.87	Main rotor 1/REV
9.6	9.74	Main rotor 2/REV
14.4	14.61	Main rotor 3/REV
18.7	18.87	MGB G3 shaft
19.3	19.48	Main rotor 4/REV
23.4	23.62	Tail rotor 1/REV
38.4	38.96	Main rotor 8/REV
46.8	47.25	Tail rotor 2/REV
57.6	58.44	Main rotor 12/REV
60.6	61.21	Tail rotor vertical drive shaft
73.2	73.91	MGB G1 shaft
79.8	80.07	MGB G2 shaft
80.2	81.02	AGB Idler shaft
80.3	81.06	Tail rotor drive shaft
82.2	83.00	AGB Idler
93.6	94.49	Tail rotor 4/REV
127.1	128.33	ECS compressor (2)
137.5	138.89	APU shaft
164.0	165.66	Nose gearbox shaft
189.8	191.67	ECS condenser fan (4)
204.2	206.24	AC Generator
210.6	212.68	Hydraulic pump
349.2	352.69	Engine shaft
379.5	383.33	APS Blower
384.5	388.33	ECS Fan (4)
384.5	388.33	Crew station fan
408.4	412.47	AC Generator 2/REV
665.3	672.03	SUN gear clash, MGB
1330.6	1344.06	2x SUN gear clash, MGB
1333.1	1346.53	Tail rotor gearbox clash
1895.0	1914.13	Hydraulic pump 9/REV
2634.1	2660.73	G1/G3 clash, MGB
2969.1	2999.10	Intermediate gearbox clash
4756.1	4804.09	MGB clash
6499.6	6565.59	GB/TR drive shaft clash
6737.7	6805.80	ACC gearbox clash
10824.1	10933.45	Nose gearbox clash

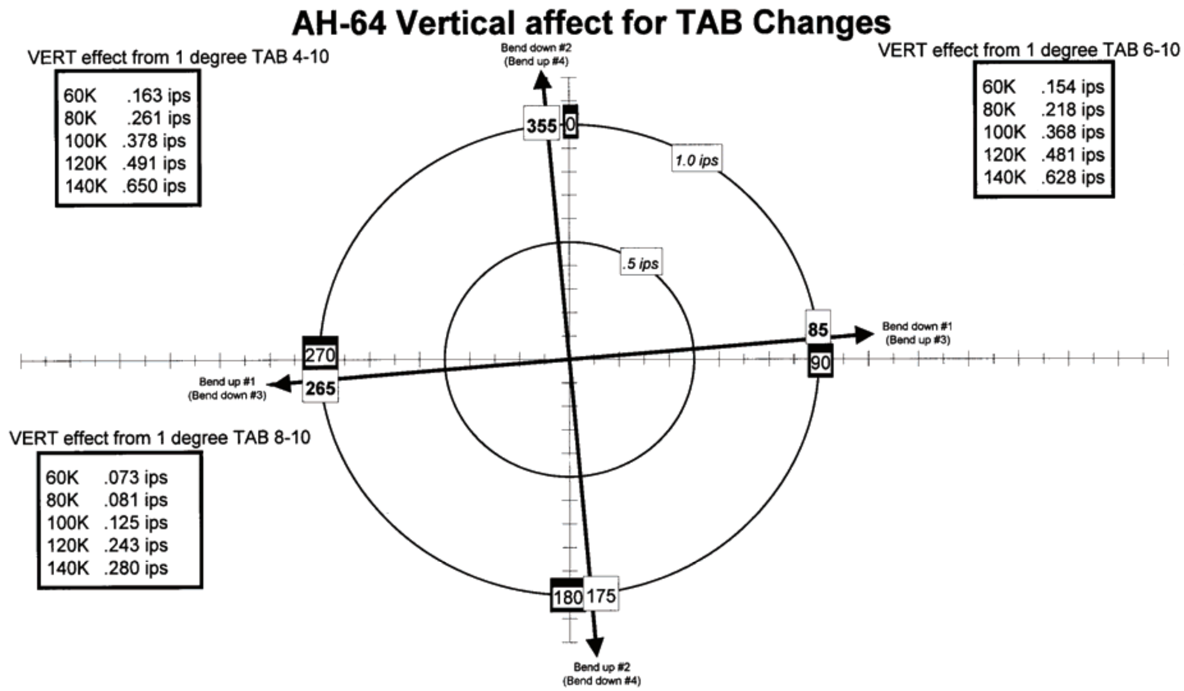


Figure 18. Vertical Affect for TAB Changes (AH-64A)

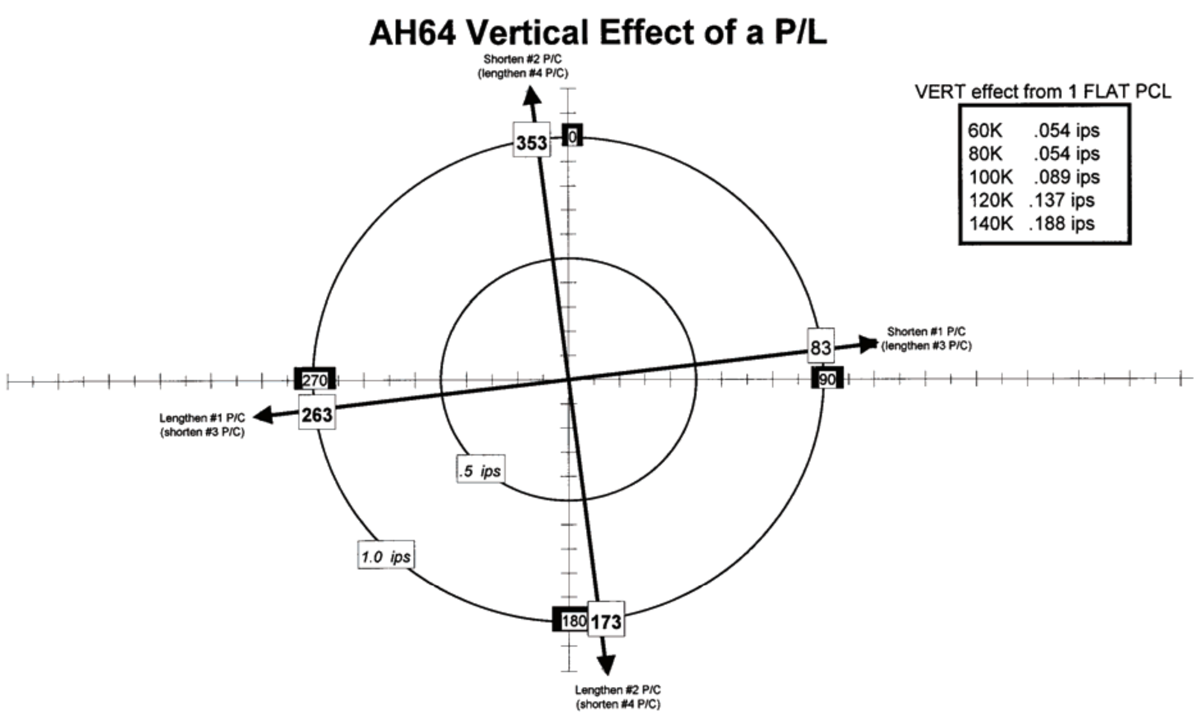


Figure 19. Vertical Effect of a P/L (AH-64A)

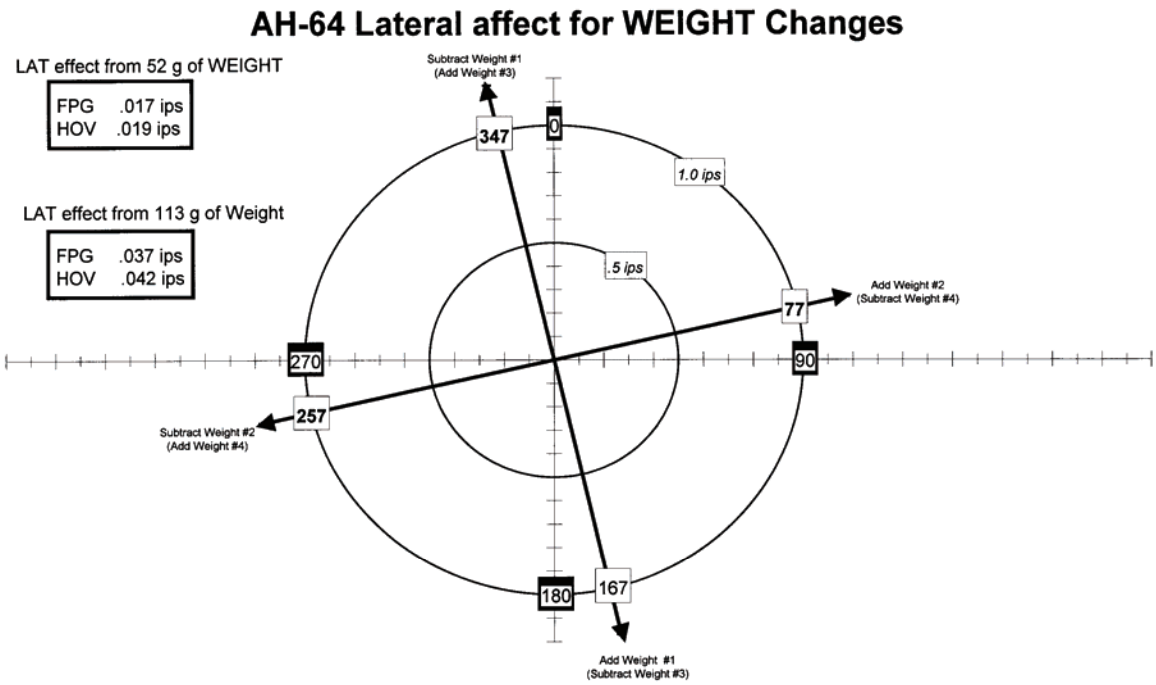


Figure 20. Lateral Effect for WEIGHT Changes (AH-64A)

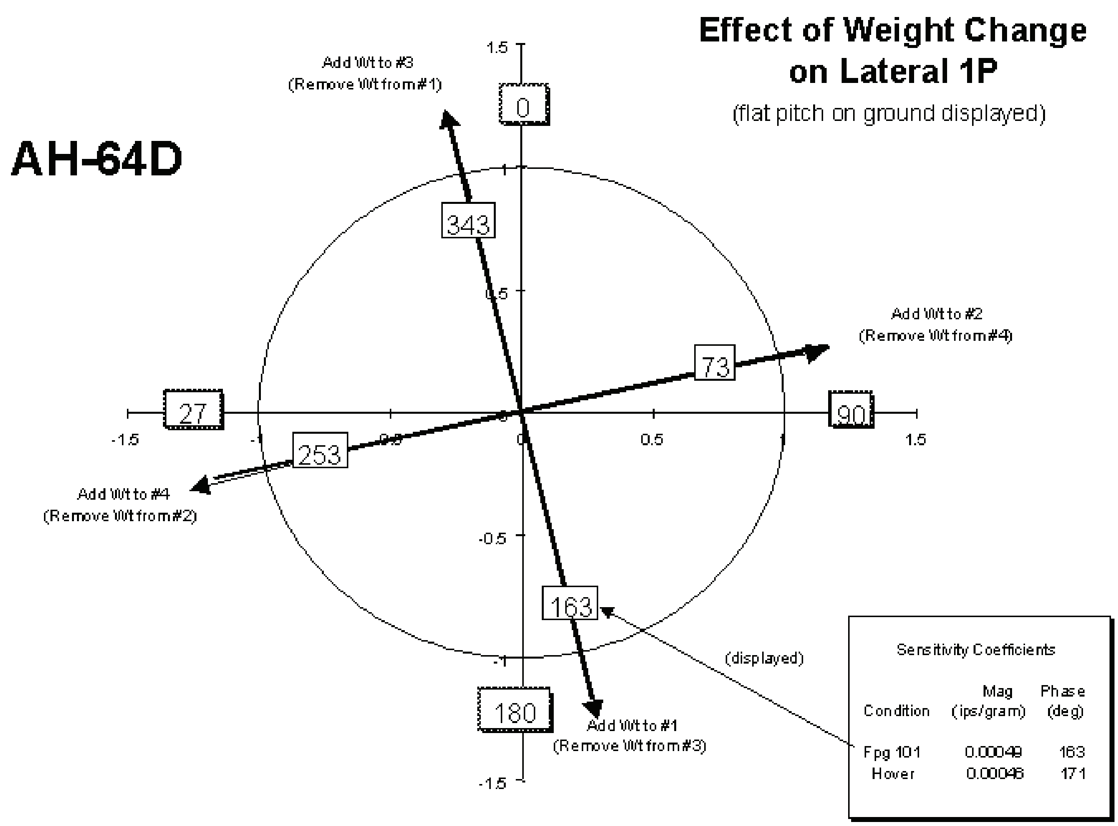


Figure 21. Effect of Weight Change on Lateral 1/REV (AH-64D)

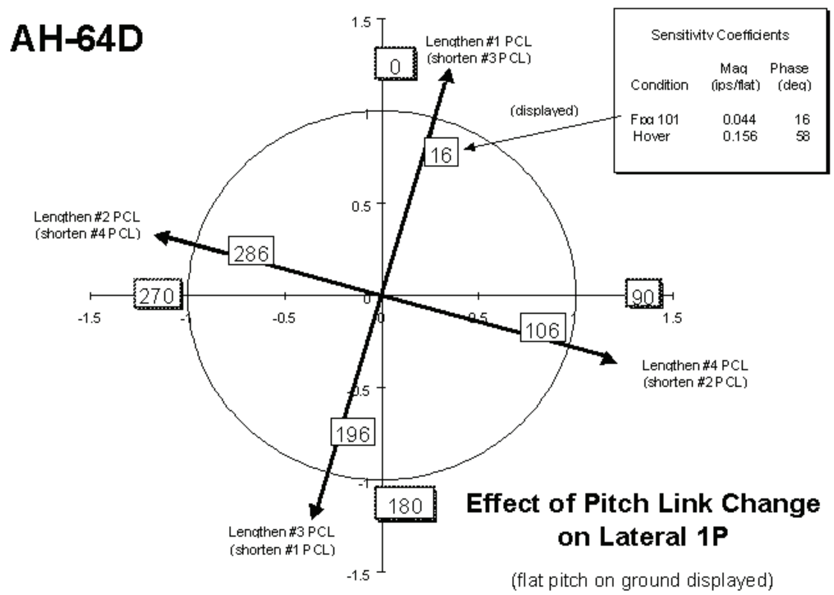


Figure 22. Effect of Pitch Link Change on Lateral 1/REV (AH-64D)

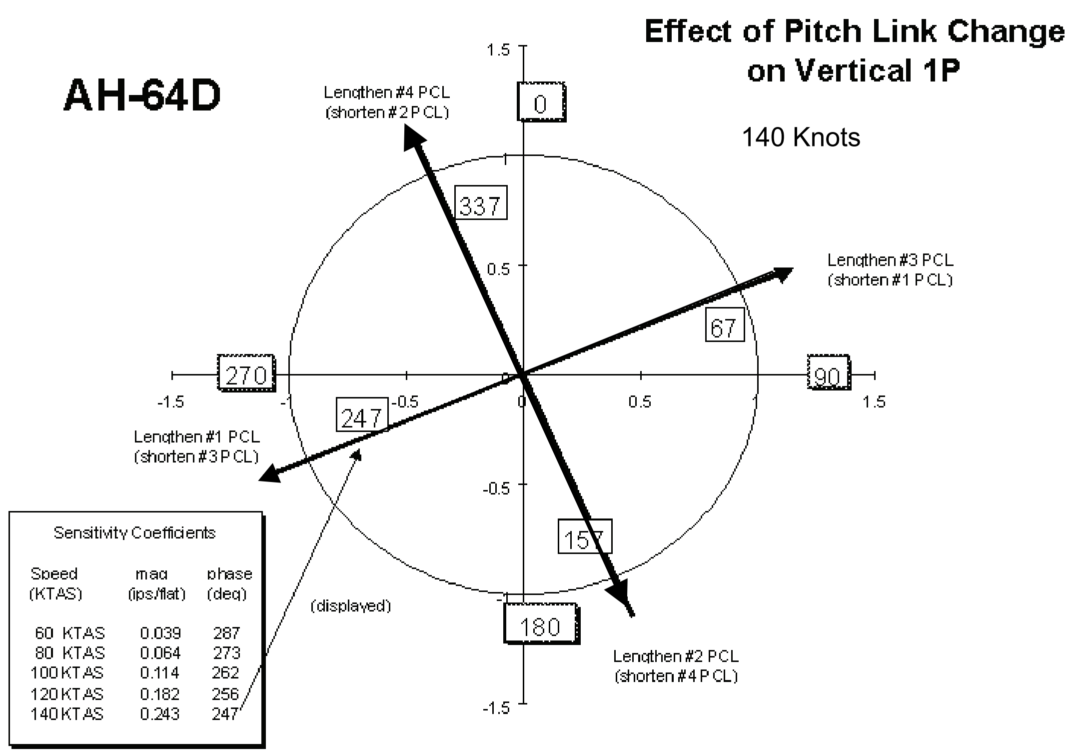


Figure 23. Effect of Pitch Link Change on Vertical 1/REV (AH-64D)

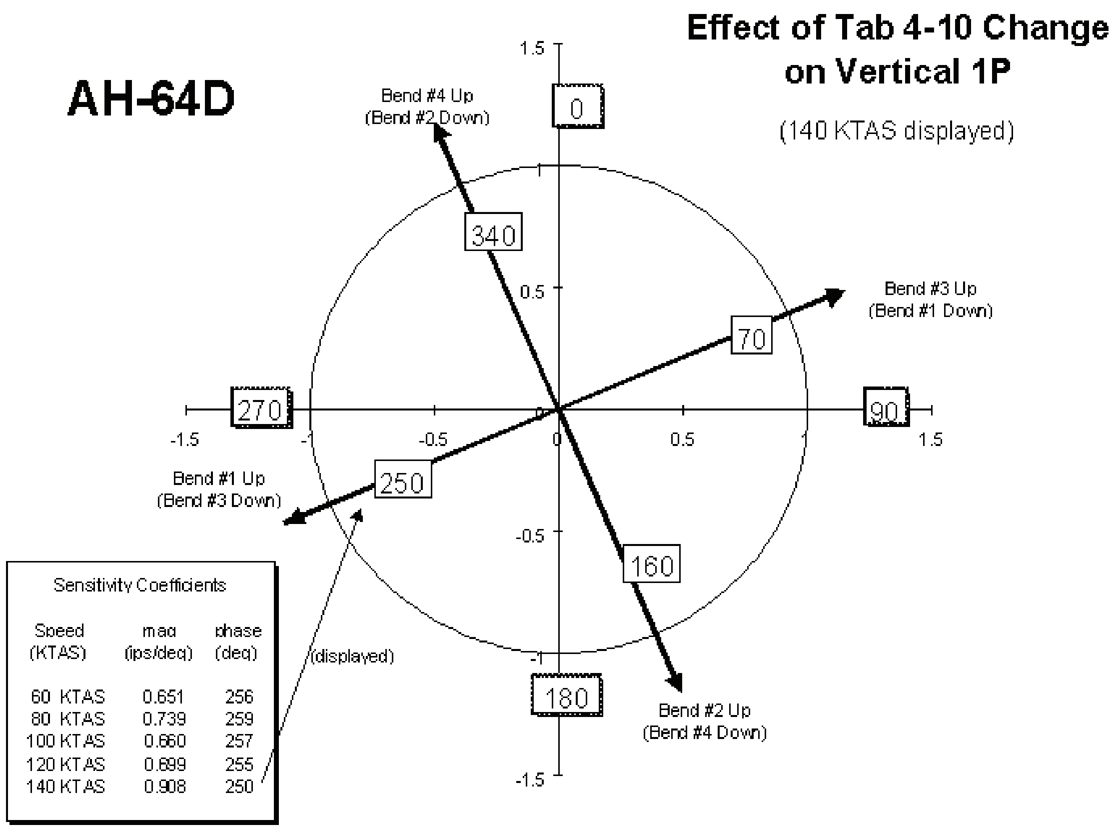


Figure 24. Effect of Tab 4-10 Change on Vertical 1/REV (AH-64D)

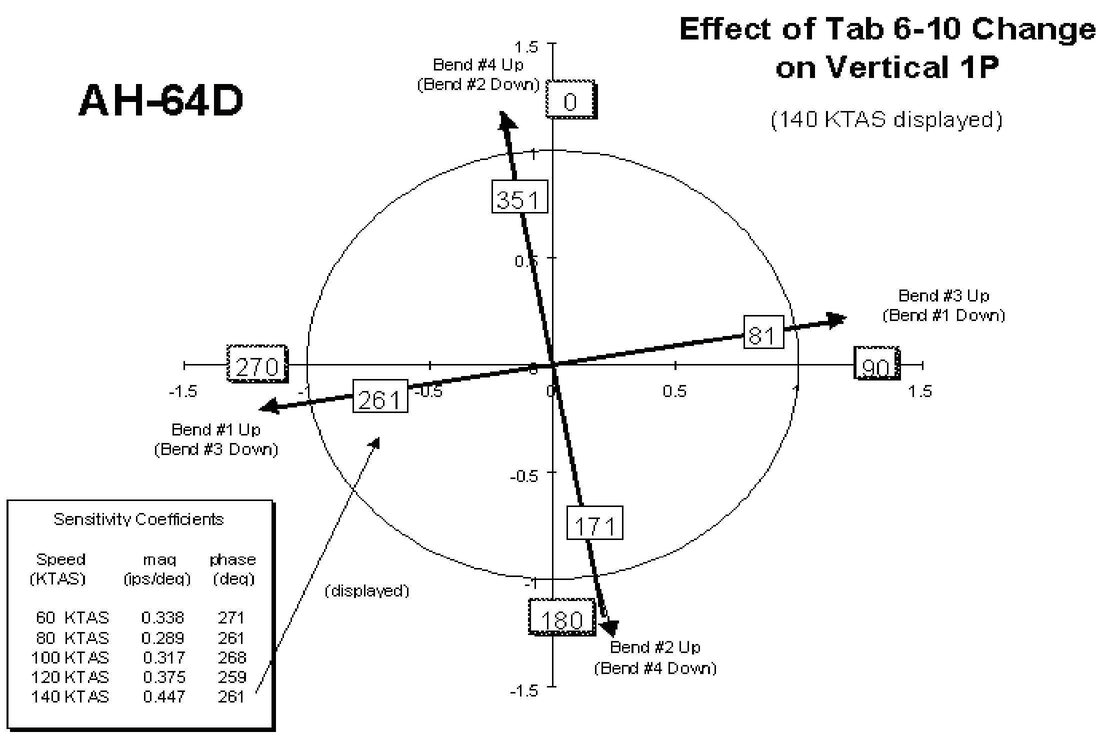


Figure 25. Effect of Tab 6-10 Change on Vertical 1/REV (AH-64D)

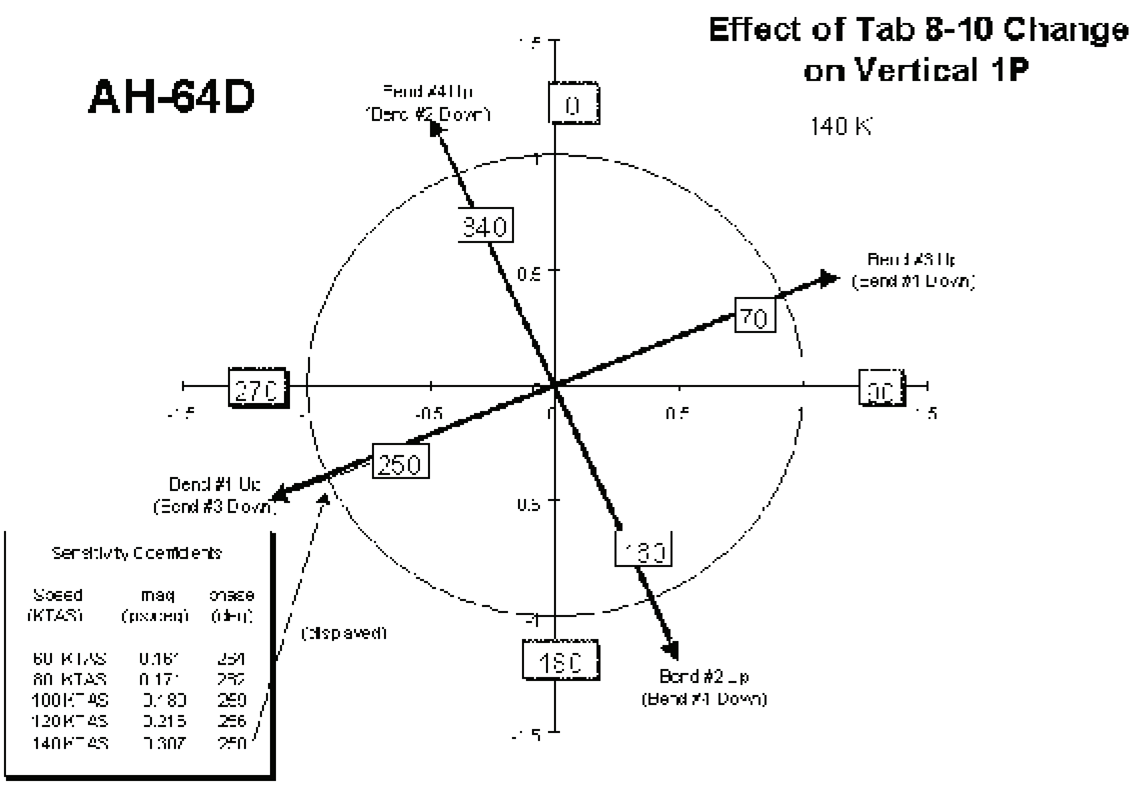


Figure 26. Effect of Tab 8-10 Change on Vertical 1/REV (AH-64D)

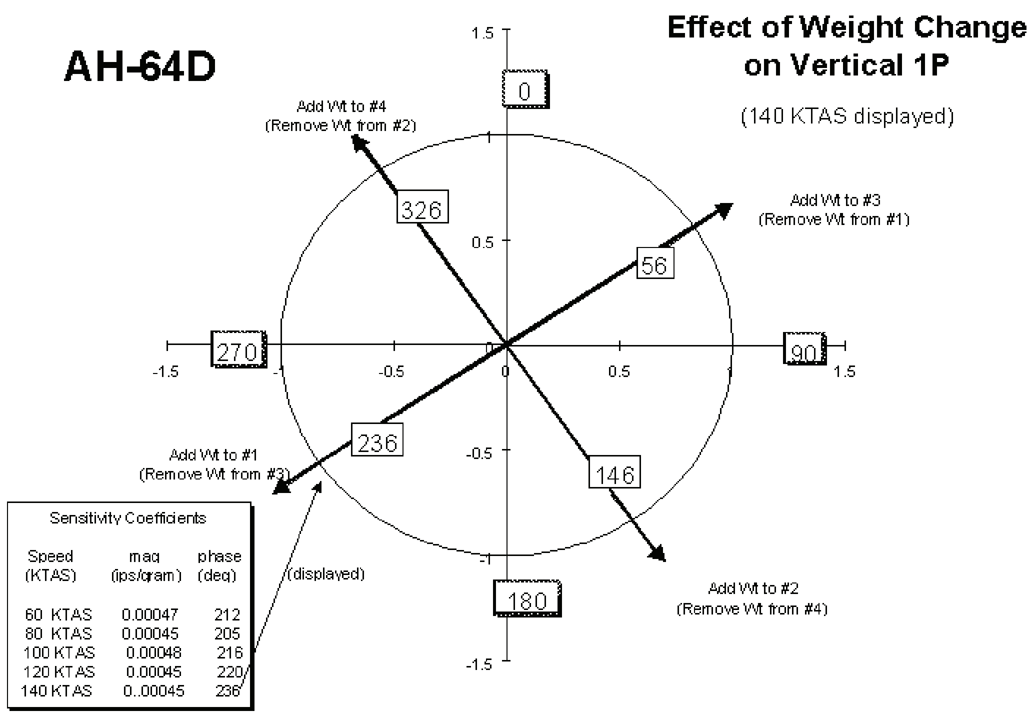


Figure 27. Effect of Weight Change on Vertical 1/REV (AH-64D)

Main Rotor Track and Balance Guidelines:

a. NEVER ignore an AVA adjustment. Instead, turn the adjustment off and re-calculate the corrections.

b. For a “new” rotor that has not been previously tracked and balanced, perform blade static phasing, remove all hub weights, and zero all tabs.

c. Perform GROUND flight plan. Weights default to OFF, pitch links default to ON. Examine default corrections.

   1. If the maximum pitch link move is 1 flat or more, make the indicated pitch link move(s).
   2. If the maximum pitch link move is 1/2 flat and track spread is greater than 0.25 inch, View Predictions and look at the predicted lateral. If predicted lateral is less than 0.1 ips, make the pitch link moves only. If predicted lateral is 0.1 ips or more, turn blades 1 and 2 weights ON, and make the computed weight/pitch link adjustments.
   3. If track spread is 0.25 inch or less but lateral vibration is 0.1 ips or more, Edit Adjustables to turn OFF all pitch links and turn ON blades 1 and 2 weights. Perform the weight-only correction.
   4. Repeat GROUND flight plan until track spread is within 0.25 inch and lateral vibration is below 0.1 ips.

d. Perform FLIGHT flight plan. Obtain measurements up to the highest forward speed that can be safely achieved (pilot’s discretion). Minimizing vibration is the primary goal of the moves given. Track is secondary.

   1. Default adjustables are pitch links and tabs (weights default to OFF) and the default solution will normally be comprised of both adjustment types.
   2. If any 6 - 10 or 8 - 10 tab adjustment is 2° or more, turn off the excessive 6 - 10 or 8 - 10 tab and turn on the next larger tab region on that blade (4 - 10 or 6 - 10). Recompute the tab adjustments. Make the smaller bend to the larger region.
   3. If max measured forward flight vertical vibration is 0.6 ips or more, View Corrections & Predictions.
      (a) If measured hover and ground lateral are both within limits, turn off all 4 pitch links and examine the tab only solution and predictions. If the tab only solution is as good or nearly as good as the pitch link/tab solution, make the tab only solution.
      (b) If measured hover or ground lateral is above limits, but predicted hover and ground lateral are both within limits, perform the default pitch link/tab corrections.
      (c) If predicted hover or ground lateral is above limits, turn blades 1 and 2 weights on, recompute corrections, and make the recommended moves.
   4. If max measured forward flight vertical vibration is below 0.6 ips, View Corrections and Predictions.
      (a) If measured hover and ground lateral are within limits, turn off all pitch links, recompute the tab only corrections, and View Predictions. Compare the predicted vibration levels with those of the pitch link/tab solution. If the tab only solution is as good as or nearly as good as the pitch link/tab solution, use the tab only solution. If the solution with pitch links is significantly more effective than the tab only solution, and the pitch link moves are 1 flat or less, use the pitch link/tab solution. If the pitch link moves are more than 1 flat, make the tab-only moves.
      (b) If no tabs have been turned on by default, turn ON tabs 8 - 10 for all 4 blades and turn all pitch links OFF. Examine the predictions. Then turn all 4 pitch links back on with all 4 8 - 10 tabs and examine the predictions. Compare the 3 sets of predictions (pitch links only, pitch links and tabs, and tabs only). Throw out any pitch link solution with moves larger than 1 flat. If the tab only solution is as good or nearly as good as the solutions with pitch links, make the tab only adjustments. If either of the pitch link solutions looks significantly better than the tab only solution, make the more reasonable of the pitch link only or pitch link/tab adjustments.
      (c) If measured hover or ground lateral is above limits, examine the corrections and predictions for the default solution. Turn blades 1 and 2 weights on and examine the corrections and predictions. Next, turn all 4 pitch links off and examine the predictions. If the weight/tab solution predicts to bring the laterals in limits and is nearly as good as or is as good as the other two solutions with pitch links, make the weight/tab solution. The weight/pitch link/tab solution should only be made if it is significantly better than the other two solutions.

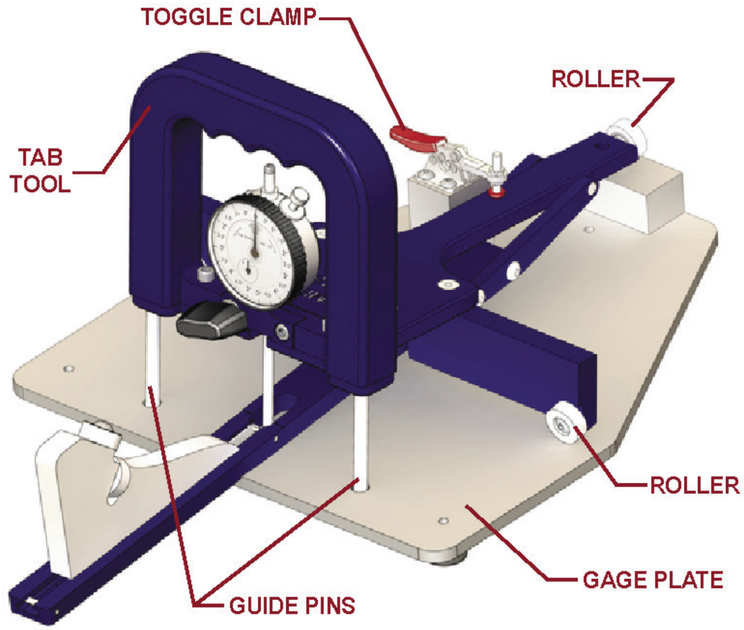


Figure 28. Tab Tool (Side View)

(d) AH-64 Tab Tool User Guide.

(1) Place folded Tab Tool (Figure 28) on Gage Plate making sure Guide Pins are inserted into alignment holes and all three Rollers are resting on Gage Plate. Clamp Tab Tool in place by pushing downward on Toggle Clamp arm.

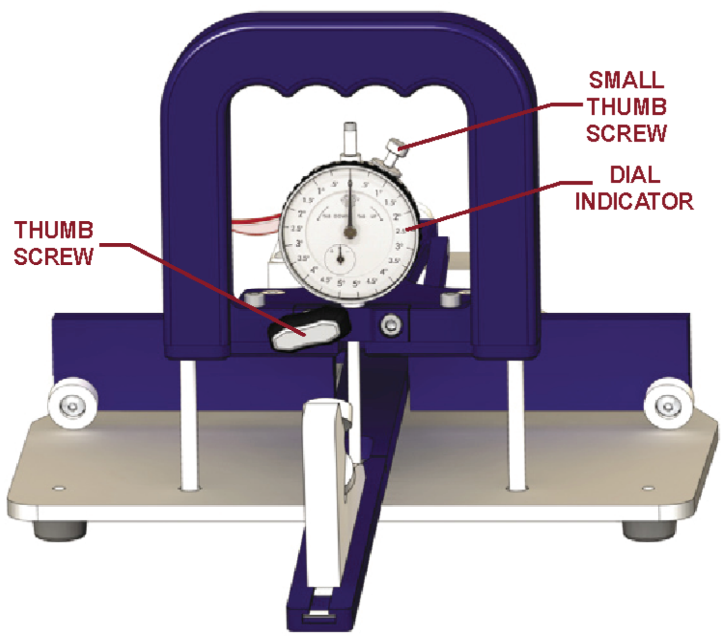


Figure 29. Tab Tool (Front View)

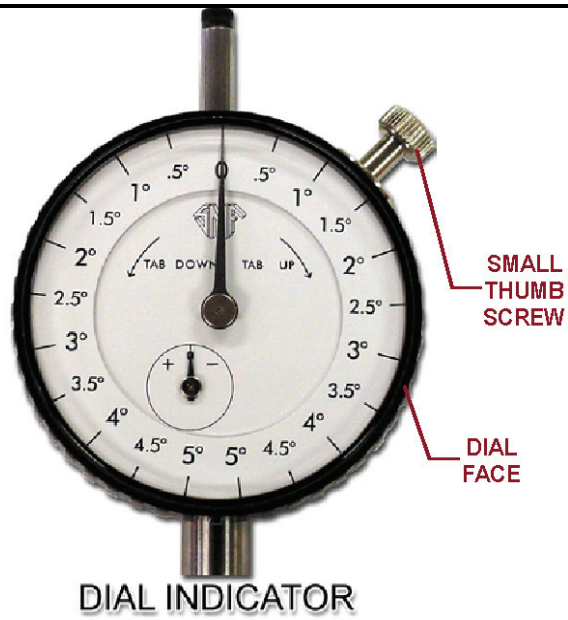


Figure 30. Dial Indicator

(2) Loosen Thumb Screw (Figure 29) and slide Dial Indicator until small pointer reads “0” and large pointer reads 0°. Tighten Thumb Screw. To make fine adjustments, loosen Small Thumb Screw on top of indicator and turn Dial Face (Figure 30) until pointer reads 0°. Retighten Small Thumb Screw.

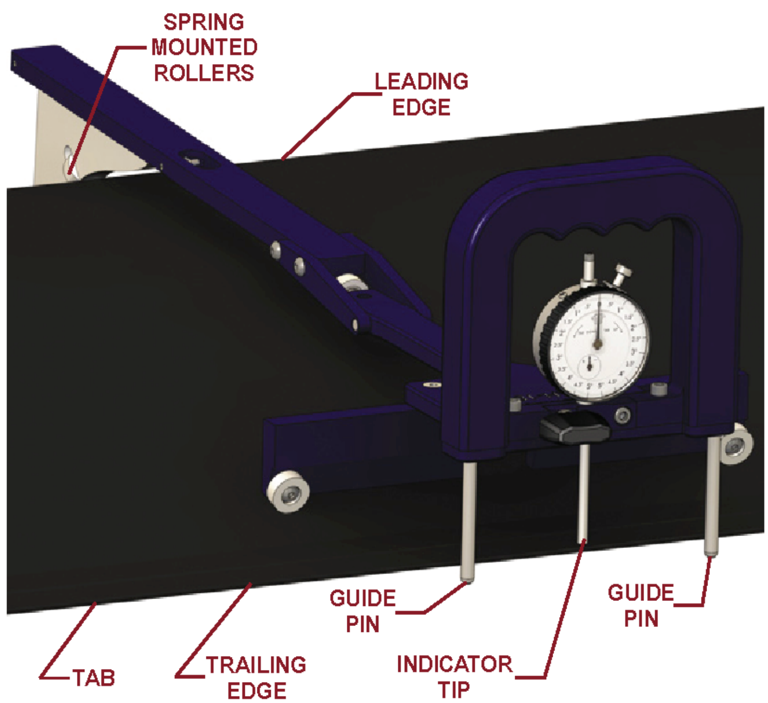


Figure 31. Tab Tool Removed From Gage Plate

(3) Remove Tab Tool from Gage Plate (Figure 31). Unfold arm and attach to blade, hooking the Spring Mounted Rollers to Leading Edge of blade and hooking the 2 Guide Pins on Trailing Edge of Tab. Indicator Tip should rest on top surface of Tab.

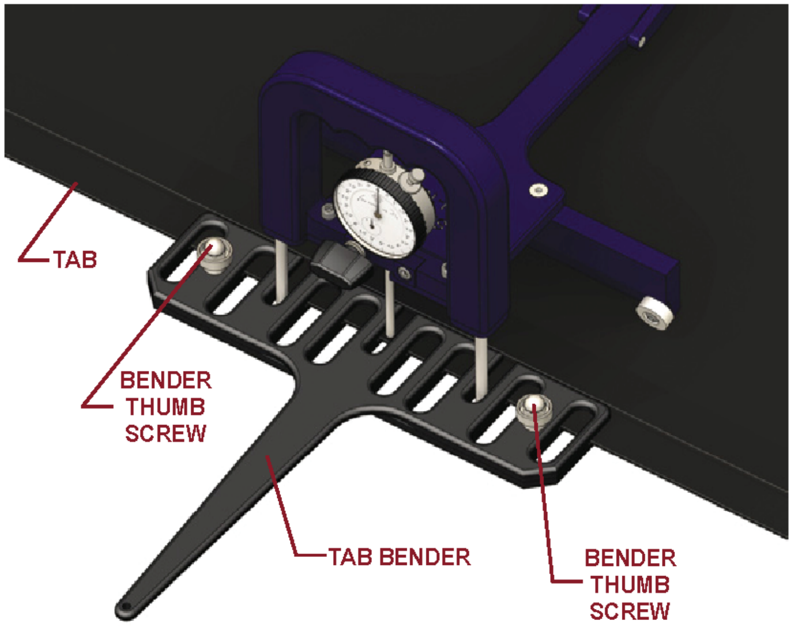


Figure 32. Tab Bender

(4) Roll Tab Tool to desired blade pocket requiring adjustments. Loosen the 2 Bender Thumb Screws (Figure 32). Place Tab Bender on Tab. Tighten Bender Thumb Screws, making sure not to over tighten.

NOTE

To properly measure a pocket, ensure Tab Bender is Inserted on blade with Thumb Screws tighten as shown.

(5) Adjust Tab to desired degrees by bending upward or downward at pocket. Loosen Bender Thumb Screw and remove Tab Bender before moving to next pocket.

End of Work Package

AVA APPLICATION AND PROCEDURES – OH-58 A/C

(Script File No. OH58AC.CMD)

WARNING

Use extreme care when flying with UTD mounted. UTD interferes with wire strike capabilities.

CAUTION

Never install cables where they can be damaged. Use wire bundle ties or clamps to route cabling along or through airframe instead of securing cables with fairing doors, panels, or seat frames. Never bundle tie cables to flight controls.

TASK 1 - TEST EQUIPMENT INSTALLATION/CHECKOUT
TASK 2 - BALANCE TAIL ROTOR
TASK 3 - FLAT TRACK MAIN ROTOR ON THE GROUND
TASK 4 - BALANCE MAIN ROTOR ON THE GROUND
TASK 5 - TRACK MAIN ROTOR IN FLIGHT
TASK 6 - ISOLATING IRREGULAR/UNUSUAL VIBRATIONS

PERSONNEL REQUIRED

Three People Required:

- Test Pilot
- Aircraft Mechanic
- Inspector/Supervisor

SUPPLIES

- Corrosion Preventive Compound (C42)
- *Reflective Tape (10605000)
- Nut, self-locking (MS21042-5), NSN 5310-00-807-1469
- Lockwire MS20995NC32 (Task 1)

TOOLS

- Aircraft Mechanic's Toolkit, NSN 5180-00-323-4692
- Aircraft Adapter Kit, (29316000) NSN 6625-01-325-8536
- Torque Wrench 150-750 in-lb, NSN 5120-00-821-3444
- *Data Acquisition Unit (DAU) (29328203)
- *Control and Display Unit (CADU) (29314106)
- *10-ft CADU to DAU Cable (29325601)
- *Universal Tracking Device (UTD) (29310700)
- *25-ft UTD Cable (29325701)
- *54 mV/g Accelerometers (28110900) (2 each)
- *Accelerometer Mounting Brackets (29313000) (2 each)
- *10-ft Aircraft Power Cable (29104700)

*Included in AVA Basic Kit

- *Magnetic RPM Sensor (27288400)
- *Magnetic RPM Sensor Cable (29105403)
- Magnetic RPM Sensor Bracket (29316100)
- Magnetic RPM Sensor Striker Plate (29316300)
- OH-58 A/C UTD Bracket (29328000)
- *25-ft 54mV/g Accelerometer Cables (29105605) (1 ea.)
- *Optical RPM Sensor Mounting Bracket (29198600)
- *50-ft Accelerometer Cable (29105600)
- *Optical RPM Sensor (29314700)
- *OH-58 A/C Aircraft Setup File (installed in CADU)
- AVA Basic Kit, Rotor Track & Balance NSN 6626-01-282-3746

ALSO NEEDED

- Balance Weights (as required)
- Tab Measuring and Bending Tools (T16, T17)

REFERENCES

- TM 55-1520-228-10
- TM 55-1520-228-23
- TM 55-1520-228-MTF
- TM 1-6625-724-13&P

The OH-58 A/C Flight Plans are listed below with a brief description of their purposes. The selectable Flight Plans (see Table 1) are listed in order of appearance in the menu on the CADU and not in the order in which they are to be performed.

FLIGHT

This test is primarily designed to reduce the in flight vertical vibrations using pitch links, sweep, tab, and weight. It is to be used after the GNDTRK and INITIAL flight plans when smoothing an aircraft after component change, or for "tuning up" an aircraft that is already in service.

GNDTRK

This flight plan is designed to get the rotor into a flyable track prior to hovering. It consists of two measurements, and will adjust pitch links only. It should be the first test that is performed after any component change or major rework on the rotor.

INITIAL

This flight plan is performed after the GNDTRK, and will balance the rotor prior to flight. It will adjust pitch links, weights, and sweep to perform this goal. This test may be performed first if the status of the rotor components is known (i.e., the same pitch links and blades were re-installed after a phase).

PROBES

This flight plan is designed to acquire data from up to four accelerometers to assist in isolating irregular or unusual vibrations. The flight plan will measure data one channel at a time on DAU ACC1 through ACC4. These accelerometers may be installed anywhere on the airframe and will measure a 0 to 500 Hz spectrum (0 to 30,000 RPM). Operator must denote orientation and location of accelerometer.

TAIL

This flight plan is designed to balance the OH-58 A/C tail rotor. It uses the optical RPM sensor on TACHO 2 and one accelerometer on ACC4. It should be performed after any rework on the tail rotor or anytime a medium to high frequency vibration is felt in the aircraft.

Table 1. OH-58 A/C Flight Plans and Test States

Flight Plan	Test States	Test Conditions
FLIGHT	IDLE	A – 245 RPM, Flat Pitch C/A 720 – 70% NR, Flat Pitch
	35% TQ	A – 103% NR, 30psi TQ C/A 720 – 100% NR, 35% TQ
	Hover	IGE Hover into the wind
	Climb	60Kts, at 1000 ft/min Climb
	80K	80Kts, Level Flight
	110K	110Kts, Level Flight
	L/DOWN	60Kts, 1000 ft/min Descent
GRNDTRK	Idle	A – 245 RPM, Flat Pitch C/A 720 – 70% NR, Flat Pitch
	35% tq	A – 103% NR, 30 psi TQ C/A 720 – 100% NR, 35% TQ
INITIAL	IDLE	A – 245 RPM, Flat Pitch C/A 720 – 70% NR, Flat Pitch
	35% TQ	A – 103% NR, 30 psi TQ C/A 720 – 100% NR, 35% TQ
	Hover	IGE Hover into the Wind
PROBES	ACC1 ACC2 ACC3 ACC4	Use as Required
TAIL	FPGTL	A – Tail Balance – Flat Pitch, 103% NR, 30 psi TQ C/A 720 – Tail Balance – Flat Pitch, 100% NR

TASK 1-TEST EQUIPMENT INSTALLATION/CHECKOUT

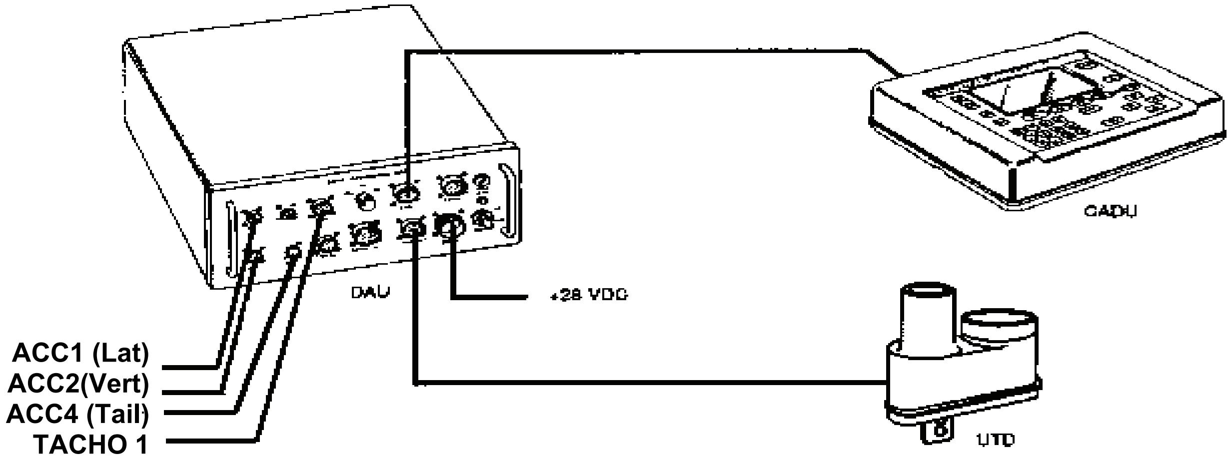


Figure 1. Typical AVA Test Setup Configuration

NOTE

If main and tail rotor track and balance is to be accomplished at the same time, always balance the tail rotor first. Refer to Task 2.

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA blade tracking equipment from transport case. Check for possible damaged equipment and frayed cables. Figure 1 is the typical AVA test setup configuration.

b. Install DAU in canvas carrying case.

c. Place DAU in a back seat with the connectors facing up and secure using aircraft shoulder and lap belts and canvas straps.

d. Connect the DC power cable (29317100) to the aircraft power receptacle in the overhead panel and to the DAU receptacle marked 28 Vdc.

e. Place CADU in front seat. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: MAGNETIC RPM SENSOR INSTALLATION

a. Remove forward transmission fairing.

b. Place the magnetic RPM sensor bracket (29316100) over the left-front pitch horn of the fixed swashplate, from the top, with the 1/4-28 inch studs pointing down (see Figure 2 and 3).

CAUTION

Install magnetic RPM sensor lower bracket parallel to upper bracket to prevent misalignment of upper bracket.

c. Place the magnetic RPM sensor clamp (29316200) on studs, from the bottom, and secure using the 1/4-28 inch self-locking nuts. Snug the nuts, but **DO NOT** TIGHTEN SO MUCH THAT IT BENDS THE BAR. Replace nuts as required.

NOTE

The jam nuts supplied in the basic kit may be too thick. If they are too thick the alternate jam nuts are (28131100) NSN 5310-00-852-0800.

d. Install jam nut on the magnetic RPM sensor (27288400). Install the sensor into the bracket from the bottom, until the end is flush with the top of the bracket. Fine adjustment of the sensor will be performed later.

e. Rotate the head so that the WHITE blade is at the 3:00 o'clock position (right side of aircraft).

f. Install a single magnetic RPM sensor striker plate (29316300) in the drain hole in the web of the rotating swashplate that is pointing forward, see Figure 2. Insert the 8/32-inch stud from the bottom, with the vane pointing down, so that it passes over the sensor and ahead of the stud, perpendicular to the mast. Place No. 8 self-locking nut on top and tighten.

g. Turn rotor so that the magnetic RPM sensor striker plate is over the magnetic RPM sensor. Using a feeler gauge, adjust the sensor to a gap of 0.060 ± 0.010 inch clearance.

h. Tighten jam nut and install lockwire.

CAUTION

When routing the cable ensure it does not interfere with flight controls and there is adequate slack to allow collective full-up position.

i. Connect magnetic RPM sensor cable (29105403) to the sensor and route to the DAU. Connect the cable to the DAU receptacle marked TACHO 1.

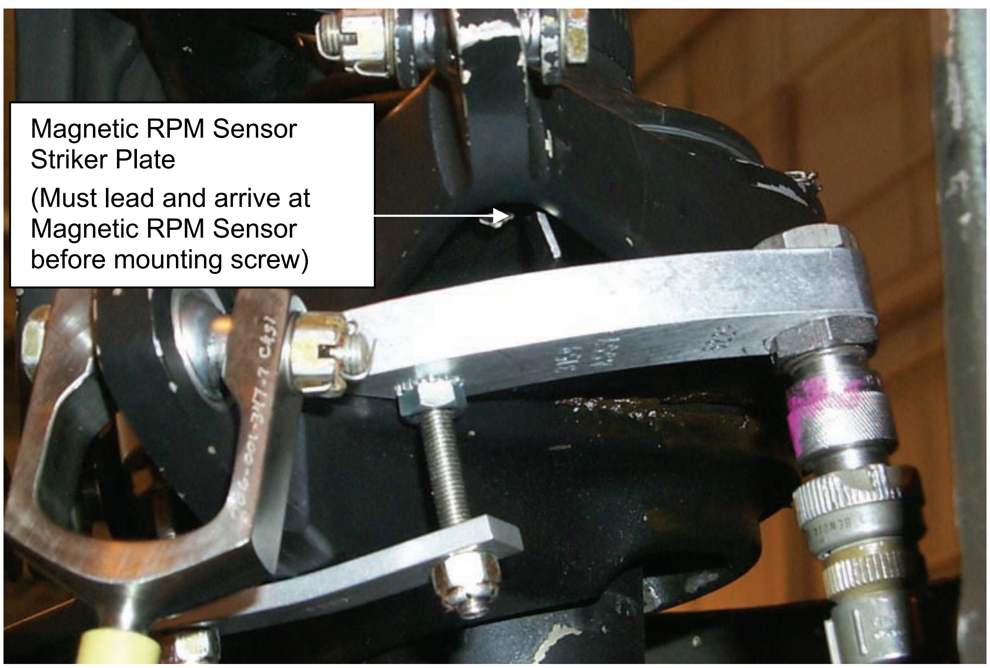


Figure 2. Single Magnetic Interrupter and Magnetic RPM Sensor

PROCEDURE 3: ACCELEROMETER INSTALLATION

a. Open left door on induction fairing.

b. Place the accelerometer mounting bracket (29313000) over the swashplate stud and existing retaining nut at 9 o'clock just below the collective scissors, so accelerometer will point as close as possible to the aircraft 9 o'clock position. See Figure 3.

NOTE

If the collective is raised, there is room to use a socket when installing nut to transmission stud.

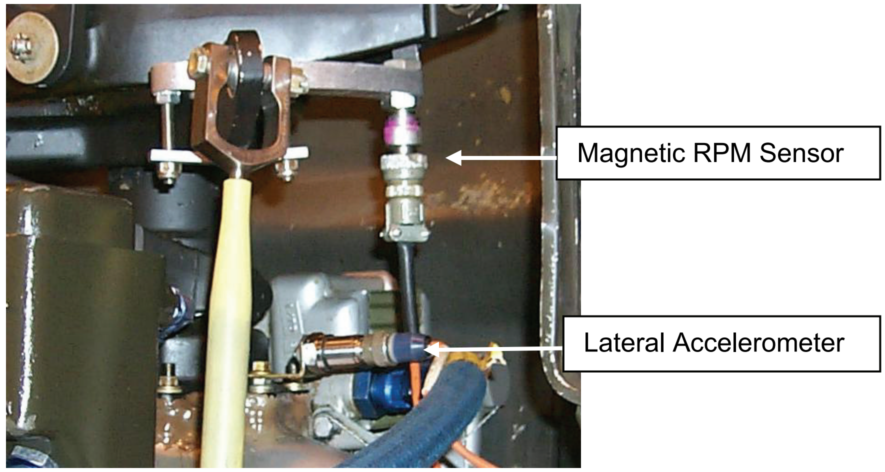


Figure 3. Magnetic RPM Sensor and Lateral Accelerometer Installation

c. Mount the bracket with a second nut and tighten. This will "pinch" the bracket tightly between the two nuts.

NOTE

If the second nut cannot be obtained, then the bracket can be mounted by first removing the nut from the transmission stud, placing the accelerometer mounting bracket over the transmission stud, and then reinstalling the nut.

d. Install accelerometer (28110900) on accelerometer mounting bracket (29313000).
e. Connect accelerometer cable (29105600) from accelerometer to the DAU receptacle marked ACC1.
f. Mount accelerometer bracket (29313000) on left side of instrument panel using aircraft panel screw at approximate location of co-pilot's right knee (see Figure 4).
g. Install accelerometer (28110900) on accelerometer mounting bracket so that the connector is pointing down.
h. Connect accelerometer cable (29105600) from accelerometer to the DAU receptacle marked ACC2.

Figure 4. Vertical Accelerometer Installation

PROCEDURE 4: TRACKER INSTALLATION

NOTE

It may be necessary to replace the aircraft screws with longer screws in order to mount the UTD mounting bracket.

a. Remove airframe screws, and install UTD mounting bracket (29328000) to chin of aircraft just above the landing light, see Figure 5.
b. Secure UTD mounting bracket with screws long enough to pass through the mating fastener and extend a minimum of two threads.

NOTE

If the UTD captive mounting bolts are lost or damaged, use NAS1305-14 bolts as replacements.

c. Mount UTD (29310700) on bracket (make sure UTD is mounted on opposite side of nutserts), also ensure that the night lens (red lens on UTD) is below the optical lens (clear lens).
d. Connect the UTD cable (29325701) to UTD connector and connect to the DAU receptacle marked TRACKER 1.
e. Ensure that the TRACKER MODE switch on the front of the DAU is in the DAY position.

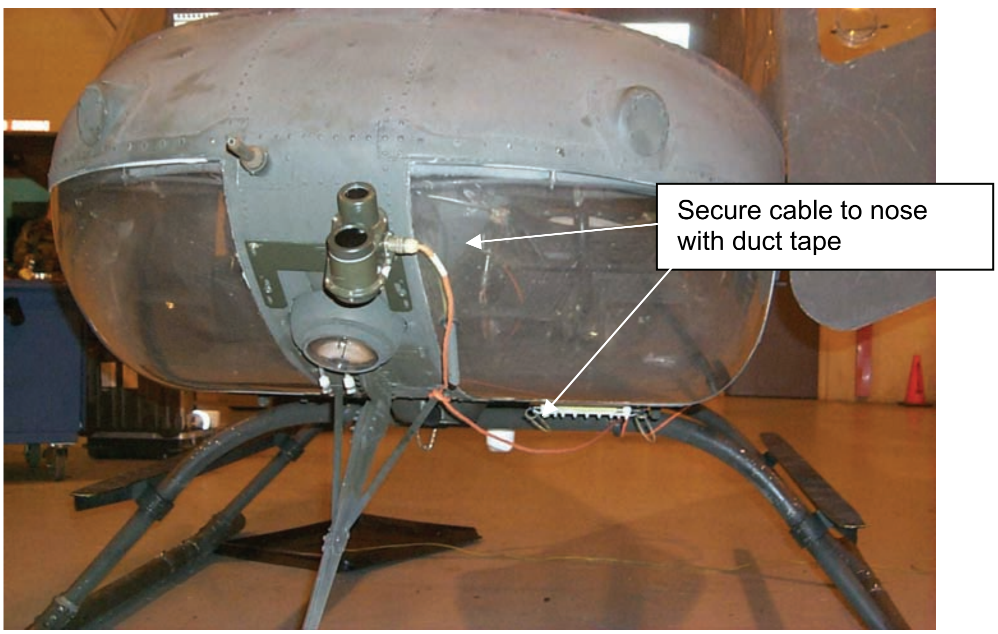


Figure 5. UTD Mounting Bracket

PROCEDURE 5: NIGHT TIME TRACKING INSTRUCTIONS

NOTE

The following steps are to be taken if nighttime tracking is anticipated. If no flights will be performed after dusk, proceed directly to Task 3.

a. Ensure that the TRACKER MODE switch on the front of the DAU is in the NIGHT position.
b. Ensure that the underside, trailing edge of all blades is as clean as possible. This is necessary for optimum adhesion of the reflective tape.

c. Place a single, 3-ft section of reflective tape on the underside, trailing edge of each blade as shown on Figure 5. Ensure that the tape is smooth and as straight as possible using the edge of the blade as a reference.

d. If verification of the tape placement is desired, it can be viewed by holding a flashlight near your head and shining it at the rotating blades. Any misplaced sections of the tape will stand out.

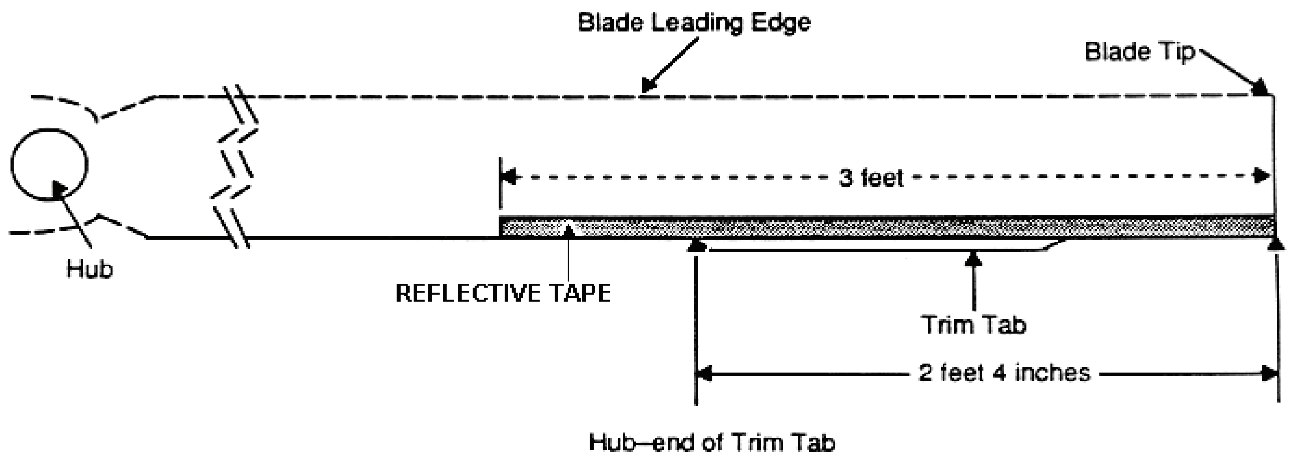


Figure 6. Placement of Reflective Tape on Rotor Blades

NOTE

Remove the reflective tape when the procedure is complete.

TASK 2 - BALANCE TAIL ROTOR

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA tail rotor balancing equipment from transport case. Check for possible damaged equipment and frayed cables.
b. Install DAU in canvas carrying case.
c. Place DAU in a back seat with the connectors facing up and secure using aircraft shoulder and lap belts and canvas straps.
d. Connect the DC power cable (29104700) to the aircraft power receptacle in the overhead panel and to the DAU receptacle marked 28 Vdc.
e. Place CADU in front seat. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: ACCELEROMETER INSTALLATION

a. Mount accelerometer mounting bracket (29313000) on the top stud of the tail rotor gearbox flange, Figure 6, with existing hardware.
b. Install accelerometer (28110900) on bracket with the connector pointing up.
c. Connect accelerometer cable (29105600) to accelerometer.

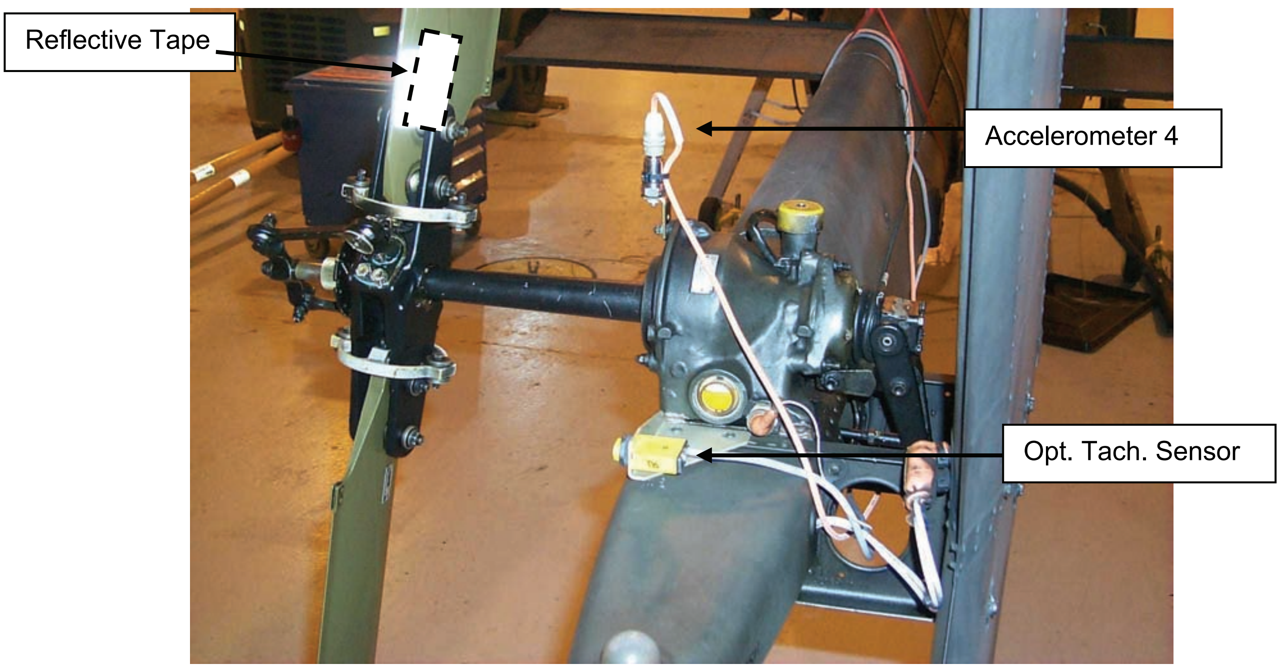


Figure 7. Installation of Accelerometer and Optical RPM Sensor Mounting Brackets

CAUTION

Keep accelerometer cable snug around tail boom to ensure cable does not contact tail rotor. Do not pull cable taut at accelerometer.

d. Wrap cable around tail boom and pass cable into cockpit. Ensure that there is a 1-inch loop of slack near the accelerometer to prevent the cable from being pulled out of the potted connector.

CAUTION

Take care that accelerometer cable cannot fall into the shaft or couplings.

e. Pass accelerometer cable between tail boom and drive shaft if the drive shaft cover is not installed.
f. Connect accelerometer cable to the DAU receptacle marked ACC4.

PROCEDURE 3: OPTICAL RPM SENSOR INSTALLATION

a. Remove the two screws at the base of the tail rotor gearbox just below the oil level sight glass, see Figure 7.
b. Mount optical RPM sensor mounting bracket (29198600) at the base of the gearbox using the two screws. The rectangular hole should be toward the left side of the aircraft.
c. Mount optical RPM sensor (29314700) to the bracket, facing the tail rotor.
d. Route the optical RPM sensor cable the same as the accelerometer cable, Procedure 2.
e. Connect the optical RPM sensor cable to the DAU receptacle marked TACHO 2.

NOTE

If there is any tape remaining from previous balance routines, this must be completely removed to ensure a clear and accurate tachometer signal to the DAU.

f. Place a single, 3-inch strip of reflective tape on the inside of one of the tail rotor blades, Figure 8, at the approximate location of the beam from the optical RPM sensor.
g. Proper alignment of the tape can be verified by applying AC power to the DAU and rotating the tail rotor until the taped blade passes in front of the optical RPM sensor. When the tape is in line with the optical RPM sensor the red LED on the back of the sensor will flash.

PROCEDURE 4: PERFORM TAIL MEASUREMENT

a. Operate aircraft at appropriate percentage.
b. Turn on DAU.
c. Turn on CADU.
d. Press **QUIT** on the CADU until all selections are undefined.
e. Use cursor keys to highlight Aircraft Type, then press **DO**.
f. Use cursor keys to highlight OH-58A/C, and then press **DO**.
g. Tail Number is highlighted. Press **DO**.
h. Use cursor keys to highlight a tail number or enter a new tail number (up to seven characters), then press **DO**.
i. Flight Plan is highlighted. Press **DO**.
j. Use cursor keys to highlight TAIL. Press **DO**. Enter the Measure mode by pressing **F1**. Verify that Test State FPGTL is highlighted.
k. Press **DO** when the aircraft is stable at the highlighted selection. Re-verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire balance data and return to the selection menu.
l. After the measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu.
m. If measured values exceed specification, press **DO** to enter the DIAGS mode. Evaluate the percentage improvements obtainable through further corrective actions and the ability to perform the corrections.
o. Perform all desired corrections displayed on the diagnostic screen. Check to ensure that all screens of a multiple screen solution have been displayed.
p. If alterations of these corrective actions are desired, use the Edit Adjustables and Edit Defaults options and use all of the edited adjustments.
q. After corrections are made, repeat Procedure 4 to verify the corrections.

r. After more than one measurement has been taken, Trend Flights to ensure that the vibration is being reduced (going towards the center of the polar chart).

s. Remove test equipment and make appropriate log entries.

TAIL ROTOR DEGREE/CLOCK ANGLE.

The degree/clock angle location for balance weight installation given by the AVA, is referenced by direction of rotation as follows:

- 0 degree/12 o'clock is the T/R blade (target) that has the reflective tape installed. See Figure 7.
- 90 degrees/3 o'clock is at a right angle from the trailing edge of the target blade.
- 180 degrees/6 o'clock is directly opposite the target blade.
- 270 degrees/9 o'clock is at a right angle from the leading edge of the target blade.

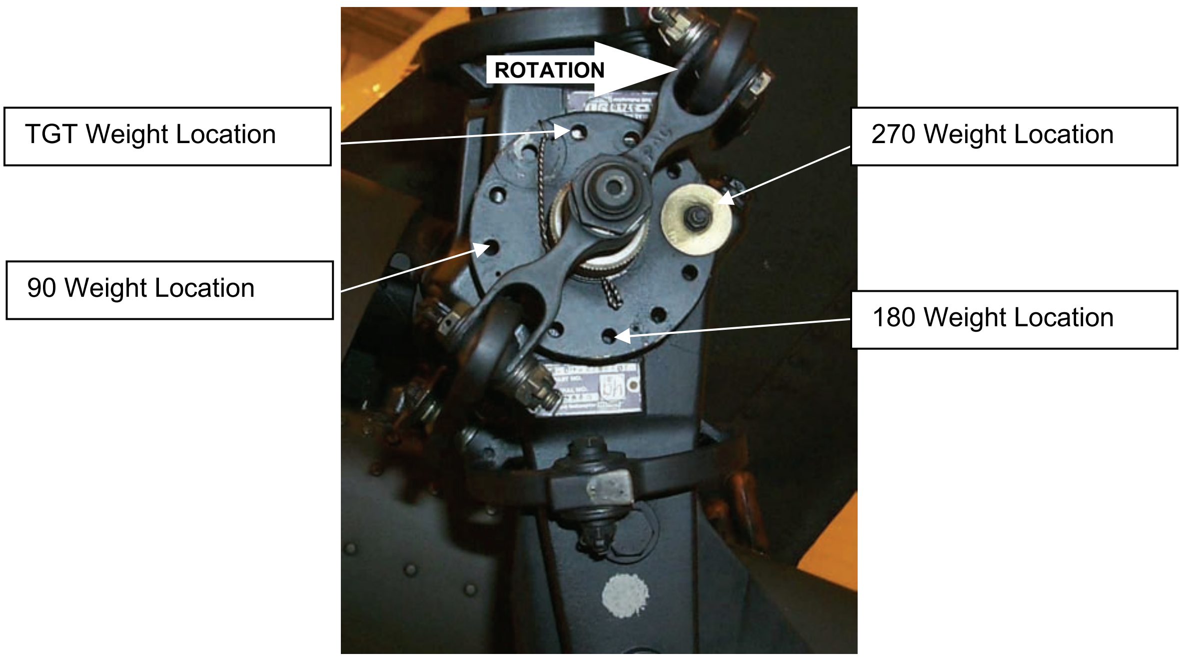


Figure 8. Tail Rotor Balance Weight Installation

TASK 3- FLAT TRACK MAIN ROTOR ON THE GROUND

PROCEDURE 1: PREPARATION

a. Install test equipment (refer to Task 1).
b. Operate aircraft at appropriate percentage. See Table 1.
c. Turn on DAU.
d. Turn on CADU.

PROCEDURE 2: PERFORM GROUND TRACK (GNDTRK) MEASUREMENT

a. Press **QUIT** on the CADU until all selections are undefined.
b. Use cursor keys to highlight Aircraft Type, and then press **DO**.
c. Use cursor keys to highlight aircraft type OH-58A/C, and then press **DO**.
d. Tail Number is highlighted. Press **DO**.
e. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.
f. Flight Plan is highlighted. Press **DO**.
g. Use cursor keys to highlight GNDTRK. Press **DO**.
h. Enter the Measure mode by pressing **F1**. Verify that Test State Idle is highlighted.
i. Press **DO** when the aircraft is stable at the highlighted selection. Re-verify that the aircraft is at the required Test State (Idle or 35% tq) and press **DO** again. Perform this operation each time a measurement is completed and another Test State is highlighted. The AVA will acquire track data and return to the selection menu.
j. After the last measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu.
k. If measured values exceed specification, press **DO** to enter the DIAGS mode.
l. Perform all corrections displayed on the diagnostic screen. Check to ensure that all screens of a multiple screen solution have been displayed.
m. After corrections are made, repeat Procedure 2 to verify the corrections.
n. If measurements are within limits proceed to Task 4.

TASK 4 - BALANCE MAIN ROTOR ON THE GROUND

PROCEDURE 1: PREPARATION

Perform Task 3 if major maintenance has been accomplished where a main rotor blade has been changed or PCL length has been altered.

PROCEDURE 2: PERFORM INITIAL MEASUREMENT

a. Use cursor keys to highlight Aircraft Type, and then press **DO**.
b. Use cursor keys to highlight aircraft type OH-58A/C, and then press **DO**.
c. Tail Number is highlighted. Press **DO**.
d. Use cursor keys to highlight a tail number or enter a new tail number (up to seven characters), then press **DO**.
e. Flight Plan is highlighted. Press **DO**.
f. Use cursor keys to highlight INITIAL. Press **DO**.
g. Enter the MEASURE mode by pressing **F1**. Verify that Test State Idle is highlighted.
h. Press **DO** when the aircraft is stable at the highlighted selection. Re-verify that the aircraft is at the required Test State (IDLE, 35% TQ, or Hover) and press **DO** again. Perform this operation each time a measurement is completed and another Test State is highlighted. The AVA will acquire track and vibration data at each Test State and then return to the selection menu.
i. After the last measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu, then proceed to step ‘o’.
j. If measured values exceed specification, press **DO** to enter the Diagnostics mode.
k. Perform all corrections displayed on the diagnostic screen. Check to ensure that all screens of a multiple screen solution have been displayed.
l. If unable to perform corrective actions, use the Edit Adjustables option to obtain an alternate solution.
m. After corrections are made, repeat Procedure 2 to verify the corrections.
n. After more than one measurement has been taken, Trend Flights.
o. Perform Task 5.

TASK 5 - TRACK MAIN ROTOR IN FLIGHT

Main rotor in-flight vertical tracking should be performed when any of the following occurs:

- 1/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 adjustments (Task 3 or 4).

PROCEDURE 1: EQUIPMENT INSTALLATION

NOTE

Aircraft ground track and balance specified requirements (Tasks 3 and 4) are to be completed prior to performing in flight Test States unless aircraft is already in service and flying.

a. Install test equipment, (see Task 1).
b. Turn on DAU.
c. Turn on CADU.

PROCEDURE 2: PERFORM FLIGHT MEASUREMENTS

a. Press **QUIT** on the CADU until all selections are undefined.
b. Use cursor keys to highlight Aircraft Type, then press **DO**.
c. Use cursor keys to highlight aircraft type OH-58A/C, and then press **DO**.
d. Tail Number is highlighted. Press **DO**.
e. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.
f. Flight Plan is highlighted. Press **DO**.
g. Use cursor keys to highlight FLIGHT. Press **DO**.
h. Enter the Measure mode by pressing **F1**. Verify that Test State Idle is highlighted.

WARNING

If main rotor 1/REV vibration becomes objectionable, acquire data normally through the highest airspeed at which vibration can be tolerated. Do not skip test conditions, data should be taken from ground to the highest airspeed possible. After data is taken at the highest speed achieved, Press QUIT then highlight "Save and Exit" and then press DO. Land the aircraft and perform corrections suggested by the CADU prior to further flight.

i. Press **DO** when the aircraft is stable at the highlighted selection. Reverify that the aircraft is at the required Test State (IDLE, 35% TQ, Hover, CLIMB, 80K, 110K, or L/DOWN) and press **DO** again. Perform this operation each time a measurement is completed and another Test State is highlighted. The AVA will acquire track and vibration data and return to the selection menu.
j. After the last measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu, then go to step q.
k. If measured values exceed specification, press **DO** to execute diagnostics. AVA will make recommendations to correct for excessive vibration.

l. Perform all corrections displayed on the diagnostic screen. Check to ensure that all screens of a multiple screen solution have been displayed.

m. If alterations of these corrective actions are desired, use the Edit Defaults options and adjust the Maximum # of Adjustments up or down starting at three (3) to obtain the desired results on the View Predictions page.

n. After more than one measurement has been taken, Trend Flights to determine if the vibration is being reduced to acceptable limits.

o. Perform autorotational check as per TM 55-1520-228-MTF on first flight after major maintenance. If aircraft is in service and autorotation rpm has been previously set, proceed to step p.

p. After corrections are installed, fly the aircraft and repeat Task 5 to re-check the 1/REV vibrations through the required flight conditions.

q. Remove test equipment and make appropriate log entries.

TASK 6 - ISOLATING IRREGULAR/UNUSUAL VIBRATIONS

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA equipment from transport case. Check for possible damaged equipment and frayed cables.
b. Install DAU in canvas carrying case.
c. Place DAU in a back seat with the connectors facing up and secure using aircraft shoulder and lap belts and canvas straps.
d. Connect the DC power cable (29104700) to the aircraft power receptacle in the overhead panel and to the DAU receptacle marked 28 Vdc.
e. Locate CADU in aircraft. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: ACCELEROMETER INSTALLATION

NOTE

Data can be acquired from up to four accelerometers to assist in isolating irregular or unusual vibrations. Operator must denote orientation and location of each accelerometer.

a. Mount/install accelerometer (28110900) (found in the basic kit) anywhere on the airframe that an irregular or unusual vibration is detected.
b. Connect accelerometer cable (29105800) (found in the basic kit) from accelerometer to the DAU receptacle marked ACC1, ACC2, ACC3, and/or ACC4. The flight plan will measure data on one channel at a time.

PROCEDURE 3: PERFORM PROBES MEASUREMENTS

a. Operate aircraft at desired flight condition. This should be the RPM or airspeed at which the vibration is strongest.
b. Turn on DAU.
c. Turn on CADU.
d. Press **QUIT** on the CADU until all selections are undefined.
e. Use cursor keys to highlight Aircraft Type, and then press **DO**.
f. Use cursor keys to highlight OH-58A/C, and then press **DO**.
g. Tail Number is highlighted. Press **DO**.
h. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.
i. Flight Plan is highlighted. Press **DO**.
j. Use cursor keys to highlight PROBES. Press **DO**.
k. Enter the MEASURE mode by pressing **F1**. Verity that Test State ACC1 is highlighted.
l. Press **DO** when the aircraft is stable at the highlighted selection. Re-verify that the aircraft is at the required Test State (ACC1, ACC2, ACC3, or ACC4) and press **DO** again. The flight plan will measure data on one channel at a time. Perform this operation each time a measurement is completed and another Test State to be measured is highlighted. The AVA will acquire vibration data at each selected Test State and then return to the selection menu.
m. After the last measurement is completed, press **DO** on Finish, then press **DO** on Main Menu.
n. Enter the Display mode by pressing **F2**. Select One Test State and press **DO**. Review each of the spectrums measured for any unusual vibrations.
o. Make corrections and repeat Task 6.
p. Make appropriate logbook entry and remove test equipment.

END OF WORK PACKAGE

AVA APPLICATION AND PROCEDURES – OH-58/D
(Script File No. OH58D_R.CMD and OH58DM_R.CMD)

This WP supersedes WP 0071 00 dated 22 December 2003

WARNING

Use extreme care when flying with UTD mounted. UTD interferes with wirestrike capabilities.

CAUTION

Never install cables where they can be damaged. Use wire bundle ties or clamps to route cabling along or through airframe instead of securing cables with fairing doors, panels or seat frames. Never bundle tie cables to flight controls.

TASK 1 - TEST EQUIPMENT INSTALLATION/CHECK OUT
TASK 2 - FLAT TRACK MAIN ROTOR ON THE GROUND
TASK 3 - TRACK AND BALANCE MAIN ROTOR ON THE GROUND
TASK 4 - TRACK MAIN ROTOR IN FLIGHT
TASK 5 - BALANCE TAIL ROTOR
TASK 6 - ISOLATE IRREGULAR/UNUSUAL VIBRATIONS

PERSONNEL REQUIRED

Four People Required:

- Aircraft Mechanic
- Inspector/Supervisor
- Pilot
- Maintenance Test Pilot

TOOLS

- Aircraft Mechanic's Tool Kit, NSN 5180-00-323-4692
- Aircraft Adapter Kit, (29316000), NSN 6625-01-325-8536
- *Data Acquisition Unit (DAU) in canvas carrying case (29328203)
- *Control and Display Unit (CADU) (29314106)
- *10-ft CADU to DAU Cable (29325601)
- *Universal Tracking Device (UTD) (29310700)
- *50-ft Accelerometer Cable (29105600)
- *54 mV/g Accelerometers (28110900)(2 each)
- *Accelerometer Mounting Brackets (29313000) (2 each)
- *10-ft Aircraft Power Cable (29104700)
- *Magnetic RPM Sensor (27288400)
- *Magnetic RPM Sensor Cable (29105403)
- Optical RPM Sensor Mounting Bracket (29198600)
- *25-ft UTD Cable (29325701)
- OH-58D UTD Bracket (29328000)
- *25-ft 54mV/g Accelerometer Cable (29105605)
- *Optical RPM Sensor (29314700)
- Torque Wrench, 150-750 in-lb, NSN 5120-00-821-3444
- AVA Basic Kit, Rotor Track & Balance, NSN 6625-01-282-3746

*Included in AVA Basic Kit

ALSO NEEDED

- Balance Weights (as required)
- Tab Measuring and Bending Tools (T16, T17)

REFERENCES

- TM 1-1520-248-MTF
- TM 1-6625-724-13&P
- TM 1-1520-248-10
- TM 1-1520-248-23

Rotor Smoothing Configuration

Two basic AVA programs are used to smooth the main and tail rotor of the OH-58D. One is OH-58DM, which is used on aircraft with a Mast Mounted Sight (MMS) and is the preferred method and the other is OH-58D, which should be used as a last resort if the MMS is not installed. These programs are stored in the CADU under the Aircraft Type option of the Main Menu. The proper configuration for smoothing the OH-58D rotor is with the MMS installed and with no external stores. Working the rotor without the MMS is obsolete.

Factory Settings of Blades

All rotor blades are mass balanced, have their trim tabs set, and have the tip tracking weights set against a master blade at the factory to insure interchangeability. These settings are stenciled on the root end of the blade. Since the blade is set to a master, the actual weight of the blade and the stenciled tip weight values mean nothing relative to tracking and balancing the rotor. The tab setting is the recommended “zero” setting or starting point for the tab when tracking new rotors.

Rotor Smoothing Adjustments

Pitch Links:

The pitch links are used primarily to track the rotor at idle rpm and as a fine adjustment for the vertical 1/REV in forward flight. Pitch link adjustments affect the balance of the rotor. The AVA specifies pitch link adjustments in the number of flats to increase or decrease blade pitch. Lengthening the pitch link increases blade pitch and shortening the pitch link decreases blade pitch. Figure 1 shows the direction to turn the barrel to increase or decrease blade pitch. Remember the coarse rod end is on the bottom so that it is the indication on which way to adjust the link, not the upper rod end. Maximum allowed upper rod end thread exposure is 14. Maximum allowed lower rod end thread exposure is 9.

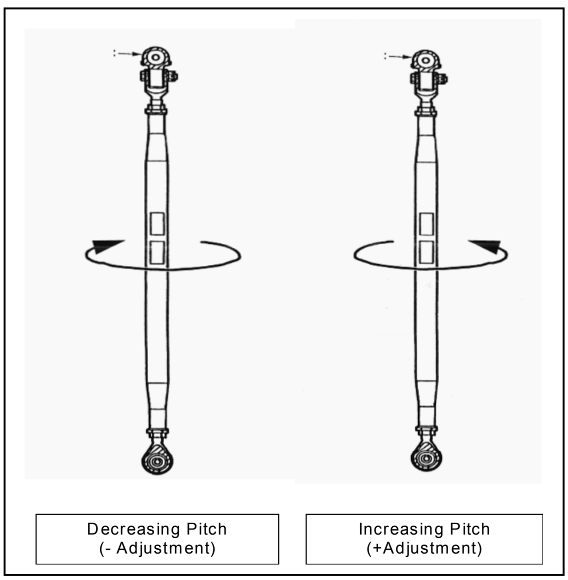


Figure 1. Pitch Link Adjustment

Balance Weights

Balance weights are added to the rotor yoke to mass balance the rotor. With the MMS installed, an out-of-balance of the rotor is detected by a 1/REV at idle. At 100% rpm the MMS absorbs most of the out-of-balance forces. On the OH-58D the proper use of balance weights is to reduce the 1/REV vibration at idle. AVA specifies hub balance adjustments as the number of grams to be added to or removed from the orange or red balance locations (obviously, the opposite adjustment can be made to the opposite blade). The maximum balance weight that can be installed per location is approximately 680 grams, which includes a maximum of four (212-010-710-3) weights split evenly between the upper and lower side of the yoke. (Note: The U. S. Army has bought some steel 710-3 weights which weigh only ½ of the Bell supplied tungsten weights so use a scale if in doubt.) Bolts up to NAS6204-50 can be used. Longer weight packages could contact the grip in extreme conditions.

Trim Tabs:

The trim tabs are the primary adjustment for vertical 1/REV in forward flight. Coarse adjustments are made on the ground to reduce changes in track from idle to 100% rpm and fine adjustments are made to reduce the vibration in forward flight. The AVA specifies trim tab adjustments as a bending up or bending down of the tab in ½ degree increments. Bending the tab up causes the blade to climb with rpm or airspeed while bending a tab down causes it to dive. The current limit for bending tabs is +/-15 degrees. The proper method of bending a tab is to space the bender away from the blade trailing edge approximately by 1/8 to 3/16 inches. When bending tabs, bend the tabs to a setting approximately 2 degrees past the desired setting and then bend it back to the desired setting. This over bending minimizes creeping of the tab over time. Note: Stiff tabs are the most likely to creep over time as the adhesive has a memory. If a tab creeps back do not bend the tab further, make the opposite move on the opposite blade to minimize the vibration.

Proper Methodology Used to Smooth the OH-58D

As stated, the recommended method for smoothing the OH-58D is conducted only with the MMS installed. The technique of smoothing the rotor without the MMS and then installing the MMS is obsolete and has been found to result in high airframe and MMS 1/REV vibration at idle. Despite some teachings, the only way to balance an OH-58D with the MMS is at idle. If the idle is rough, the rotor is out-of-balance.

The OH-58D is smoothed in two steps: a ground or initial tracking and an in-flight final smoothing of the rotor. Properly conducting the ground or initial step greatly reduces the amount of effort required to smooth the rotor in flight and yields a superior ride.

The recommended ground/initial method to smooth the OH-58D uses these basic steps:

a. Use GRNTRK to adjust pitch links to track the rotor at 65% rotor speed. This corrects for basic lift variations between blades. Getting the rpm correct is critical, it has been found that using the NP to set the rpm correctly is the easiest method because of its fast response.
b. Use INIT-SG with weights turned off and adjust trim tabs at 100% rpm and 35% mast torque as per the MFD to correct for changes in track from idle to 100%rpm. This corrects for pitching differences between blades.
c. Once the track is close for INIT-SG turn hub weights on and use hub balance weights to reduce fore-and-aft 1/REV at idle. This is the last step as pitch link and tab adjustments affect the balance of the rotor.

In the AVA the GRNDTRK flight plan only adjusts the 65% track while the INIT-SG conducts all three operations simultaneously. When initially tracking the rotor using INIT-SG it is best to turn off the hub balance weights until the rotor is in close track. Once the rotor is close to proper track, the hub weights can be left on to finish balancing and tracking the rotor. It should take approximately three initial runs to get the rotor in track. If after three runs the rotor track is not within the 0.1-0.2 inch range, review the adjustment procedures to make sure the correct adjustments are being made and re-orient the aircraft to make sure that the tracker is not looking at the sun or that the sun is at the left front of the aircraft. As long as the 65% and 100% track are in the 0.1-inch range (2-3mm) it is acceptable to discontinue the initial mode and press into flight if problems are being encountered getting the 65% balance acceptable.

NOTE

The better the ground track is the less vibration will be encountered in the first flight and the rotor will be closer to finished levels.

Once the ground tracking or initial phase has been conducted and the aircraft is taken to forward flight, only the tabs and hub weights are used to smooth the rotor. **When smoothing the rotor in flight the 65% rpm condition and at least one forward flight condition must be taken on every run to ensure that the program specifies correct adjustments.** History has shown the idle balance to vary from run to run, this is a characteristic of the aircraft. While the balance may vary, the tabs for reducing vertical in flight are very accurate. If the aircraft is not responding properly to tabs make sure that the over bending method described above is used. If a stiff tab is found use the “Edit Adjustables” to turn off that tab and recalculate the adjustments. When the vertical is close and you do not have confidence in making small tab moves, use the editor to turn off the tabs and turn on the pitch links for the final moves (no more than 1-2 flats). The only criteria for successfully completing the in flight smoothing of the rotor is the vibration levels, the final track does not matter. If all that is out is the track, it is acceptable to stop and consider the aircraft finished. Once the vertical is acceptable and if the fore-and-aft at 65% rpm is still too high, then it is acceptable to conduct only 65% rpm balance runs to get the rotor smoother using the FLT-SG flight plan (edit out trim tabs). Balance moves do not change the vertical 1/REV in flight significantly.

NOTE

Past problems with AVA software have been related to the balance characteristics of the OH-58D at idle and track data errors if proper steps are not made to insure high quality track data. Bell has not altered the basic methods to track and balance the rotor of the OH-58D for six years and have been used on 200+ new and retrofit deliveries. Recent experience has shown them clearly superior to “home grown” methods. The new 65%NRC approach is designed to improve balancing at idle. Exact control of rpm is critical.

FLIGHT PLANS

The OH-58D flight plans are listed below with a brief description of their purposes. The selectable flight plans are listed in order of appearance in the menu on the CADU and not in the order in which they are to be performed. Tables 1 (OH-58D) and 2 (OH-58DM) list those Test States that are associated with each flight plan.

FLI-SG

This flight plan is used to acquire data in flight (FLI). FLI-SG is used with aircraft equipped with standard landing gear (SG). Data is used to produce corrections using weights and trim tabs (the pitch change links are defaulted to OFF). This program assumes that the criteria of the GRDTRK and INT-SG have been met. While track is measured and recorded for each test condition, the ride quality is the deciding factor in releasing the aircraft for service.

GNDTRK

This flight plan is designed to get the main rotor into a perfect mechanical track (all blades within 0.2 inches of each other). Data is used to produce corrections using pitch change links (weight is defaulted to OFF). If the low RPM track (65% Nr) goal is achieved, the pitch change links may not require additional adjustments in subsequent flight Plans. It should be the first test that is performed after any component change or major rework on the main rotor. Ensuring that the ground track is below limits may reduce the time required for initial and in-flight rotor smoothing.

INT-SG

This flight plan is used to acquire data for an initial (INT) setting. INT-SG is used with aircraft equipped with standard landing gear (SG). Data is used to produce corrections using weights, pitch change links and trim tabs. This is the only flight plan that uses all three adjustments. This flight plan is also designed to adjust the main rotor into a perfect mechanical track, but will also give a balance solution. This flight plan should not be abandoned until track at Idle is <0.2 inches, the track change from Idle to 35%_TQ is <0.2 inches and fore/aft vibration is <0.2 ips.

TAIL

This flight plan is designed to balance the tail rotor. The program is the same regardless of the type of aircraft selected (OH-58D or OH-58DM). Data is used to produce corrections using weights for a chordwise or spanwise imbalance.

Table 1. OH-58D Flight Plans and Test States

Flight Plan	Test States	Test Condition
FLI-SG	65% NR 35% TQ Hover 60K 100K 110K L/DOWN	65% NR, Flat Pitch (Use MPD) 35% TQ, 100% NR (Use MPD) Hover (Stabilized Hover Into the wind) 60 Kts, Level Flight 100 Kts, Level Flight 110 Kts, Level Flight 60 Kts at 1000 FT/Min Descent
GNDTRK	65%-NR 35%-TQ	65% NR, Flat Pitch (Use MPD) 35% TQ, 100% NR (Use MPD)
INT-SG	65%_ NR 35%_TQ	65% NR, Flat Pitch (Use MPD) 35%_TQ, 100% NR (Use MPD)
PROBES	ACC1 ACC2 ACC3 ACC4	Used as required. Operator is required to denote location and orientation of accelerometers.
TAIL	100%NR	Flat Pitch, 100% NR (Use MPD)

Table 2. OH-58DM Flight Plans and Test States (Preferred Method)

Flight Plan	Test States	Test Condition
FLI-SG	65%NRC 35% TQ Hover 60K 100K 110K L/DOWN	65% NR, Pitch @ 17% eng. Tq. (Use MPD) 35% TQ, 100% NR (Use MPD) Hover (Stabilized Hover into the wind) 60 Kts, Level Flight 100 Kts, Level Flight 110 Kts, Level Flight 60 Kts at 1000 Ft/Min Descent
GNDTRK	65%Nr	65% NR, Flat Pitch (Use MPD)
INT-SG	65%Nr 65%NrC 35% TQ	65% NR, Flat Pitch (Use MPD) 65% NR, Pitch @ 17% eng. Tq. (Use MPD) 35% TQ, 100% NR (Use MPD)
PROBES	ACC1 ACC2 ACC3 ACC4	Used as required. Operator is required to denote location and orientation of accelerometers.
TAIL	100%NR	Flat Pitch, 100% NR (Use MPD)

TASK 1 - TEST EQUIPMENT INSTALLATION/CHECKOUT

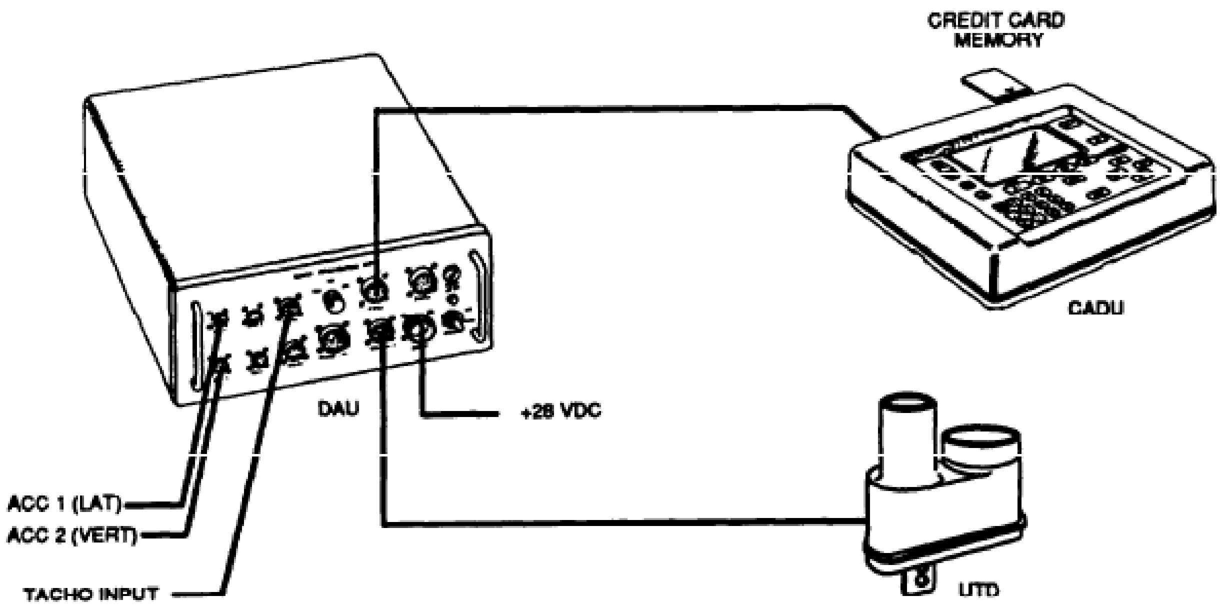


Figure 2. Typical AVA Test Setup Configuration

NOTE

If main and tail rotor track and balance are to be accomplished, always perform task 5 Balance Tail Rotor first.

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA blade tracking equipment from transport case. Check for possible damaged equipment and frayed cables. Figure 2 is the typical AVA test setup configuration.

b. Install DAU in the canvas carrying case. Secure DAU in avionics compartment strapped on top of the ASN-137 Doppler signal data converter using the canvas straps and rings, with connectors facing forward.

NOTE

It is recommended that the CPO cyclic be locked out during rotor smoothing operations.

c. Connect the power cable (29104700) to the aircraft power receptacle located to the right side of the CPO's cyclic and to the DAU receptacle marked 28 Vdc.

d. Place CADU in front cockpit area ensuring not to obstruct the pilot's flight controls. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: MAGNETIC RPM SENSOR INSTALLATION

a. Install magnetic RPM sensor (27288400) through underside of magnetic RPM sensor bracket. The magnetic RPM sensor bracket is permanently installed on the swashplate assembly. Connect previously stowed airframe-supplied magnetic tachometer interface cable to magnetic sensor, see figure 3.

b. Connect magnetic RPM sensor cable (27288400) to connector located to the right side of the CPO's cyclic and to the DAU receptacle marked TACHO 1. As an alternative to using the airframe-supplied harness, you may route the magnetic RPM sensor cable (27288400) externally to the RPM sensor and to TACHO1 on the DAU. The preferred method is to use the airframe-supplied harness. If using the external method of connecting to the RPM sensor, make sure to include enough slack in the cable to allow for swashplate movement during flight.

c. Rotate main rotor blades until the BLUE blade is forward, this should position the interrupter over the RPM sensor. If any other blade is forward at this time, the interrupter requires repositioning.

d. Adjust sensor in bracket to obtain a gap of 0.025 between sensor and interrupter. Secure sensor with jam nuts and install lockwire to hold jam nuts securely in place.

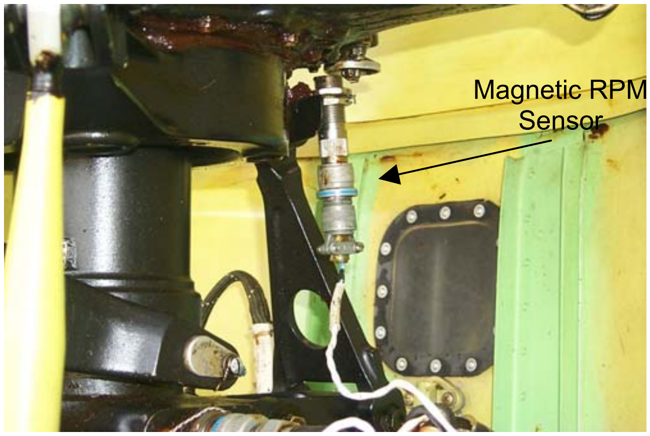


Figure 3. Magnetic RPM Sensor Installation

PROCEDURE 3: FORE/AFT AND VERTICAL ACCELEROMETER INSTALLATION

a. Install one accelerometer (28110900) on accelerometer mounting bracket (29313000). Mount accelerometer bracket to the right side of the pilot's seat pan (side next to the door). Ensure that the connector is facing aft. This is the fore/aft accelerometer, see figure 4.

b. Install one accelerometer (28110900) on accelerometer mounting bracket (29313000). Mount accelerometer bracket on the left side of the pedestal with panel screw. Ensure that the connector is facing down. This is the vertical accelerometer, see figure 4.

c. Connect accelerometer cable (29105605) to fore/aft accelerometer and to the DAU receptacle marked ACC1.

d. Connect accelerometer cable (29105600) to vertical accelerometer and to the DAU receptacle marked ACC2.

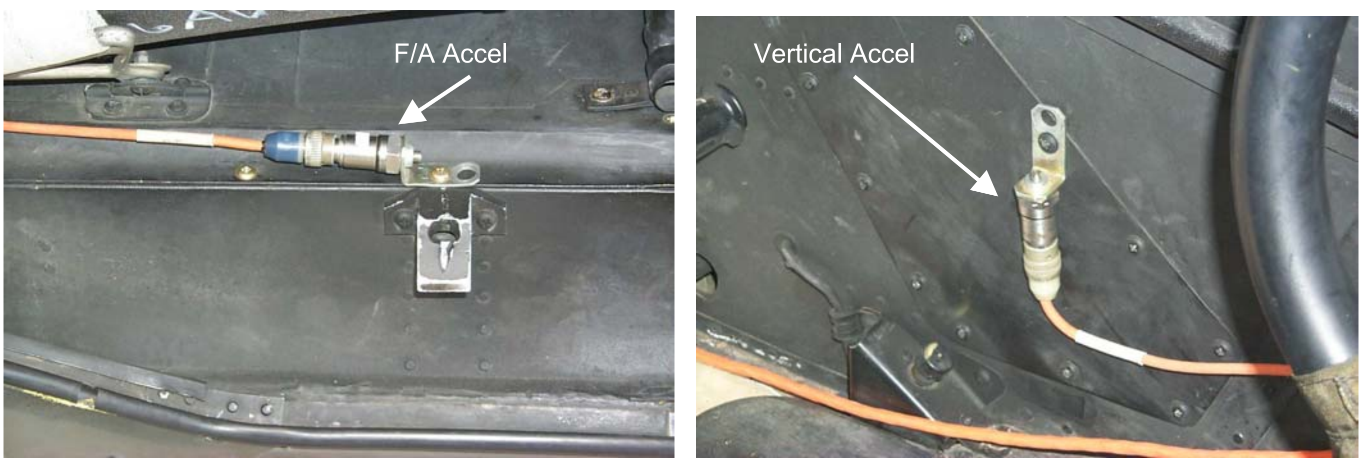


Figure 4. Main Rotor Accelerometer Installation

PROCEDURE 4: TRACKER INSTALLATION

a. Secure UTD bracket (29328000) to chin of aircraft just above search light, figure 5, with screws long enough to pass through the mating fastener and extend a minimum of two threads.

NOTE

If the UTD captive mounting bolts are lost or damaged, use NAS1305-14 bolts as replacements.

NOTE

Once the UTD is installed, access to the DC external power receptacle is not possible.

b. Mount UTD to bracket, ensuring that the night lens (red lens) is below the optical lens (clear lens).

Figure 5. Universal Tracking Device (UTD) Installation

WARNING

Ensure UTD cable does not interfere with the CPO pedal travel.

c. Connect UTD cable (29325701) to UTD connector. Route cable through the drain hole in CPO chin bubble. Connect cable to the DAU receptacle marked TRACKER 1. Secure cable to chin bubble with reinforced tape (duct tape).

d. Ensure that the TRACKER MODE switch on the front of the DAU is in the DAY position.

e. Paint the bottoms of all four blades with flat black paint in the area where the UTD views the blades. Reference figure 6.

NOTE

While tracking the rotor without a sunshield is possible, it is recommended that the operator use sunshield (29722100) when tracking on sunny days. The use of the sun shield will result in fewer tracker errors.

PROCEDURE 5: NIGHT-TIME TRACKING INSTRUCTIONS

NOTE

The following steps are required prior to performing night tracking. If no flights will be performed after dusk, proceed directly to task 2.

a. Ensure that the TRACKER MODE switch on the front of the DAU is in the NIGHT position.

b. Ensure that the underside, trailing edge of all blades is as clean as possible. This is necessary for optimum adhesion of the reflective tape.

NOTE

The placement of the tape can be verified by holding a flashlight near your head and shining it at the rotating blades. Any misplaced sections of the tape will stand out.

c. Attach a single, 3-ft section of reflective tape on the underside, trailing edge of each blade as shown in figure 6. Ensure that the tape is smooth and as straight as possible using the edge of the blade as a reference.

d. Remove sunshield if installed.

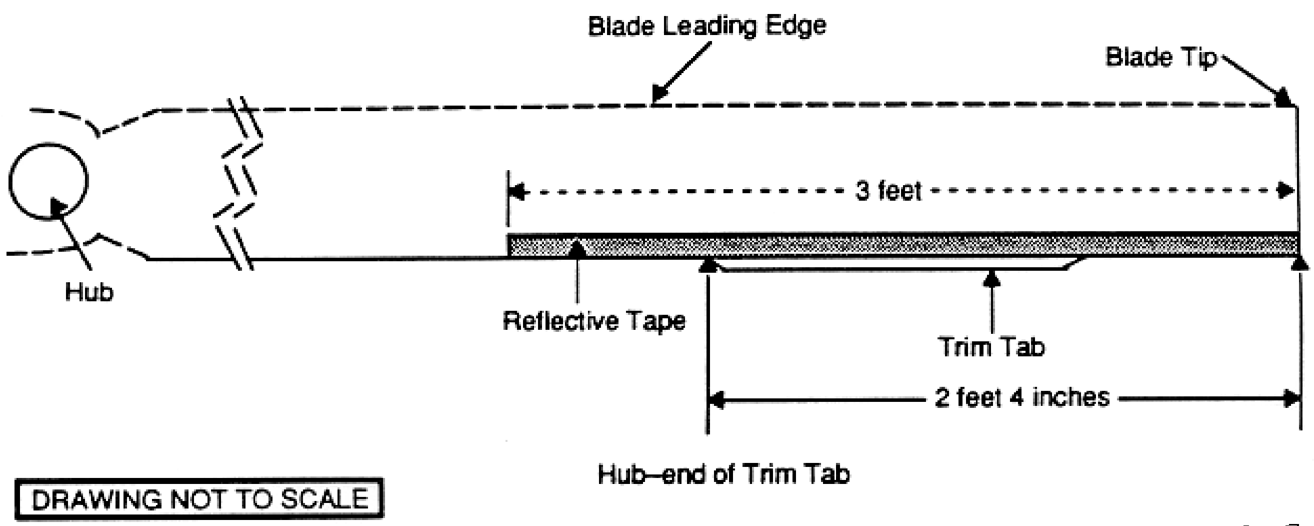


Figure 6. Placement of Reflective Tape on Rotor Blades

TASK 2 - FLAT TRACK MAIN ROTOR ON THE GROUND

- The preferred method of tracking the OH-58D is tracking it with the MMS installed. Removing the sight and working the rotor until smooth and then reinstalling the sight is considered an obsolete method and could result in high vibration levels at Idle RPM when the sight is reinstalled. Working the rotor with the sight installed and using the OH-58DM script file will preclude having high vibration levels at idle RPM.
- When using the GNDTRK flight plan in the OH-58D setup file, the correct procedure is to obtain a track picture of less than 0.2 inches at both 65%-NR and 35%-TQ test conditions. The diagnostics will use the main rotor pitch change links to obtain a track not greater than 0.2 inches at 65%-NR and then use the trim tabs to correct for less than 0.2 inches track change from 65%-NR to 35%-TQ.
- When using the GNDTRK flight plan in the OH-58DM setup file, the correct procedure is to obtain a track picture of <0.2 inches at 65% nr using pitch change links.

PROCEDURE 1: PREPARATION

a. Install test equipment. See task 1).
b. Operate aircraft at appropriate rotor speed (see table 1 or table 2).
c. Turn on DAU.
d. Turn on CADU.

PROCEDURE 2: PERFORM GROUND TRACK (GNDTRK) MEASUREMENT

a. Press **QUIT** on the CADU until all selections are undefined.
b. Use cursor keys to highlight Aircraft Type. Press **DO**.
c. Select aircraft type OH-58D for aircraft without MMS and OH-58DM for those aircraft with MMS, then press **DO**.
d. Tail Number is highlighted. Press **DO**.
e. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.
f. Flight Plan is highlighted. Press **DO**.
g. Use cursor keys to highlight GNDTRK. Press **DO**.
h. Enter the measure mode by pressing **F1**.
i. Press **DO** when the aircraft is stable at the highlighted selection. The first time the **DO** key is pressed, the system performs a self-test of all installed equipment and readies the DAU to acquire data for that Test State (the CADU will prompt the operator with an asterisk and the test condition when all equipment is ready). Verify that the aircraft is at the required Test State (65%-NR or 35%-TQ for OH-58D aircraft with SG, 65%nr for OH-58DM aircraft) and press **DO** again. Perform this operation each time a measurement is completed and another Test State is highlighted. The AVA will acquire track and vibration data and return to the selection menu.
j. After the 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 task 3.
k. If measured values exceed specifications, press **DO** to execute diagnostics. AVA will make recommendations to correct track using pitch change links and trim tabs.
l. Shut down aircraft and perform all corrections displayed on the diagnostic screen. Check to ensure that all screens of a multiple screen solution have been displayed. Do not use a partial set of adjustments.
m. After corrections are installed, repeat procedure 2 until ground track criteria are met.
n. Proceed to task 3.

TASK 3-TRACK AND BALANCE MAIN ROTOR ON THE GROUND

The preferred method of tracking the OH-58D is tracking it with the MMS installed. Removing the sight and working the rotor until smooth and then reinstalling the sight is considered an obsolete method and could result in high vibration levels at idle RPM when the sight is reinstalled. Working the rotor with the sight installed and using the OH-58DM script file will preclude from having high vibration levels at Idle RPM.

When using the INT-SG flight plan in the OH-58D setup file, the correct procedure is to obtain a track picture of less than 0.2 inches at both 65%_NR and 35%_TQ test conditions. The diagnostics will use the main rotor pitch links to obtain a track not greater than 0.2 inches at 65% NR and then use the outboard trim tabs to correct for less than 0.2 inches track change from 65%_NR to 35%_TQ. It will also give a correction to reduce fore/aft vibration at the 35%_TQ test condition.

When using the INT-SG flight plan in the OH-58DM setup file, the correct procedure is to obtain a track picture of less than 0.2 inches at both 65%Nr and 35% TQ test conditions. The diagnostics will use the main rotor pitch links to obtain a track not greater than 0.2 inches at 65%Nr and then use the outboard trim tabs to correct for less than 0.2 inches track change from 65%Nr to 35% TQ. It will also give a correction to reduce fore/aft vibration at the 65%NrC test condition.

PROCEDURE 1: PREPARATION

Perform task 2, Flat Track Main Rotor on the Ground.

PROCEDURE 2: PERFORM INITIAL MEASUREMENT - Standard Landing Gear
(For aircraft equipped with RDG landing gear, go to Procedure 2A)

a. Press **QUIT** on the CADU until all selections are undefined.

b. Use cursor keys to highlight Aircraft Type. Press **DO**.

c. Select aircraft type OH-58D for aircraft without MMS and OH-58DM for those aircraft with MMS, then press **DO**.

d. Deleted.

e. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.

f. Flight Plan is highlighted. Press **DO**.

g. Use cursor keys to highlight flight plan INT-SG. Press **DO**.

h. Enter the Measure mode by pressing **F1**.

i. Press **DO** when the aircraft is stable at the highlighted selection. The first time the **DO** key is pressed, the system performs a self-test of all installed equipment and readies the DAU to acquire data for that Test State (the CADU will prompt the operator with an asterisk and the test condition when all equipment is ready). Verify that the pilot is at the required Test State (65%_NR or 35%_TQ for OH-58D aircraft with SG. 65% Nr, 65%NrC or 35% TQ for OH-58DM aircraft) and press **DO** again. Perform this operation each time a measurement is completed and another Test State is highlighted. The AVA will acquire track and balance data and return to the selection menu.

j. After the last measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu. Proceed to task 4.

k. If measured values exceed specifications, press **DO** to execute diagnostics. The AVA will make recommendations to correct track and balance using pitch change links, trim tabs, and hub balance weights.

l. Shut down aircraft and perform all corrections displayed on the diagnostic screen. Check to ensure that all screens of a multiple screen solution have been displayed. Do not use a partial set of adjustments.

NOTE

It should take approximately three initial runs to get the rotor in track. If after three runs the rotor track is not within the 0.1-0.2 inch range, review the adjustment procedures to make sure the correct adjustments are being made and re-orient the aircraft so that the tracker is not looking at the sun or that the sun is at the left front of the aircraft. As long as the 65% and 100% track are in the 0.1-inch range (2-3 mm) it is acceptable to discontinue the initial mode and press into flight if problems are being encountered getting the 65% balance acceptable.

m. After corrections are installed, repeat procedure 2 until ground track and balance criteria are met.

n. Proceed to task 4.

Procedure 2A : PERFORM INITIAL MEASUREMENT – Rapid Deployment Gear

OH58D aircraft equipped with the Rapid Deployment Gear must be ground balanced differently than aircraft equipped with standard landing gear.

NOTE

This procedure applies to aircraft that have had one or more blades replaced, post phase inspection rotor smoothing or maintenance involving any of the main rotor flight controls that requires rotor smoothing checks. Aircraft that are in service and only need moderate inflight rotor smoothing should proceed directly to the “Flight” portion of the rotor smoothing procedures IAW AVA TM (Task 4)

NOTE

Aircraft with RDG must be ground balanced at 70% Nr.

NOTE

Ground track the main rotor to 2 mm or less using the AVA GNDTRK flight plan before starting ground balance procedure, use 70% Nr.

Ground Balance Procedures for OH58D aircraft with RDG

a. Remove all MR hub weight.
b. Press **QUIT** on the CADU until all selections are undefined.
c. Use cursor keys to highlight Aircraft Type. Press **DO**.
d. Select aircraft type OH-58DM for those aircraft with MMS, then press **DO**.
e. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.
f. Flight Plan is highlighted. Press **DO**.
g. Use cursor keys to highlight flight plan INT-SG. Press **DO**. Enter the Measure mode by pressing **F1.**

NOTE

Before taking measurements, it is suggested that the “limits” function be turned ON by pressing F4 when on the “measurements page”.

h. Press **DO** when the aircraft is stable at 70% Nr, select (65%NrC) for the measurement. The first time the **DO** key is pressed, the system performs a self-test of all installed equipment and readies the DAU to acquire data for that Test State (the CADU will prompt the operator with an asterisk and the test condition when all equipment is ready). Verify that the pilot is at the required Test State. Press **DO** a second time to initiate the measurement.

- Take data only at the 65%NrC test state, with the aircraft at 70% Nr.
- Disregard the 65%Nr and 35% Tq test states.

i. After taking the measurement, press QUIT, then SAVE and EXIT to go to the MAIN MENU.

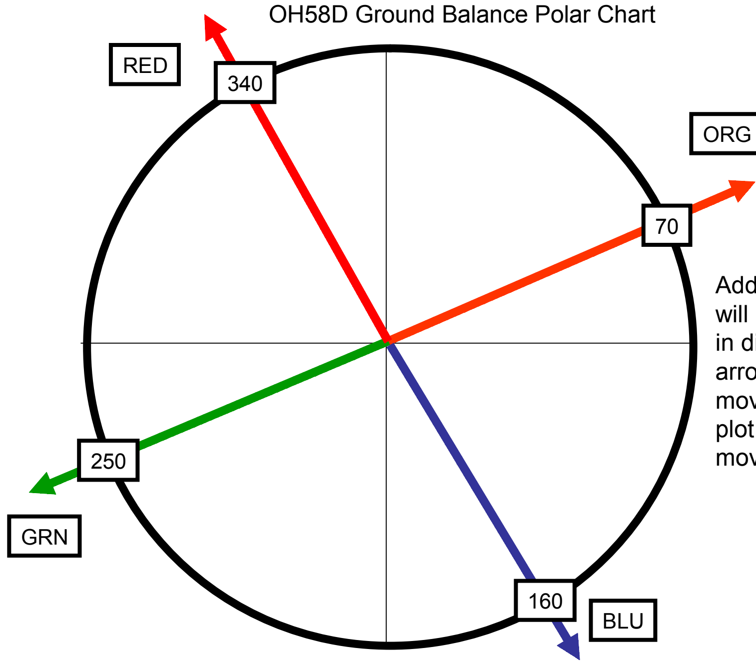
j. From the MAIN MENU, press F3 to run Diagnostics for the INT-SG flight plan,

- Disregard any notes or error messages concerning the lack of data for the other two test states not measured.
- Go to EDIT DEFAULTS and change the maximum # of adjustments to two (2).
- Go to EDIT ADJUSTABLES and turn everything off except the weights for the ORANGE and RED blades.
- Press **DO** to calculate a new solution.

k. Make the two (2) weight moves provided by the AVA.

- Run the aircraft again at 70% Nr, note measured IPS and phase.
- Repeat steps h., i. and j. if the vibration is above 0.3 IPS vibration.
- If necessary, manually plot the initial IPS and phase and subsequent measurements on the OH58D ground balance polar chart fig 6A.
- Once the ground balance vibration is below 0.3 IPS and the ground track is still within limits (2 mm or less), repeat the INT-SG measurement by taking measurements at all three test states and using the AVA's default diagnostics to verify that main rotor track is acceptable at idle to 100% Nr.
- Use 70% Nr in place of 65% NrC. Once all limits are met, proceed to the AVA FLIGHT flight plan and take measurements as normal, except using 70% Nr in place of 65% NrC.

OH58D Ground Balance Polar Chart



Adding weight will move plot in direction of arrow. Weight moves will move plot parallel to move lines.

Coefficient for ground balance is .002 IPS per gram

TASK 4 - TRACK MAIN ROTOR IN FLIGHT

PROCEDURE 1: EQUIPMENT INSTALLATION

The preferred method of tracking the OH-58D is tracking it with the MMS installed. Removing the sight and working the rotor until smooth and then reinstalling the sight is considered an obsolete method and could result in high vibration levels at idle RPM when the sight is reinstalled. Working the rotor with the sight installed and using the OH-58DM script file will preclude from having high vibration levels at idle RPM.

NOTE

Aircraft ground track and balance specified requirements (tasks 2 and 3) are to be completed prior to performing in-flight Test States, unless aircraft is already in service.

a. Install test equipment (refer to task 1).

b. Operate aircraft at appropriate rotor speed (see table 1 or table 2).

c. Turn on DAU.

d. Turn on CADU.

PROCEDURE 2: PERFORM FLIGHT MEASUREMENT

a. Press **QUIT** on the CADU until all selections are undefined.

b. Use cursor keys to highlight Aircraft Type. Press **DO**.

c. Select OH-58D for aircraft without MMS and OH-58DM for those aircraft with MMS, then press **DO**.

d. Tail Number is highlighted. Press **DO**.

e. Use cursor keys to highlight a tail number or enter a new tail number (up to seven characters), then press **DO**.

f. Flight Plan is highlighted. Press **DO**.

g. Use cursor keys to highlight flight plan FLI-SG. Press **DO**.

h. Enter the Measure mode by pressing **F1**.

i. Press **DO** when the aircraft is stable at the highlighted selection. The first time the **DO** key is pressed, the system performs a self-test of all installed equipment and readies the DAU to acquire data for that Test State (the CADU will prompt the operator with an asterisk and test condition when all equipment is ready). Reverify that the pilot is at the required Test State (65% NR, 35% TQ, Hover, 60K, 100K, 110K, and L/DOWN for OH-58D aircraft or 65%NRC, 35% TQ, Hover, 60K, 100K, 110K, and L/DOWN for OH-58DM aircraft) and press **DO** again. Perform this operation each time a measurement is completed and another Test State is highlighted. The AVA will acquire track data and return to the selection menu.

j. After the last measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu, then proceed to step p.

WARNING

If Main Rotor RPM cannot be maintained in the normal operating range, terminate test flight.

k. Perform autorotational check as per TM 55-1520-248-MTF.

l. If measured values exceed specifications, press **DO** to execute diagnostics. AVA will make recommendations to correct track and balance using trim tabs, and hub balance weights. Shut down aircraft and make corrections.

NOTE

When the vertical vibration is close to being within limits and recommended tab moves are too small to be made, use Edit Adjustables to turn off tabs and turn on pitch links for the final 1–2 flat end moves. The only criteria for successfully completing the in-flight smoothing of the rotor is the vibration levels, the final track is not important. Once the vertical vibration is acceptable and if fore/aft ground vibration is still above limits use the Edit Adjustables to turn off tabs and pitch links. Hub weight only moves do not affect the 1/REV vertical in forward flight significantly.

m. If alterations are desired to the fault solution, use Edit Defaults and/or Edit Adjustables to make desired changes. Always select View Predictions to check that the predicted vibration levels, with the altered set of adjustments, will be reduced.
n. After each set of adjustments and verification flight it is recommended to use the Trend Flights display to view the in-flight vertical vibration. Vibration levels should be decreasing and moving towards the center of the polar plot. If not (see Chapter 2, Displays WP 0010) for troubleshooting.
o. Repeat procedure 2 until acceptable vibration levels are met.
p. Remove test equipment and make appropriate log entries.

PROCEDURE 3: TROUBLESHOOTING

Experience on new aircraft and high time retrofit aircraft have shown the following sources of track and balance problems:

- Changing Ride:
  Loss of torque on upper and/or lower hub to mast cone joints. 1/REV can be corrected with trim tab only.
- Vertical Ground Bounce at 100% RPM:
  When pulling collective if a vertical 1/REV vibration is felt on the ground then the most likely source is a loose swashplate sleeve.
- Vertical 1/REV in Hover:
  High levels of vertical 1/REV in a hover have been scarce. Check for a loose main rotor grip/pitch horn joint.
- Vertical 1/REV Torque Sensitive “HOP”:
  Worn drive links, rotor not rpm tracked.
- Vertical 1/REV During Entry and Recovery from Maneuvers:
  Low swashplate friction.
- Vertical 1/REV in a Steady Turn Which Builds as a Function of Load Factor:
  Out of product balanced blade. Confirm by looking at track change from ground to hover and take data in a turn. If the blade is seen to change track from ground to hover and do the same thing in a turn, then the blade is out of product balance. Replace blade and return to manufacturer for re-whirling if 1/REV is unacceptable.

TASK 5 - BALANCE TAIL ROTOR

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA blade tracking equipment from transport case. Check for possible damaged equipment and frayed cables. Figure 1 is the typical AVA test setup configuration.

b. Install DAU in the canvas carrying case.

c. Place DAU in the CPO's seat with the connectors facing up and secure DAU using seat belts.

d. Connect the power cable (29104700) to the aircraft power receptacle (located to the right of the CPO's cyclic) and to the DAU receptacle marked 28 Vdc.

e. Locate CADU in the front cockpit area ensuring not to obstruct the pilot's flight controls. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: ACCELEROMETER INSTALLATION

a. Mount accelerometer mounting bracket (29313000) on the top stud of the tail rotor gearbox flange, see figure 7.

b. Install accelerometer (28110900) on bracket with the connector pointing up.

c. Connect accelerometer cable (either 29105600 or 29105605) to accelerometer.

CAUTION

Keep accelerometer cable snug around tail boom to ensure that cable does not contact tail rotor. The cable should have a proper bend radius at the accelerometer and not pulled taut.

d. Route cable downward on the right side of tail boom from tail rotor and secure along tail boom HF antenna with tie-down straps. If antenna is not installed, wrap cable around tail boom.

e. Connect accelerometer cable to the DAU receptacle marked ACC4.

PROCEDURE 3: OPTICAL RPM SENSOR INSTALLATION

a. Remove the two screws at the base of the tail rotor gearbox where the tail cone attaches and just below the oil level sight glass, see figure 7.

b. Mount optical RPM sensor mounting bracket (29198600) at the base of the gearbox using the two screws. The rectangular hole should be toward the left side of the aircraft.

c. Mount optical RPM sensor (29314700) to the bracket, facing the tail rotor.

d. Connect the optical RPM sensor cable to the optical RPM sensor and route the optical RPM sensor cable the same as the accelerometer cable (procedure 2).

e. Connect the optical RPM sensor cable to the DAU receptacle marked TACHO 2.

NOTE

If there is any tape remaining from previous balance routines, this must be completely removed to ensure a clear and accurate tachometer signal to the DAU.

f. Place a single, 3-inch strip of reflective tape on the inside of one of the tail rotor blades, figure 7, at the approximate location of the beam from the optical RPM sensor. The reflective tape must not extend around or onto the leading edge.

g. Proper alignment of the tape can be verified by applying 28 Vdc power to the DAU and rotating the tail rotor until the taped blade passes in front of the optical RPM sensor. A red LED on the back of the sensor will light if the sensor picks up a return from the reflective tape.

Figure 7. Reflective Tape Installation

PROCEDURE 4: PERFORM TAIL MEASUREMENT

a. Operate aircraft at appropriate rotor speed.
b. Turn on DAU.
c. Turn on CADU.
d. Press **QUIT** on the CADU until all selections are undefined.
e. Use cursor keys to highlight Aircraft Type, and then press **DO**.
f. Select aircraft type OH-58D. Press **DO**.
f. Tail Number is highlighted. Press **DO**.
g. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.
h. Flight Plan is highlighted. Press **DO**.
i. Use cursor keys to highlight Tail. Press **DO**.
j. Enter the Measure mode by pressing **F1**. Verify that 100% NR is selected.
k. Press **DO** when the aircraft is stable at the highlighted selection. The first time the **DO** key is pressed, the system performs a self-test of all installed equipment and readies the DAU to acquire data for that Test State (the CADU will prompt the operator with an asterisk and test condition when all equipment is ready). Re-verify that the aircraft is at the required Test State (100%NR) and press **DO** again. Perform this operation each time a measurement is completed and another Test State is highlighted. The AVA will acquire track balance data and return to the selection menu.
l. After the last measurement is completed, press **DO** on Finish, then press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu. Proceed to step q.
m. If measured values exceed specifications, press **DO** to execute diagnostics. AVA will make a recommendation to correct balance using spanwise (outboard blade bolt) weights and/or chordwise (trunnion balance arm) weights. Shut down the aircraft and use the recommended correction provided by the diagnostics.
n. After each set of adjustments and verification run it is recommended to use the Trend Flights display (see chapter 2, Displays WP 0010) to view the tail vibration. Vibration should be decreasing and moving towards the center of the polar plot. If not check for mechanical problems.
p. Repeat the procedure until the tail rotor balance is below 0.2 ips.
q. Once acceptable vibration levels have been obtained, remove all test equipment from aircraft and make appropriate log entries.

TASK 6 - ISOLATING IRREGULAR/UNUSUAL VIBRATIONS

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA balancing equipment from transport case. Check for possible damaged equipment and frayed cables.

b. Install DAU in canvas carrying case.

c. Secure DAU in Avionics compartment strapped on top of the ASN-137 Doppler Signal Data Converter with the connectors facing forward and secure DAU using straps.

d. Connect the DC power cable (29104700) to the aircraft power receptacle located to the right side of the CPO's cyclic and to the DAU receptacle marked 28 Vdc.

e. Place CADU in front seat. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: ACCELEROMETER INSTALLATION

NOTE

Data can be acquired from up to four accelerometers to assist in isolating irregular or unusual vibrations.

a. Mount/install accelerometer (28110900) (found in the basic kit) anywhere on the airframe that an irregular or unusual vibration is detected.

b. Connect accelerometer cable (29105600) (found in the basic kit) from accelerometer to the DAU receptacle marked ACC1, ACC2, ACC3 or ACC4.

PROCEDURE 3: PERFORM PROBES MEASUREMENTS

a. Operate aircraft at desired flight condition. This should be the RPM or airspeed at which the vibration is strongest.

b. Turn on DAU.

c. Turn on CADU.

d. Press **QUIT** on the CADU until all selections are undefined.

e. Use cursor keys to highlight Aircraft Type, and then press **DO**.

f. Select aircraft type OH-58D. Press **DO**.

g. Tail Number is highlighted. Press **DO**.

h. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.

i. Flight Plan is highlighted. Press **DO**.

j. Use cursor keys to highlight PROBES. Press **DO**.

k. Enter the Measure mode by pressing **F1**. Verify that Test State ACC1 is highlighted.

l. Press **DO** when the aircraft is stable at the highlighted selection. The first time the **DO** key is pressed, the system performs a self-test of all installed equipment and readies the DAU to acquire data for that Test State (the CADU will prompt the operator with an asterisk and test condition when all equipment is ready). Re-verify that the aircraft is at the required Test State (ACC1, ACC2, ACC3, or ACC4) and press **DO** again. The flight plan will measure data on one channel at a time. Perform this operation each time a measurement is completed and another Test State to be measured is highlighted. The AVA will acquire vibration data at each selected Test State and then return to the selection menu.

m. After the last measurement is completed, press **DO** on Finish, then press **DO** on Main Menu.

n. Enter the Display mode by pressing **F2**. Select One Test State and press **DO**. Review each of the spectrums measured for any unusual vibrations.

o. Replace or repair component causing vibration problem.

p. Repeat procedure 3 again to determine if vibration is in fact reduced to acceptable levels.

q. Once acceptable vibration levels have been obtained, remove all test equipment from aircraft and make appropriate log entries.

END OF WORK PACKAGE

AVA APPLICATION AND PROCEDURES – UH-1H/M

(Script File No. UH1_R.CMD and UH1CRB_R.CMD)

WARNING

Use extreme care when flying with UTD mounted. UTD interferes with wire strike capabilities.

CAUTION

Never install cables where they can be damaged. Use wire bundle ties or clamps to route cabling along or through airframe instead of securing cables with fairing doors, panels, or seat frames. Never bundle tie cables to flight controls.

TASK 1 - TEST EQUIPMENT INSTALLATION/CHECKOUT
TASK 2 - FLAT TRACK MAIN ROTOR ON THE GROUND
TASK 3 - INITIAL TRACK AND BALANCE OF ROTOR
TASK 4 - TRACK MAIN ROTOR IN FLIGHT
TASK 5 - BALANCE TAIL ROTOR
TASK 6 - ISOLATING IRREGULAR/UNUSUAL VIBRATIONS

PERSONNEL REQUIRED

Four People Required:
- Pilot
- Aircraft Mechanic
- Inspector/Supervisor
- Maintenance Test Pilot

SUPPLIES

- Lockwire MS20995NC32 (task 1)
- Reflective Tape (10605000)

TOOLS

- Aircraft Mechanic's Toolkit, NSN 5180-00-323-4692
- Aircraft Adapter Kit (29316900)
  NSN 6625-01-324-9822
- *Data Acquisition Unit (DAU) in canvas carrying case (29328203)
- *Control and Display Unit (CADU) (29313106)
- *10-ft CADU to DAU Cable (29325601)
- *Universal Tracking Device (UTD) (29310700)
- *25-ft UTD Cable (29325701)
- UH-1 H/M UTD Bracket (29328001)
- *Accelerometer Mounting Bracket (29313000) (2 ea.)
- *10-ft Aircraft Power Cable (29104700)
- *Magnetic RPM Sensor (27288400)
- *Magnetic RPM Sensor Cable (29105403)
- Magnetic RPM Sensor Bracket (29312600)
- Magnetic RPM Sensor Striker Plate (29312700)
- *Optical RPM Sensor Mounting Bracket (29198700)
- *25-ft 54mV/g Accelerometer Cable (29105605)
- *50-ft 54mV/g Accelerometer Cable (29105600)
- *54mV/g Accelerometers (28110900) (2 each)
- Torque Wrench, 0-100 inch-pounds
- *Optical RPM Sensor (29314700)
- UH-1 DC Power Adapter (29312800)
- AVA Basic Kit, Rotor Track & Balance
  NSN 6625-01-282-3746

* Included in AVA Basic Kit

ALSO NEEDED

- Balance weights (as required)
- Tab Measuring and Bending Tools
- Bundle Ties

REFERENCES

- TM 55-1520-210-10
- TM 55-1520-210-23
- TM 55-1520-210-MTF
- TM 1-6625-724-13&P

The UH-1H/M Flight Plans are listed below with a brief description of their purpose. The selectable Flight Plans (see table 1) are listed in order of appearance in the menu on the CADU and not in the order in which they are to be performed. The UH1 script file is for aircraft with metal blades and the UH1CRB script file is for aircraft with composite blades.

FLIGHT

This test is primarily designed to reduce the in-flight vertical vibrations using pitch links, sweep, tab, and weights. It is to be used after the GNDTRK and INITIAL flight plans when smoothing an aircraft after component change, or for "tuning up" an aircraft that is already in service.

GNDTRK

This flight plan is designed to get the rotor into a flyable track prior to hovering. It consists of two measurements, and will adjust pitch links and tabs only. It should be the first test that is performed after any component change or major rework on the rotor.

INITIAL

This flight plan is performed after the GNDTRK, and will balance the rotor prior to flight. It will adjust pitch links, weights, tabs, and sweep to perform this goal. This test should be performed after any component change or major rework on the rotor.

PROBES

This flight plan is designed to acquire data from up to four accelerometers to assist in isolating irregular or unusual vibrations. The flight plan will measure data one channel at a time on DAU ACC1 through ACC4. These accelerometers may be installed anywhere on the airframe and will measure a 0 to 500 Hz spectrum (0 to 30,000 RPM).

tail

This flight plan is designed to balance the UH-1H/M tail rotor. It uses the optical RPM sensor on TACHO 2 and one accelerometer on ACC4. It should be performed after any rework on the tail rotor or anytime a medium to high frequency vibration is felt in the aircraft.

ROTOR SMOOTHING OVERVIEW

The UH-1H/M is smoothed in two steps: a ground or initial tracking and an in-flight final smoothing of the rotor. Properly conducting the ground or initial step greatly reduces the amount of effort required to smooth the rotor in flight and yields a good ride.

The recommended ground/initial method to smooth the UH-1H/M uses these basic steps:

a. Use GNDTRK to adjust pitch links to flat track the rotor at 226 rpm rotor speed and trim tabs for a flat track at 324 rpm rotor speed. This flight plan will not balance the rotor while on the ground and is used to obtain a flat track condition prior to hover.
b. Use INITIAL flight plan the same as GNDTRK except that the software now includes the Hover test condition where the rotor will be balanced by including the sweep and span weight adjustments. If GNDTRK flight plan has been previously accomplished it is still recommended that all test conditions be recorded even though the idle and 100FPG were previously recorded.

It should take approximately three initial runs to get the rotor in track. If after three runs the rotor track is not within the 0.1-0.2 inch range, review the adjustment procedures to make sure the correct adjustments are being made and re-orient the aircraft to make sure that the tracker is not looking at the sun or that the sun is at the left front of the aircraft. As long as the 226 rpm and 324 rpm track are in the 0.1-inch range (2-3 mm) and hover balance is below 0.2 ips, it is acceptable to discontinue the initial mode and press into flight.

NOTE

The better the ground track is the less vibration will be encountered in the first flight and the rotor will be closer to finished levels.

Once the ground tracking or initial phase has been conducted and the aircraft is taken to forward flight at least one forward flight condition must be taken on every run to insure that the program specifies correct adjustments. The only criteria for successfully completing the in flight smoothing of the rotor is the vibration levels, the final track does not matter.

Table 1. UH-1H/M Flight Plans and Test States

Flight Plan	Test States	Test Condition
FLIGHT	IDLE	226 Rotor RPM (Nr)
	FPG100	Flat Pitch, 324 Rotor RPM (Nr)
	HOVER	Hover
	60K	60 Kts, Level Flight
	90K	90 Kts, Level Flight
	110K	110 Kts, Level Flight
	L/DOWN	L/Down: 70 Kts at 1000 Ft/Min Descent
GNDTRK	Idle	226 Rotor RPM
	Fpg100	Flat Pitch, 324 Rotor RPM (Nr)
INITIAL	IDLE	Flat Pitch, 226 Rotor RPM (Nr)
	FPG100	Flat Pitch, 324 Rotor RPM (Nr)
	HOVER	Hover
PROBES	ACC1	Used as required
	ACC2	User must denote
	ACC3	location and orientation
	ACC4	
tail	Fpgtl	Tail Balance - Flat Pitch, 324 Rotor RPM (Nr)

TASK 1 - TEST EQUIPMENT INSTALLATION/CHECKOUT

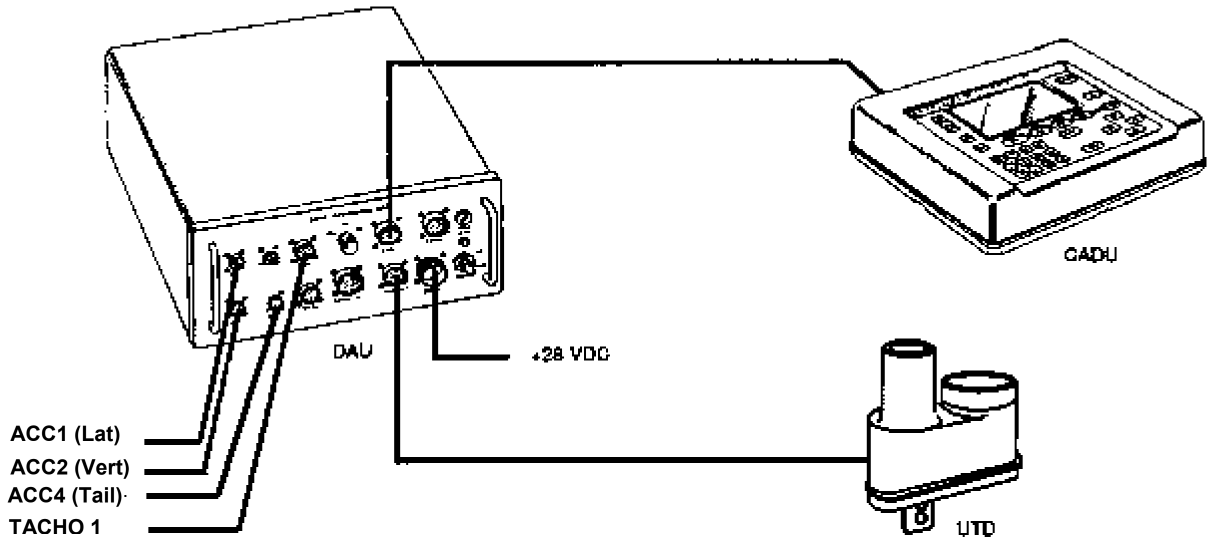


Figure 1. Typical AVA Test Setup Configuration

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA blade tracking equipment from transport case. Check for possible damaged equipment and frayed cables. Figure 1 is the typical AVA test setup configuration.

b. Install DAU (29328201) in the canvas carrying case.

c. Place DAU in the back seat with the connectors facing up and secure DAU using lap and shoulder belts and canvas straps and D-rings.

d. Connect the UH-1 DC power adapter cable (29312800), figure 2, to the heater blanket receptacle and to the 10-ft power cable (29104700).

e. Connect power cable to the DAU receptacle marked 28 Vdc.

f. Install CADU (29313107) in aircraft. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

Figure 2. DC Power Cable Installation

PROCEDURE 2: MAGNETIC RPM SENSOR INSTALLATION

a. Remove the top two (of three) nuts on retaining bolts of the trunnion bearing assembly, figure 3, which is located on the left cyclic non-rotating swashplate pitch horn.

NOTE

The bolts should be installed with their heads to the front-right (toward the centerline of the aircraft) and the nuts at the left-rear (outboard).

b. Place the magnetic RPM sensor bracket (29312600) on the two bolts. Replace washers and nuts, and tighten the nuts.

c. Install magnetic RPM sensor (27288400) into the bracket, figure 3, with the connector away from the mast. Use a jam nut on each side of the bracket, figure 3 leaving them loose and with the top of the sensor extending as little as possible. Nuts will be adjusted later.

d. Turn the head so that the WHITE blade is forward.

e. Remove the nuts and washers from two studs, figure 3, of the twelve studs located on the outer ring of the rotating swashplate.

f. Place the single Magnetic RPM Striker Plate (29312700) with pointed flange down, at the left front of the swashplate.

g. Replace washers and nuts, and tighten nuts.

h. Turn the rotor head slowly to line up the Magnetic RPM Striker Plate with the Magnetic RPM sensor.

i. Adjust the Magnetic RPM sensor for a 0.060-inch, ±0.010 inch, clearance, and tighten the jam nut and install lockwire.

j. Connect Magnetic RPM sensor cable (29105403) to the Magnetic RPM sensor.

k. Move cyclic stick of aircraft to its farthest right-rear position. This will place the left front control rod in its fully extended position.

l. Tie-wrap the Magnetic RPM sensor cable to control rod, just below rivets in wedged end, with only an inch or so of slack.

Figure 3. Magnetic RPM Sensor Installation

CAUTION

Ensure magnetic RPM sensor cable cannot interfere with any moving components, as this installation is used during flight. When routing cable, make sure that there is enough slack so that when the swashplate moves it will not damage cable.

m. Tie-wrap the magnetic RPM sensor cable to a fixed portion of the aircraft with enough slack to allow cyclic control movement throughout the entire range of motion without breaking the cable.

n. Route the cable under the transmission cowling and pass it through the left sliding cabin door and position cable so that it enters the cabin between sliding door and hinged panel. Secure cable to airframe using reinforced tape.

o. Connect magnetic RPM sensor cable to the DAU receptacle marked TACHO 1.

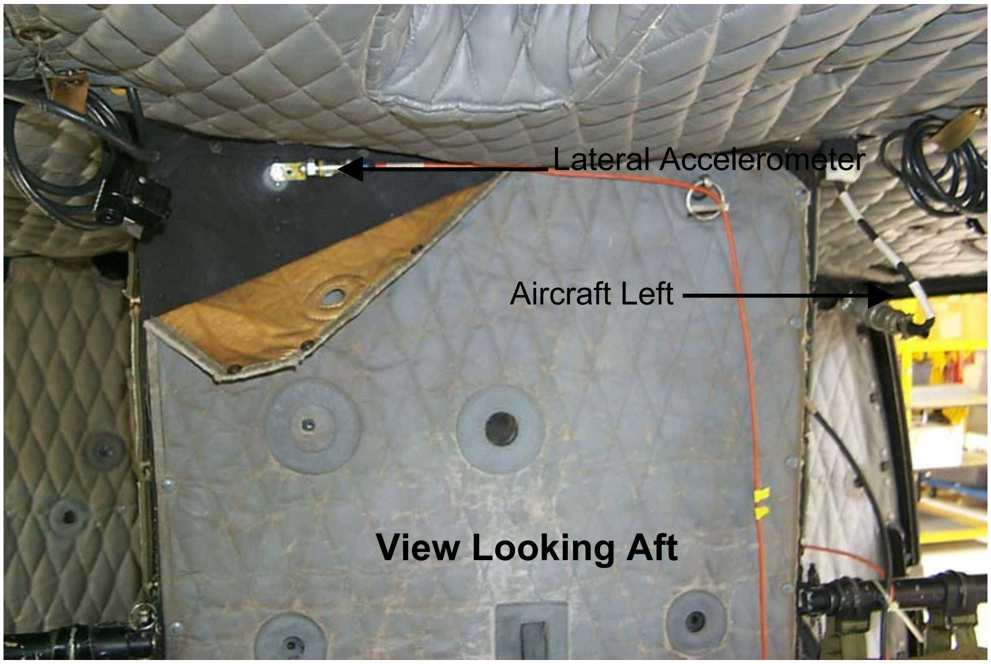


Figure 4. Lateral accelerometer Installation on Forward Transmission Bulkhead

PROCEDURE 3: ACCELEROMETER INSTALLATION

a. Install accelerometer (PN 28110900) on accelerometer mounting bracket (29313000). Mount accelerometer bracket (PN 29313000) at the top of the forward transmission bulkhead using one of the 5/16-inch tapped tie ring holes. The orientation of the accelerometer must be horizontal, figure 4, with the connector pointing to the left side of the aircraft (to your right when you are facing the bulkhead).

b. Connect accelerometer cable (29105605) from accelerometer to the DAU receptacle marked ACC1.

c. Install accelerometer (28110900) on accelerometer mounting bracket (29313000). Mount accelerometer bracket on the existing screw at the bottom edge of the instrument panel, see figure 5. Place it to the right of the ashtray by the co-pilot's right knee, with the connector facing down.

d. Connect accelerometer cable (29105600) from accelerometer to the DAU receptacle marked ACC2.

Figure 5. Vertical Accelerometer Installation on Instrument Panel

PROCEDURE 4: TRACKER INSTALLATION

NOTE

It may be necessary to replace the five aircraft screws with longer screws in order to mount the UTD mounting bracket.

a. Remove the five-airframe screws, and install UTD bracket (29328001) on aircraft, see figure 6.

b. Secure UTD bracket with screws long enough to pass through the mating fastener and extend a minimum of two threads.

NOTE

If the UTD captive mounting bolts are lost or damaged, use NAS1305-14 bolts as replacements.

c. Mount UTD (29310700) on bracket, ensuring that the red lens on the UTD is below the optical lens (clear lens). See figure 6.

d. Connect the UTD Cable (29325701) to UTD connector and connect to the DAU receptacle marked TRACKER 1.

e. Ensure that the TRACKER MODE switch on the front of the DAU is in the DAY position.

f. Paint leading edges of main rotor blade as required.

Figure 6. UTD Mounting Bracket

PROCEDURE 5: NIGHTTIME TRACKING INSTRUCTIONS

NOTE

The following steps are to be taken if nighttime tracking is anticipated. If no flights will be performed after dusk, proceed directly to task 2.

a. Ensure that the TRACKER MODE switch on the front of the DAU is in the NIGHT position.

b. Ensure that the underside, trailing edge of all blades is as clean as possible. This is necessary for optimum adhesion of the reflective tape.

c. Place a single, 4-ft strip of reflective tape on the underside, trailing edge of each blade as shown in figure 7. Ensure that the tape is smooth and as straight as possible using the edge of the blade as a reference.

d. If verification of the tape placement is desired, it can be viewed by holding a flashlight near your head and shining it at the rotating blades. Any misplaced sections of the tape will stand out.

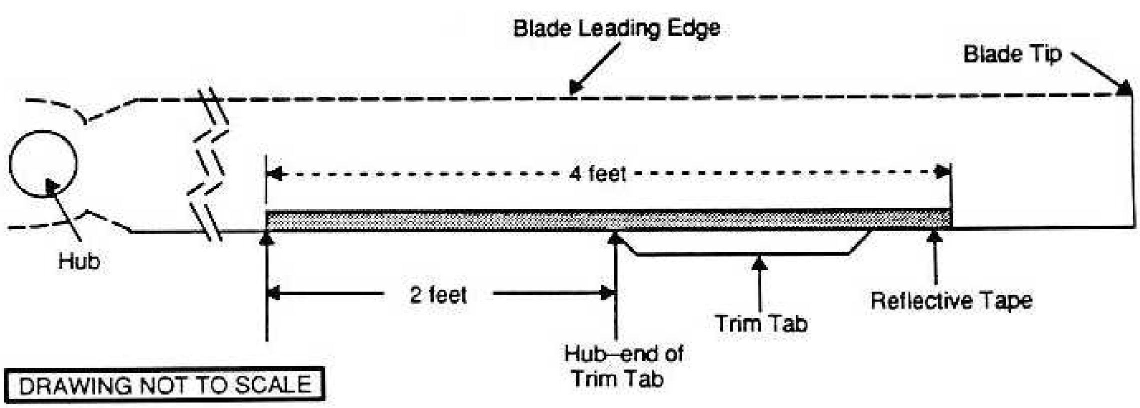


Figure 7. Placement of Reflective Tape on Rotor Blades

TASK 2 - FLAT TRACK MAIN ROTOR ON THE GROUND

PROCEDURE 1: PREPARATION

a. Install test equipment (refer to task 1).
b. Operate aircraft at Idle (226 Rotor RPM).
c. Turn on DAU.
d. Turn on CADU.

PROCEDURE 2: PERFORM GROUND TRACK (GNDTRK) MEASUREMENT

a. Press **QUIT** on the CADU until all selections are undefined.
b. Use cursor keys to highlight Aircraft Type, and then press **DO**.
c. Use cursor keys to highlight UH1 for metal blades and UH1CRB for composite blades, then press **DO**.
d. Tail Number is highlighted. Press **DO**.
e. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.
f. Flight Plan is highlighted. Press **DO**.
g. Use cursor keys to highlight GNDTRK. Press **DO**.
h. Enter the MEASURE mode by pressing **F1**. Verify that Test State Idle is highlighted.
i. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State (Idle or Fpg100) and press **DO** again. Perform this operation each time a measurement is completed and another Test State is highlighted. The AVA will acquire track data at each Test State and then return to the selected display.
j. After the 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 perform task 3.
k. If measured values exceed specifications, press **DO** to enter the DIAGS mode.
l. Perform corrections shown, making certain to view all screens of a multiple screen solution.
m. Repeat steps above until all measurements are within limits.
n. Perform task 3.

TASK 3 - BALANCE MAIN ROTOR ON THE GROUND

PROCEDURE 1: PREPARATION
Perform task 2, Flat Track Main Rotor on the Ground.

PROCEDURE 2: PERFORM INITIAL MEASUREMENT

a. Use cursor keys to highlight Aircraft Type, and then press **DO**.
b. Use cursor keys to highlight UH1 for metal blades and UH1CRB for composite blades, then press **DO**.
c. Tail Number is highlighted. Press **DO**.
d. Use cursor keys to highlight a tail number used in task 2, then press **DO**.
e. Flight Plan is highlighted. Press **DO**.
f. Use cursor keys to highlight INITIAL. Press **DO**.
g. Enter the Measure mode by pressing **F1**. Verify that Test State IDLE is highlighted.
h. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State (IDLE, FPG100, or HOVER) and press **DO** again. Perform this operation each time a measurement is completed and another Test State is highlighted. The AVA will acquire track and vibration data at each Test State and then return to the selection menu.
i. After the 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 task 4, Track Main Rotor in Flight.
j. If measured values exceed specifications, press **DO** to enter the DIAGS mode.
k. Perform corrections shown, making certain to view all screens of a multiple screen solution.
l. Repeat steps above until all measurements are within limits.
m. Proceed to task 4.

TASK 4 - TRACK MAIN ROTOR IN FLIGHT

NOTE

Ensure tail rotor is balanced (task 5) before proceeding to fly.

Main rotor in-flight vertical tracking should be performed when any of the following occurs:

- 1/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 adjustments (task 2 or task 3).

PROCEDURE 1: EQUIPMENT INSTALLATION

NOTE

Aircraft ground track and balance specified requirements (tasks 2 or 3) are to be completed prior to performing in-flight Test States if the aircraft was not in a previously flight worthy condition. Do not exceed any airspeed at which excessive vibration is present.

NOTE

For UH-1 with composite blades it is suggested that the operator stop working the rotor when the vertical 1/REV vibrations are in the 0.2 to 0.3 ips range at cruise flight. Working the rotor levels significantly lower will obtain a smooth 1/REV vibration but the perceived vibration by the crew will not be as good due to the feel of 2/REV vibrations in absence of the 1/REV. vibration.

a. Install test equipment (refer to task 1).
b. Turn on DAU.
c. Turn on CADU.

PROCEDURE 2: PERFORM FLIGHT MEASUREMENTS

a. Press **QUIT** on the CADU until all selections are undefined.
b. Use cursor keys to highlight Aircraft Type, and then press **DO**.
c. Use cursor keys to highlight UH1 for metal blades and UH1CRB for composite blades, then press **DO**.
d. Tail Number is highlighted. Press **DO**.
e. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.
f. Flight Plan is highlighted. Press **DO**.
g. Use cursor keys to highlight FLIGHT. Press **DO**.
h. Enter the Measure mode by pressing **F1**. Verify that IDLE is highlighted.
i. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State (IDLE, FPG100, HOVER, 60K, 90K, 110K, or L/DOWN) and press **DO** again. Perform this operation each time a measurement is completed and another Test State is highlighted. The AVA will acquire track and vibration data at each Test State and then return to the selection menu.
j. After the 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 o.
k. If measured values exceed specifications, press **DO** to enter the DIAGS mode.
l. Evaluate the percentage improvements obtainable through View Predictions. The AVA will make recommendations to correct for excessive vibration. Perform corrections, making certain to view all screens of a multiple screen solution.

m. If alterations to the corrective actions are desired, use the Edit Defaults options. Change MAXIMUM # OF ADJUSTMENTS up or down to get an acceptable solution if the default is not acceptable. Do not use a partial set of adjustments.

n. After corrections are installed, fly the aircraft and repeat task 4 to re-check the 1/REV vibrations through the required flight conditions.

o. Remove test equipment and make appropriate log entries.

TASK 5 - BALANCE TAIL ROTOR

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA blade tracking equipment from transport case. Check for possible damaged equipment and frayed cables. Figure 1 is the typical AVA test setup configuration.

b. Install DAU in the canvas carrying case.

c. Place DAU in the back seat with the connectors facing up and secure DAU using lap and shoulder belts and canvas straps and D-rings.

d. Connect the UH-1 DC power adapter cable (29312800), figure 2, to the heater blanket receptacle and to the 10-ft power cable (29104700).

e. Connect power cable to the DAU receptacle marked 28 Vdc.

f. Connect CADU to DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: ACCELEROMETER INSTALLATION

a. Mount accelerometer mounting bracket (29313000) on the 4 o'clock stud of the 90-degree tail rotor gearbox.

b. Install accelerometer (28110900) on accelerometer mounting bracket with the connector outboard and radial to the 90-degree gearbox input drive shaft.

c. Connect accelerometer cable (29105600) to accelerometer.

CAUTION

Keep accelerometer cable snug around tail boom, but do not pull cable tight enough to cause stress to the accelerometer connector.

d. Wrap cable forward around tail boom and pass into cockpit. Connect accelerometer cable to the DAU receptacle marked ACC4.

PROCEDURE 3: OPTICAL RPM SENSOR INSTALLATION

a. Remove the two center screws from the FM antenna faring just aft of the tail rotor gearbox.

b. Mount optical RPM sensor mounting bracket (29198700) at the base of the FM antenna-fairing base using the two center screws, see figure 8.

c. Mount optical RPM sensor (29314700) to the bracket, facing the tail rotor.

CAUTION

Keep the optical RPM sensor cable snug around the tail boom but do not pull cable tight enough to cause stress to the optical sensor.

d. Route the optical RPM sensor cable the same as the accelerometer cable and connect it to the DAU receptacle marked TACHO 2.

Figure 8. Optical RPM Sensor Mounting Bracket

NOTE

It there is any tape remaining from previous balance routines, this must be completely removed to ensure a clear and accurate tachometer signal to the DAU.

e. Place a single, 3-inch strip of reflective tape on the inside of one of the tail rotor blades at the approximate location as the beam of the optical interrupter, see figure 9. This becomes the target (TGT) blade.

Figure 9. Tail Rotor Reflective Tape

f. Proper alignment of the tape can be verified by applying AC power to the DAU and rotating the tail rotor until the taped blade passes in front of the optical RPM sensor. A red LED on the back of the sensor will light if the sensor picks up a return from the reflective tape.

PROCEDURE 4: PERFORM TAIL MEASUREMENT

a. Operate aircraft at 324 Rotor RPM.

b. Turn on DAU.

c. Turn on CADU.

d. Press **QUIT** on the CADU until all selections are undefined.

e. Use cursor keys to highlight Aircraft Type, and then press **DO**.

f. Use cursor keys to highlight UH1 or UH1CRB, and then press **DO**.

g. Tail Number is highlighted. Press **DO**.

h. Use cursor keys to highlight a tail number or enter a new tail number (up to seven digits), then press **DO**.

i. Flight Plan is highlighted. Press **DO**.

j. Use cursor keys to highlight tail. Press **DO**.

k. Enter the MEASURE mode by pressing **F1**. Verify that fpgtl is selected.

l. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire track and vibration data and return to the selection menu.

m. After the 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 r.

n. If measured values exceed specifications, press **DO** to enter the DIAGS mode.

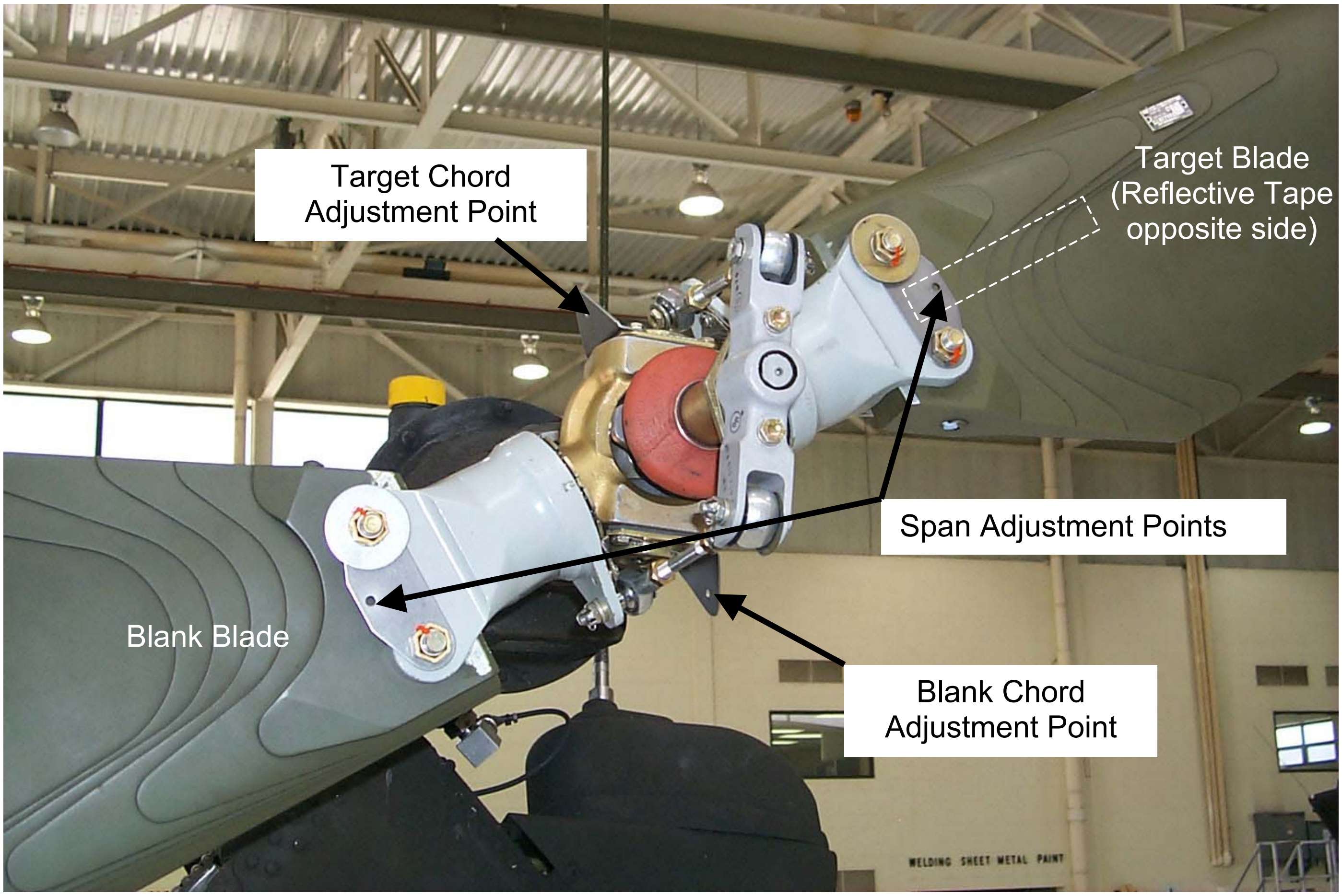


Figure 10. Tail Rotor Balance Locations

o. Evaluate the percentage improvements obtainable through View Predictions. The AVA will make recommendations to correct for excessive vibration. Perform corrections, making certain to view all screens of a multiple screen solution.

p. If alterations to the corrective actions are desired, use the Edit Adjustables and turn on or off those adjustments perceived not necessary. Use all of the new displayed corrections, don't use a partial set of adjustments.

q. Repeat task 5 and verify results.

r. Remove test equipment and make appropriate log entries.

TASK 6 - ISOLATING IRREGULAR/UNUSUAL VIBRATIONS

PROCEDURE 1: EQUIPMENT INSTALLATION

a. Remove AVA blade tracking equipment from transport case. Check for possible damaged equipment and frayed cables. Figure 1 is the typical AVA test setup configuration.

b. Install DAU in the canvas carrying case.

c. Place DAU in the back seat with the connectors facing up and secure DAU using lap and shoulder belts and canvas straps and D-rings.

d. Connect the UH-1 dc power adapter cable (29312800), figure 2, to the heater blanket receptacle and to the 10-ft power cable (29104700).

e. Connect power cable to the DAU receptacle marked 28 Vdc.

f. Install CADU in aircraft. Connect CADU-to-DAU cable (29325601) to CADU and to DAU receptacle marked CADU.

PROCEDURE 2: ACCELEROMETER INSTALLATION

a. Mount/install accelerometer (28110900) anywhere on the airframe that an irregular or unusual vibration is detected.

b. Connect accelerometer cable (29105600) from accelerometer to the DAU receptacle marked ACC1, ACC2, ACC3, and/or ACC4. The flight plan will measure data on one channel at a time.

PROCEDURE 3: PERFORM PROBES MEASUREMENTS

a. Operate aircraft at desired RPM.

b. Turn on DAU.

c. Turn on CADU.

d. Press **QUIT** on the CADU until all selections are undefined.

e. Use cursor keys to highlight Aircraft Type, then press **DO**.

f. Use cursor keys to highlight UH1 or UH1CRB, and then press **DO**.

g. Tail Number is highlighted. Press **DO**.

h. Use cursor keys to highlight a tail number or enter a new tail number (up to seven characters), then press **DO**.

i. Flight Plan is highlighted. Press **DO**.

j. Use cursor keys to highlight PROBES. Press **DO**.

k. Enter the MEASURE mode by pressing **F1**. Verify that ACC1 is selected.

l. Press **DO** when the aircraft is stable at the highlighted selection. Verify that the aircraft is at the required Test State (ACC1, ACC2, ACC3, or ACC4) and press **DO** again. Perform this operation each time a measurement is completed and another Test State to be measured is highlighted. The AVA will acquire vibration data and return to the selection menu.

m. After the last measurement is completed, press **DO** on Finish, then press **DO** on Main Menu.

n. Enter the Display mode by pressing **F2**. Select One Test State and press **DO**. Review each of the spectrums measured for any unusual vibrations.

o. When finished, remove test equipment and make appropriate log entries.

END OF WORK PACKAGE

AVA APPLICATION AND PROCEDURES – CH-47D
(Script File No. CH47.CMD)

This WP supersedes WP 0075 00 dated, 22 December 2003

CAUTION

When routing cables, ensure that cables are secured and tied away from rotating assemblies.

TASK 1 - TEST EQUIPMENT INSTALLATION/CHECKOUT
TASK 2 - TRACK FWD AND AFT ROTORS (ON THE GROUND)
TASK 3 - TRACK AND BALANCE FWD AND AFT ROTORS (IN HOVER)
TASK 4 - TRACK ROTORS (IN FORWARD FLIGHT)
TASK 5 - MAINTENANCE TESTS (50 HOUR, FWD VIB & AFT VIB TEST)

PERSONNEL REQUIRED

Four People Required:
- Pilots (2)
- Flight Helicopter Repairer
- Inspector

TOOLS
- Aircraft Mechanic's Toolkit, NSN 5180-00-323-4692
- Trim Tab Bending Fixture 145G1019-55
- Aircraft Adapter Kit (29315200) NSN 6625-01-364-4477
- *Data Acquisition Unit (DAU) (29328203)
- *Control and Display Unit (CADU) (29314106)
- *Universal Tracking Device (2 each) (29310700)
- *Accelerometer (2 each) (28110900)
- *10-ft CADU-to-DAU Cable (29325601)
- 15-ft CH-47 Bulkhead-to-DAU Breakout Cable (29085700)
- *Accelerometer Bracket (29313000)
- *25-ft UTD Cable (29325701)
- *25-ft Accelerometer Cable (29105605)
-
- *50-ft Accelerometer Cable (29105600)
- *50-ft UTD Cable (29725500)
- Accelerometer Bracket (29339500)
- Forward UTD Bracket (29141700)
- Aft UTD Bracket (29724300)
- Sun Shield (2 pieces) (29722100)
- *CH-47 Aircraft Setup File (installed in CADU)
- Screws (MS35308-326)
- Torque Wrench 1050 to 1300 in-lb.
- Crow's Foot
- AVA Basic Kit, Rotor Track & Balance NSN 6625-01-282-3746

ALSO NEEDED
- Balance Weights (as required)
- Lockwire, MS20955NC32 (STEPS 1 and 2)
- Reflective Tape (10605000)
- Accelerometer Blocks (29703800 or equivalent)
- Accelerometer (3 each) (28110900 or equivalent)
- Tie Wraps
- Cotter Pins

EQUIPMENT CONDITIONS
- Electrical power off
- Hydraulic power off
- Tiedown lines connected to one forward and one aft main rotor blade (task 1-26)
- Forward and aft pylon work platforms open (task 2-2)

REFERENCES
- TM 55-1520-240-10
- TM 55-1520-240-23
- TM 55-1520-240-MTF
- TM 1-6625-724-13&P

The CH-47 Flight Plans are listed below with a brief description of their purpose. The selectable Flight Plans (see Table 1) are listed in order of appearance in the menu of the CADU and not in the order in which they are to be performed.

50HOUR
The CH-47 50-hour vibration survey is performed on the combining and aft transmission oil cooler fans, see Task 5. This procedure measures vibration levels of the components only, and does not offer corrective actions for out of tolerance conditions.

AFTVIB
The aft vibration survey is performed whenever an unusual vibration is suspected in the aft part of the synchronizing drive shaft or cross shaft area, see Task 5. This procedure measures vibration at hanger bearings 4, 5, 6, 7, cross shaft No. 1 and cross shaft No. 2. This procedure measures the vibration levels of the components only, and does not offer corrective action.

FLIGHT
This test, see Task 4, is designed to reduce rotor system lateral and vertical vibration to specified levels, using pitch change links, tabs and tracking weights. It is to be used after GROUND and HOVER or for “tuning up” an aircraft that is already in service.

FWDVIB
The forward vibration survey is performed whenever an unusual vibration is suspected in the forward transmission or synchronizing drive shaft area, see Task 5. This procedure measures vibration at the forward transmission oil cooler and at hanger bearings 1 through 3. This procedure measures the vibration levels of the components only, and does not offer corrective action.

GROUND
This Flight Plan is designed to track the rotors prior to hover balancing, using pitch change links only. It is the first step to be performed after any component change or major rework on the rotor.

HOVER
This Flight Plan is designed to be used after GROUND has been completed. It is designed to reduce the rotor system’s lateral vibrations to specified levels, using pitch change links and spanwise balance weights.

PROBES
This Flight Plan is designed to use data from up to 8 accelerometers to assist in isolating irregular or unusual vibrations. It will measure data one channel at a time on DAU ACC1 through ACC4 and the multi-channel cable connected to the track and balance accelerometer blocks. All accelerometers will measure a 0 to 500 Hz spectrum (0 to 30,000 RPM).

Table 1. CH-47 Test States

FLIGHT PLAN	TEST STATES	TEST CONDITION
GROUND	FPG100	100% NR, 3 degree GND detent
HOVER	Hover	Hover
FLIGHT	Hover	Hover
	80K	80 Knots level flight
	120K	120 Knots level flight
	140K	140 Knots level flight
50Hour	OILCLR	Vibes at forward trans. Oil Cooler.
	AFTFAN	Vibes at AFT XM cooling fan
FWDVIB	FWDOIL	Vibes at forward trans. Oil Cooler
	H/B#1	Vibes at hanger bearing #1
	H/B#2	Vibes at hanger bearing #2
	H/B#3	Vibes at hanger bearing #3
AFTVIB	H/B#4	Vibes at hanger bearing #4
	H/B#5	Vibes at hanger bearing #5
	H/B#6	Vibes at hanger bearing #6
	H/B#7	Vibes at hanger bearing #7
	XSHFT1	Vibe readings for cross shaft No. 1
	XSHFT2	Vibe readings for cross shaft No. 2
PROBES	ACC1	Operator must denote location and
	ACC2	orientation for ACC1 – ACC4.
	ACC3	
	ACC4	
	F-Lat	Power Spectrum acquisition
	F-Vert	Power Spectrum acquisition
	A-Lat	Power Spectrum acquisition
	A-Vert	Power Spectrum acquisition

TASK 1 – TEST EQUIPMENT INSTALLATION/CHECKOUT

PROCEDURE 1: CONFIGURE AIRCRAFT

a. Check that the phase detector and the three interrupter brackets are attached securely to the forward swashplate and ensure that the double interrupter is installed under the green pitch link.

NOTE

Rotor blade tracking errors such as “Blade Apparently Too Close,” “Blades Apparently Moving at Wrong Speed” or “Blade Chords Apparently Different” may be caused by excessive paint wear due to erosion on the leading edge of the blades. Light paint touchup on the underside of the rotor blades’ leading edges in the UTD viewing area may eliminate these errors.

b. Position brackets over detector by turning blades. Check clearance between each of three interrupter brackets and phase detector. Clearance shall be 0.015 to 0.025 inch.

c. Turn blades to position double interrupter over phase detector. The position of the blade should match Figure 1.

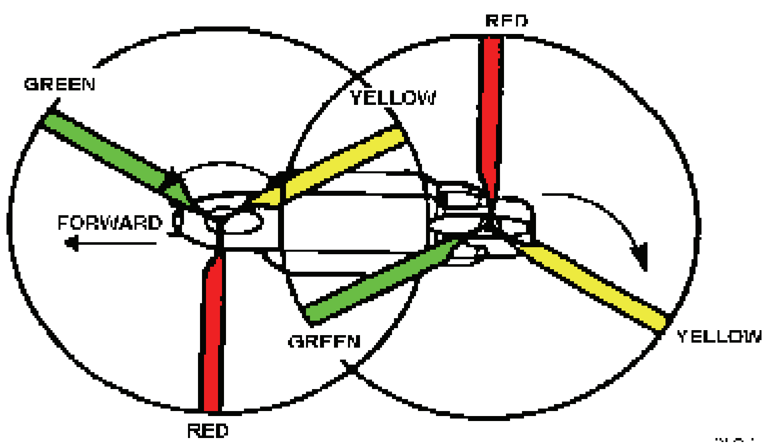


Figure 1. Rotor Blades Position

NOTE

The open side of both accelerometer blocks, steps d and e, face inboard.

d. Remove plug from dummy receptacle, see Figure 2, and connect to forward accelerometer block.

e. Remove plug from dummy receptacle, Figure 3 and connect to aft accelerometer block.

f. Check that blade TCK circuit breaker on No. 2 power distribution panel is closed.

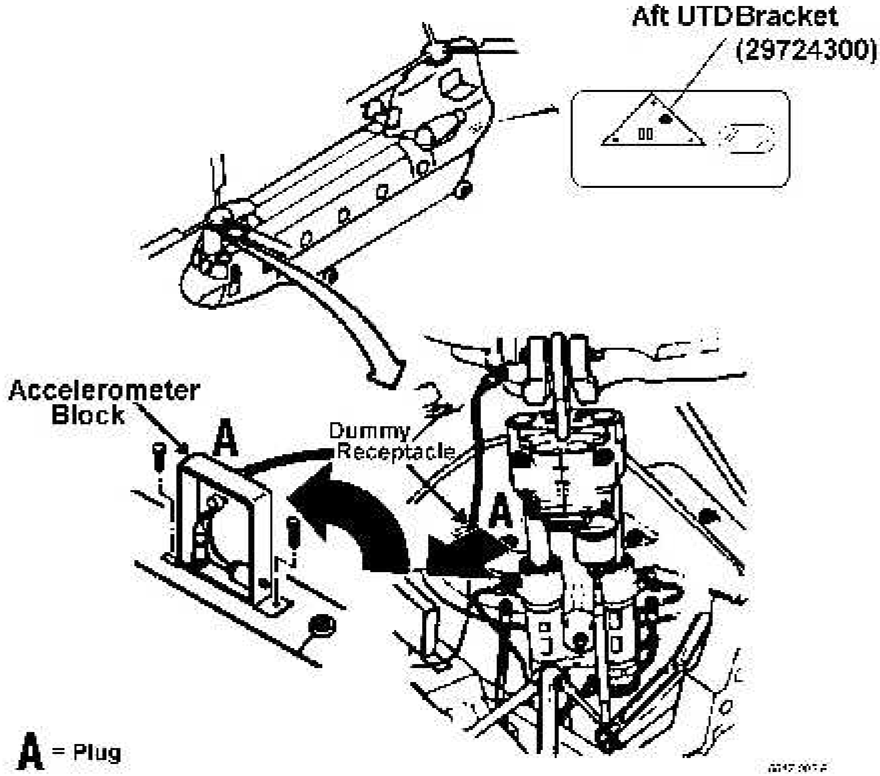


Figure 2. Dummy Receptacle and Forward Accelerometer Block

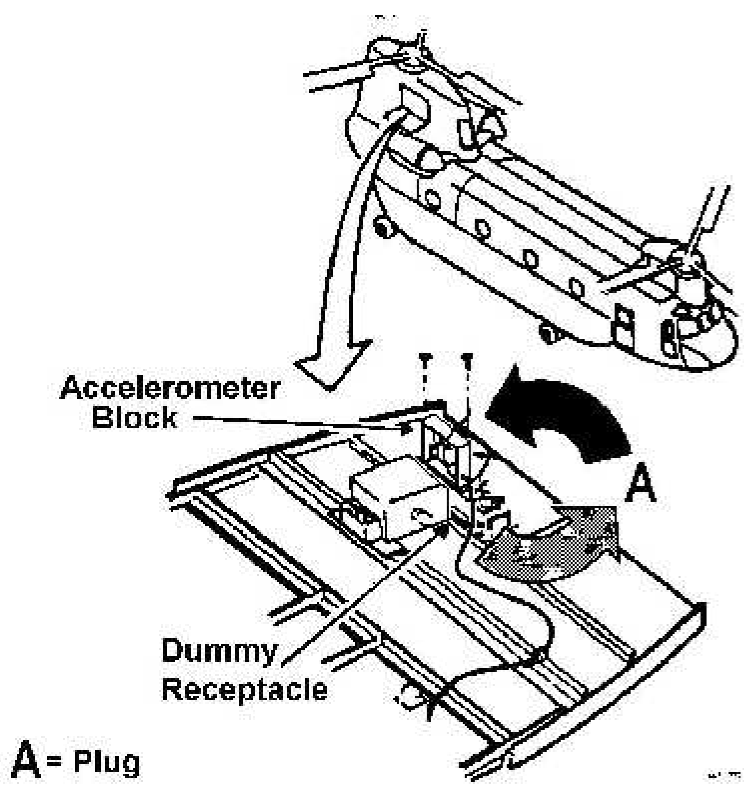


Figure 3. Dummy Receptacle and Aft Accelerometer Block

PROCEDURE 2: CONFIGURE AVA

a. Inventory and remove AVA blade tracking equipment from transport cases. Check for possible damaged equipment and frayed cables.

b. Ensure DAU is installed in canvas carrying case.

c. Secure DAU to seat using lap belts and the DAU's straps and D-rings.

NOTE

If the seats are not installed, the DAU can be secured to the floor's tiedown rings.

d. Connect the 15-ft. cable assembly (29085700) to the BLADE TRACK bulkhead receptacle, located on the right side of the cabin near station 256. See Figure 4.

e. Connect the 15-ft. breakout cable (29085700) terminations to the DAU receptacles marked MULTI-CH, TACHO1 and 28VDC.

f. Connect the 10-ft. CADU to DAU cable (29325601).

Figure 4. BLADE TRACK Bulkhead Receptacle Near STA 256

PROCEDURE 3: FORWARD UTD INSTALLATION

a. Remove 6 screws (3 fwd, 3 aft) from the access panel located on the chin of the aircraft. See Figure 5.

b. Place forward blade UTD bracket (29141700) over screw holes with the arrow on the bracket pointing forward (the stepped foot should be aft) and attach to the aircraft with the removed screws.

c. Attach the sun shield (29722100) by placing the sun shield over the UTD (29310700) sensor receiving lens. Then swing the sun shield locking arm under the body of the UTD, placing the UTD bolts through the arm. This will place the arm between the UTD and bracket.

NOTE

If the UTD captive mounting bolts are lost or damaged, use NAS1305-14 bolts as alternate replacements.

d. Attach UTD (29310700) to bracket (29141700) using the bolts provided. Ensure that the arrow on the UTD body points in the direction of the forward rotor rotation.

e. Attach the 25-ft UTD cable (29325701) to the FWD UTD.

f. Route UTD cable through nose compartment access panel located above UTD past copilot's feet, adjacent to the center console, and aft to the DAU.

g. Connect UTD cable to the receptacle on the DAU marked TRACKER 1.

Figure 5. Forward/Aft Blade Tracker Bracket and UTD Location

PROCEDURE 4: AFT UTD INSTALLATION

a. If the flare dispenser will not be installed during the rotor smoothing operations, attach the aft UTD bracket (29724300) using MS35308-310 hardware on top three bolt locations of the dispenser. See Figure 5.

b. If mounting the UTD with the flare dispenser, replace the flare dispenser's mounting bolts with the adapter kit screws (MS35308-326). Place the bracket against the flare dispenser onto the top 3 bolts. Mount the assembly back on to the airframe.

c. Attach the sun shield (29722100) by placing the sun shield over the UTD (29310700) sensor receiving lens. Then swing the locking arm under the body of the UTD, placing the UTD bolts through the arm. This will place the arm between the UTD and bracket.

d. Install the UTD (29310700) on the aft UTD bracket (29724300). Ensure that the arrow on the UTD body points in the direction of rotation.

e. Attach 50-ft. UTD cable (29725500) to the breakout cable (29085700) connected to the DAU receptacle marked MULTI-CH.

f. Install the 50-ft. UTD cable (29725500) and attach the cable with a small loop of slack to prevent unnecessary strain on the UTD plug or cable potting and tie wrap the cable to the mounting bracket.

g. Connect ground lug from cable (29725500) to the stud on the aft UTD bracket (29724300).

h. Ensure that the tracker select switch on the front panel of the DAU is in the DAY position.

NOTE

The following steps are to be followed if nighttime tracking is anticipated. If tracking is only to be performed during the day, proceed to Procedure 6.

PROCEDURE 5: NIGHT TIME TRACKING INSTRUCTIONS

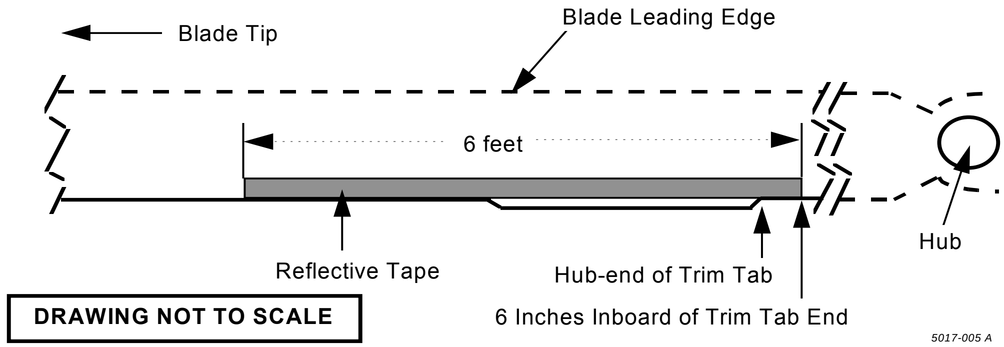
a. Ensure that the tracker select switch on the DAU is in the NIGHT position.

b. Ensure that UTD sunshields, if installed, are removed prior to flight.

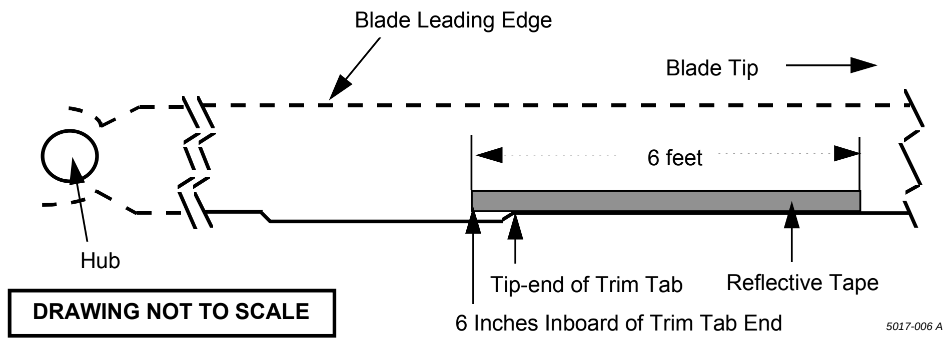
c. Ensure that the underside, trailing edge of all blades are as clean as possible. This is to ensure optimum adhesion of the reflective tape.

d. Place a 6-ft. strip of reflective tape (10605000) on the bottom of the blade. The tape is applied on the trailing edge of the blade starting 6 inches inboard of the tab, and moving outboard. See Figure 6. Do not follow the contour of the tab.

e. If verification of the tape placement and reflection quality is desired, it can be verified by holding a flashlight aligned with UTD and shining it at the rotating blades. Any misplaced tape or tape with reduced reflectivity will stand out.



6A. FORWARD ROTOR BLADES



6B. AFT ROTOR BLADES

Figure 6. Placement of Reflective Tape on Forward and Aft Rotor Blades

PROCEDURE 6: COMBINER TRANSMISSION OIL COOLING FAN SENSORS INSTALLATION (50 HOUR CHECK ONLY)

a. Complete Procedure 2.

b. Gain access to the combiner transmission cooling fan area, see Figure 7.

c. Remove nuts from combiner transmission oil cooling fan mounting flange studs at the 5:00 and 8:30 clock positions.

d. Mount an accelerometer mounting bracket (29339500) to each of the studs with the nuts provided. See Figure 7.

NOTE

When mounting accelerometers, make certain that they are in line with the corresponding axis (lateral and longitudinal). See Figure 7 top view.

e. Install accelerometer (28110900), accelerometer 1 (ACC1), in the lateral axis on the mounting bracket (29339500) that is on the stud at 5 o'clock. The nose of the aircraft is at the 12 o'clock position.

f. Install accelerometer (28110900), accelerometer 3 (ACC3), in the longitudinal axis on the mounting bracket that is on the stud at the 8:30 clock position.

g. Connect 50-ft accelerometer cable assemblies (29105600) to the lateral accelerometer (ACC1), and to the longitudinal accelerometer (ACC3).

h. Run the cable from the longitudinal accelerometer around the back of the oil cooler.

i. Identify each accelerometer cable (ACC1 and ACC3) and feed the cables through the lightening hole at station 482 on the right side.

j. Tie-wrap the accelerometer cables away from the sync shaft and engine drive shaft and route the cables to the DAU.

k. Connect the lateral accelerometer (ACC1) cable to the receptacle on the DAU marked ACC1.

l. Connect the longitudinal accelerometer (ACC3) cable to the receptacle on the DAU marked ACC3.

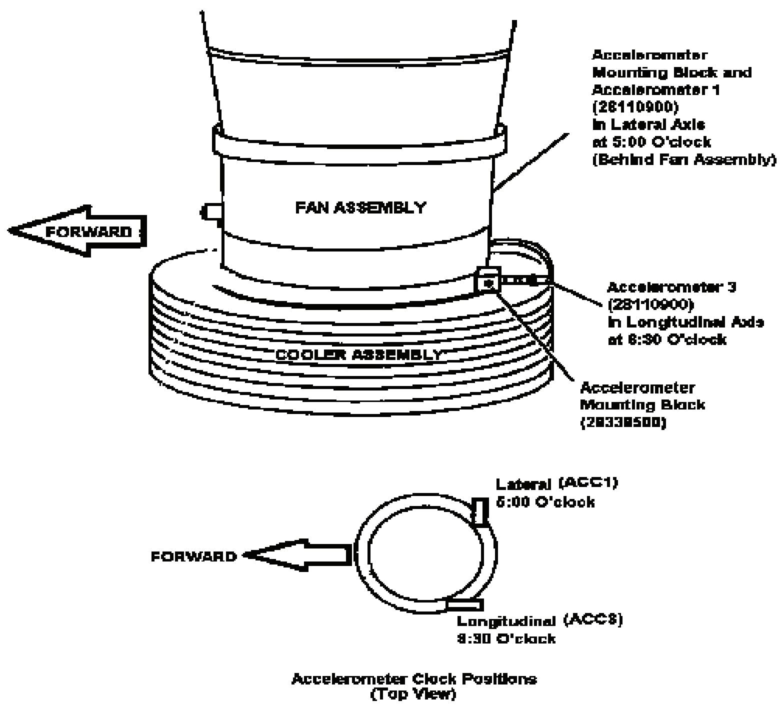


Figure 7. Combiner Transmission Oil Cooling Fan Accelerometers Installation

CAUTION

When routing cables, ensure that cables are secured and tied away from rotating assemblies.

PROCEDURE 7: AFT TRANSMISSION OIL COOLING FAN SENSORS INSTALLATION (50 HOUR CHECK ONLY)

a. Complete Procedure 2.

b. Gain access to the AFT transmission oil cooling fan area, see Figure 8.

c. Remove the nut from the stud at the 8:30 clock position on the AFT transmission cooling fan flange.

d. Mount an accelerometer mounting bracket (29313000) to the stud with the nut provided and orient the bracket so that the accelerometer will be lateral when it is installed.

e. Install an accelerometer (28110900), accelerometer 9 (ACC9), on the mounting bracket.

f. Remove the nut from the stud at the 7:30 clock position on the AFT transmission cooling fan flange.

g. Mount an accelerometer mounting bracket (29313000) to the stud with the nut provided and orient the bracket so that the accelerometer will be vertical when installed.

h. Install an accelerometer (28110900), accelerometer 10 (ACC10), on the mounting bracket.

i. Connect a 50-ft. accelerometer cable assembly (29105600) to each accelerometer.

CAUTION

When routing cables, ensure that the cables are secured and tied away from rotating assemblies.

j. Identify each accelerometer cable (ACC9 and ACC10) and route forward to the DAU.

k. Tie-wrap the accelerometer cables clear of all rotating components and flight controls.

l. Connect AFT transmission lateral accelerometer (ACC9) cable to connector on the 15-ft. DAU cable assembly (29085700) labeled ACC9.

m. Connect AFT transmission vertical accelerometer (ACC10) cable to connector on the 15-ft. DAU cable assembly (29085700) labeled ACC10.

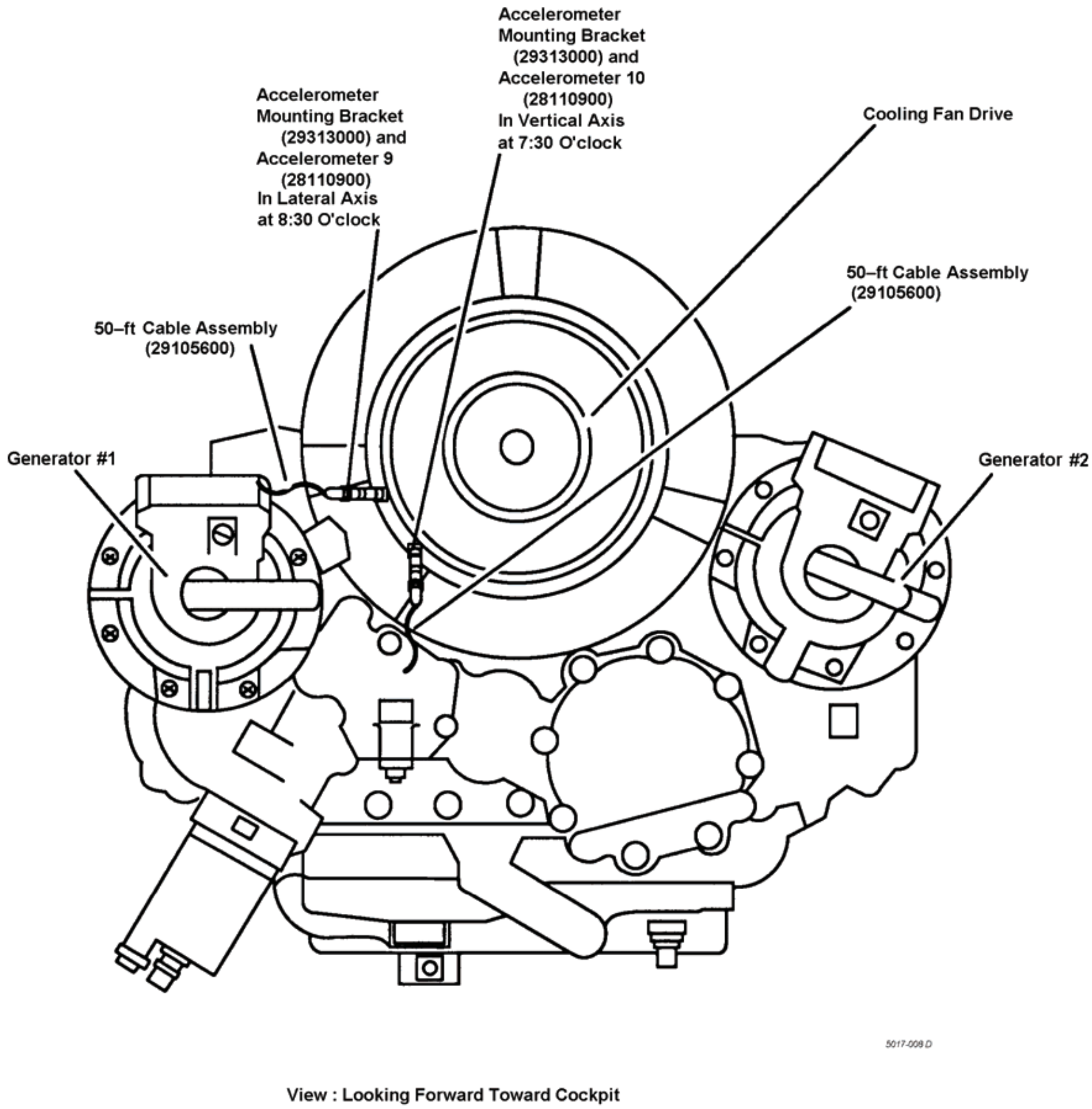


Figure 8. Aft Transmission Oil Cooling Fan Accelerometers Installation

PROCEDURE 8: AFTVIB CHECK SENSORS INSTALLATION (CROSS SHAFTS AND HANGER BEARINGS 4-7)

a. Complete Procedure 2.

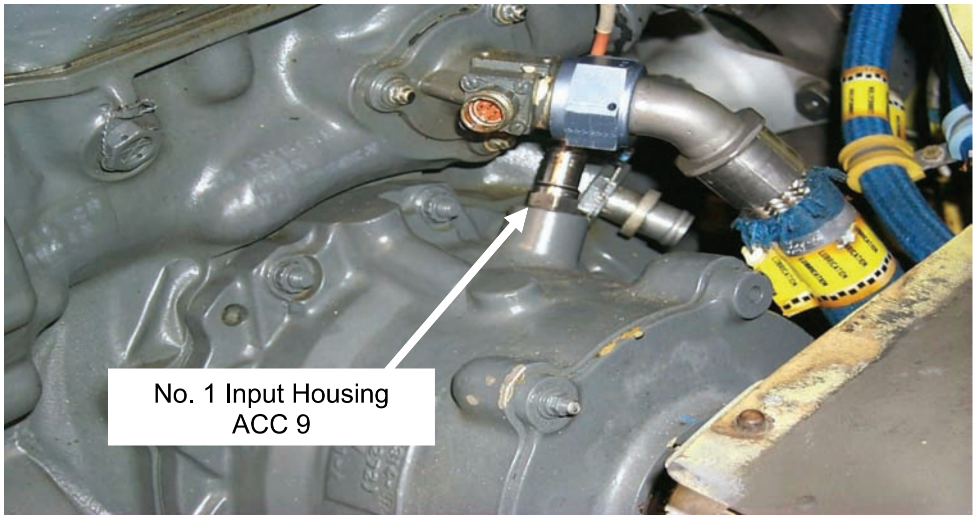
b. Not all sensors need to be installed, install only the accelerometers that are needed to diagnose the problem.

c. Gain access to the engine combining transmission area and hanger bearings Nos. 4, 5, 6 and 7.

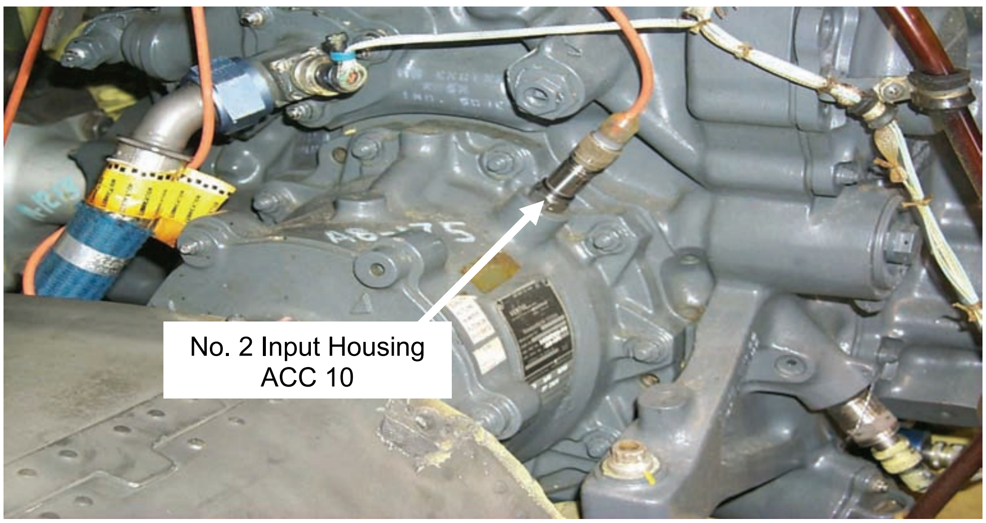
d. Install an accelerometer (28110900), accelerometer 9 (ACC 9), on the accelerometer mounting pad on the C-BOX No. 1 cross shaft input housing. See Figure 9.

e. Install an accelerometer (28110900), accelerometer 10 (ACC 10) on the accelerometer mounting pad on the C-BOX No. 2 cross shaft input housing. See Figure 9.

f. Connect a 50-ft accelerometer cable assembly (29105600) to each accelerometer.



Number 1 Cross Shaft Input



Number 2 Cross Shaft Input

Figure 9. C-BOX Transmission Input Accelerometer Installation

CAUTION

When routing cables, ensure that cables are secured and tied away from rotating assemblies.

g. Identify each accelerometer (ACC9 and ACC10) and route the cables from the accelerometers around the C-BOX area then down through the lightning hole at station 482 near the right aft corner of the C-BOX. Route cables forward through the cabin to the DAU.

h. Tie-wrap the accelerometer cables clear of all rotating components and flight controls.

i. Connect the Engine 1 cross shaft accelerometer cable to connector marked (ACC9) on the 15-ft. DAU cable assembly (29085700).

j. Connect the Engine 2 cross shaft accelerometer cable to connector marked (ACC10) on the 15-ft. DAU cable assembly (29085700).

k. Mount an accelerometer (28110900) to the accelerometer bracket (29339500) for hanger bearing No. 4.

l. Remove nut from the top bolt of the right hand No. 4 hanger bearing shock mount and orient the accelerometer and bracket with the accelerometer pointing to the center of rotation and the connector pointed away from the center, (use the small hole in the AVA accelerometer bracket) and tighten nut. See Figure 10.

m. Repeat steps k and l for hanger bearings no. 5, 6 and 7.

n. Connect a 50-ft accelerometer cable to each hanger bearing accelerometer.

CAUTION

When routing cables, ensure that cables are secured and tied away from rotating assemblies.

o. Identify each accelerometer cable and route the cables from the accelerometers aft along the hydraulic lines past the C-BOX down into the cabin to the DAU and connect as follows:

DAU Channel	Accel. Location
ACC1	H/B#4
ACC2	H/B#5
ACC3	H/B#6
ACC4	H/B#7
ACC9	NO. 1 Cross Shaft
ACC10	NO. 2 Cross Shaft

p. Tie-wrap the accelerometer cables clear of all rotating components and flight controls.

PROCEDURE 10: FWDVIB CHECK SENSOR INSTALLATION (FORWARD OIL COOLER AND HANGER BEARINGS 1-3)

a. Complete Procedure 2.

b. Gain access to the forward transmission area, see Figure 10.

c. Remove the self-locking nut from the stud at the 5 o'clock position on the forward transmission oil cooler, looking forward, see Figure 11.

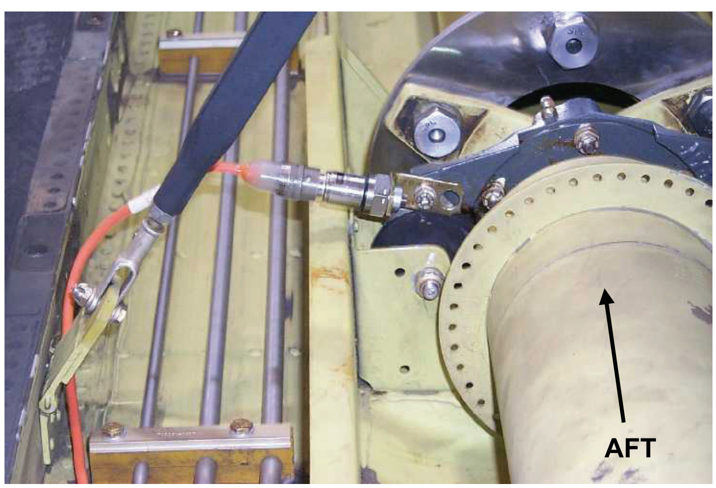


Figure 10. Typical Hanger Bearing Installation

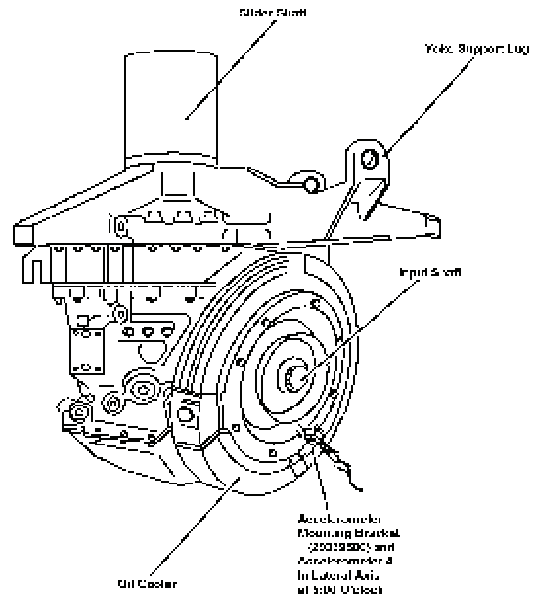


Figure 11. Forward Transmission Impeller Accelerometer Installation

d. Mount an accelerometer (28110900) to the accelerometer bracket (29339500).
e. Install the accelerometer bracket on the stud with the accelerometer pointed to the center of rotation and the connector pointed away from the center. See Figure 11.
f. Connect a 25-ft accelerometer cable (29105605) to the accelerometer.

CAUTION

When routing cables, ensure that cables are secured and tied away from rotating assemblies.

g. Run the cable from the accelerometer through the most convenient cabin access to the DAU. Tie-wrap the cable clear of all rotating components and flight controls.
h. Connect the accelerometer cable to ACC1 connector on the DAU.
i. Mount an accelerometer (28110900) to the accelerometer bracket (29339500) for hanger bearing No. 1.
j. Remove nut from the top bolt of the right hand No. 1 hanger bearing shock mount and orient the accelerometer and bracket with the accelerometer pointing to the center of rotation and the connector pointed away from the center, (use the small hole in the AVA accelerometer bracket) and tighten nut. See Figure 11.
k. Repeat i and j for hanger bearings Nos. 2 and 3.
l. Connect a 50-ft accelerometer cable to each hanger bearing accelerometer.

CAUTION

When routing cables, ensure that cables are secured and tied away from rotating assemblies.

m. Identify each accelerometer cable and route the cables from the accelerometers forward along the hydraulic lines to the forward tunnel cover. Pass the cables under tunnel cover in the forward cabin door to the DAU and connect as follows:

DAU Channel	**Accel. Location**
ACC1	Forward Transmission Oil Cooler
ACC2	H/B#1
ACC3	H/B#2
ACC4	H/B#3

n. Tie-wrap the accelerometer cables clear of all rotating components and flight controls.

TASK 2 – TRACK FWD AND AFT ROTORS (ON THE GROUND)

PROCEDURE 1: CONFIGURE AVA FOR GROUND RUN

a. Perform Task 1, Test Equipment Installation/Checkout, Procedures 1 through 6.
b. Operate aircraft at 100% Nr, and ground detent.
c. Turn on DAU.
d. Turn on CADU.

PROCEDURE 2: PERFORM GROUND TRACK MEASUREMENT

a. Press **QUIT** on the CADU until all selections show undefined.
b. Select CH47 under Aircraft Type menu.
c. Select proper tail number from previous selections in Tail Number menu or enter a new tail number (up to seven characters).
d. Enter the Flight Plan menu and select GROUND.
e. Enter the MEASURE mode by pressing **F1**. Verify that FPG100 is selected.
f. Press **DO** when the aircraft is stable at the proper test condition. Re-verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire track and vibration data and return to the selection display when the system is ready for the next measurement.
g. After the measurement is completed, press **DO** on Finish, press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu and proceed to Task 3.

NOTE

Evaluate the ability to use the recommended adjustments. If modifications to the adjustments are desired, enter the menu option Edit Adjustables. Make the desired changes and press the **DO** key.

h. If measured values exceed manufacturer's desired levels, press the **DO** key to enter the Diagnostics mode. Evaluate the percentage improvements obtainable through further corrective action. Perform all corrections displayed on the screen. Do not use a partial set of the adjustments.

NOTE

Make corrective adjustments in accordance with TM 55-1520-240-23.

i. If any adjustments have been made, perform Procedure 2 again and verify the corrections.

TASK 3 – TRACK AND BALANCE FWD AND AFT ROTORS (HOVER)

PROCEDURE 1: CONFIGURE AVA FOR HOVER RUN

a. Perform Task 1, Test Equipment Installation/Checkout, Procedures 1 through 6.
b. Turn on DAU.
c. Turn on CADU.
d. Operate aircraft in a hover.

PROCEDURE 2: PERFORM HOVER MEASUREMENT

a. Press **QUIT** on the CADU until all selections show undefined.
b. Select CH47 under Aircraft Type menu.
c. Select proper tail number from previous selections in Tail Number menu or enter a new tail number (up to seven characters).
d. Enter the Flight Plan menu and select HOVER.
e. Enter the MEASURE mode by pressing **F1**. Verify that HOVER is selected.
f. Press **DO** when the aircraft is stable at the proper test condition. Re-verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire track and vibration data and return to the selection display when the system is ready for the next measurement.
g. After the measurement is completed, press **DO** on Finish, press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to Main Menu and select next flight plan (FLIGHT).

NOTE

Evaluate the ability to use the recommended adjustments. If modifications to the adjustments are desired, enter the menu option Edit Adjustables. Make the desired changes and press the **DO** key.

h. If measured values exceed manufacturer's desired levels, press the DO key to enter the Diagnostics mode. Perform all corrections displayed on the correction screens. Check to ensure that all screens of a multiple screen solution have been performed. If alterations of these corrective actions are desired, use the Edit Adjustables and Edit Defaults diagnostic editors. See Figure 12 for a detailed flow chart concerning HOVER diagnostics.

NOTE

Do not use a partial set of the adjustments. The recommended adjustments have accounted for the cross coupling effects of the tandem rotors and using a partial set of the corrections may increase the total vibration environment.

NOTE

Make corrective adjustments in accordance with TM 55-1520-240-23.

i. If any adjustments have been made, perform the flight test again and verify the corrections.

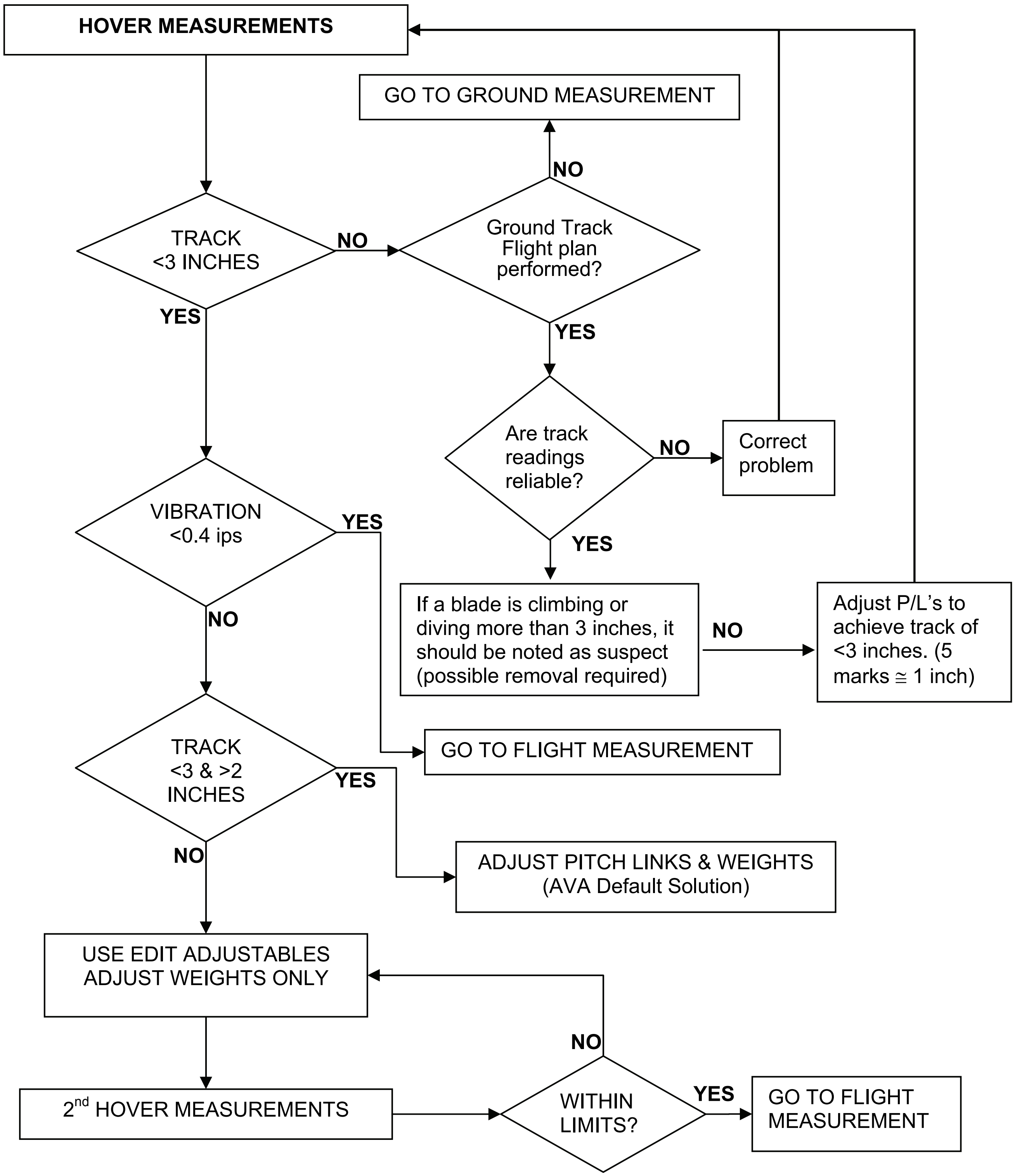


Figure 12. HOVER Diagnostic Flow Chart

TASK 4 – TRACK ROTORS (IN FORWARD FLIGHT)

PROCEDURE 1: CONFIGURE AVA FOR FORWARD FLIGHT

a. Perform task 1, Test Equipment Installation/Checkout, procedures 1 through 6.
b. Turn on DAU.
c. Turn on CADU.
d. Operate aircraft in forward flight.

PROCEDURE 2: PERFORM FLIGHT MEASUREMENT

a. Press **QUIT** on the CADU until all selections show undefined.
b. Select CH47 from Aircraft Type menu.
c. Select proper tail number from previous selections in Tail Number menu or enter a new tail number (up to seven characters).
d. Enter the Flight Plan menu and select FLIGHT.
e. Enter MEASURE mode by pressing **F1**. Verify that FLIGHT is selected.
f. Press **DO** when the pilot is stable at the highlighted selection. Re-verify that the pilot is at the required Test State and press **DO** again. The AVA will acquire track and vibration data and return to the selection display when the system is ready for the next measurement.
g. After the last measurement is completed, press **DO** on Finish, press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to the Main Menu.

CAUTION

DELETED

h. If measured values exceed manufacturer's desired levels, press the **DO** key to enter the DIAGS mode. Perform all corrections displayed on the screen. Check to ensure that all screens of a multiple screen solution have been performed. If alterations to these corrective actions are desired, use the Edit Adjustables and Edit Defaults options. Do not use a partial set of the adjustments. The recommended adjustments have accounted for the cross coupling effects of the tandem rotors and using a partial set of the corrections may increase the total vibration environment. See figure 13 for a detailed flow chart concerning FLIGHT.

NOTE

Evaluate the ability to use the recommended adjustments. If modifications to the adjustments are desired, enter the menu option Edit Adjustables. Make the desired changes and press the **DO** key.

NOTE

Make corrective adjustments in accordance with TM 55-1520-240-23.

NOTE

Adjustment of the trim tab will change the hover track approximately 1/6 inch per degree bent. The AVA will compensate for this if the Edit Adjustables display is not altered.

NOTE

If a blade requires more than a 15-degree tab bend from 0 in either direction, refer to the manufacturer's procedure for isolation of a defective blade.

i. If any adjustments have been made, perform the flight test again and verify the corrections.

j. Remove the AVA equipment from the aircraft.

k. Inventory AVA kit and adapter kit to ensure all parts are removed from the aircraft.

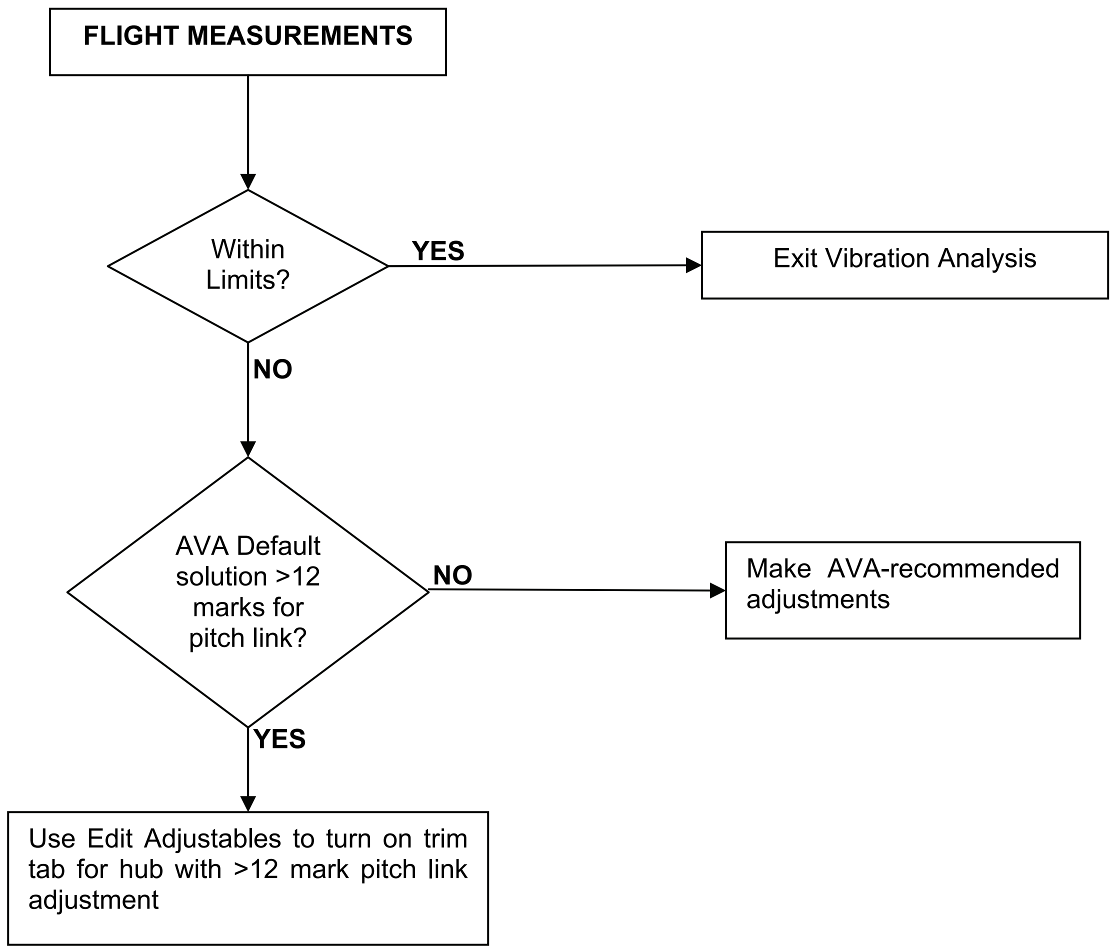


Figure 13. FLIGHT Flow Chart

TASK 5 – MAINTENANCE TESTS

PROCEDURE 1: PERFORM 50HOUR VIBRATION CHECKS

a. Perform Task 1, Test Equipment Installation/Checkout, Procedures 2, 7 and 8.

b. Turn on aircraft power.

c. Setup the measurement mode on the CADU using the flight plan 50HOUR.

d. After the measurement setup parameters have been run, the available Test States are displayed (OILCLR and AFTFAN).

e. Operate aircraft on the ground at 100% NR, flat pitch.

f. Highlight OILCLR using the arrow keys. Press the **DO** key twice. This test will measure data from the two accelerometers mounted to the combiner transmission oil cooling fan mounting flange studs (Task 1, Procedure 7).

NOTE

After the first measurement startup has been run and vibration data is measured on laterally mounted accelerometer 1 (ACC1), a second measurement setup is run and vibration data is measured on the longitudinally-mounted accelerometer 3 (ACC3).

NOTE

If measurement errors occur, press **QUIT** on the CADU. Either "partial" or "failed" is displayed. When an error occurs, an error code is displayed and the error is identified. Either correct the cause of the error or, if safe to do so, continue with the sequence tests.

g. Highlight the AFTFAN line using the arrow keys. Press the **DO** key twice. This test will measure data from the two accelerometers mounted on the AFT transmission cooling fan flange (Task 1, Procedure 8).

NOTE

After the first measurement startup has been run and vibration data is measured on laterally mounted accelerometer 9 (ACC9), a second measurement startup is run and vibration data is measured on vertically mounted accelerometer 10 (ACC10).

NOTE

If measurement errors occur, press **QUIT** on the CADU. Either "partial" or "failed" is displayed. When an error occurs, an error code is displayed and the error is identified. Either correct the cause of the error or, if safe to do so, continue with the sequence tests.

h. If no errors occur and the AFTFAN test is "done," a menu will appear to either finish or continue. Highlight the finished condition and press **DO** to have the data stored.

i. Press **QUIT** on CADU. The Main Menu is displayed on the CADU.

j. Press **F2** to enter DISPLAY mode.

k. Select View Limits from the Display Mode menu and press **DO** on the CADU.

l. If measured values exceed limits, perform procedures from TM 55-1520-240-23.

m. If values are within limits, press **UP** arrow to view all values.

n. Remove AVA equipment from the aircraft.

o. Inventory AVA kit and adapter kit to ensure all parts are removed from the aircraft.

PROCEDURE 2: PERFORM FWDVIB TEST

a. Perform Task 1, Test Equipment Installation/Checkout, Procedures 2 &10.

b. Turn on aircraft power.

c. Setup the measurement mode on the CADU using the flight plan FWDVIB.

d. After the measurement setup parameters have been run, the available Test States are displayed (FWDOIL, H/B#1, H/B#2, and H/B#3).

e. Operate aircraft on the ground at 100% NR, flat pitch.

f. Select FWDOIL using the arrow keys. Press the **DO** key twice. This test will measure data from the accelerometer mounted to the forward transmission oil cooling fan.

NOTE

If measurement errors occur, press **QUIT** on the CADU. Either "partial" or "failed" is displayed. When an error occurs, an error code is displayed and the error is identified. Either correct the cause of the error or, if safe to do so, continue with the sequence tests.

g. Repeat measurements for all accelerometers that are installed.

h. If all Test States are measured a menu will appear to either finish or continue. Highlight finish and press **DO**, and then select Main Menu and press **DO**.

i. If all Test States were not measured press **QUIT**, then highlight Save and Exit and press **DO** to go to the Main Menu.

j. Press **F2** to enter DISPLAY mode.

k. Select Summary Displays and press **DO**. Select the appropriate component and press **DO** to display the sync shaft peak vibration for that component. Press **QUIT** to return back to the Summary Display Menu and select other components described above.

l. Press **QUIT** to return back to the Display Mode menu.

m. Select One Test State to view spectrum data plots for each accelerometer if desired.

n. Remove AVA equipment from the aircraft.

o. Inventory AVA kit and adapter kit to ensure all parts are removed from the aircraft.

PROCEDURE 3: PERFORM AFTVIB TEST

a. Perform Task 1, Test Equipment Installation, Procedures 2 & 9.

b. Turn on aircraft power.

c. Setup the measurement mode on the CADU using the flight plan AFTVIB.

d. After the measurement setup parameters have been run, the available Test States are displayed (H/B#4, H/B#5, H/B#6, H/B#7, XSHFT1 and XSHFT2).

e. Operate aircraft on the ground detent at 100% NR, flat pitch.

f. Select the desired Test State using the arrow keys. Press the **DO** key twice. This test will measure vibration data.

NOTE

If measurement errors occur, press **QUIT** on the CADU. Either "partial" or "failed" is displayed. When an error occurs, an error code is displayed and the error is identified. Either correct the cause of the error or, if safe to do so, continue with the sequence tests.

g. Repeat measurements for all accelerometers that are installed.

h. If all Test States are measured a menu will appear to either finish or continue. Highlight finish and press **DO**, and then select Main Menu and press **DO**.

i. If all Test States were not measured press **QUIT**, then highlight Save and Exit and press **DO** to go to the Main Menu.

j. Select Summary Displays and press **DO**. Select the appropriate component and press **DO** to display the peak vibration for hanger bearings and cross shaft. Press **QUIT** to return back to the Summary Display Menu and select the components described above.

k. Press **QUIT** to return back to the Display Mode menu.

l. Select One Test State to view spectrum data plots for each accelerometer if desired.

m. Inventory AVA kit and adapter kit to ensure all parts are removed from the aircraft.

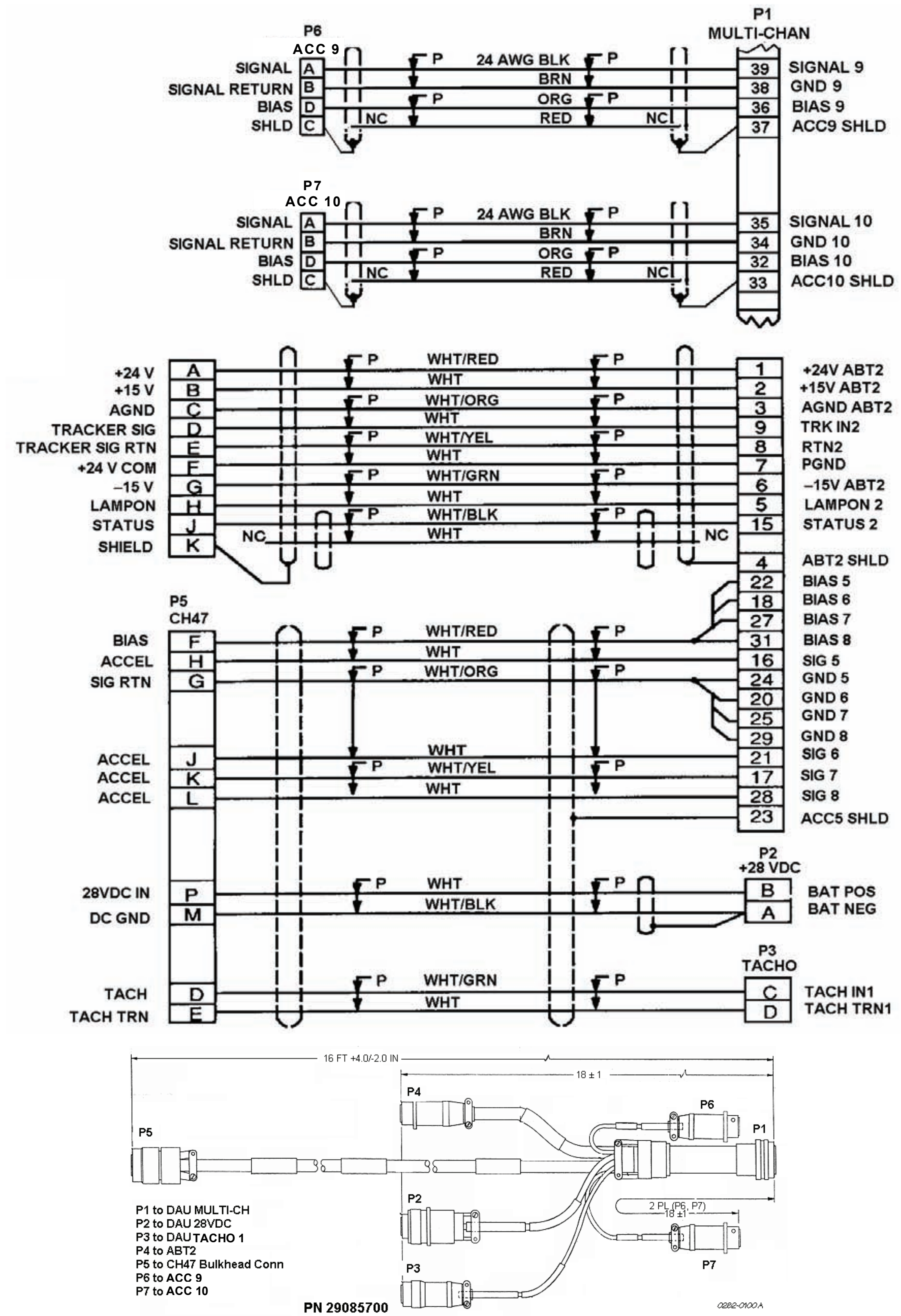


Figure 14. Multi-Channel Cable

END OF WORK PACKAGE

AVA APPLICATION AND PROCEDURES – H-47 SERIES

(Script File No. H47ST.CMD)

This WP supersedes WP 0075 00 dated 22 December 2003

CAUTION

When routing cables, ensure that cables are secured and tied away from rotating assemblies.

TASK 1 - TEST EQUIPMENT INSTALLATION/CHECKOUT
TASK 2 - TRACK FWD AND AFT ROTORS (ON THE GROUND)
TASK 3 - TRACK AND BALANCE FWD AND AFT ROTORS (IN HOVER)
TASK 4 - FORWARD FLIGHT ROTOR SMOOTHING
TASK 5 - MAINTENANCE TESTS (50 HOUR, FWD VIB & AFT VIB TEST)

PERSONNEL REQUIRED

Four People Required:
- Pilot
- Maintenance Test Pilot
- Flight Helicopter Repairer
- Inspector

TOOLS

- Aircraft Mechanic's Toolkit, NSN 5180-00-323-4692
- Torque Wrench 1050 to 1300 in-lb.
- Crow's Foot
- Screws (MS35308-326)
- Trim Tab Bending Fixture 145G1019-55
- AVA Basic Kit, Rotor Track & Balance NSN 6625-01-282-3746
  - Data Acquisition Unit (DAU) (29328203)
  - Control and Display Unit (CADU) (29314106)
  - Universal Tracking Device (UTD) (29310700)
  - Accelerometers (Qty 2) (28110900)
  - 10-ft CADU-to-DAU Cable (29325601)
  - Accelerometer Bracket (Qty 2) (29313000)
  - 25-ft UTD Cable (29325701)
  - 25-ft Accelerometer Cable (29105605)
  - 50-ft Accelerometer Cable (29105600)
- Aircraft Adapter Kit (29315203) Accelerometer Boxes (Qty 2) (182122-001) NSN 4920-01-550-2475
  - Accelerometers (Qty 8) (28110900)
  - 15-ft H-47 Bulkhead-to-DAU Breakout Cable (29085700)
  - Accelerometer "L" Bracket (Qty 4) (29313000)
  - Accelerometer Mounting Block (Qty 2) (29339500)
  - 50-ft Accelerometer Cable (Qty 6) (29105600)
  - Sun Shield (29722100)
  - UTD Y-cord (183965-001)
  - H-47 Aircraft Script File (installed in CADU)

ALSO NEEDED

- Balance Weights (as required)
- Lockwire, MS20955NC32 (STEPS 1 and 2)
- Reflective Tape (10605000) (as required)
- Tie Wraps
- Cotter Pins

EQUIPMENT CONDITIONS

- Electrical power off
- Hydraulic power off
- Tiedown lines connected to one forward and one aft main rotor blade (Task 1-26)
- Forward and aft pylon work platforms open (Task 2-4)

REFERENCES

- TM 1-1520-240-10
- TM 1-1520-240-23
- TM 1-1520-240-MTF
- TM 1-6625-724-13&P

The H-47 Flight Plans are listed below with a brief description of their purpose. The selectable Flight Plans (see table 1) are listed in order of appearance (alphabetically) in the menu of the CADU and not in the order in which they are to be performed.

50HOUR

The H-47 50-hour vibration survey is performed on the combining and aft transmission oil cooler fans, see Task 5. This procedure measures vibration levels of the components and compares them to defined limits. It does not offer corrective actions for out of tolerance conditions.

AFTVIB

The aft vibration survey is performed whenever an unusual vibration is suspected in the aft part of the synchronizing drive shaft or cross shaft area, see Task 5. This procedure measures vibration in the frequency range of 0-250 Hz (0-15,000 rpm) at hanger bearings 4, 5, 6, 7, cross shaft No. 1 and cross shaft No. 2. This procedure only measures the vibration levels of the components. It does not offer corrective action.

FLIGHT

This test, see Task 4, is designed to reduce rotor system lateral and vertical vibration to specified goals, using pitch change links, tabs, and balance weights. It is to be used after GROUND and HOVER or for “tuning up” an aircraft that is already in service. Diagnostics are based on vertical and lateral 1/rev vibration data measured at the forward and aft pylon accelerometer boxes. Blade track is not measured during FLIGHT.

FWDVIB

The forward vibration survey is performed whenever an unusual vibration is suspected in the forward transmission or synchronizing drive shaft area, see Task 5. This procedure measures vibration in the frequency range of 0-250 Hz (0-15,000 rpm) at the forward transmission oil cooler and at hanger bearings 1 through 3. This procedure only measures the vibration levels of the components. It does not offer corrective action.

GROUND

This Flight Plan is designed to track the rotors prior to hover balancing, using pitch change links only. It is the first step to be performed after any component change or major rework on the rotor. The forward and aft rotors’ track are measured using a single tunnel mounted tracker. The vertical and lateral 1/rev vibrations are measured at the forward and aft pylon accelerometer boxes. Diagnostics are based on blade track.

HOVER

This Flight Plan is designed to be used after GROUND has been completed. It is designed to reduce the rotor system’s lateral vibrations to specified levels, using pitch change links and balance weights. The forward and aft rotors’ track are measured using a single tunnel mounted tracker. The vertical and lateral 1/rev vibrations are measured at the forward and aft pylon accelerometer boxes. Diagnostics are based on lateral vibration data measured at the forward and aft pylon accelerometer boxes and blade track.

PROBES

This Flight Plan is designed to use data from up to 8 accelerometers to assist in isolating irregular or unusual vibrations. It will measure data one channel at a time on DAU ACC1 through ACC4 and the multi-channel cable connected to the track and balance accelerometer blocks. All accelerometers will measure a 0 to 500 Hz spectrum (0 to 30,000 RPM).

Table 1. H-47 Test States

FLIGHT PLAN	TEST STATES	TEST CONDITION	MEASUREMENT DESCRIPTION
GROUND	FPG100	Ground run, 100% Nr, 3 degree GND detent, aircraft nose into the wind	Blade track and forward and aft accelerometer box vertical and lateral 1/rev vibration
HOVER	HOVER	Hover, aircraft nose into the wind	Blade track and forward and aft accelerometer box vertical and lateral 1/rev vibration
FLIGHT	Hover 100K 130K	Hover, aircraft nose into the wind 100 Knots level flight 130 Knots level flight	Forward and aft accelerometer box vertical and lateral 1/rev vibration
50Hour	OILCLR AFTFAN	Ground run, 100% Nr	Forward transmission oil cooler vibration Aft transmission cooling fan vibration
FWDVIB	FWDOIL H/B#1 H/B#2 H/B#3	Ground run, 100% Nr	Forward transmission oil cooler vibration Hanger bearing #1 vibration Hanger bearing #2 vibration Hanger bearing #3 vibration All measurements produce a 0-250 Hz (0-15,000 rpm) frequency spectrum.
AFTVIB	H/B#4 H/B#5 H/B#6 H/B#7 XSHFT1 XSHFT2	Ground run, 100% Nr	Hanger bearing #4 vibration Hanger bearing #5 vibration Hanger bearing #6 vibration Hanger bearing #7 vibration Cross shaft No. 1 vibration Cross shaft No. 2 vibration All measurements produce a 0-250 Hz (0-15,000 rpm) frequency spectrum.
PROBES	ACC1 ACC2 ACC3 ACC4 F-Lat F-Vert A-Lat A-Vert	User's Discretion Operator must denote location and orientation for ACC1 – ACC4	All measurements produce a 0-500 Hz (0-30,000 rpm) frequency spectrum

TASK 1 – TEST EQUIPMENT INSTALLATION/CHECKOUT

PROCEDURE 1: CONFIGURE AIRCRAFT

a. Check that the phase detector and the three interrupter brackets are attached securely to the forward swashplate and ensure that the double interrupter is installed under the green pitch link.

NOTE

Rotor blade tracking errors such as “Blade Apparently Too Close,” “Blades Apparently Moving at Wrong Speed” or “Blade Chords Apparently Different” may be caused by excessive paint wear due to erosion on the leading edge of the blades. Light paint touchup on the underside of the rotor blades’ leading edges in the UTD viewing area may eliminate these errors.

b. Position brackets over detector by turning blades. Check clearance between each of three interrupter brackets and phase detector. Clearance shall be 0.015 to 0.025 inch.

c. Turn blades to position double interrupter over phase detector. The position of the blades should match Figure 1.

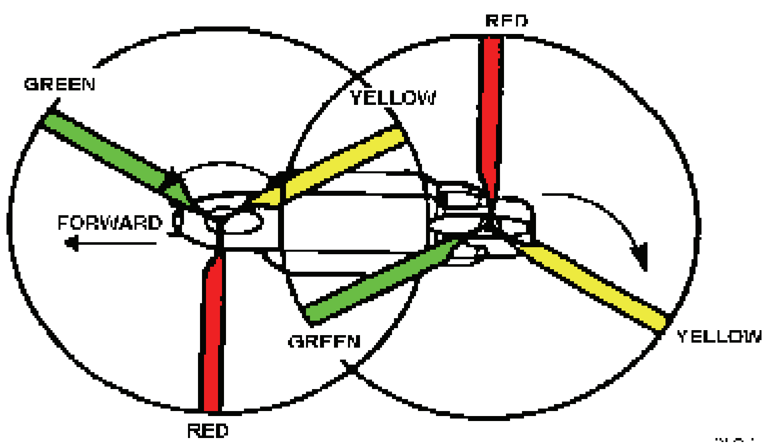


Figure 1. Rotor Blades Position

NOTE

The open side of both accelerometer boxes, steps d and e, face inboard.

d. Install forward accelerometer box with the open side facing aft (Figure 2).

e. Remove plug from dummy receptacle and connect to forward accelerometer box (Figure 2).

f. Install aft accelerometer box with the open side facing forward (Figure 3).

g. Remove plug from dummy receptacle and connect to aft accelerometer box (Figure 3).

h. Check that blade TCK circuit breaker on No. 2 power distribution panel is closed.

Figure 2. Forward Accelerometer Block

Figure 3. Aft Accelerometer Block

PROCEDURE 2: CONFIGURE AVA

a. Inventory and remove AVA blade tracking equipment from transport cases. Check for possible damaged equipment and frayed cables.
b. Ensure DAU is installed in canvas carrying case.
c. Secure DAU to seat using lap belts and the DAU's straps and D-rings.

NOTE

If the seats are not installed, the DAU can be secured to the floor's tiedown rings.

d. Connect the 15-ft. bulkhead-to-DAU breakout cable assembly (29085700) to the BLADE TRACK bulkhead receptacle, located on the right side of the cabin near station 256 (Figure 4).
e. Connect the 15-ft. bulkhead-to-DAU breakout cable (29085700) terminations to the DAU receptacles marked MULTI-CH, TACHO1 and 28VDC.
f. Connect the 10-ft. CADU to DAU cable (29325601).

Figure 4. BLADE TRACK Bulkhead Receptacle Near STA 256

PROCEDURE 3: UTD INSTALLATION

a. Attach the sun shield (29722100) by placing the sun shield over the UTD (29310700) sensor receiving lens. Then swing the sun shield locking arm under the body of the UTD, placing the UTD bolts through the arm. This will place the arm between the UTD and bracket.

NOTE

If the UTD captive mounting bolts are lost or damaged, use NAS1305-14 bolts as alternate replacements.

b. Attach UTD (29310700) to permanently installed #2 tunnel cover UTD bracket using the bolts provided. The UTD will point aft and the arrow on the UTD body points in the direction of the forward rotor rotation (Figure 5).
c. Attach the 25-ft UTD cable (29325701) to the UTD.
d. Route UTD cable through left sidegunner's window or either of the two m ost forward fuel vent holes on the aircraft's left side and into the cabin to the DAU(Figure 5). Secure UTD cable to the HF antenna using cable ties.
e. Connect UTD cable to UTD Y-cord
f. Connect one end of the UTD Y-cord to the receptacle on the DAU marked TRACKER 1.
g. Connect the other end of the UTD Y-cord to the MULTI-CH breakout cable (29085700) tracker receptacle.
h. Ensure that the tracker select switch on the front panel of the DAU is in the DAY position.

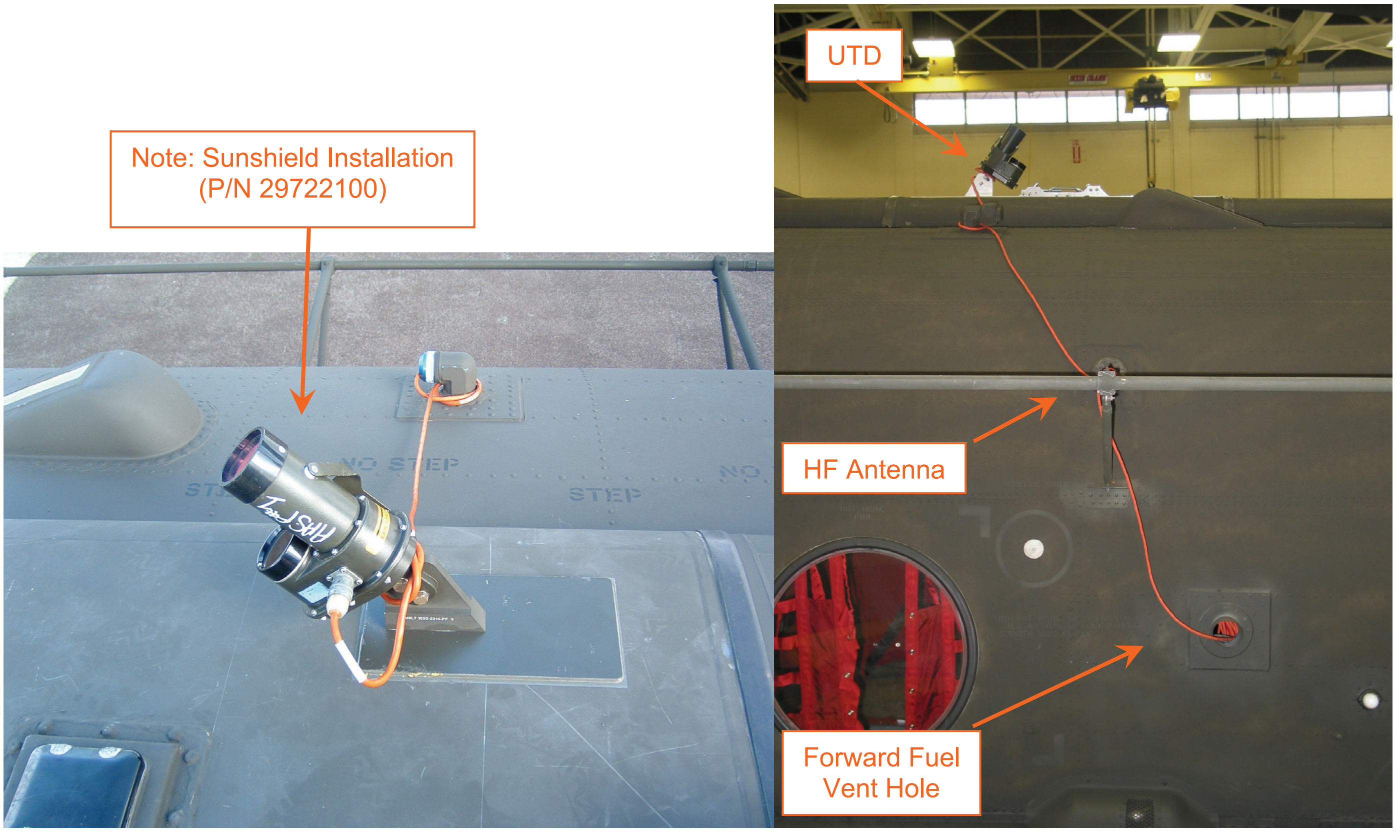


Figure 5. #2 Tunnel Tracker Bracket with UTD and suggested cable route

NOTE

The following steps are to be followed if nighttime tracking is anticipated. If tracking is only to be performed during the day, proceed to Procedure 6.

PROCEDURE 4: NIGHT TIME TRACKING INSTRUCTIONS

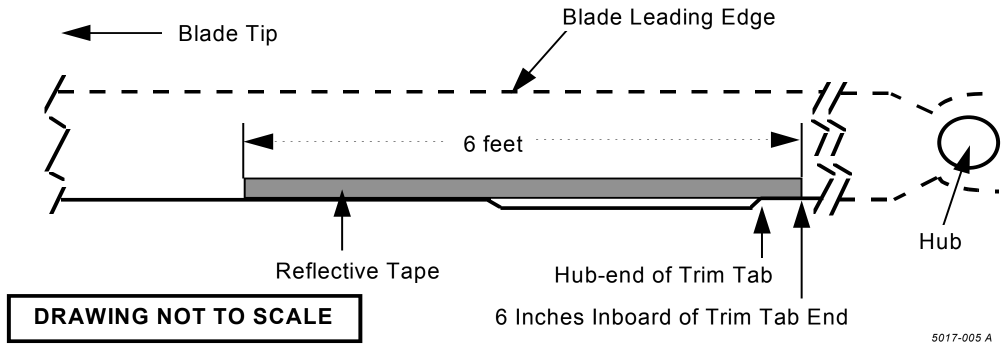
a. Ensure that the tracker select switch on the DAU is in the NIGHT position.

b. Ensure that UTD sunshields, if installed, are removed prior to flight.

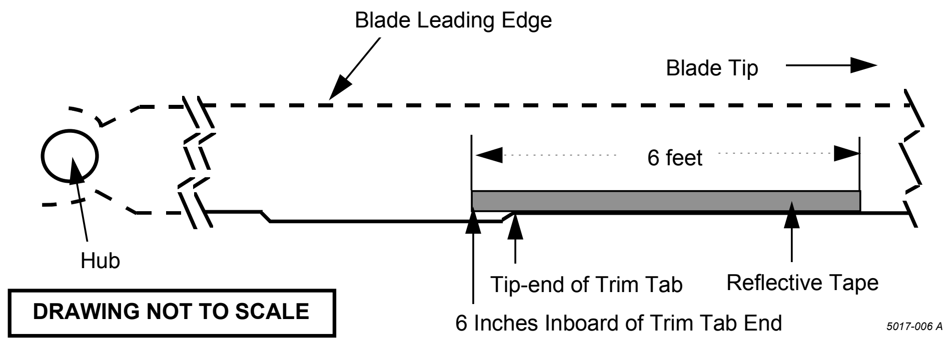
c. Ensure that the underside, trailing edge of all blades are as clean as possible. This is to ensure optimum adhesion of the reflective tape.

d. Place a 6-ft. strip of reflective tape (10605000) on the bottom of the blade. The tape is applied on the trailing edge of the blade starting 6 inches inboard of the tab and moving outboard. See Figure 6. Do not follow the contour of the tab.

e. If verification of the tape placement and reflection quality is desired, it can be verified by holding a flashlight aligned with UTD and shining it at the rotating blades. Any misplaced tape or tape with reduced reflectivity will stand out.



6A. FORWARD ROTOR BLADES



6B. AFT ROTOR BLADES

Figure 6. Placement of Reflective Tape on Forward and Aft Rotor Blades

PROCEDURE 5: COMBINER TRANSMISSION OIL COOLING FAN SENSORS INSTALLATION (50 HOUR CHECK ONLY)

a. Complete Procedure 2.

b. Gain access to the combiner transmission cooling fan area, see Figure 7.

c. Remove nuts from combiner transmission oil cooling fan mounting flange studs at the 5:00 and 8:30 clock positions.

d. Mount an accelerometer mounting bracket (29339500) to each of the studs with the nuts provided. See Figure 7.

NOTE

When mounting accelerometers, make certain that they are in line with the corresponding axis (lateral and longitudinal). See Figure 7 top view.

e. Install accelerometer (28110900), accelerometer 1 (ACC1), in the lateral axis on the mounting bracket (29339500) that is on the stud at 5 o'clock. The nose of the aircraft is at the 12 o'clock position.

f. Install accelerometer (28110900), accelerometer 3 (ACC3), in the longitudinal axis on the mounting bracket that is on the stud at the 8:30 clock position.

g. Connect 50-ft accelerometer cable assemblies (29105600) to the lateral accelerometer (ACC1), and to the longitudinal accelerometer (ACC3).

h. Run the cable from the longitudinal accelerometer around the back of the oil cooler.

i. Identify each accelerometer cable (ACC1 and ACC3) and feed the cables through the lightening hole at station 482 on the right side.

j. Tie-wrap the accelerometer cables away from the sync shaft and engine drive shaft and route the cables to the DAU.

k. Connect the lateral accelerometer (ACC1) cable to the receptacle on the DAU marked ACC1.

l. Connect the longitudinal accelerometer (ACC3) cable to the receptacle on the DAU marked ACC3.

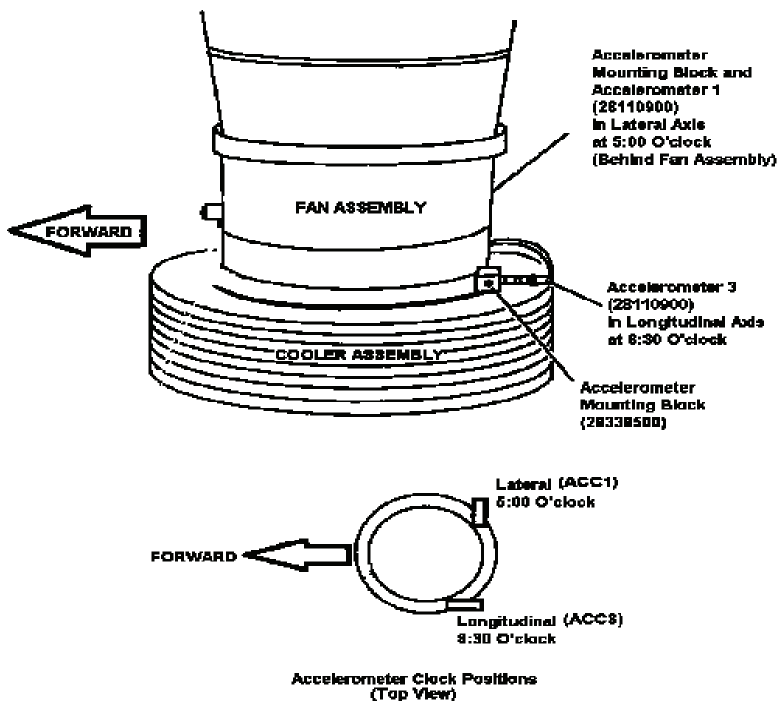


Figure 7. Combiner Transmission Oil Cooling Fan Accelerometers Installation

CAUTION

When routing cables, ensure that cables are secured and tied away from rotating assemblies.

PROCEDURE 6: AFT TRANSMISSION OIL COOLING FAN SENSORS INSTALLATION (50 HOUR CHECK ONLY)

a. Complete Procedure 2.

b. Gain access to the AFT transmission oil cooling fan area, see Figure 8.

c. Remove the nut from the stud at the 8:30 clock position on the AFT transmission cooling fan flange.

d. Mount an accelerometer mounting bracket (29313000) to the stud with the nut provided and orient the bracket so that the accelerometer will be lateral when it is installed.

e. Install an accelerometer (28110900), accelerometer 9 (ACC9), on the mounting bracket.

f. Remove the nut from the stud at the 7:30 clock position on the AFT transmission cooling fan flange.

g. Mount an accelerometer mounting bracket (29313000) to the stud with the nut provided and orient the bracket so that the accelerometer will be vertical when installed.

h. Install an accelerometer (28110900), accelerometer 10 (ACC10), on the mounting bracket.

i. Connect a 50-ft. accelerometer cable assembly (29105600) to each accelerometer.

CAUTION

When routing cables, ensure that the cables are secured and tied away from rotating assemblies.

j. Identify each accelerometer cable (ACC9 and ACC10) and route forward to the DAU.

k. Tie-wrap the accelerometer cables clear of all rotating components and flight controls.

l. Connect AFT transmission lateral accelerometer (ACC9) cable to connector on the 15-ft. DAU cable assembly (29085700) labeled ACC9.

m. Connect AFT transmission vertical accelerometer (ACC10) cable to connector on the 15-ft. DAU cable assembly (29085700) labeled ACC10.

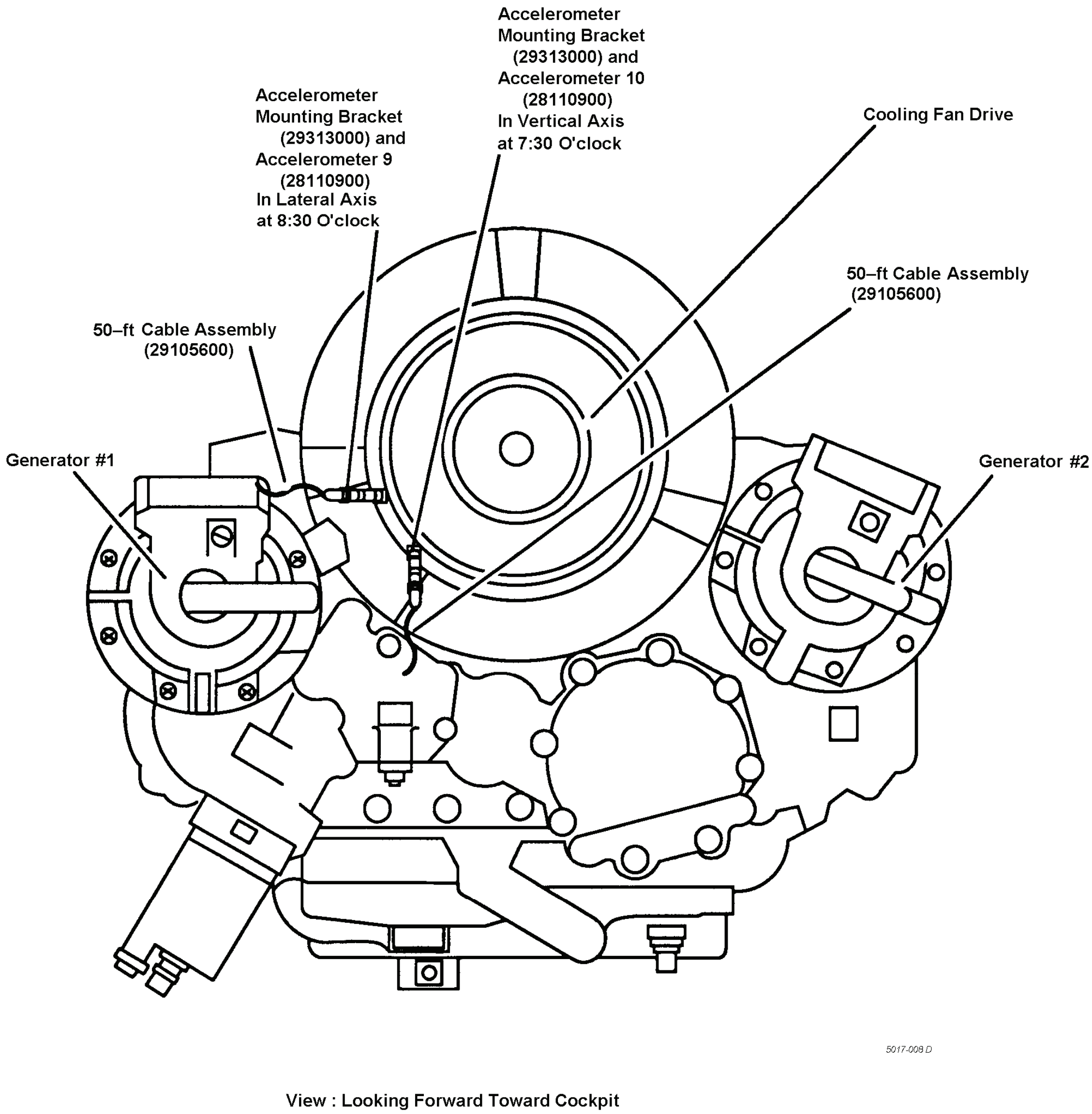


Figure 8. Aft Transmission Oil Cooling Fan Accelerometers Installation

PROCEDURE 7: AFTVIB CHECK SENSORS INSTALLATION (CROSS SHAFTS AND HANGER BEARINGS 4-7)

a. Complete Procedure 2.

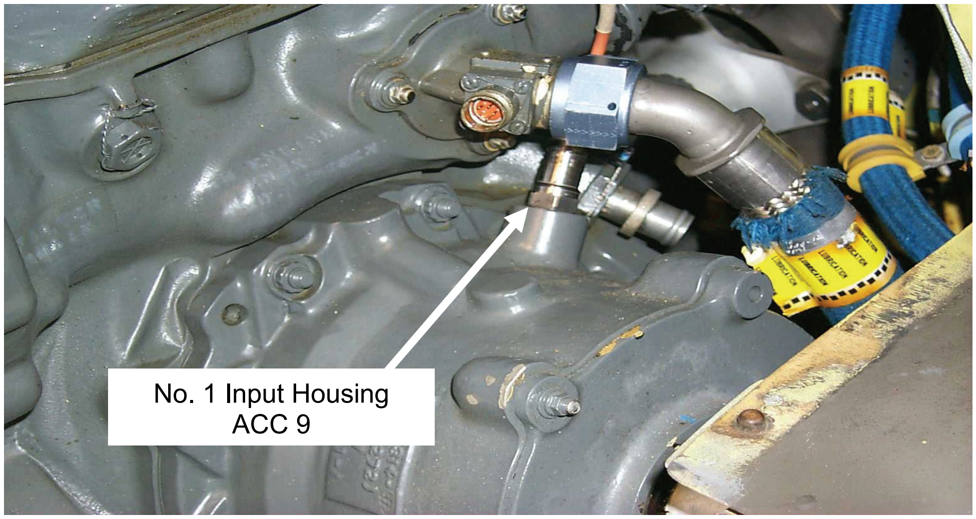
b. Not all sensors need to be installed, install only the accelerometers that are needed to diagnose the problem.

c. Gain access to the engine combining transmission area and hanger bearings Nos. 4, 5, 6 and 7.

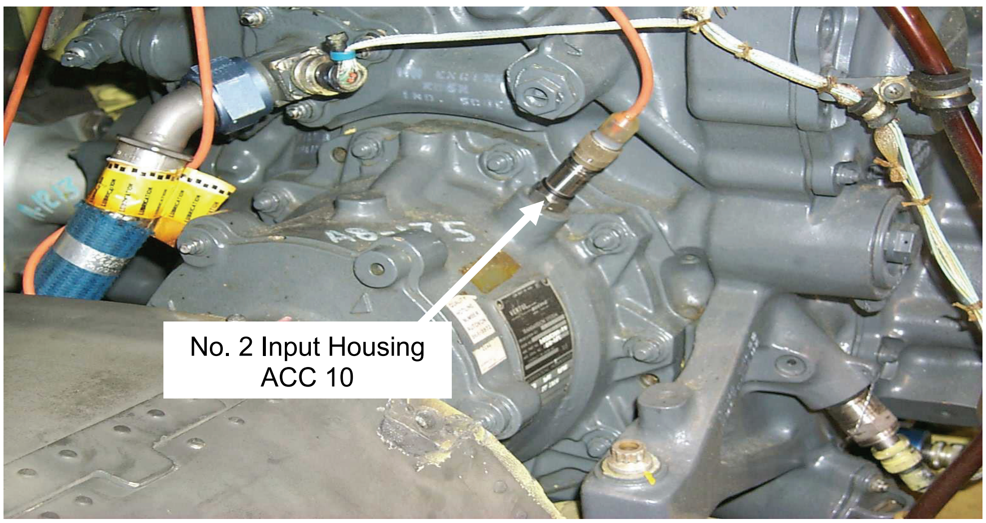
d. Install an accelerometer (28110900), accelerometer 9 (ACC 9), on the accelerometer mounting pad on the C-BOX No. 1 cross shaft input housing. See Figure 9.

e. Install an accelerometer (28110900), accelerometer 10 (ACC 10) on the accelerometer mounting pad on the C-BOX No. 2 cross shaft input housing. See Figure 9.

f Connect a 50-ft accelerometer cable assembly (29105600) to each accelerometer.



Number 1 Cross Shaft Input



Number 2 Cross Shaft Input

Figure 9. C-BOX Transmission Input Accelerometer Installation

CAUTION

When routing cables, ensure that cables are secured and tied away from rotating assemblies.

g. Identify each accelerometer (ACC9 and ACC10) and route the cables from the accelerometers around the C-BOX area then down through the lightning hole at station 482 near the right aft corner of the C-BOX. Route cables forward through the cabin to the DAU.

h. Tie-wrap the accelerometer cables clear of all rotating components and flight controls.

i. Connect the Engine 1 cross shaft accelerometer cable to connector marked (ACC9) on the 15-ft. DAU cable assembly (29085700).

j. Connect the Engine 2 cross shaft accelerometer cable to connector marked (ACC10) on the 15-ft. DAU cable assembly (29085700).

k. Mount an accelerometer (28110900) to the accelerometer bracket (29339500) for hanger bearing No. 4.

l. Remove nut from the top bolt of the right hand No. 4 hanger bearing shock mount and orient the accelerometer and bracket with the accelerometer pointing to the center of rotation and the connector pointed away from the center, (use the small hole in the AVA accelerometer bracket) and tighten nut. See Figure 10.

m. Repeat steps k and l for hanger bearings no. 5, 6 and 7.

n. Connect a 50-ft accelerometer cable to each hanger bearing accelerometer.

CAUTION

When routing cables, ensure that cables are secured and tied away from rotating assemblies.

o. Identify each accelerometer cable and route the cables from the accelerometers aft along the hydraulic lines past the C-BOX down into the cabin to the DAU and connect as follows:

DAU Channel	Accel. Location
ACC1	H/B#4
ACC2	H/B#5
ACC3	H/B#6
ACC4	H/B#7
ACC9	NO. 1 Cross Shaft
ACC10	NO. 2 Cross Shaft

p. Tie-wrap the accelerometer cables clear of all rotating components and flight controls.

PROCEDURE 8: FWDVIB CHECK SENSOR INSTALLATION (FORWARD OIL COOLER AND HANGER BEARINGS 1-3)

a. Complete Procedure 2.

b. Gain access to the forward transmission area, see Figure 10.

c. Remove the self-locking nut from the stud at the 5 o'clock position on the forward transmission oil cooler, looking forward, see Figure 11.

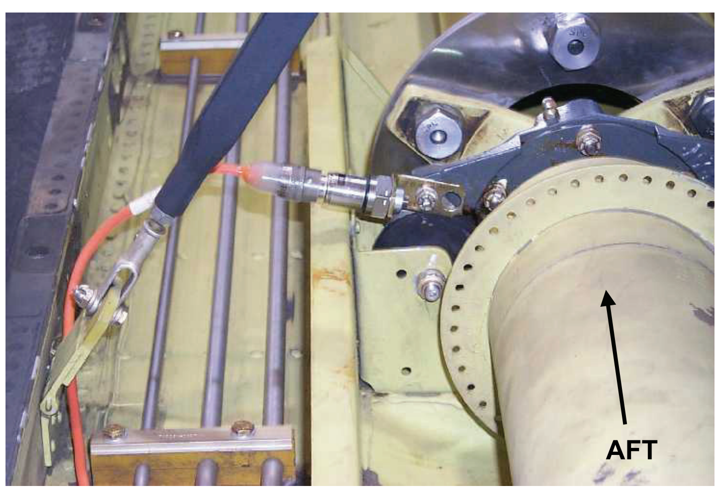


Figure 10. Typical Hanger Bearing Installation

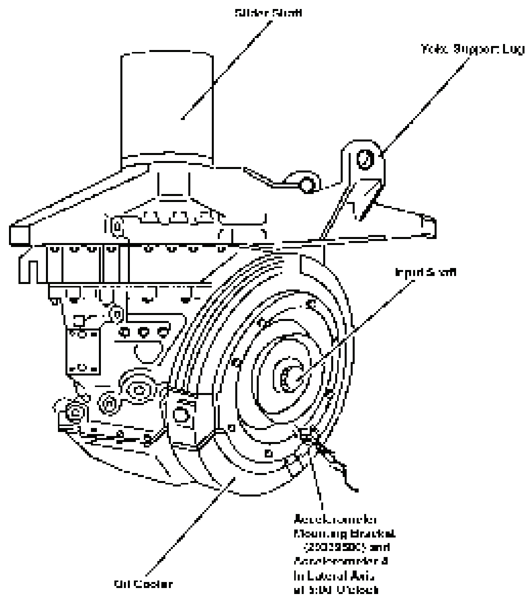


Figure 11. Forward Transmission Impeller Accelerometer Installation

d. Mount an accelerometer (28110900) to the accelerometer bracket (29339500).

e. Install the accelerometer bracket on the stud with the accelerometer pointed to the center of rotation and the connector pointed away from the center. See Figure 11.

f. Connect a 25-ft accelerometer cable (29105605) to the accelerometer.

CAUTION

When routing cables, ensure that cables are secured and tied away from rotating assemblies.

g. Run the cable from the accelerometer through the most convenient cabin access to the DAU. Tie-wrap the cable clear of all rotating components and flight controls.

h. Connect the accelerometer cable to ACC1 connector on the DAU.

i. Mount an accelerometer (28110900) to the accelerometer bracket (29339500) for hanger bearing No. 1.

j. Remove nut from the top bolt of the right hand No. 1 hanger bearing shock mount and orient the accelerometer and bracket with the accelerometer pointing to the center of rotation and the connector pointed away from the center, (use the small hole in the AVA accelerometer bracket) and tighten nut. See Figure 11.

k. Repeat i and j for hanger bearings Nos. 2 and 3.

l. Connect a 50-ft accelerometer cable to each hanger bearing accelerometer.

CAUTION

When routing cables, ensure that cables are secured and tied away from rotating assemblies.

m. Identify each accelerometer cable and route the cables from the accelerometers forward along the hydraulic lines to the forward tunnel cover. Pass the cables under tunnel cover in the forward cabin door to the DAU and connect as follows:

DAU Channel	Accel. Location
ACC1	Forward Transmission Oil Cooler
ACC2	H/B#1
ACC3	H/B#2
ACC4	H/B#3

n. Tie-wrap the accelerometer cables clear of all rotating components and flight controls.

TASK 2 – TRACK FWD AND AFT ROTORS (ON THE GROUND)

PROCEDURE 1: CONFIGURE AVA FOR GROUND RUN

a. Perform Task 1, Test Equipment Installation/Checkout, Procedures 1 through 4.

b. Operate aircraft at 100% Nr, and ground detent.

c. Turn on DAU.

d. Turn on CADU.

PROCEDURE 2: PERFORM GROUND TRACK MEASUREMENT

a. Press **QUIT** on the CADU until all selections show undefined.

b. Select H47ST under Aircraft Type menu.

c. Select proper tail number from previous selections in Tail Number menu or enter a new tail number (up to seven characters).

d. Enter the Flight Plan menu and select GROUND.

e. Enter the MEASURE mode by pressing **F1**. Verify that FPG100 is selected.

f. Press **DO** when the aircraft is stable at the proper test condition. Re-verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire track and vibration data and return to the selection display when the system is ready for the next measurement.

g. After the measurement is completed, press **DO** on Finish, press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to return to the Main Menu and proceed to Task 3.

NOTE

Evaluate the ability to use the recommended adjustments. If modifications to the adjustments are desired, enter the menu option Edit Adjustables. Make the desired changes and press the **DO** key.

h. If measured values exceed manufacturer's desired levels, press the **DO** key to enter the Diagnostics mode. Evaluate the percentage improvements obtainable through further corrective action. Perform all corrections displayed on the screen. Do not use a partial set of the adjustments.

NOTE

Make corrective adjustments in accordance with TM 1-1520-240-23.

i. If any adjustments have been made, perform Procedure 2 again and verify the corrections.

TASK 3 – TRACK AND BALANCE FWD AND AFT ROTORS (HOVER)

PROCEDURE 1: CONFIGURE AVA FOR HOVER RUN

a. Perform Task 1, Test Equipment Installation/Checkout, Procedures 1 through 4
b. Turn on DAU.
c. Turn on CADU.
d. Operate aircraft in a hover.

PROCEDURE 2: PERFORM HOVER MEASUREMENT

a. Press **QUIT** on the CADU until all selections show undefined.
b. Select H47ST under Aircraft Type menu.
c. Select proper tail number from previous selections in Tail Number menu or enter a new tail number (up to seven characters).
d. Enter the Flight Plan menu and select HOVER.
e. Enter the MEASURE mode by pressing **F1**. Verify that HOVER is selected.
f. Press **DO** when the aircraft is stable at the proper test condition. Re-verify that the aircraft is at the required Test State and press **DO** again. The AVA will acquire track and vibration data and return to the selection display when the system is ready for the next measurement.
g. After the measurement is completed, press **DO** on Finish, press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to return to the Main Menu and proceed to Task 4.

NOTE

Evaluate the ability to use the recommended adjustments. If modifications to the adjustments are desired, enter the menu option Edit Adjustables. Make the desired changes and press the **DO** key.

h. If measured values exceed manufacturer's desired levels, press the DO key to enter the Diagnostics mode. Perform all corrections displayed on the correction screens. Check to ensure that all screens of a multiple screen solution have been performed. If alterations of these corrective actions are desired, use the Edit Adjustables and Edit Defaults diagnostic editors.

NOTE

Do not use a partial set of the adjustments. The recommended adjustments have accounted for the cross coupling effects of the tandem rotors and using a partial set of the corrections may increase the total vibration environment.

NOTE

Make corrective adjustments in accordance with TM 1-1520-240-23.

i. If any adjustments have been made, perform the flight test again and verify the corrections.

TASK 4 – FORWARD FLIGHT ROTOR SMOOTHING

PROCEDURE 1: CONFIGURE AVA FOR FORWARD FLIGHT

a. Perform Task 1, Test Equipment Installation/Checkout, Procedures 1 through 4.

b. Turn on DAU.

c. Turn on CADU.

d. Operate aircraft in forward flight.

PROCEDURE 2: PERFORM FLIGHT MEASUREMENT

a. Press **QUIT** on the CADU until all selections show undefined.

b. Select H47ST from Aircraft Type menu.

c. Select proper tail number from previous selections in Tail Number menu or enter a new tail number (up to seven characters).

d. Enter the Flight Plan menu and select FLIGHT.

e. Enter MEASURE mode by pressing **F1**. Verify that FLIGHT is selected.

f. Press **DO** when the pilot is stable at the highlighted selection. Re-verify that the pilot is at the required Test State and press **DO** again. The AVA will acquire vibration data and return to the selection display when the system is ready for the next measurement.

g. After the last measurement is completed, press **DO** on Finish, press **DO** on Diagnostics. If measurements are within specified limits, press **QUIT** to the Main Menu.

NOTE

Evaluate the ability to use the recommended adjustments. If modifications to the adjustments are desired, enter the menu option Edit Adjustables. Make the desired changes and press the **DO** key.

h. If measured values exceed manufacturer's desired levels, press the **DO** key to enter the DIAGS mode. Perform all corrections displayed on the screens. Check to ensure that all screens of a multiple screen solution have been performed. If alterations to these corrective actions are desired, use the Edit Adjustables and Edit Defaults options. Do not use a partial set of the adjustments. The recommended adjustments have accounted for the cross coupling effects of the tandem rotors and using a partial set of the corrections may increase the total vibration environment.

NOTE

Make corrective adjustments in accordance with TM 1-1520-240-23.

i. If any adjustments have been made, perform the flight test again and verify the corrections.

Remove the AVA equipment from the aircraft.

j. Inventory AVA kit and adapter kit to ensure all parts are removed from the aircraft.

TASK 5 – MAINTENANCE TESTS

PROCEDURE 1: PERFORM 50HOUR VIBRATION CHECKS

a. Perform Task 1, Test Equipment Installation/Checkout, Procedures 2, 5 and 6.

b. Turn on aircraft power.

c. Setup the measurement mode on the CADU using the flight plan 50HOUR.

d. After the measurement setup parameters have been run, the available Test States are displayed (OILCLR and AFTFAN).

e. Operate aircraft on the ground at 100% NR, flat pitch.

f. Highlight OILCLR using the arrow keys. Press the **DO** key twice. This test will measure data from the two accelerometers mounted to the combiner transmission oil cooling fan mounting flange studs (Task 1, Procedure 7).

NOTE

After the first measurement startup has been run and vibration data is measured on laterally mounted accelerometer 1 (ACC1), a second measurement setup is run and vibration data is measured on the longitudinally-mounted accelerometer 3 (ACC3).

NOTE

If measurement errors occur, press **QUIT** on the CADU. Either “partial” or “failed” is displayed. When an error occurs, an error code is displayed and the error is identified. Either correct the cause of the error or, if safe to do so, continue with the sequence tests.

g. Highlight the AFTFAN line using the arrow keys. Press the **DO** key twice. This test will measure data from the two accelerometers mounted on the AFT transmission cooling fan flange (Task 1, Procedure 8).

NOTE

After the first measurement startup has been run and vibration data is measured on laterally mounted accelerometer 9 (ACC9), a second measurement startup is run and vibration data is measured on vertically mounted accelerometer 10 (ACC10).

NOTE

If measurement errors occur, press **QUIT** on the CADU. Either “partial” or “failed” is displayed. When an error occurs, an error code is displayed and the error is identified. Either correct the cause of the error or, if safe to do so, continue with the sequence tests.

h. If no errors occur and the AFTFAN test is “done,” a menu will appear to either finish or continue. Highlight the finished condition and press **DO** to have the data stored.

i. Press **QUIT** on CADU. The Main Menu is displayed on the CADU.

j. Press **F2** to enter DISPLAY mode.

k. Select View Limits from the Display Mode menu and press **DO** on the CADU.

l. If measured values exceed limits, perform procedures from TM 55-1520-240-23.

m. If values are within limits, press **UP** arrow to view all values.

n. Remove AVA equipment from the aircraft.

o. Inventory AVA kit and adapter kit to ensure all parts are removed from the aircraft.

PROCEDURE 2: PERFORM FWDVIB TEST

a. Perform Task 1, Test Equipment Installation/Checkout, Procedures 2 & 8.

b. Turn on aircraft power.

c. Setup the measurement mode on the CADU using the flight plan FWDVIB.

d. After the measurement setup parameters have been run, the available Test States are displayed (FWDOIL, H/B#1, H/B#2, and H/B#3).

e. Operate aircraft on the ground at 100% NR, flat pitch.

f. Select FWDOIL using the arrow keys. Press the **DO** key twice. This test will measure data from the accelerometer mounted to the forward transmission oil cooling fan.

NOTE

If measurement errors occur, press **QUIT** on the CADU. Either "partial" or "failed" is displayed. When an error occurs, an error code is displayed and the error is identified. Either correct the cause of the error or, if safe to do so, continue with the sequence tests.

g. Repeat measurements for all accelerometers that are installed.

h. If all Test States are measured a menu will appear to either finish or continue. Highlight finish and press **DO**, and then select Main Menu and press **DO**.

i. If all Test States were not measured press **QUIT**, then highlight Save and Exit and press **DO** to go to the Main Menu.

j. Press **F2** to enter DISPLAY mode.

k. Select Summary Displays and press **DO**. Select the appropriate component and press **DO** to display the sync shaft peak vibration for that component. Press **QUIT** to return to the Summary Display Menu and select other components described above.

l. Press **QUIT** to return back to the Display Mode menu.

m. Select One Test State to view spectrum data plots for each accelerometer if desired.

n. Remove AVA equipment from the aircraft.

o. Inventory AVA kit and adapter kit to ensure all parts are removed from the aircraft.

PROCEDURE 3: PERFORM AFTVIB TEST

a. Perform Task 1, Test Equipment Installation, Procedures 2 & 7.

b. Turn on aircraft power.

c. Setup the measurement mode on the CADU using the flight plan AFTVIB.

d. After the measurement setup parameters have been run, the available Test States are displayed (H/B#4, H/B#5, H/B#6, H/B#7, XSHFT1 and XSHFT2).

e. Operate aircraft on the ground detent at 100% NR, flat pitch.

f. Select the desired Test State using the arrow keys. Press the **DO** key twice. This test will measure vibration data.

NOTE

If measurement errors occur, press **QUIT** on the CADU. Either "partial" or "failed" is displayed. When an error occurs, an error code is displayed and the error is identified. Either correct the cause of the error or, if safe to do so, continue with the sequence tests.

g. Repeat measurements for all accelerometers that are installed.

h. If all Test States are measured a menu will appear to either finish or continue. Highlight finish and press **DO**, and then select Main Menu and press **DO**.

i. If all Test States were not measured press **QUIT**, then highlight Save and Exit and press **DO** to go to the Main Menu.

j. Select Summary Displays and press **DO**. Select the appropriate component and press **DO** to display the peak vibration for hanger bearings and cross shaft. Press **QUIT** to return to the Summary Display Menu and select the components described above.

k. Press **QUIT** to return back to the Display Mode menu.

l. Select One Test State to view spectrum data plots for each accelerometer if desired.

m. Inventory AVA kit and adapter kit to ensure all parts are removed from the aircraft.

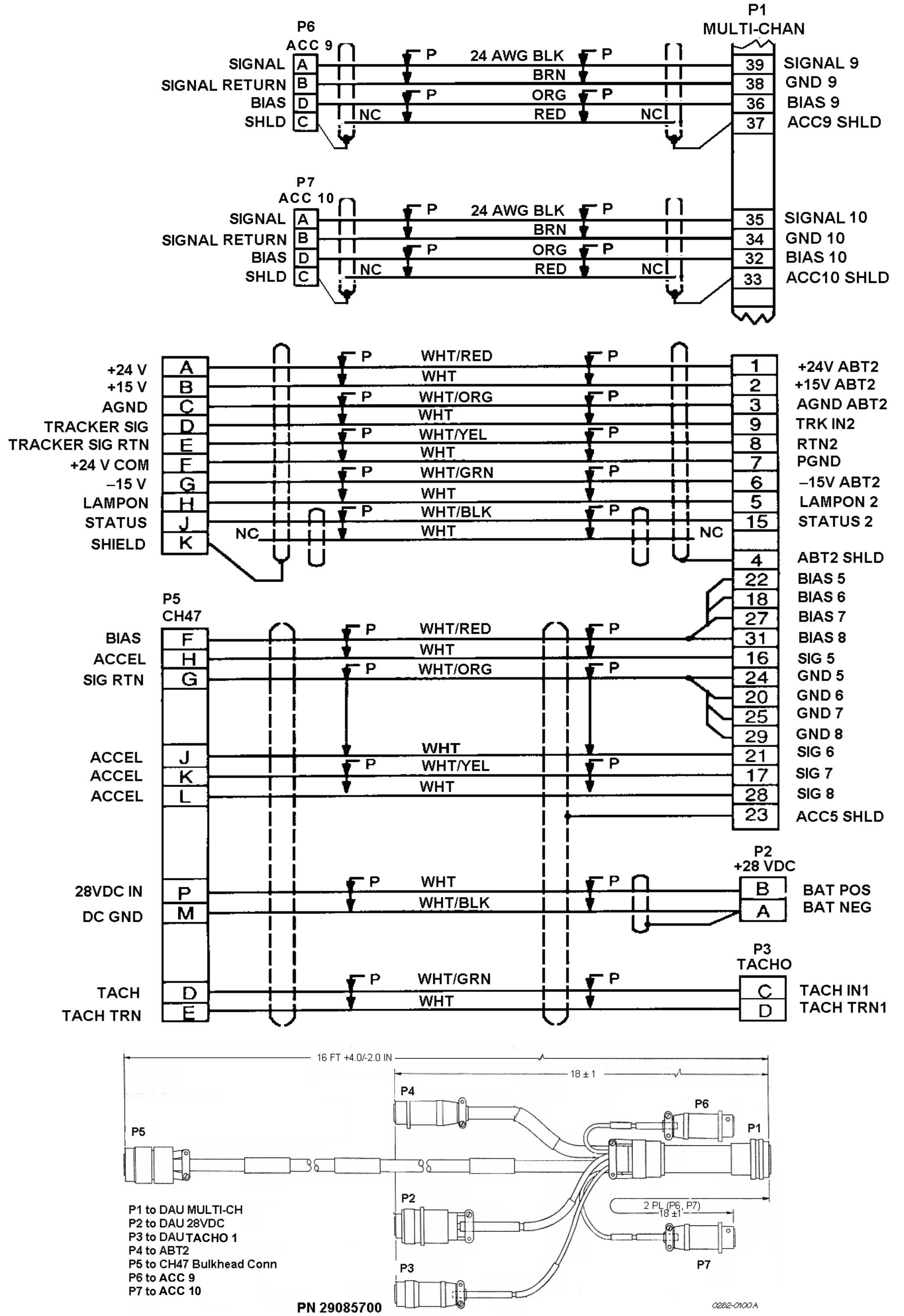


Figure 11. Multi-Channel Cable

END OF WORK PACKAGE

ALPHABETICAL INDEX

ALPHABETICAL INDEX (cont'd)

WP No./Page

ALPHABETICAL INDEX (cont'd)

WP No./Page

By Order of the Secretary of the Army:

Official:

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

JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army
0202801

DISTRIBUTION:
To be distributed in accordance with Initial Distribution Number (IDN) 313275 requirements for TM 1-6625-724-13&P.

These are the instructions for sending an electronic 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: “Whomever” <whomever@wherever.army.mil>
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.

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25–30; the proponent agency is ODISC4.	Use Part II (*reverse*) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/ Supply Manuals (SC/SM)	DATE 8/30/02

TO: (*Forward to proponent of publication or form)(Include ZIP Code)*	FROM: (*Activity and location)(Include ZIP Code)*
Commander, U.S. Army Aviation and Missile Command ATTN: AMSAM–MMC–MA–NP Redstone Arsenal, AL 35898	MSG, Jane Q. Doe 1234 Any Street Nowhere Town, AL 34565

PART 1 – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
TM 1-6625-724-13&P	7 Mar 2002	Operator's, Aviation Unit, and Intermediate Maintenance Manual (Including Repair Parts and Special Tools List) for Test Set, Aviation Vibration Analyzer (AVA)

ITEM NO.	PAGE NO.	PARA–GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON
1	WP0005 PG 3		2			Test or Corrective Action column should identify a different WP number.

* *Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/ AUTOVON, PLUS EXTENSION	SIGNATURE
MSG, Jane Q. Doe, SFC	788–1234	

TO: (*Forward direct to addressee listed in publication*)	**FROM:** (*Activity and location) (Include ZIP Code)*	**DATE**
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PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III – REMARKS (*Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
MSG, Jane Q. Doe, SFC	788–1234	

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25–30; the proponent agency is ODISC4.	Use Part II (*reverse*) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/ Supply Manuals (SC/SM)	DATE
TO: (*Forward to proponent of publication or form)(Include ZIP Code)* Commander, U.S. Army Aviation and Missile Command ATTN: AMSAM-MMC-MA-NP Redstone Arsenal, AL 35898	FROM: (*Activity and location)(Include ZIP Code)*	

PART 1 – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE

ITEM NO.	PAGE NO.	PARA– GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON

** Reference to line numbers within the paragraph or subparagraph.*

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TO: (*Forward direct to addressee listed in publication*) Commander, U.S. Army Aviation and Missile Command ATTN: AMSAM-MMC-MA-NP Redstone Arsenal, AL 35898	**FROM:** (*Activity and location) (Include ZIP Code)*	**DATE**

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

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PART III – REMARKS (*Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

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: 079830-000