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STUDENT GUIDE

FOR

UH-60 AVIATION VIBRATION ANALYSIS

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PROPONENT FOR THIS TSP IS:	**U.S. Army Maintenance Test Pilot School AVIATION TRAINING BRIGADE ATTN: ATZQ-ATB-CA Ft. Rucker, Alabama 36362-5000**
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AVIATION VIBRATION ANALYSIS

TABLE OF CONTENTS

SECTION I. - INTRODUCTION

TERMINAL LEARNING OBJECTIVE:

ACTION: Identify the characteristics of the UH-60 Vibration analysis equipment.

CONDITIONS: As a UH-60 maintenance test pilot.

STANDARD: IAW TM 1-6625-724-13&P

SAFETY REQUIREMENTS: Remove all watches, rings and other jewelry before operating, or maintaining electronic equipment.

RISK ASSESSMENT LEVEL: Low

ENVIRONMENTAL CONSIDERATIONS: There are no environmental concerns for this lesson.

EVALUATION: Evaluation will be accomplished with performance exam at the end of this module of instruction.

SECTION II. - PRESENTATION

A. ENABLING LEARNING OBJECTIVE ELO No.1

ACTION: Identify the characteristics of Vibration Analysis.

CONDITIONS: Using TM 1-6625-724-13&P.

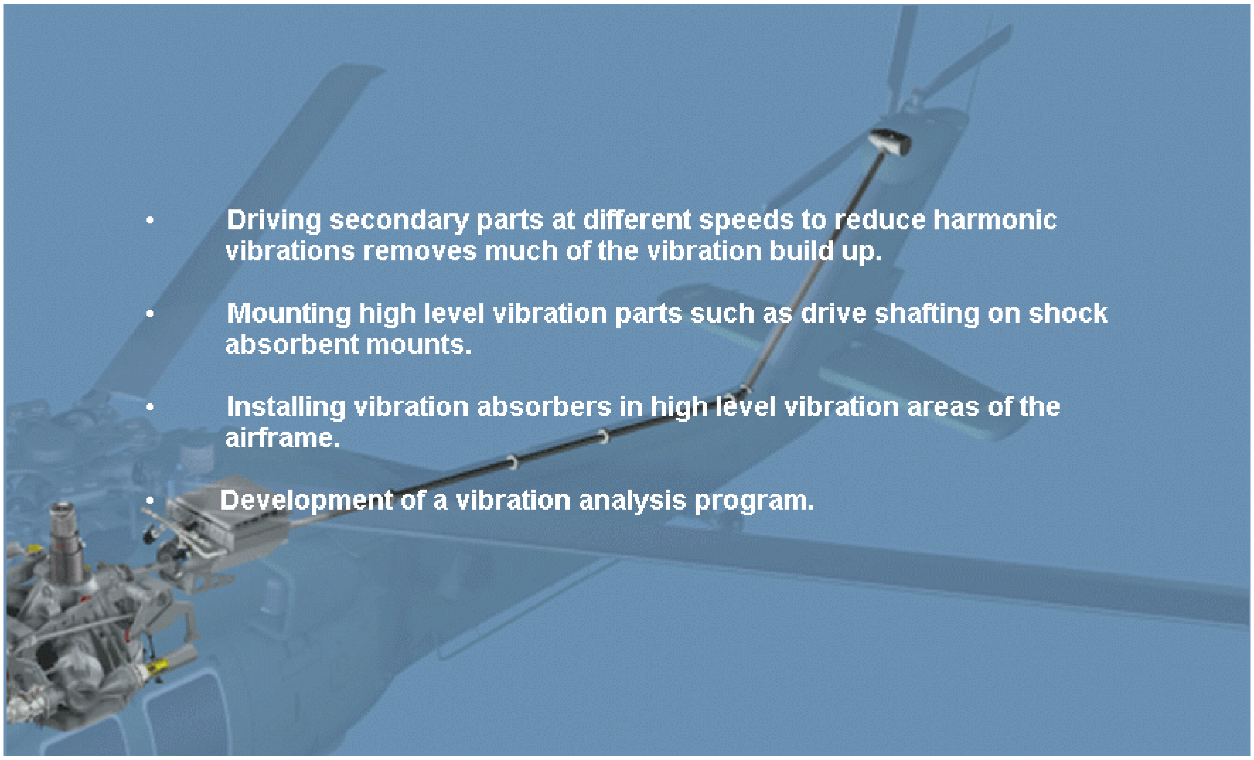
STANDARD: IAW TM 1-6625-724-13&P

Frame #0505 (MENU)

a. To better understand what the Aviation Vibration Analysis (AVA) is, and what it can do for you as a maintenance test pilot, you need to have an understanding of the characteristics of vibration analysis.

(1) Vibration Analysis

Frame #0510 (Vibe Analysis)



(a) Any type of machine vibrates.

(b) However, greater than normal vibration usually means that there is a malfunction.

(c) Malfunctions can be caused by worn bearings, out-of-balance conditions, or loose hardware.

(d) If allowed to continue unchecked, vibrations can cause material failure or machine destruction.

(e) Aircraft, particularly helicopters, have a high vibration level due to their many moving parts.

(f) Designers have been forced to use many different dampening and counteracting methods to keep vibrations at acceptable levels.

(g) Some examples are listed.

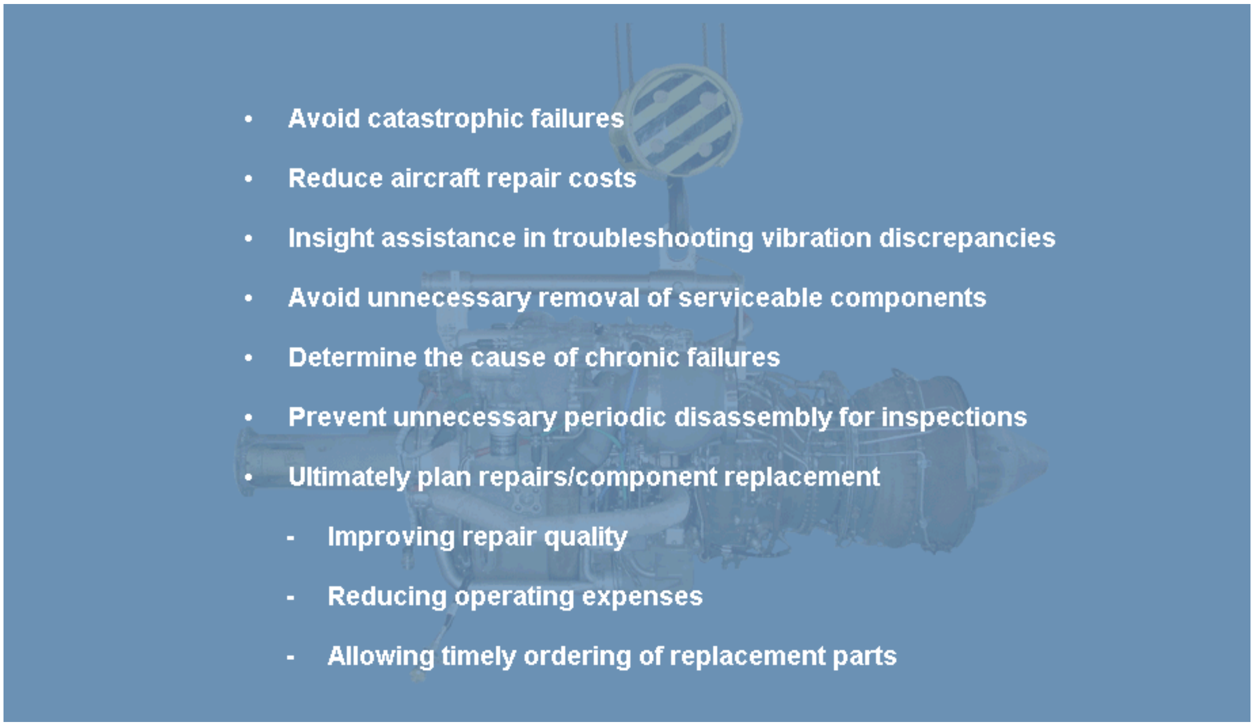
1) Driving secondary parts at different speeds to reduce harmonic vibrations removes much of the vibration build up.

2) Mounting high level vibration parts such as drive shafting on shock absorbent mounts.

3) Installing vibration absorbers in high level vibration areas of the airframe.

4) Development of a vibration analysis program.

Frame #0515 (Vibe Analysis)



(h) Vibration analysis examines the measured readings of vibrations produced by dynamic components during operation.

(i) The purpose and goals of vibration analysis are listed.

1) Avoid catastrophic failures.

2) Reduce aircraft repair costs.

3) Insight assistance in troubleshooting vibration discrepancies.

4) Avoid unnecessary removal of serviceable components.

5) Determine the cause of chronic failures.

6) Prevent unnecessary periodic disassembly for inspections.

7) Ultimately plan repairs/component replacement.

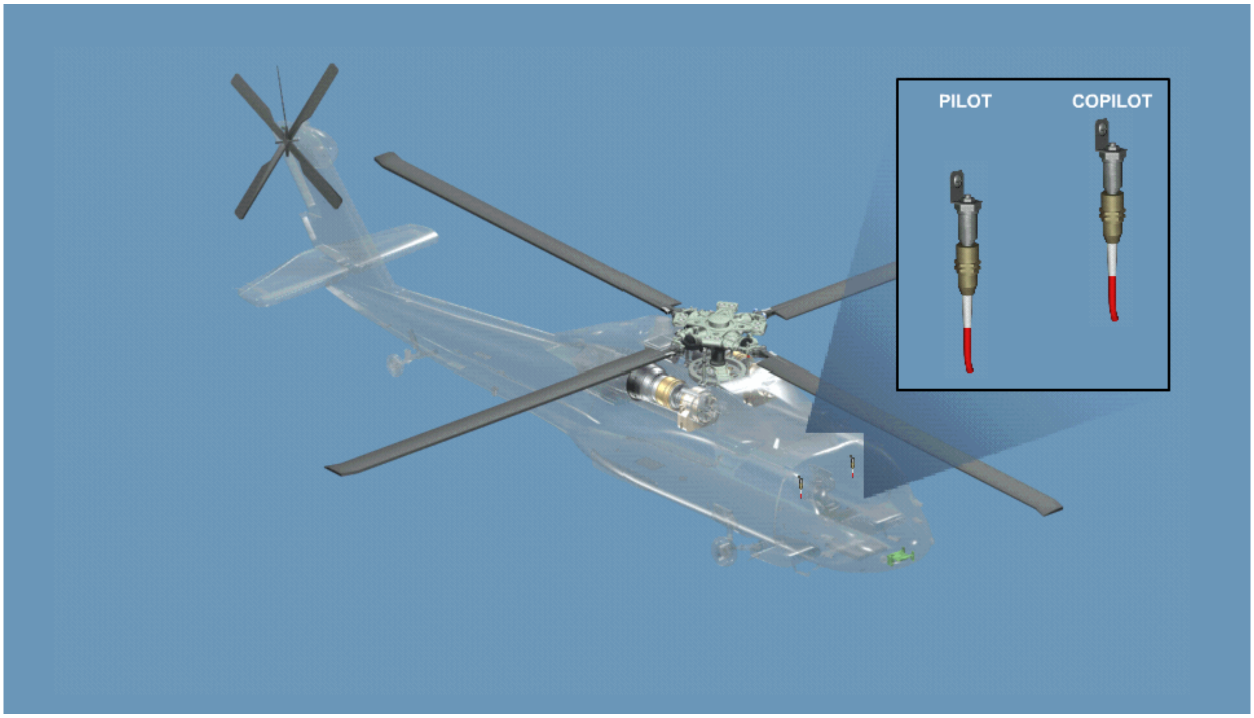
a) Improving repair quality.

b) Reducing operating expenses.

c) Allowing timely ordering of replacement parts.

(2) Terminology

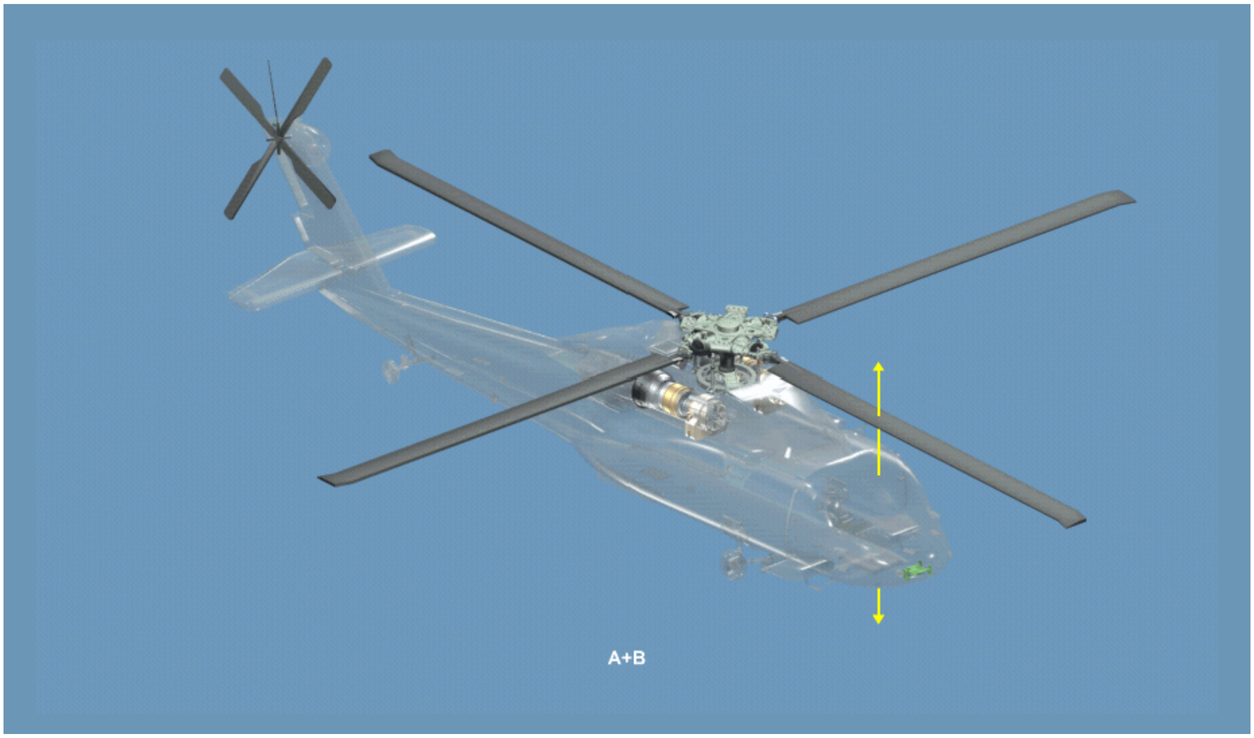
Frame #0520 (Terminology FLASH)



(a) To better understand vibration analysis, an understanding of the basic terms is needed.

(b) The four basic terms used in vibration analysis are A+B, A-B, 1 - 5/Revolution (1 - 5/REV), (1 - 5/R) or (1 - 5P), and Inches Per Second (IPS).

Frame #0520 (Terminology FLASH)

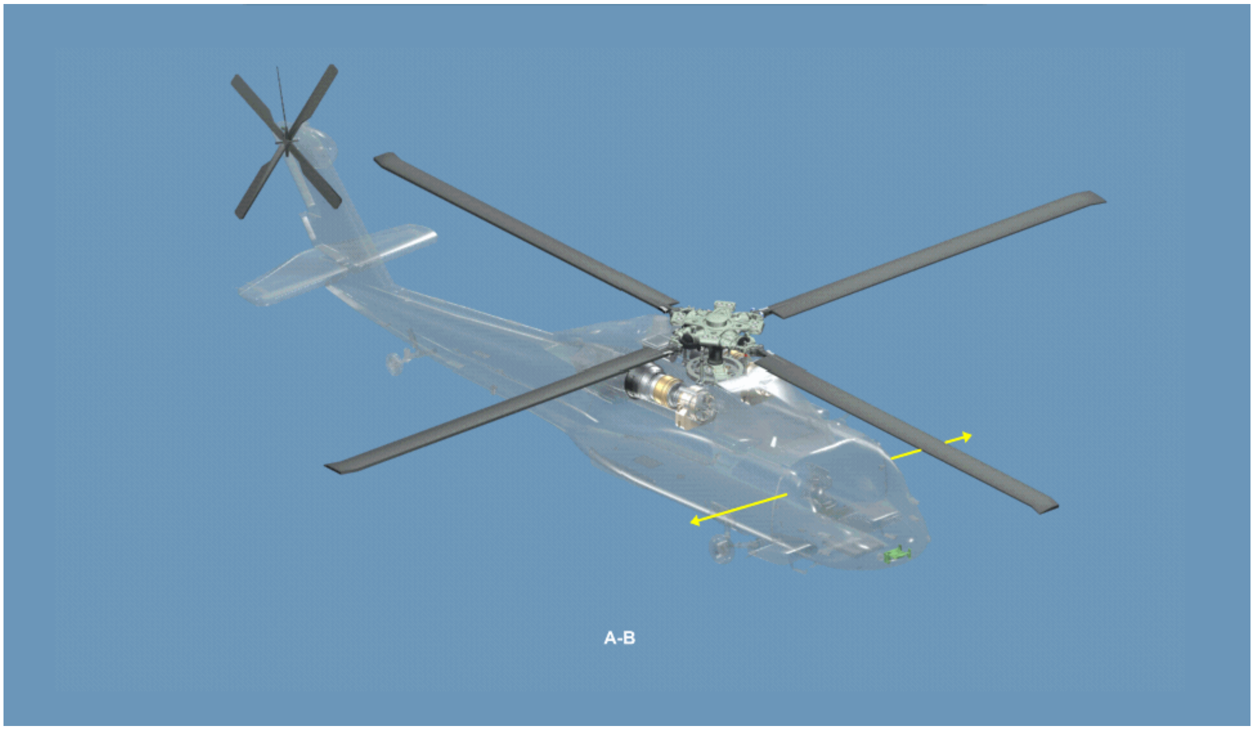


1) A+B is the term used to indicate vertical vibration.

2) Vertical vibrations are evident in the up-and-down movement that produces a thumping effect.

3) An out-of-track rotor blade will cause this type of vibration.

Frame #0520 (Terminology FLASH)

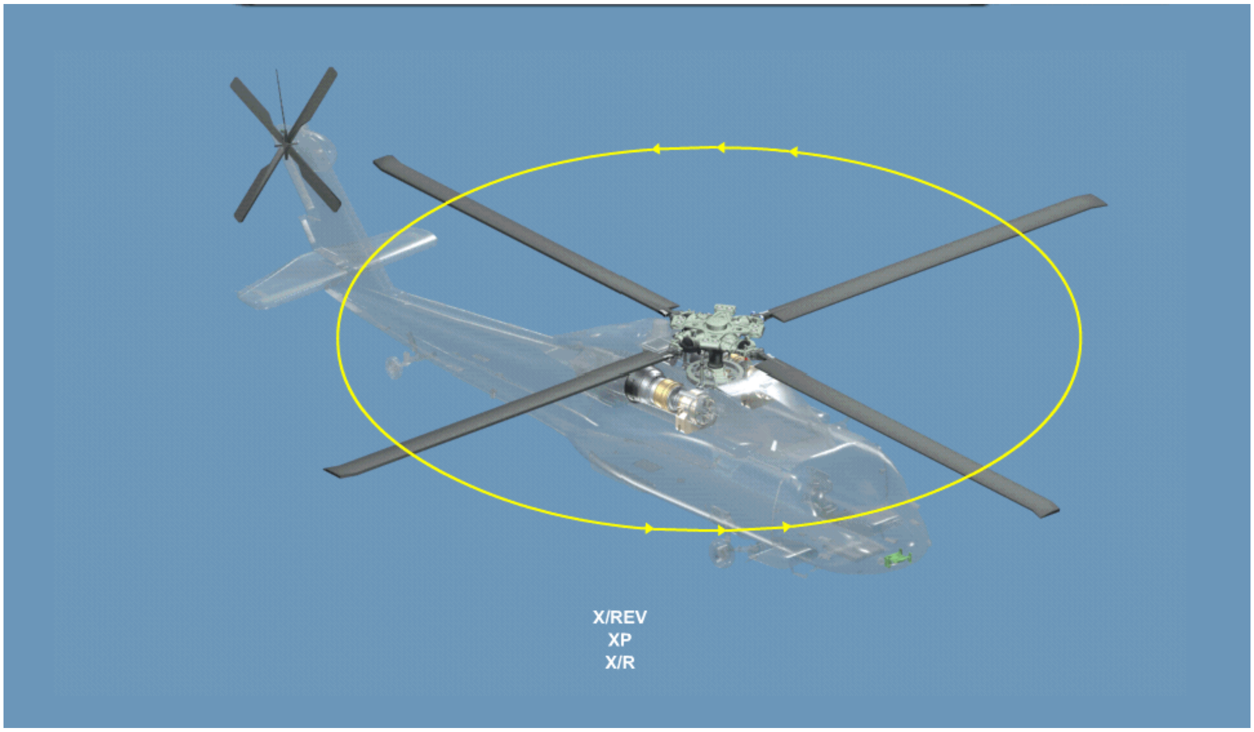


4) A-B is the term used to indicate lateral vibration.

5) Lateral vibrations are evident in side-to-side swinging rhythms.

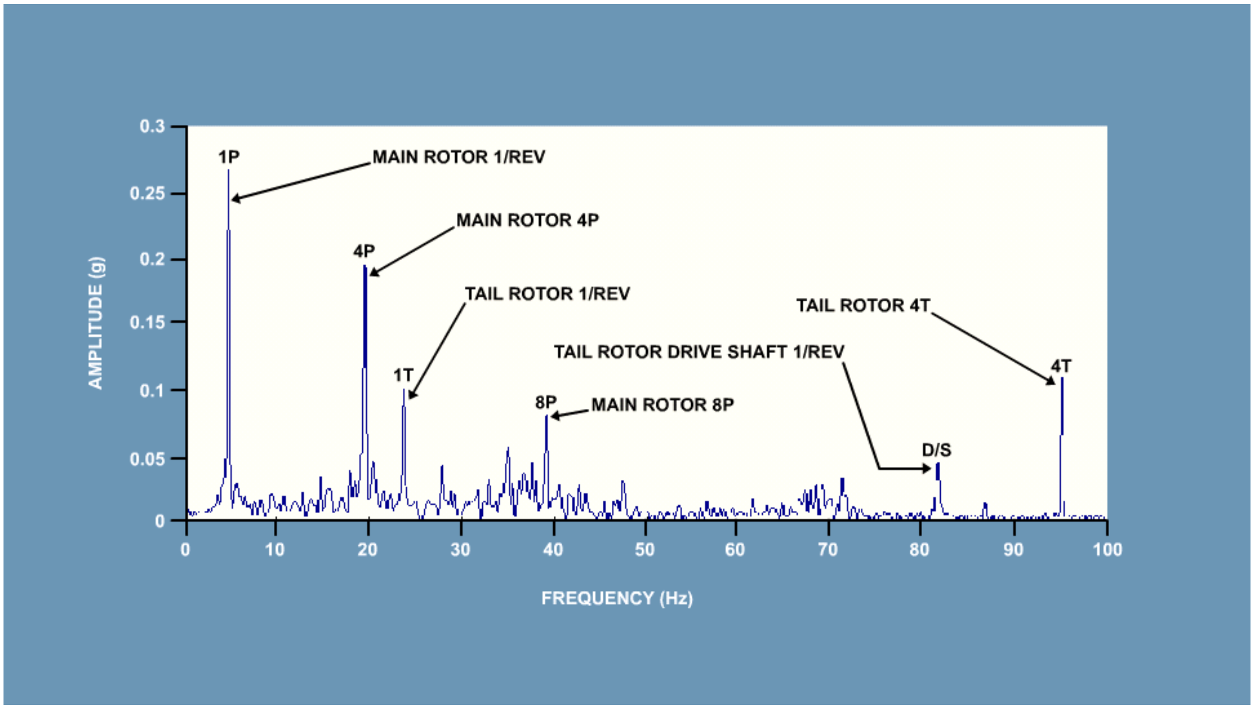
6) An out-of-balance main rotor will cause this type of vibration.

Frame #0520 (Terminology FLASH)



7) X/REV, XP, or X/R is referring to the occurrence of vibration felt to the number of Revolutions Per Minute (RPM) on the component being tested.

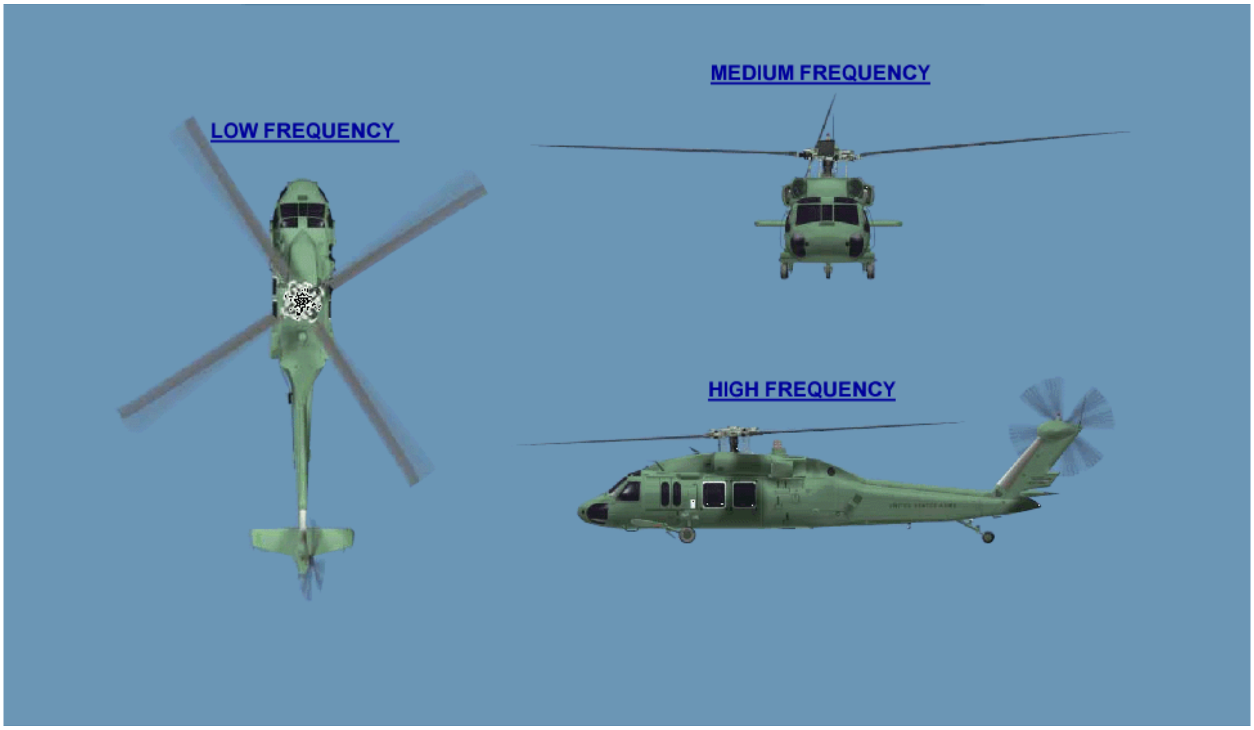
Frame #0520 (Terminology FLASH)



8) IPS is the measured velocity of the vibration experienced at the source of the vibration (component).

(3) Types of Vibrations

Frame #0525 (Types of Vibration)



(a) Types of vibration can be broken down into three major categories: low, medium, and high frequency vibrations.

1) Low Frequency Vibrations

Frame #0526 (Low Frequency Vibrations)

a) A low frequency vibration is normally related to the 1/REV of the main rotor and associated components.

b) The aircraft will feel like it has a lateral oscillation or wallow.

c) Other low frequency vibrations felt are ground roll and vertical bounce.

d) A vertical bounce normally occurs on the ground and is caused by the position of the cyclic or the collective stick.

e) Repositioning of the controls by the pilot will correct this problem.

f) An in-flight vertical oscillation or bounce can be caused by turbulence, external load oscillation when performing cargo sling or hoist operations, oscillation in the Stability Augmentation System (SAS), or by inadvertent pilot input into the collective controls.

2) Medium Frequency Vibrations

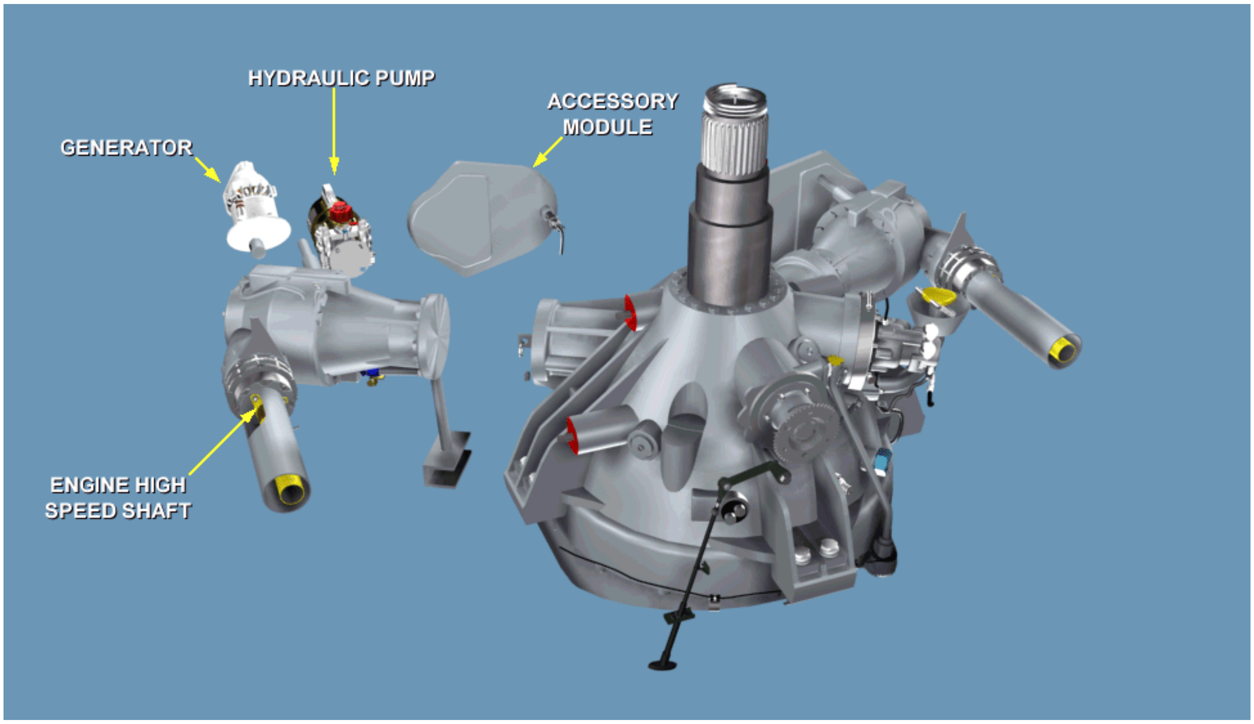
Frame #0527 (Medium Frequency Vibrations)

a) A medium frequency vibration is often hard to distinguish from a high frequency vibration.

b) For a medium frequency vibration check the tail rotor drive shaft, oil cooler, and tail rotor.

3) High Frequency Vibrations

Frame #0528 (High Frequency Vibrations)

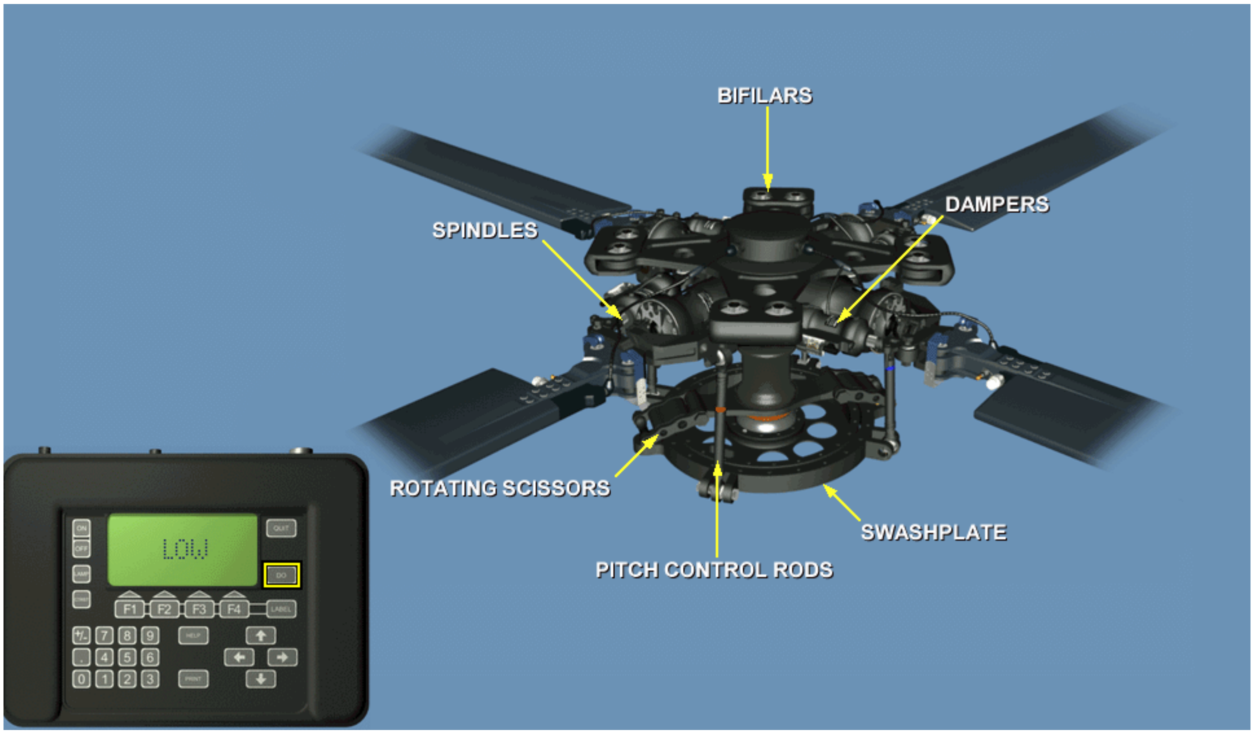


a) High frequency vibrations are associated with components operating at a higher speed than the tail rotor and it components (above 4110 rpm).

b) They are more dangerous than any other type of vibration because of metal fatigue and crystallization.

(4) Sources of Vibrations

Frame #0530 (Sources of Vibrations)

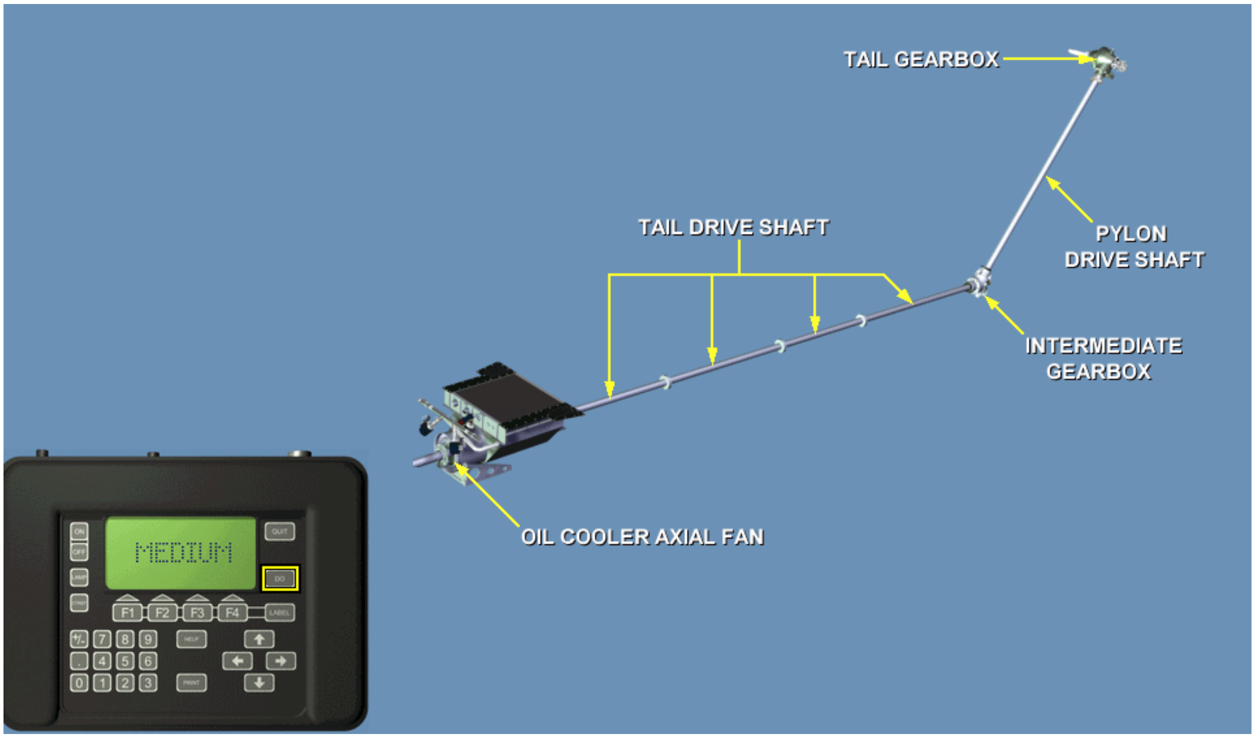


(a) The most probable cause of a low frequency vibration would be an out of balance main rotor.

(b) Other areas to check would be the main rotor components such as the swashplate, rotating scissors, spindles, bifilars, pitch control rods, and dampers.

(c) Main landing gear struts or tires requiring servicing normally cause ground rolls.

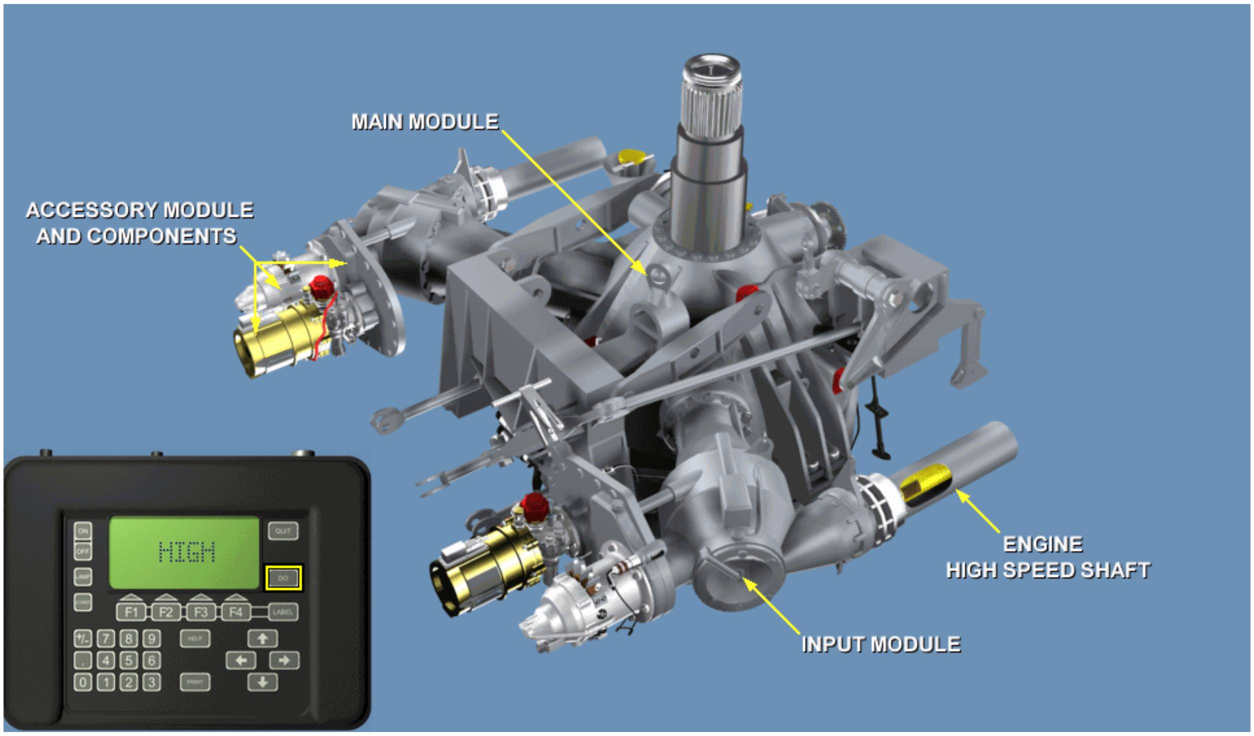
Frame #0530 (Sources of Vibrations)



(d) Sources of medium frequencies would include the tail drive shaft, pylon drive shaft, intermediate and tail gearboxes, main module oil pump, oil cooler axial fan, and the one-per-rev of the tail rotor.

(e) Components that would be looked at are the nose and cabin vibration absorbers (tune as required), main rotor swashplate, rotating scissors, tail rotor retention plates (inner and outer), tail pitch links, tail drive shaft bearings, shafts, disk couplings, shaft run-out on the axial fan, and other associated components.

Frame #0530 (Sources of Vibrations)



(f) High vibration is normally associated with the engine, engine high speed shaft, input modules, main module mounted accessory section modules (and components mounted to them), gear mesh frequencies within the main module, and intermediate and tail gear boxes.

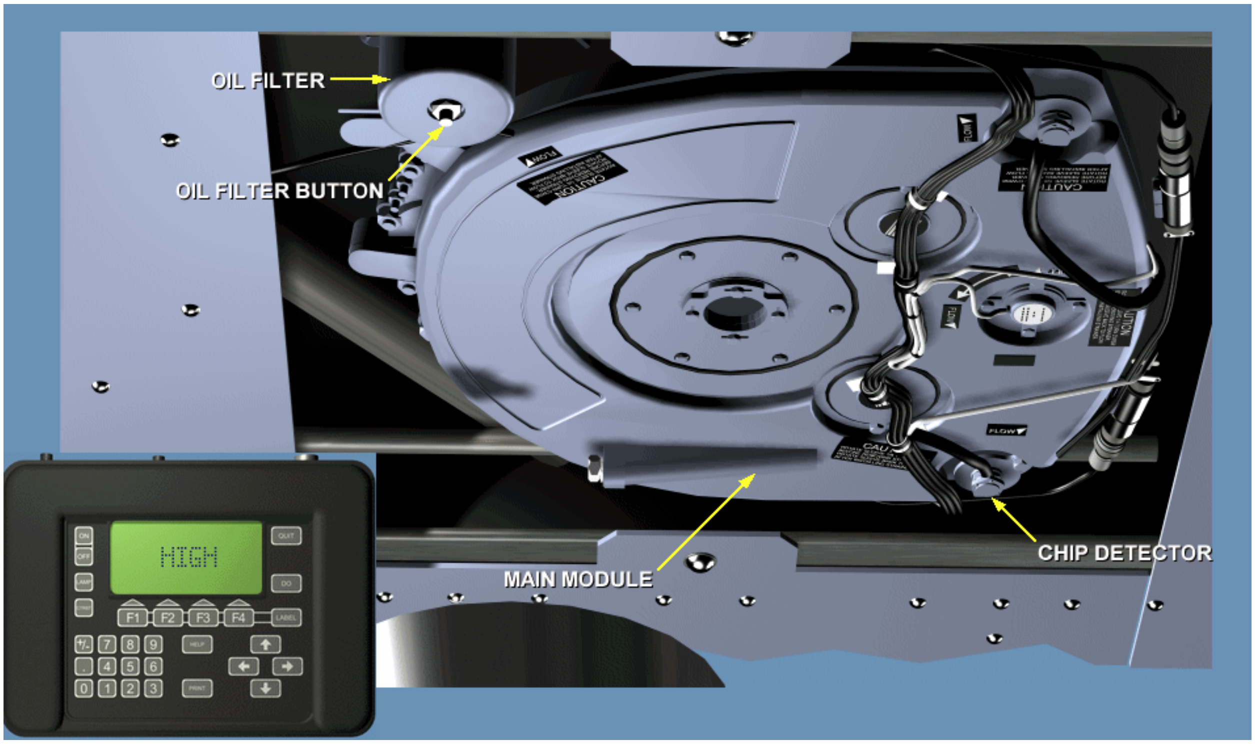
(g) This also includes multiples or harmonics of some medium frequency components such as tail drive shafts and the oil cooler axial fan.

(h) There are several components that run at the same frequency such as the input module quill shaft and the accessory section drive gear.

(i) The entire input module will usually be replaced when an excessive high frequency vibration develops.

(j) Normally rebalancing the shaft will correct the vibration problem (with the engine high-speed shaft).

Frame #0530 (Sources of Vibrations)



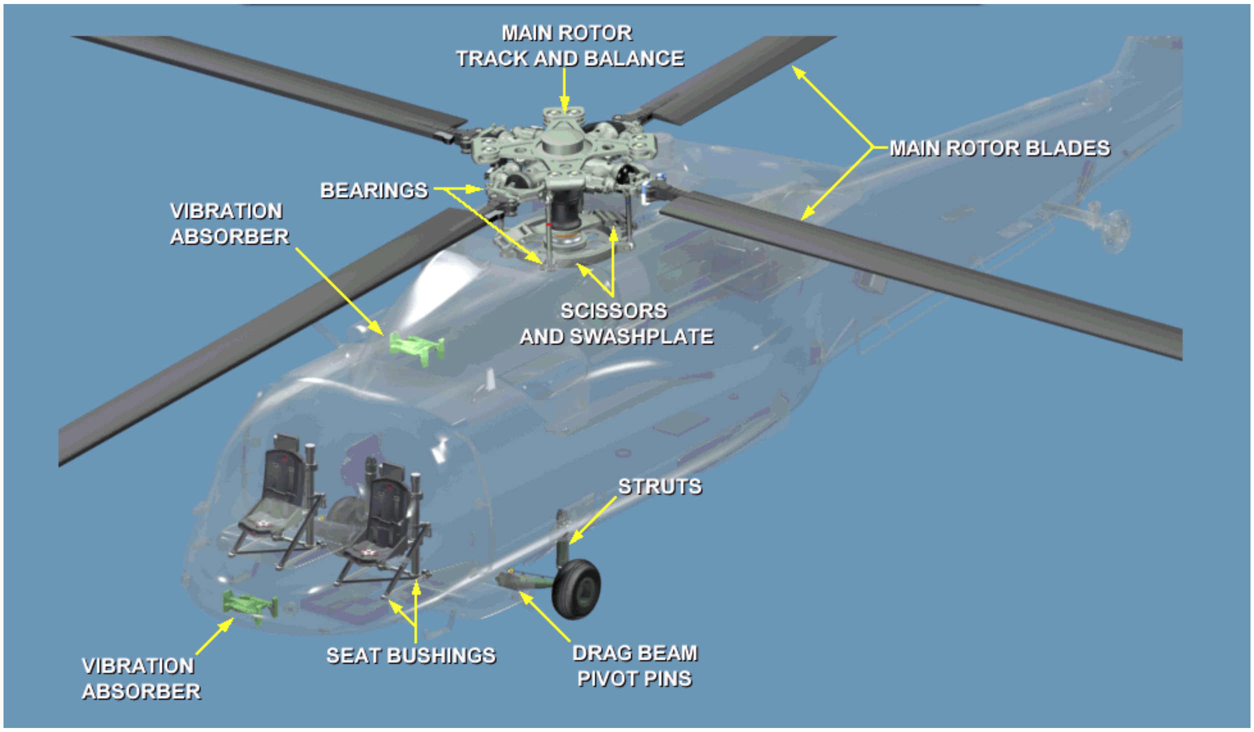
(k) Vibrations related to gear mesh frequencies in the main module, intermediate and tail gearboxes are of concern, but look for secondary indications before making a judgment on the serviceability of the component.

(l) Secondary indications should be chip detector lights, type and size of the chips found in the detectors or filters, oil filter pins popping, and oil pressure and temperature problems.

(m) Other high-frequency sources are hydraulic pumps, vent blowers, APU, and generators.

(5) Corrections

Frame #0540 (Low Frequency Corrections)



(a) For low frequency vibrations the following corrections are suggested:

1) 1P - Track and balance main rotor, replace bearings, replace seat bushings, service struts, replace drag beam pivot pins.

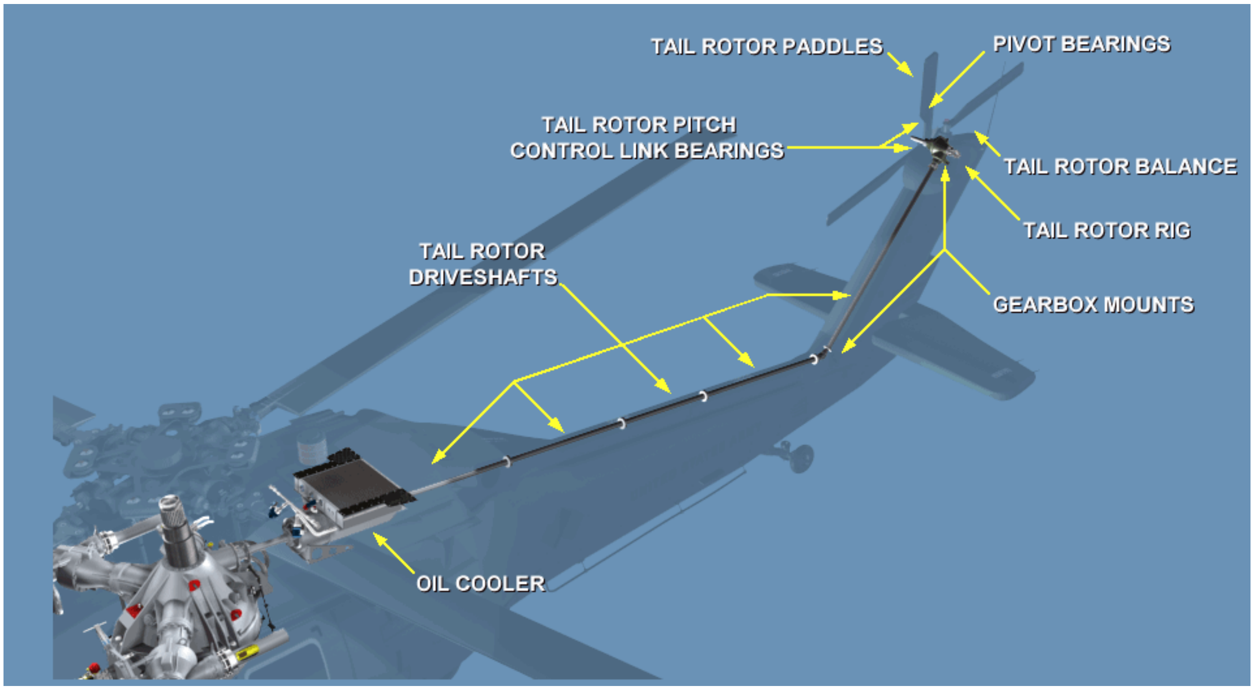
2) 2P - Track and balance main rotor, service or replace dampers, repair or replace scissors, repair or replace swashplate.

3) 3P - Weigh bifiliars, change a main rotor blade after all other vibrations are isolated.

4) 4P - Tune vibration absorbers.

5) 5P - Change a main rotor blade after all other vibrations are isolated.

Frame #0545 (Medium Frequency Corrections)



(b) For medium frequency vibrations the following corrections are suggested:

1) Verify the tail rotor rig

2) Tail rotor pitch control link bearing replacement

3) Verify the Tail rotor balance

4) Tail rotor paddle replacement

5) Inspect/replace Pivot bearings

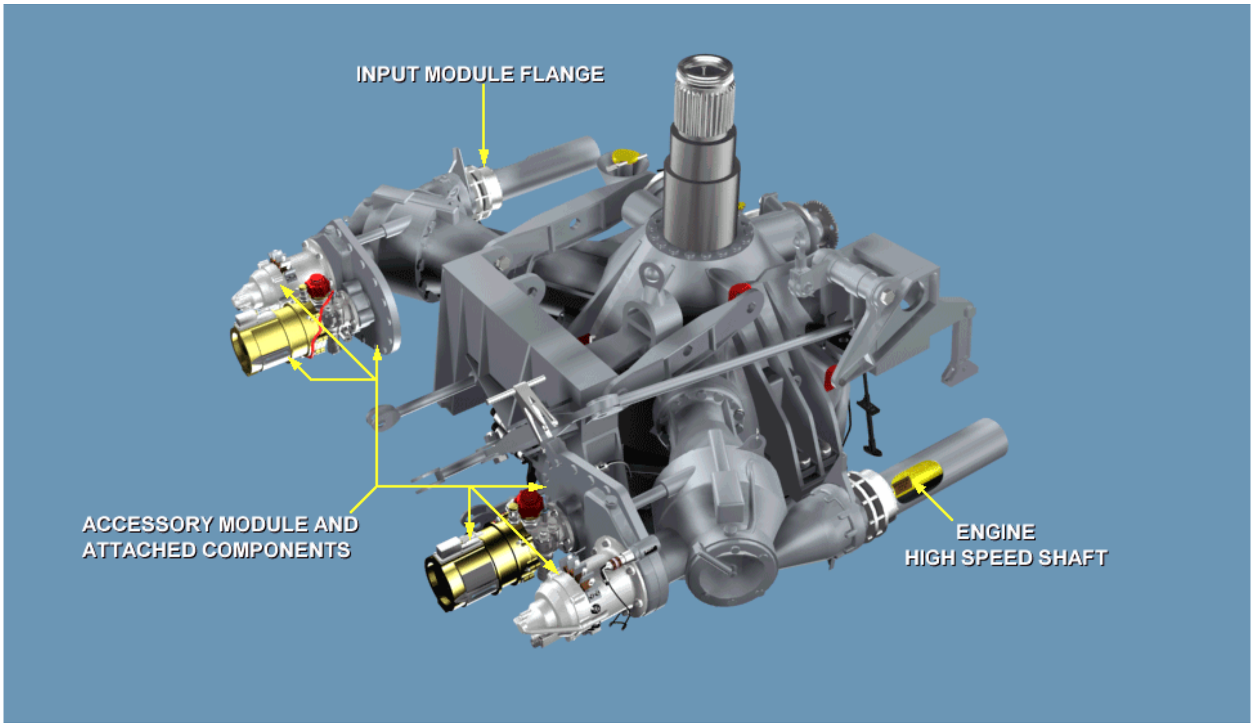
6) Replace tail rotor drive shafts with weights missing

7) Retorque gearbox mounts

8) Retorque tail rotor drive shafts

9) Balance the Oil cooler

Frame #0550 (High Frequency Corrections)



(c) For high frequency vibrations the following corrections are suggested:

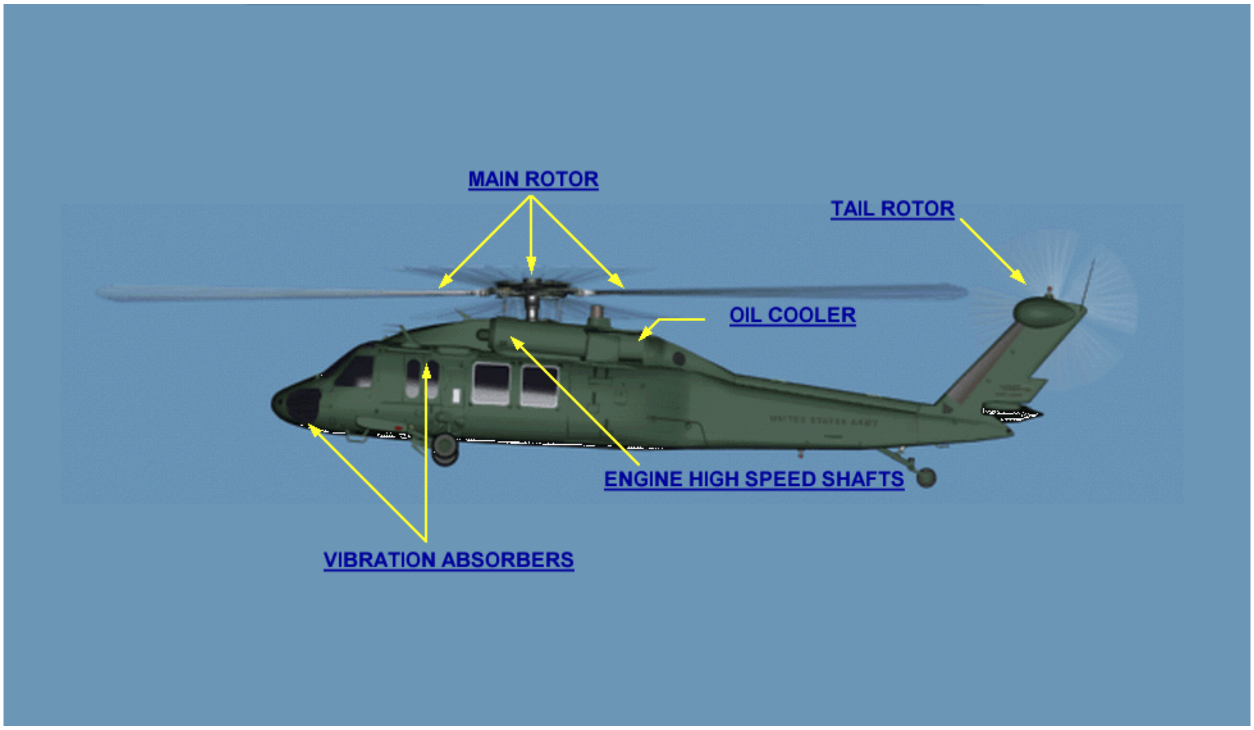
1) Balance high speed shafts

2) Torque check input module flange

3) Check accessory modules and attached components

(6) Limits

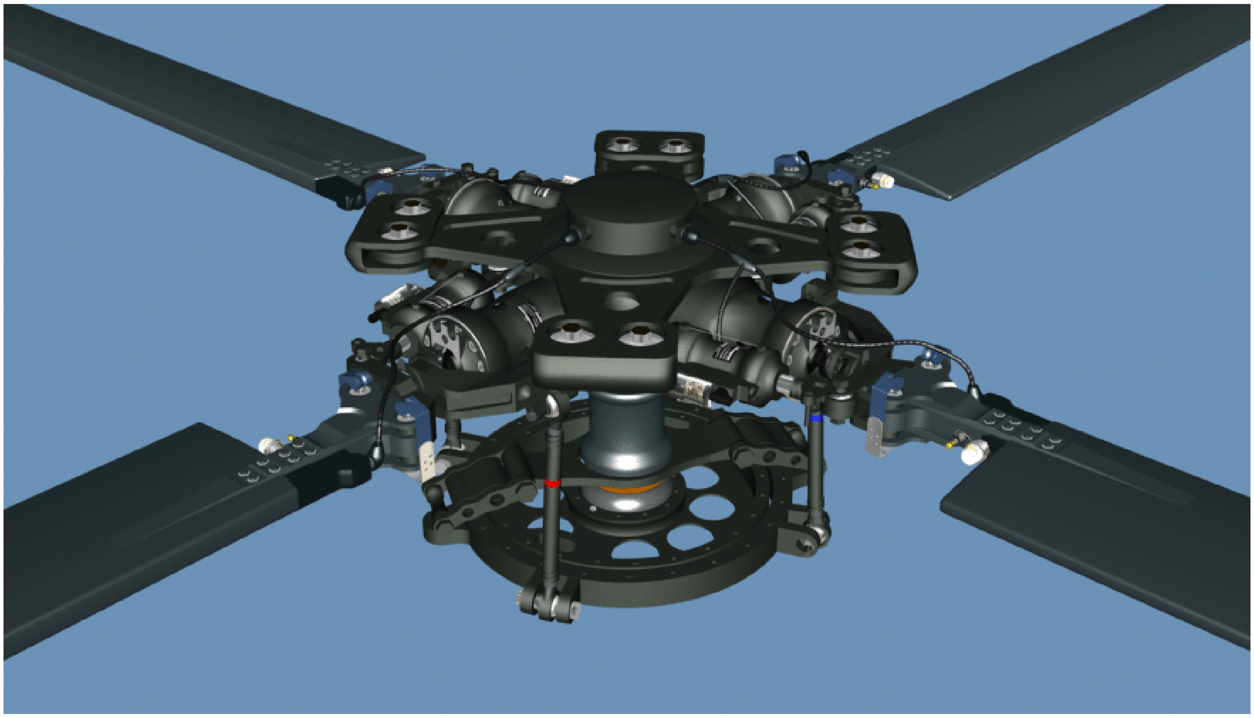
Frame #0555 (Limits)



(a) The limits addressed in the AVA system are separated into five sections: the main rotor, tail rotor, vibration absorbers, engine high-speed shafts, and the oil cooler.

1) Main Rotor Limits

Frame #0560 (Main Rotor Limits)



a) Limits for the main rotor are separated into four areas: blade track, ground balance, A+B hover, and A-B hover.

b) The AVA test is designed to track the main rotor to 0.5 inch or less at 100% main rotor speed (nr) on the ground only.

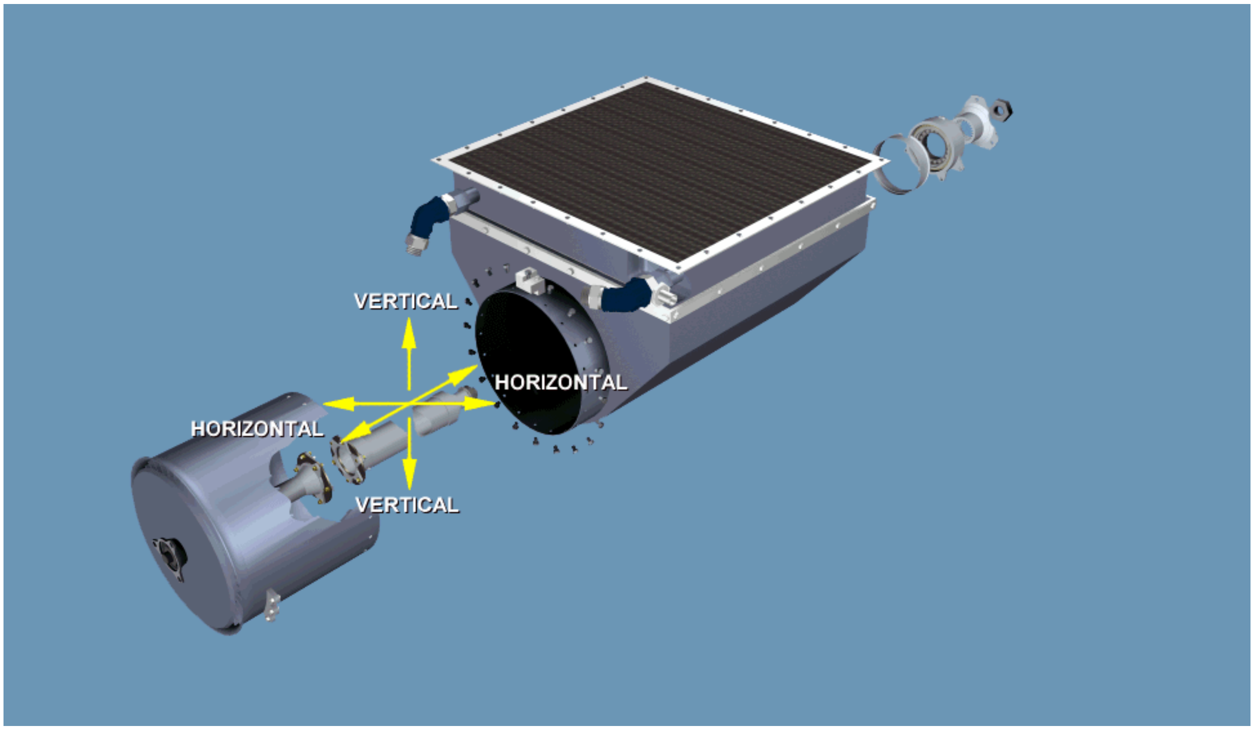
c) The ground balance limit has been established at 0.2 IPS at 100% Nr.

d) The limits set for the A+B at a hover are 0.25 IPS at the following airspeeds (80, 120, and 145 Knots { KTS }).

e) A-B limits at hover, 80, 120, and 145 knots are 0.2 IPS.

2) Oil Cooler Limits

Frame #0580 (Oil Cooler Limits)



a) The limit established by the AVA test equipment for the oil cooler is 1.0 IPS, vertical and horizontal.

b) This limit is measured on the ground only.

3) Tail Rotor Limits

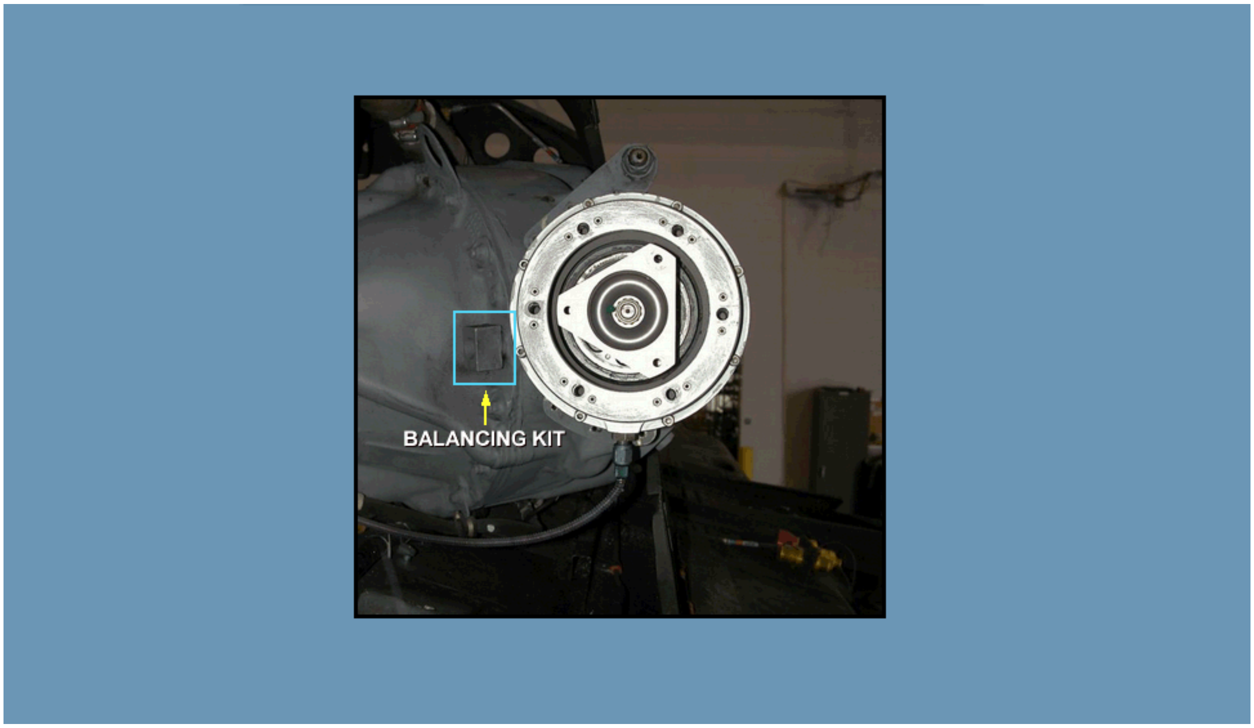
Frame #0565 (Tail Rotor Limits)

a) The limit established by the AVA test equipment for the tail rotor is 0.2 IPS.

b) This limit is measured on the ground only.

4) Engine High Speed Shafts Limits

Frame #0575 (Engine High Speed Shafts Limits)



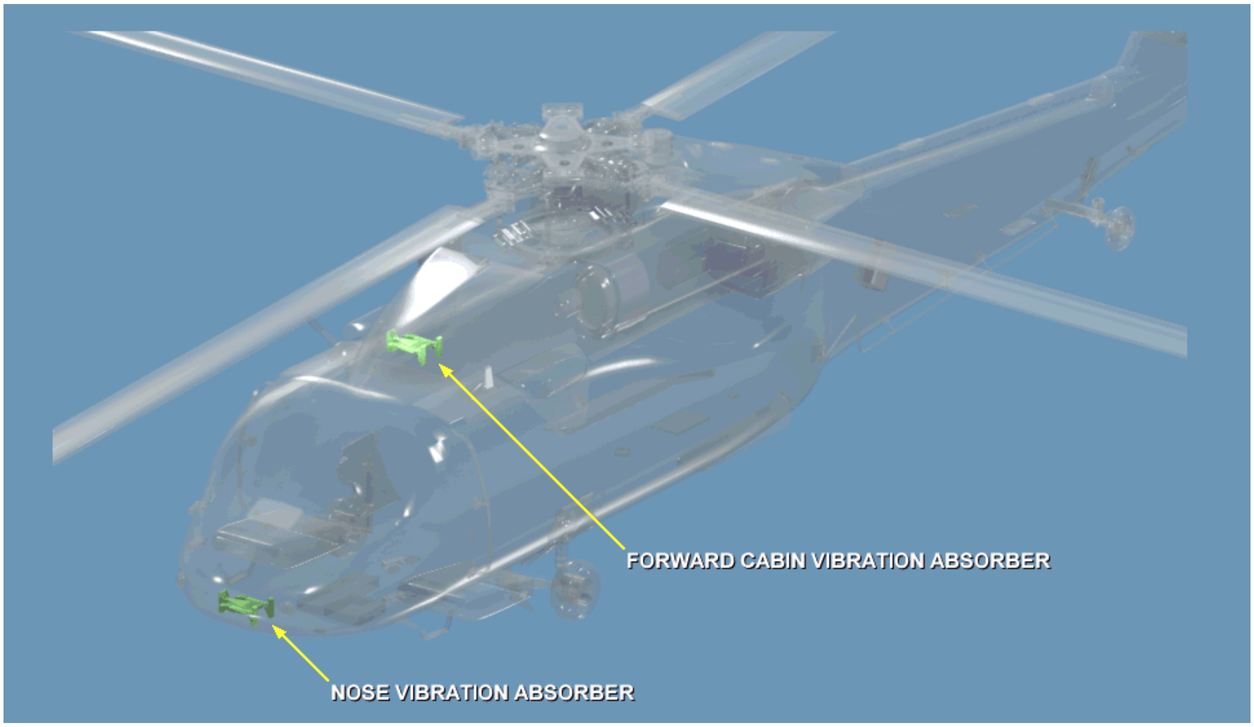
a) For UH-60L helicopters and EH/UH-60A helicopters with balancing kit installed, vibration levels shall be 0.50 IPS or less.

b) If vibration levels are within this range, engine high-speed shaft is balanced.

c) If vibration level is greater than 2.0 IPS, replace high-speed shaft.

5) Vibration Absorbers Limits

Frame #0570 (Vibration Absorbers Limits)



a) The AVA system has established the limits for both the nose and forward cabin vibration absorbers. The nose vibration absorber limits have been established at an IPS range instead of a specific NR.

b) Those limits are 0.3 - 0.6 IPS, with a goal of 0.5 IPS.

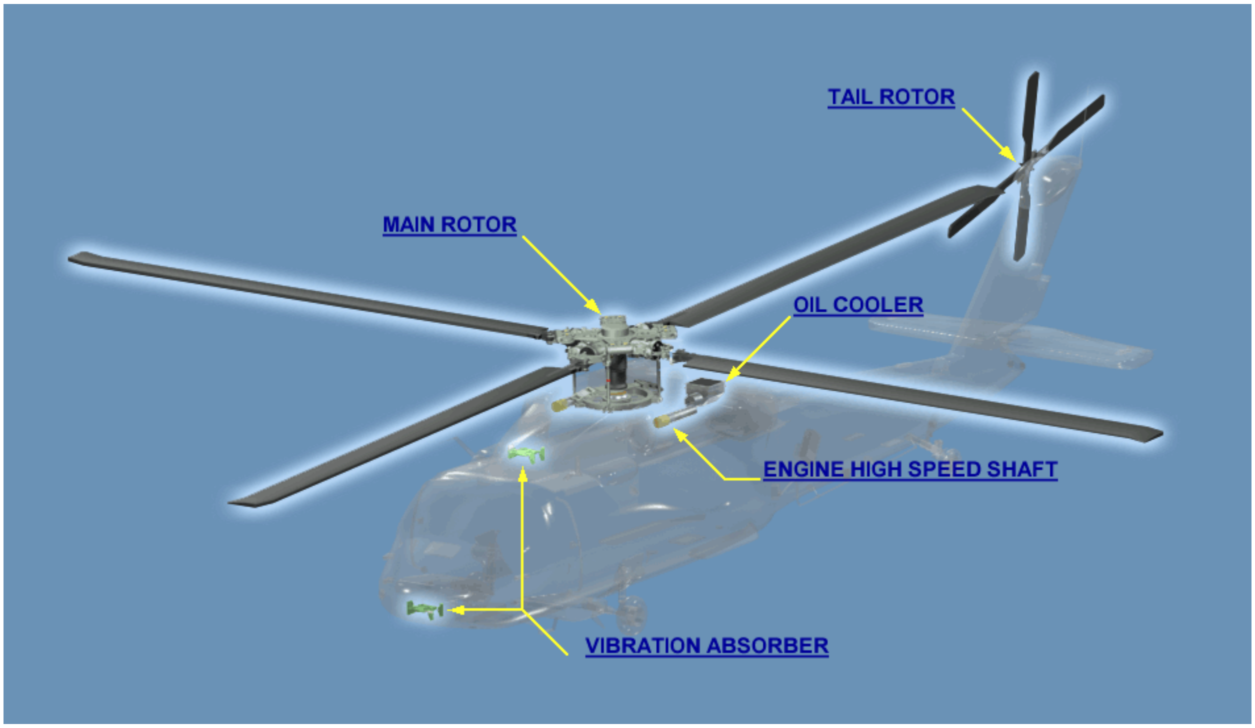
c) Should the IPS level drop below 0.3 IPS, the nose absorber may interfere with the forward cabin absorber turning and actually degrade the cabin and cockpit 4/rev vibration.

d) Measurements for the forward cabin absorber are taken at 120 KTS and 145 KTS.

e) If they are found to be out of limits tuning is done at 145 KTS using Nr speeds of 96-103%".

(7) Adjustments

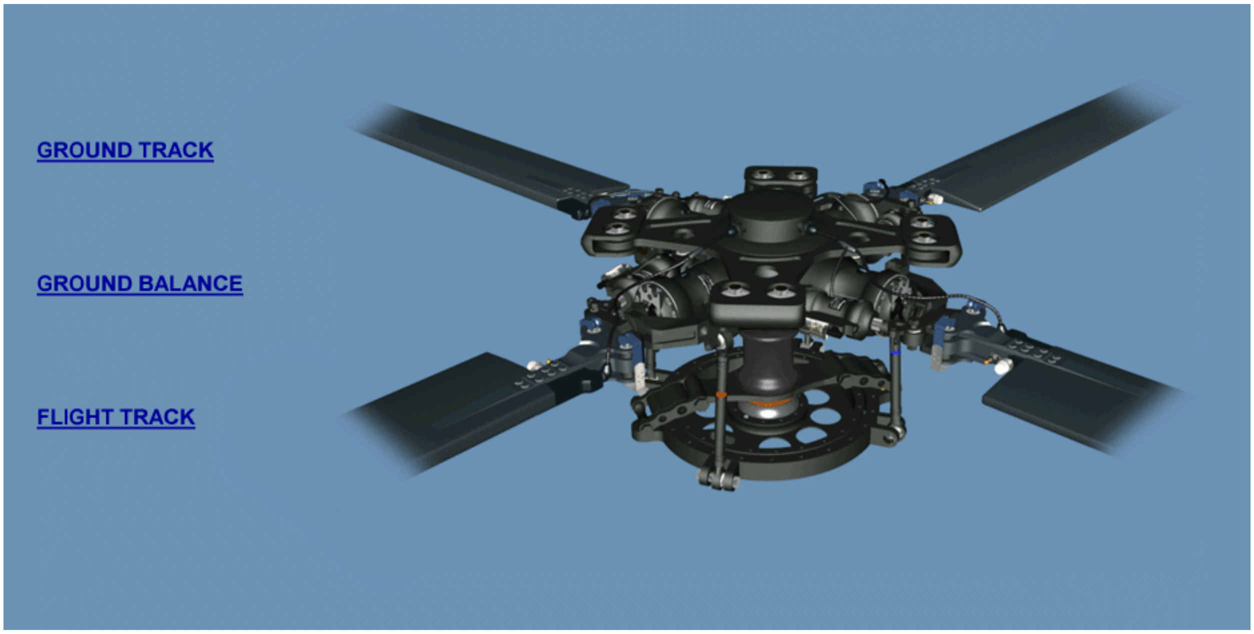
Frame #0590 (Adjustments)



(a) To further minimize vibrations components were designed to allow adjustments to correct for excessive vibrations.

1) Main Rotor Adjustments

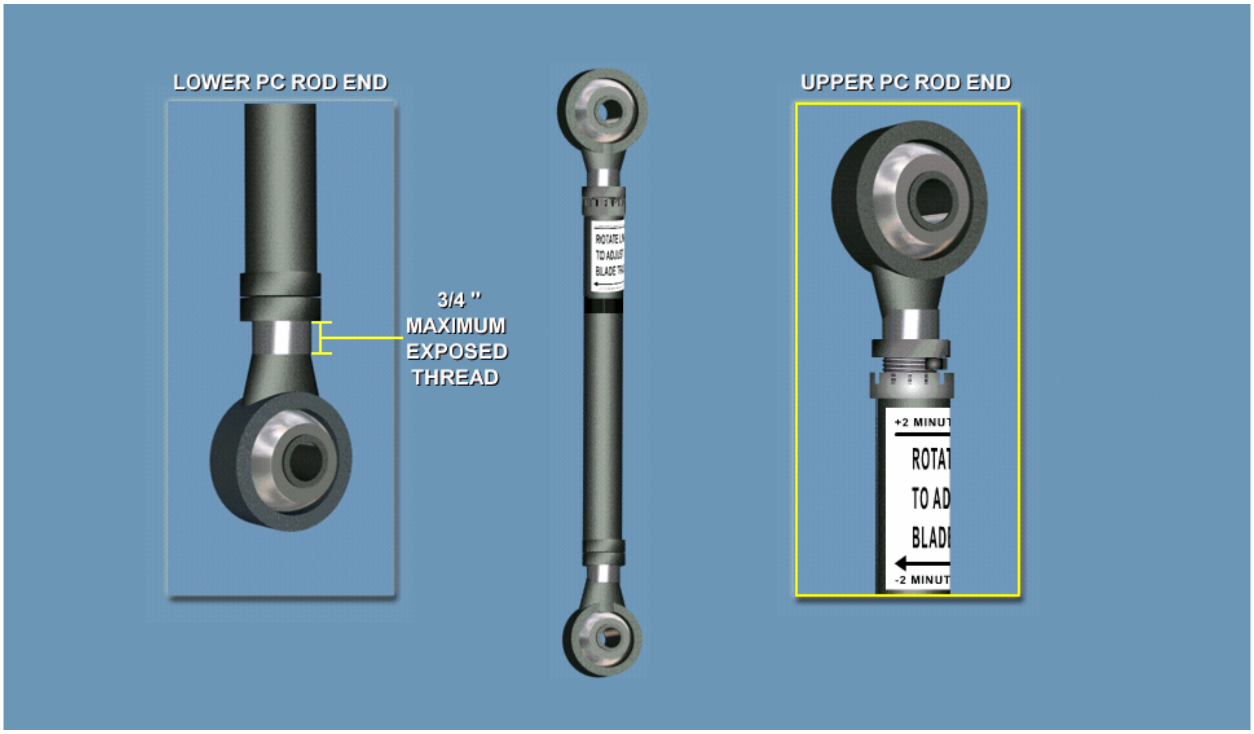
Frame #0600 (Main Rotor Adjustments)



a) Adjustments to the main rotor system can be separated into three categories: ground track, ground balance and flight track.

1 Ground Track

Frame #0605 (Ground Track Flash)



a Ground track is adjusted through the main rotor Pitch Control Rod (PC).

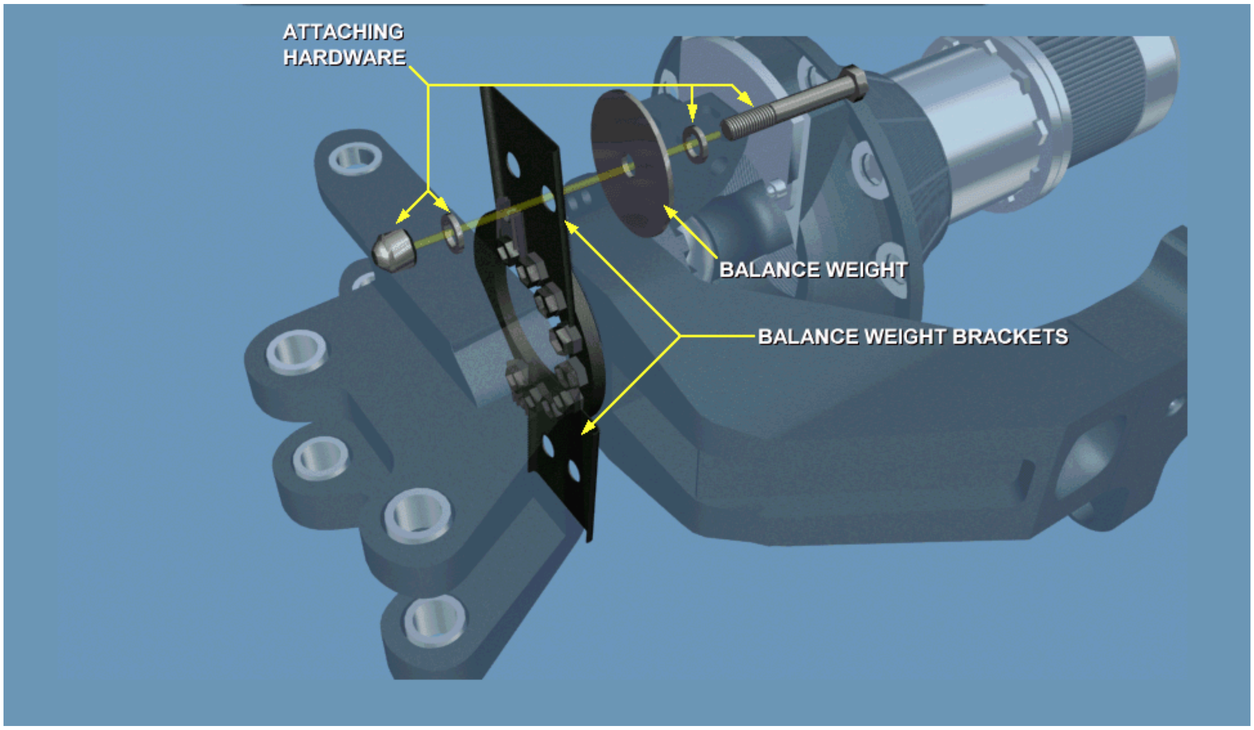
b The PC rods are color coded to the corresponding blade.

c One notch is equal to 1/4" track.

d A maximum of 3/4" of exposed threads on the upper end of the PC rod is permitted when making adjustments.

2 Ground Balance

Frame #0610 (Ground Balance)



a Ground balance is done at the main rotor spindle by adding weights to the balance weight brackets.

b A maximum of 5 lbs per spindle is allowed. The weight of the bolt and attaching hardware is approximately 2 ounces.

c The weight of the balance washers are approximately 1 and 1/2 ounces.

d There are four locations to install balance weights: two on the upper and two on the lower bracket.

e The weight of the attaching hardware must be included in the total weight computation.

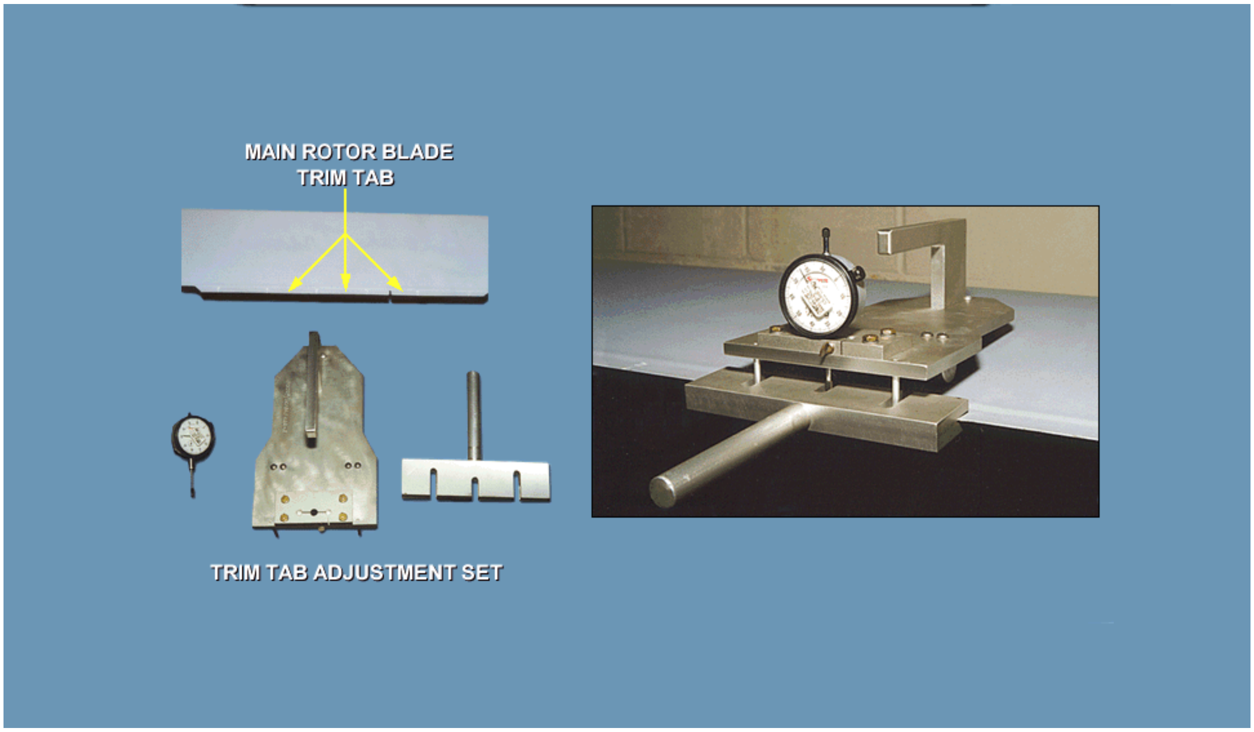
f The maximum number of balance weights that can be used per bolt is 18, with washer under bolt head removed to obtain the 5 lb maximum.

g If the washer under the nut is installed, the maximum number of balance weights per bolt is 17.

h The weight should be as equal as possible. When adding balance weights to the main rotor if you are using 2 lbs or less, use trailing bolt hole; for more than 2 lbs, divide weight equally among all four-bolt holes.

3 Flight Track

Frame #0615 (Flight Track)



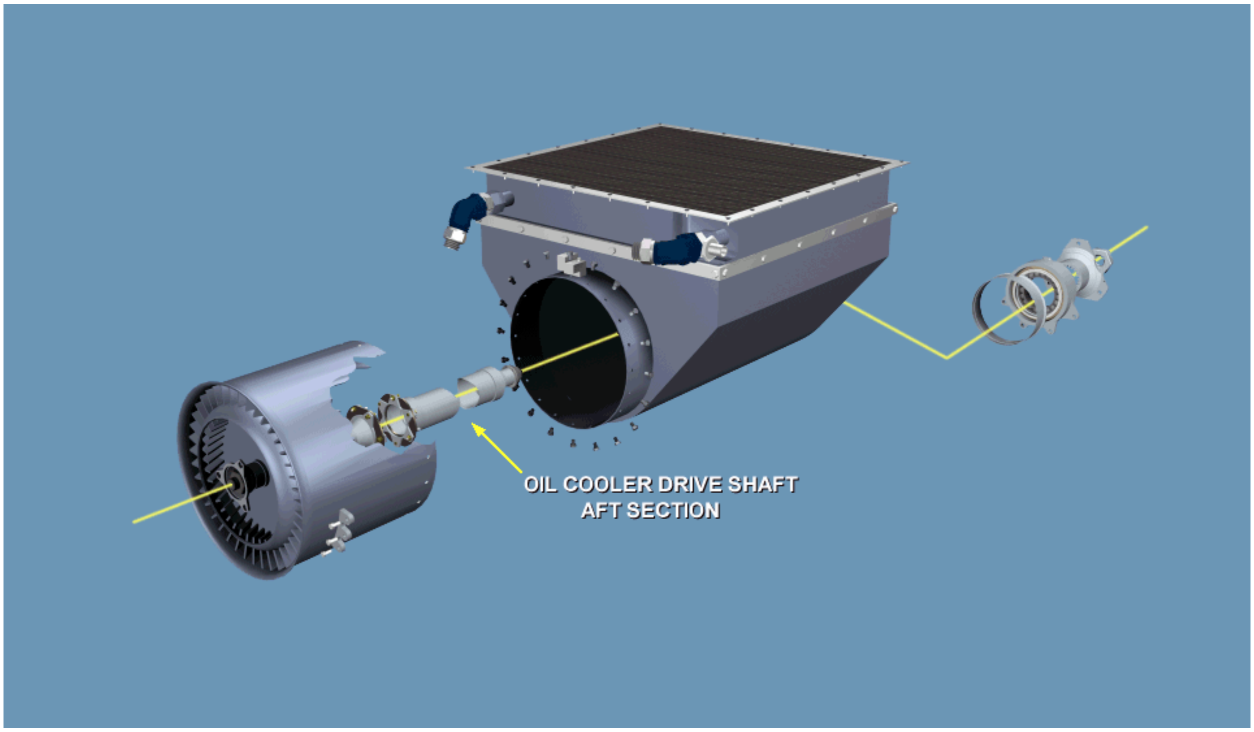
a Flight track adjustments to the PC rods are the same as the ground track

b Trim tab adjustments are added for further smoothing of the main rotor.

c Adjustments to the trim tabs are in mils, with maximum adjustment of 30 mils from factory setting.

2) Oil Cooler Adjustments

Frame #0630 (Oil Cooler Adjustments)



a) Should adjustments to the drive shaft of the oil cooler be required, rotating of the aft drive shaft section of the oil cooler is the only method available.

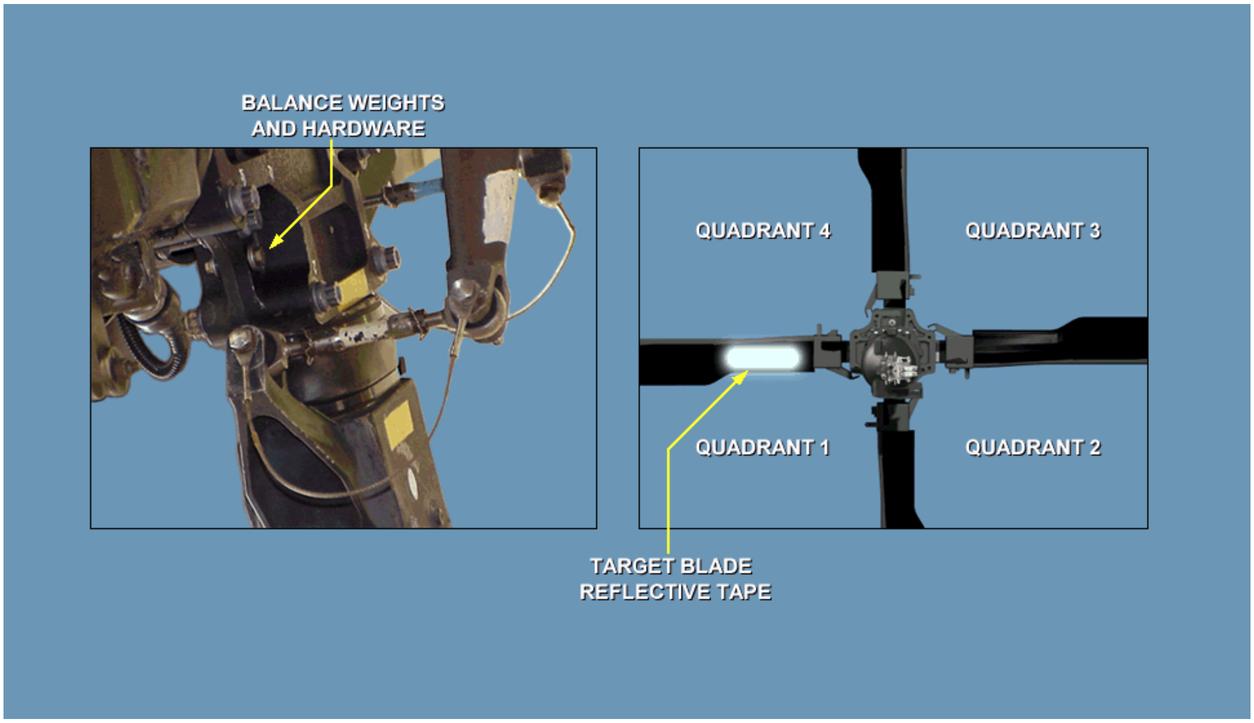
b) This is done by removing the attaching hardware connecting the aft end of the oil cooler drive shaft from the No. 1 drive shaft of section II.

c) Then rotate the drive shaft of the oil cooler 120º in either direction.

d) Make sure the direction of rotation is clearly marked should another adjustment be required. If the oil cooler is not within limits after the second rotation, should it be required, replace the oil cooler.

3) Tail Rotor Adjustments

Frame #0620 (Tail Rotor Adjustments)



a) The tail rotor is separated into four quadrants, with the target blade, marked by reflective tape, being quadrant 1.

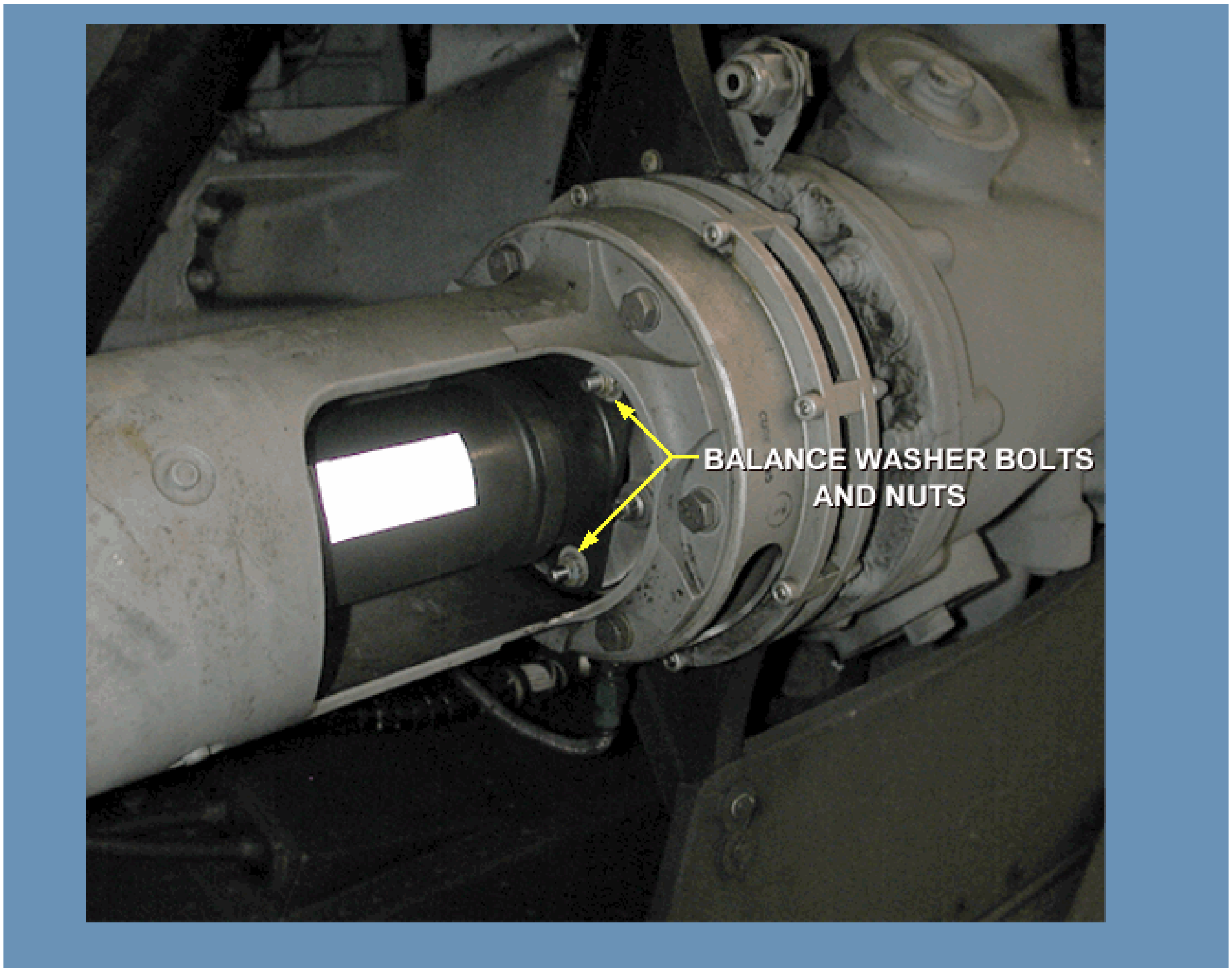
b) For balancing, weights are added to the quadrant identified by the AVA kit.

c) As the weights are being added, the bolt hole closest to the blade is considered the primary location.

d) A maximum of 227 grams per quadrant, 113.5 grams per bolt hole, is allowed.

4) Engine High Speed Shaft

Frame #0635 (Engine High Speed Shaft)



a) When balancing the engine high-speed shaft, the balance washers are installed under the nut on the bolts that connect the engine output shaft to the flexible coupling.

b) The maximum number of balance washers that can be added to any one balance bolt is two.

c) Do not remove bolts securing flexible coupling to output shaft.

d) If balance washers must be added, remove nut only.

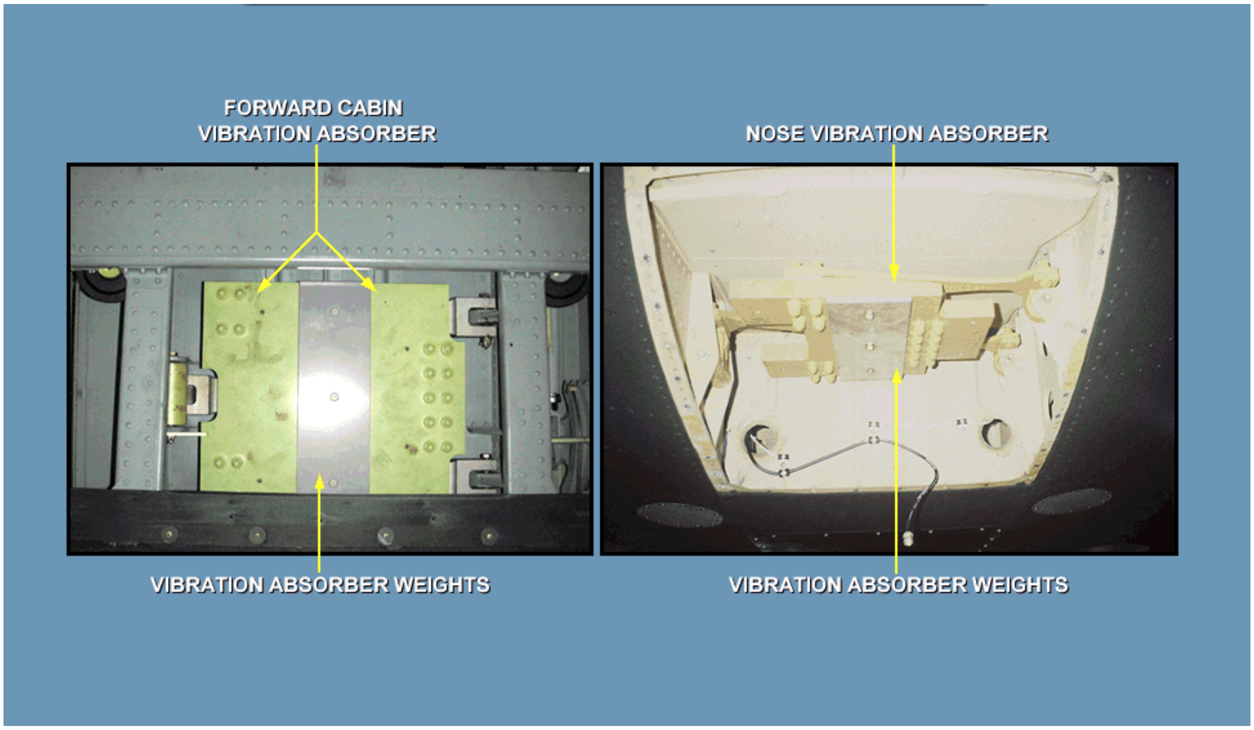
e) Only one nut should be removed at any time. If balance washers are added or removed on two different balance bolts, the nut on the first balance bolt adjusted must be installed and torqued before removing next nut.

f) Should you be unable to balance the engine high-speed shaft using the balance weights, rotate the engine high-speed shaft 120º in either direction.

g) Make sure the direction of rotation is clearly marked should another adjustment be required.

5) Vibration Absorber Adjustments

Frame #0625 (Vibration Absorber Adjustments)



a) Vibration absorber tuning is done by In-flight measurements only.

b) The adjustments may be made on ground or in flight around 80 KTS.

c) The nose vibration absorber must be in tune before adjusting the forward cabin absorber.

d) The maximum weight allowed per vibration absorber is 15 lbs, with each 1 lb of weight being equal to 0.1 IPS.

CHECK ON LEARNING

1. Vibrations associated with components operating at a higher speed than the tail rotor and its components are _______.

2. The maximum amount of weight allowed per spindle when balancing the main rotor is _______.

3. One notch is equal to _______ track when adjusting the main rotor PC rod during the ground track operation.

4. The maximum weight allowed per quadrant of the tail rotor when performing the tail rotor balance operation is _______.

SECTION III. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the Characteristics of vibration analysis topic.
The key points to remember are:

- Designs have been made for dampening and counteracting vibrations such as driving secondary parts at different speeds, mounting high level vibration parts on shock absorbent mounts, and installing vibration absorbers in high level vibration areas of the airframe.
- The purpose and goals of vibration analysis are to avoid catastrophic failures, provide insight and assistance in troubleshooting vibration discrepancies, prevent unnecessary periodic disassembly for inspection, and plan for repairs/component replacement.
- Vibration analysis has four basic terms: A+B (vertical vibrations), A-B (lateral vibrations), 1 - 5/REV, 1 - 5P, and 1 - 5R (occurrence of vibration felt to the number of RPMs on the component being tested), and IPS (inches per second).
- There are three categories of vibrations: low, medium and high frequency.
- A low frequency vibration is normally related to the 1/REV of the main rotor and its associated components. The most probable cause of a low frequency vibration would be an out of balance main rotor.
- A medium frequency vibration is generally related to the 4/REV of the main and tail rotor (1032 - 4760 rpm), and all the frequencies in between. Sources of this frequency would include the tail drive shaft, pylon drive shaft, intermediate and tail rotor gear boxes, main module oil pump, oil cooler axial fan, and the 1/REV of the tail rotor.
- High frequency vibrations are associated with components operating at a higher speed than the tail rotor and its components (above 4110 rpm). The high frequency vibration is normally associated with the engine, engine high speed shaft, input modules, main module mounted accessory section modules (and components mounted to them), gear mesh frequencies with the main module, and the intermediate and tail gear boxes.
- The maximum amount of weight that may be added to a tail rotor quadrant is 227 grams, or 113.5 grams per bolt hole.
- When balancing the engine high speed shaft, the maximum number of balance washers that can be added to any one bolt is two.
- The maximum amount of weight allowed per vibration absorber is 15 lbs total when tuning the vibration absorbers.

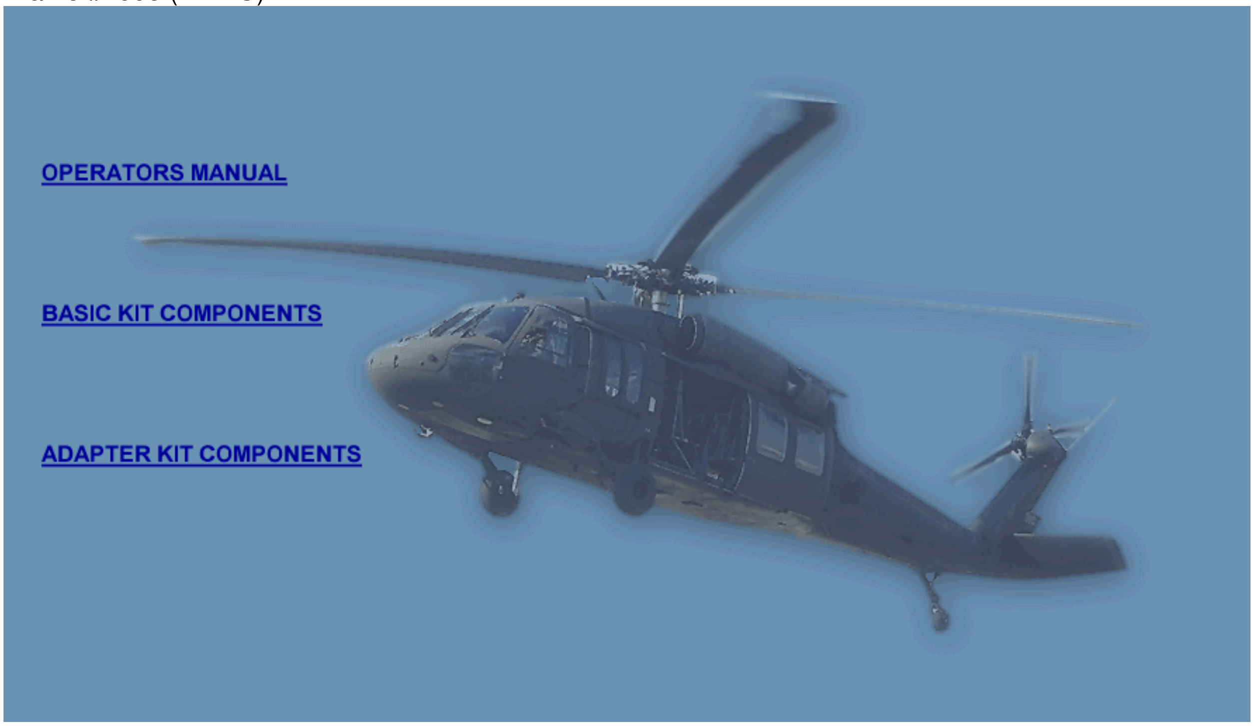
B. ENABLING LEARNING OBJECTIVE ELO No.2

ACTION: Identify the components of the Aviation Vibration Analysis kit

CONDITION: Using TM 1-6625-724-13&P

STANDARD: IAW TM 1-6625-724-13&P

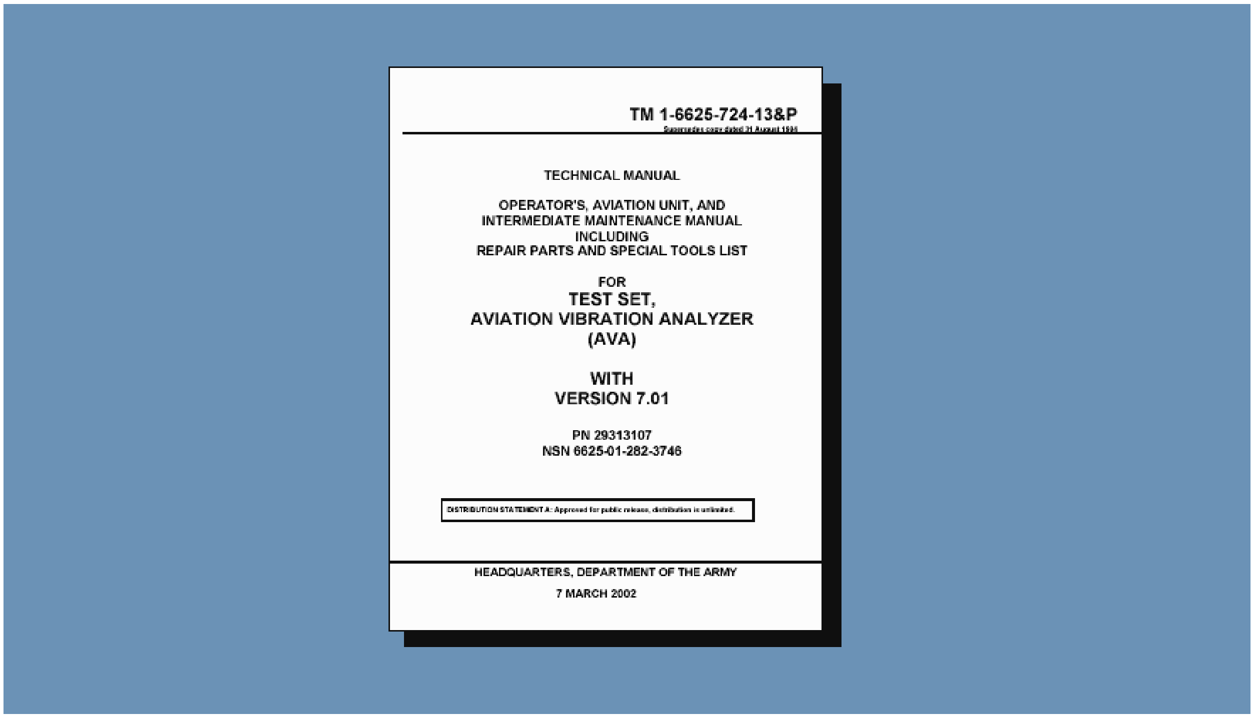
Frame #1005 (MENU)



a. To better understand what Aviation Vibration Analysis (AVA) is and what it can do for you as a maintenance test pilot, you need to have an understanding of the operators manual (TM 1-6625-724-13&P), basic kit components, and the adapter kit components for the UH-60.

(1) Operators Manual

Frame #1010 (Operators Manual)


TM 1-6625-724-13&P

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

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

HEADQUARTERS, DEPARTMENT OF THE ARMY

7 MARCH 2002

(a) The Operator's Manual for the AVA Test set is the TM 1-6625-724-13&P.

(b) This TM provides the necessary information required to perform the initial setup and installation of the AVA software, aircraft specific installation procedures for the basic and adapter kits, and operational procedures for diagnostic analysis of measured vibrations.

Frame #1010 (Operators Manual)

TABLE OF CONTENTS

(c) In this Technical Manual, the chapters we are most concerned with are chapters 1, 2, and 5.

1) Chapter 1 addresses general information, equipment description and the technical principles of operation for the AVA kit.

2) Chapter 2 covers the operating instructions, system setup, taking measurements, displays and system diagnostics.

3) In chapter 5, the specific installation and operations of the AVA kit for the EH/UH-60 are explained.

(2) Basic Kit Components

Frame #1015 (Basic Kit Components)

(a) 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.

(b) 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.

(c) The AVA is separated into three major components: the Control and Display Unit (CADU), Data Acquisition Unit (DAU), and the Universal Tracking Device (UTD) with additional components for installation and operation.

1) Control and Display Unit

Frame #1020 (Control and Display Unit)

a) The CADU is used to control data acquisition, display measurement and analysis results, print reports, and transfer data to or receive data from an off-line computer.

b) Equipped with a 2 megabyte memory, the CADU has power supplied by four sources.

c) A Nicad battery powers the CADU for approximately eight hours.

d) The battery charger supplies power to the CADU and charges the nicad battery.

e) Aircraft power, through the 10' DC power cable, provides a power source for the CADU while charging the NiCad battery.

f) The CADU contains a lithium battery for backing up memory.

g) The life of the lithium battery is approximately two years.

2) Data Acquisition Unit

Frame #1025 (Data Acquisition Unit)

a) The DAU processes tracker and vibration signals.

b) Internally the DAU, like the CADU, comes equipped with 2 megabytes of memory.

c) Additionally, the DAU contains three circuit boards, power, acquisition, and processing.

d) A recirculating fan contained inside the unit produces airflow for cooling of the circuit boards.

e) A self-calibrating program calibrates the DAU every 24 hours of operation.

f) Located on the face of the DAU are eleven electrical connectors; 4 accelerometer, 2 tachometer, multi-channel, tracker, CADU, strobe, and power (28 V dc).

g) Also located on the face of the DAU are a tracker mode knob, fuse, and power switch.

1 Functions for accelerometer 1 include main rotor track and balance (located behind the copilot seat), and high-speed shaft balancing for the No. 1 engine (located on the No. 1 input module).

2 Functions for accelerometer 2 include main rotor track and balance (located behind the pilot seat), and high-speed shaft balancing for the No. 2 engine (located on the No. 1 input module).

3 Functions for accelerometer 3 include nose vibration absorber tuning (located by the pilot left tail rotor pedal), and oil cooler balancing in the vertical plane (located on the oil cooler balancing bracket in the vertical position).

4 Functions for accelerometer 4 include balancing (located on the left side of the tail rotor), and oil cooler balancing in the horizontal plane (located on the oil cooler balancing bracket in the fore and aft position).

5 The function of tachometer 1 is main rotor balancing (located on the underside of the main rotor stationary swashplate).

6 The functions of tachometer 2 are tail rotor track (located on the right side of the tail rotor), and engine high speed shaft balancing (located on either engine high speed shaft forward support tube).

7 The tracker mode allows the operator to select either a day or night operation of the UTD, or conduct a test of the UTD, illuminating a light on the UTD, by selecting the desired mode of operation.

8 The multi-channel is used for the Army AH-64 and CH-47 only.

9 The CADU electrical connector provides the interface between the DAU and the CADU.

10 The function of tracker 1 is to receive data from the UTD (located on the avionics compartment door screen).

11 The strobe electrical connector provides the connecting point for an external strobe light for night operations.

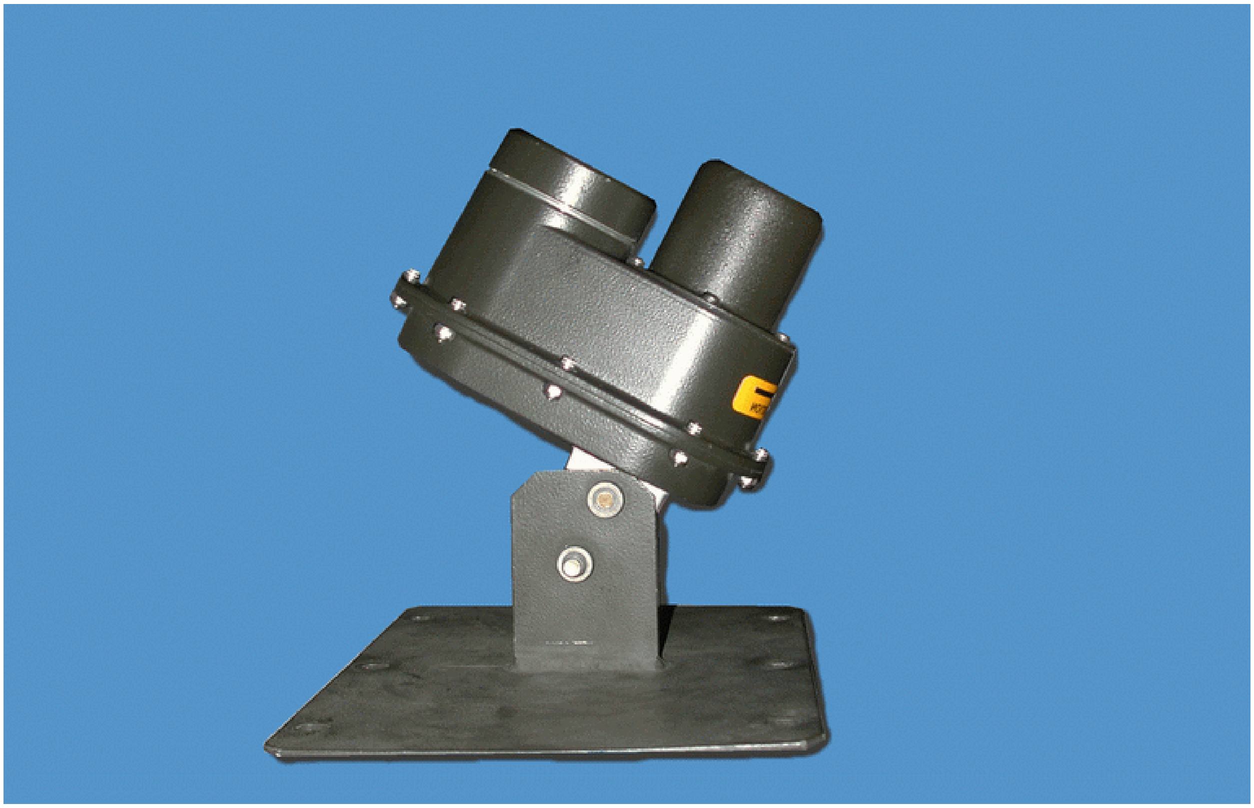
12 A power supply cable attaches to the 28 V dc electrical connector allowing 24 - 36 V dc at about 15 amps to be applied to the DAU from the 28 V dc power connector of the aircraft (located in the cabin ceiling).

13 A 15 amp fuse protects the DAU from power surges.

14 The ON/OFF switch places the DAU in an operation or nonoperation mode.

3) Universal Tracking Device

Frame #1030 (Universal Tracking Device)



a) The UTD tracks the main rotor target blade as it passes in front of the UTD by projecting a light source for blade rotation during night/active by receiving intensity changes to obtain blade height information during day/passive.

b) The UTD sends a signal to the DAU each time the target blade passes with information concerning the main rotor blade track for each individual blade.

c) Characteristics of the UTD include a DAY/NIGHT mode, tracking of the main rotor blades to 1 millimeter lead - lag to 1 millimeter. The UTD has an arrow pointing in direction of the main rotor blade rotation.

d) Possible problems experienced during use of the UTD, if the UTD is pointing into direct sunlight, erroneous readings may be experienced.

e) Should this occur, reposition the aircraft 15 degrees in either direction.

f) Additionally, main rotor blade paint erosion of more than 10% will cause a tracker failure error.

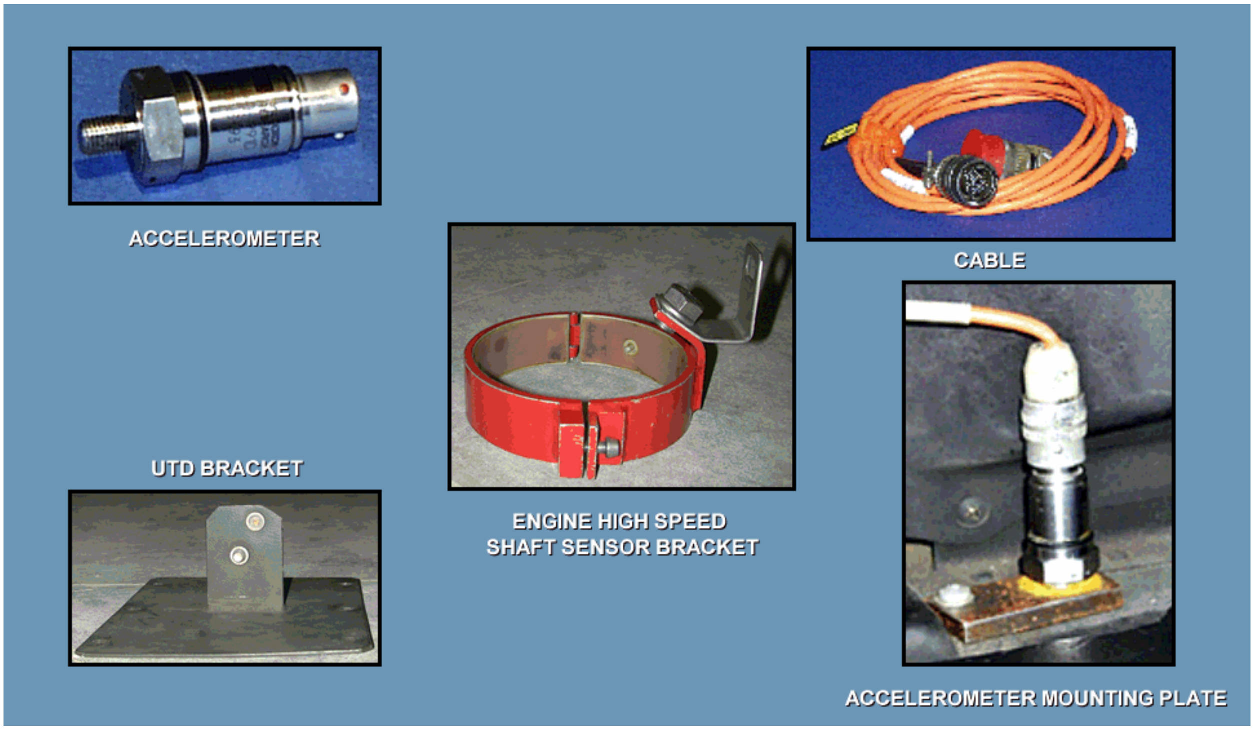
4) Basic Kit

Frame #1035 (Basic Kit)

a) The basic kit for the AVA also comes with cables for the CADU to DAU, DAU to UTD, power cable, optical sensor with a bracket, 150 feet of reflective tape, magnetic pick up and cable, two accelerometers with a 25 foot and a 50 foot cable, and a scale that is adjustable between grams and ounces.

(3) Adapter Kit Components

Frame #1040 (Adapter Kit Components)



(a) The adapter kits for the AVA are aircraft specific.

(b) The adapter kit for the EH/UH-60 contain a carrying case, accelerometer, angle bracket, engine high speed shaft sensor bracket, accelerometer mounting plate, hexagon cap screw, lock washer, cable and the UTD bracket.

CHECK ON LEARNING

1. In TM 1-6625-724-13&P, general information is found in chapter 1, operating instructions are found in chapter 2, and specific installation and operation for the EG/UH-60 is found in chapter _______.

2. Which of the following is correct when describing the UTD?

3. The CADU has power supplied by four sources: a Nicad battery, a battery charger, a lithium battery for backing up memory, and _______.

4. A self calibrating program calibrates the DAU every _______ of operation.

5. The adapter kits for the AVA _______.

SECTION IV. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the Characteristics of vibration analysis
The key points to remember are:

- The Operators manual for the AVA test set is the TM 1-6625-724-13&P.
- The chapters addressed in this lesson are chapter 1 (general information), chapter 2 (operating instructions, system setup, taking measurements, displays, and system diagnostics), and chapter 5 (installation and operation of the AVA test set for the EH/UH-60).
- The AVA test set is designed to measure, record, and process vibration and blade position information in order to diagnose and correct rotor and vibration related faults.
- The three major components: the Control and Display Unit (CADU), Data acquisition Unit (DAU), and the Universal Tracking Device (UTD).
- The UTD tracks the main rotor target blade as it passes in front of the UTD, sending a signal to the DAU each time the target blade passes with information concerning the main rotor blade track for each individual blade.
- Equipped with a 2 megabyte memory, the CADU has power supplied by four sources: a nicad batter, battery charger, aircraft power, and a lithium battery.
- The DAU is equipped with a 2 megabyte memory and three circuit boards for power, acquisition, and processing.
- The DAU has a self calibrating program that calibrates the DAU every 24 hours of operation.

C. ENABLING LEARNING OBJECTIVE ELO No.3

ACTION: Identify the procedures for the Aviation Vibration Analysis Kit installation.

CONDITION: Using TM 1-6625-724-13&P

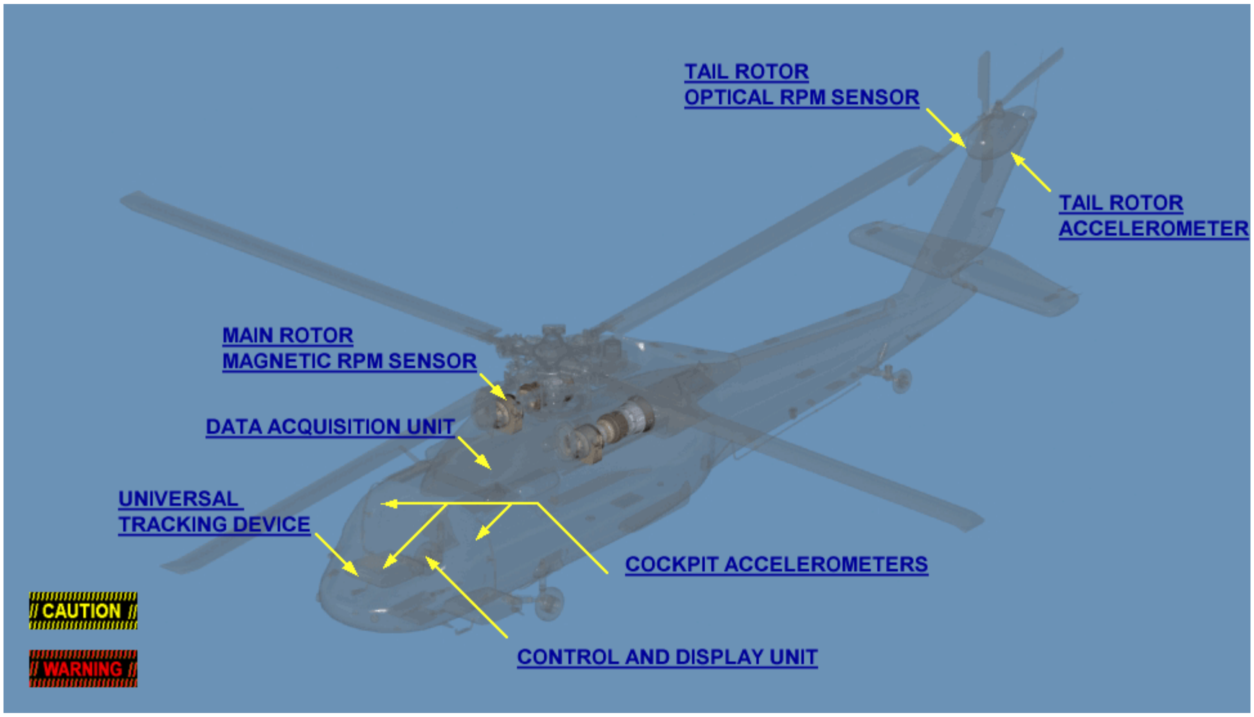
STANDARD: IAW TM 1-6625-724-13&P

Frame #1505 (MENU)

a. To better understand how the Aviation Vibration Analysis (AVA) kit and its related components can be used as a maintenance test pilot, you need to have an understanding of the installation locations and procedures for the basic kit components and the adapter kit components for the UH-60.

(1) Main Rotor and Tail Rotor

Frame #1510 (Main Rotor and Tail Rotor)



WARNING: Use extreme care when flying with UTD mounted. UTD interferes with wire strike cutter capabilities.

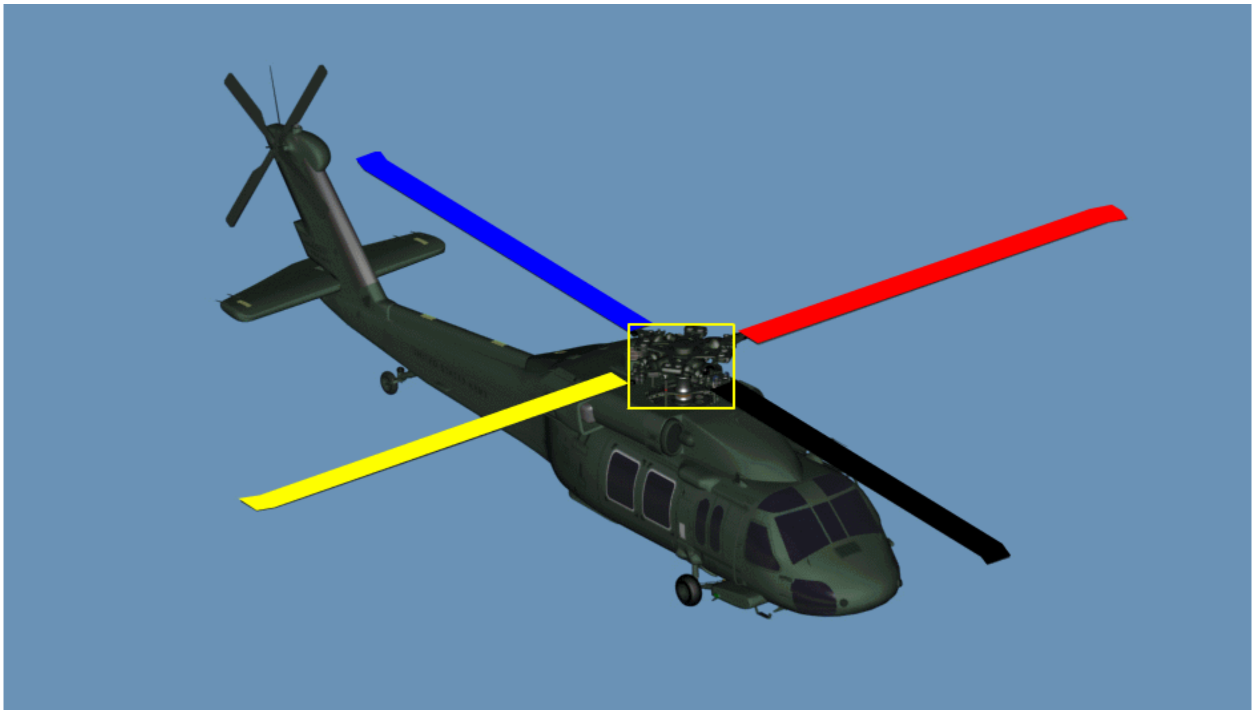
CAUTION: Never install cables where they can be damaged. Use wire bundle ties or clamps to route cabling along or through airframe instead of securing cables with fairing doors, panels or seat frames. Never bundle tie cables to flight controls.

(a) For main rotor and tail rotor track and balancing, proper installation of the AVA kit is critical.

(b) Installing the AVA kit incorrectly will create false readings resulting in incorrect adjustments.

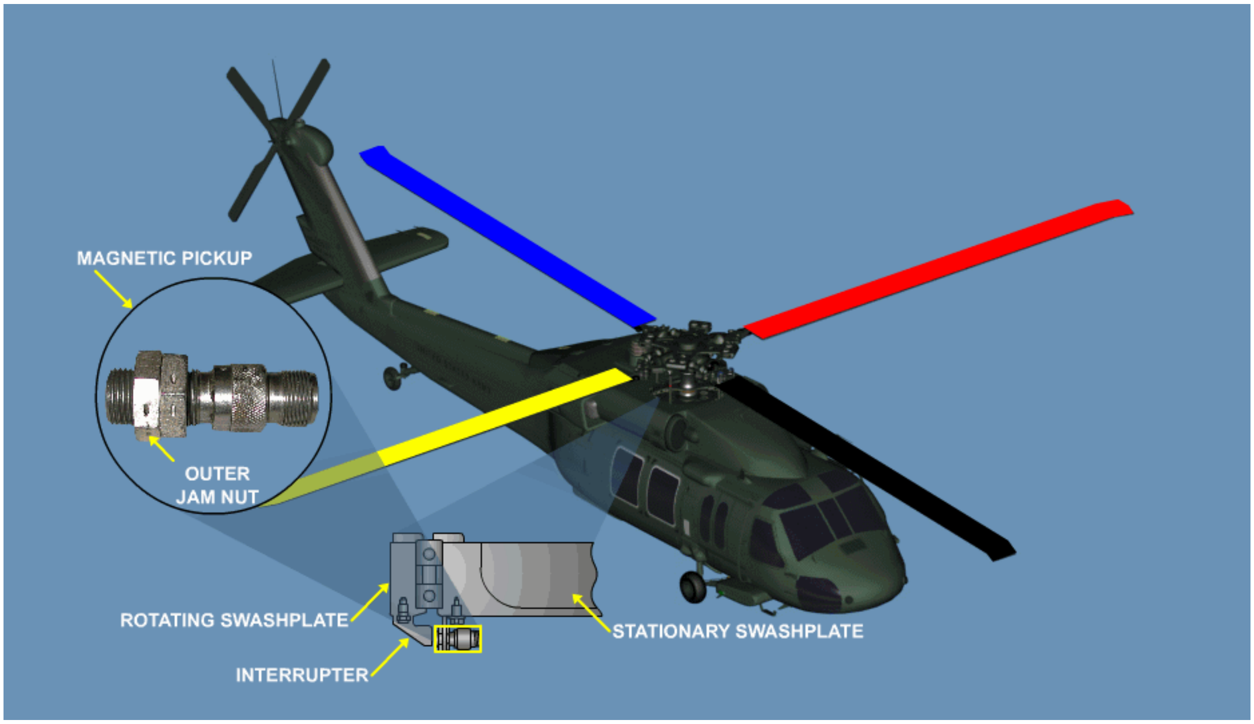
1) Main Rotor Magnetic Pickup

Frame #1515 (Main Rotor Magnetic Pickup FLASH)



a) For installation of the Magnetic RPM sensor, position the main rotor blades with the black (target) blade over the nose of the aircraft.

Frame #1515 (Main Rotor Magnetic Pickup)



1 Remove the outer jam nut from the magnetic RPM sensor, install it into the bracket on the stationary swashplate.

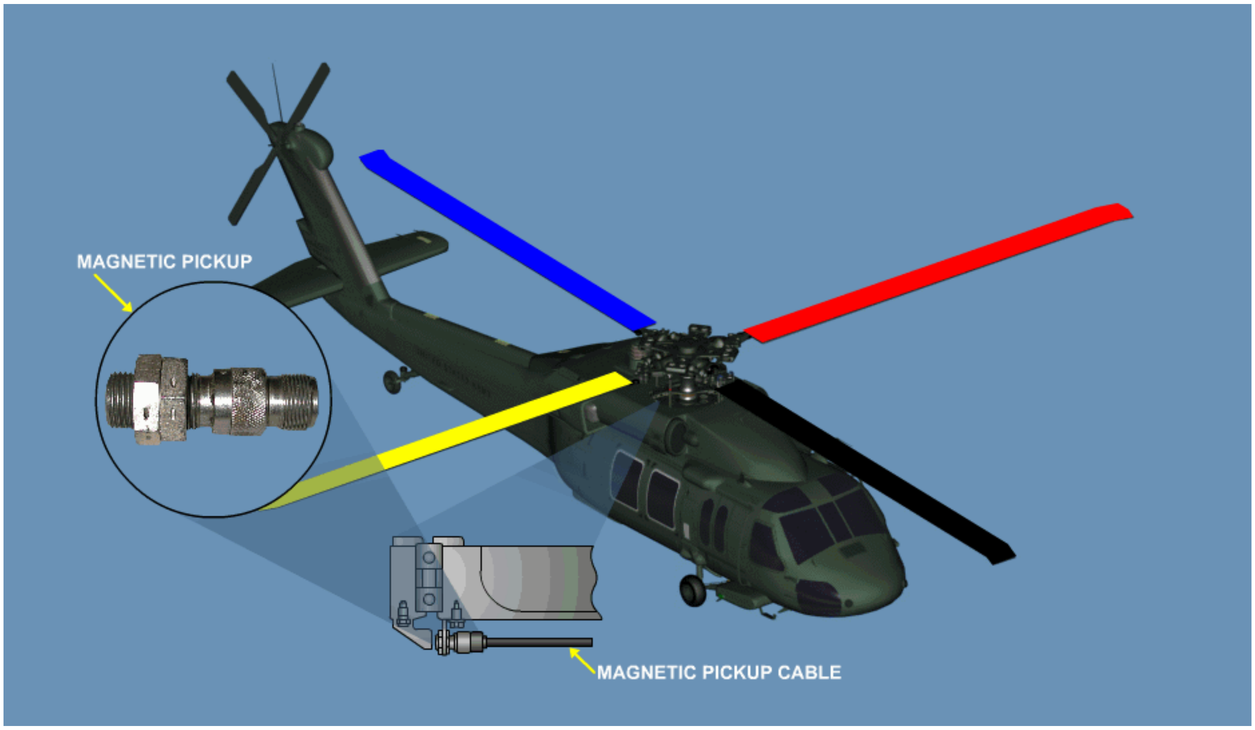
2 Reinstall the outer jam nut, but do not tighten it.

3 Check the clearance between the magnetic RPM sensor and the interrupter mounted to the rotating swashplate.

4 Adjust the clearance between the magnetic RPM sensor and the interrupter to 0.22 - 0.24 inch.

5 Tighten the outer jam nut on the magnetic pickup until a sharp rise in torque is felt, then tighten 1/6 - 1/3 turn more.

Frame #1515 (Main Rotor Magnetic Pickup)



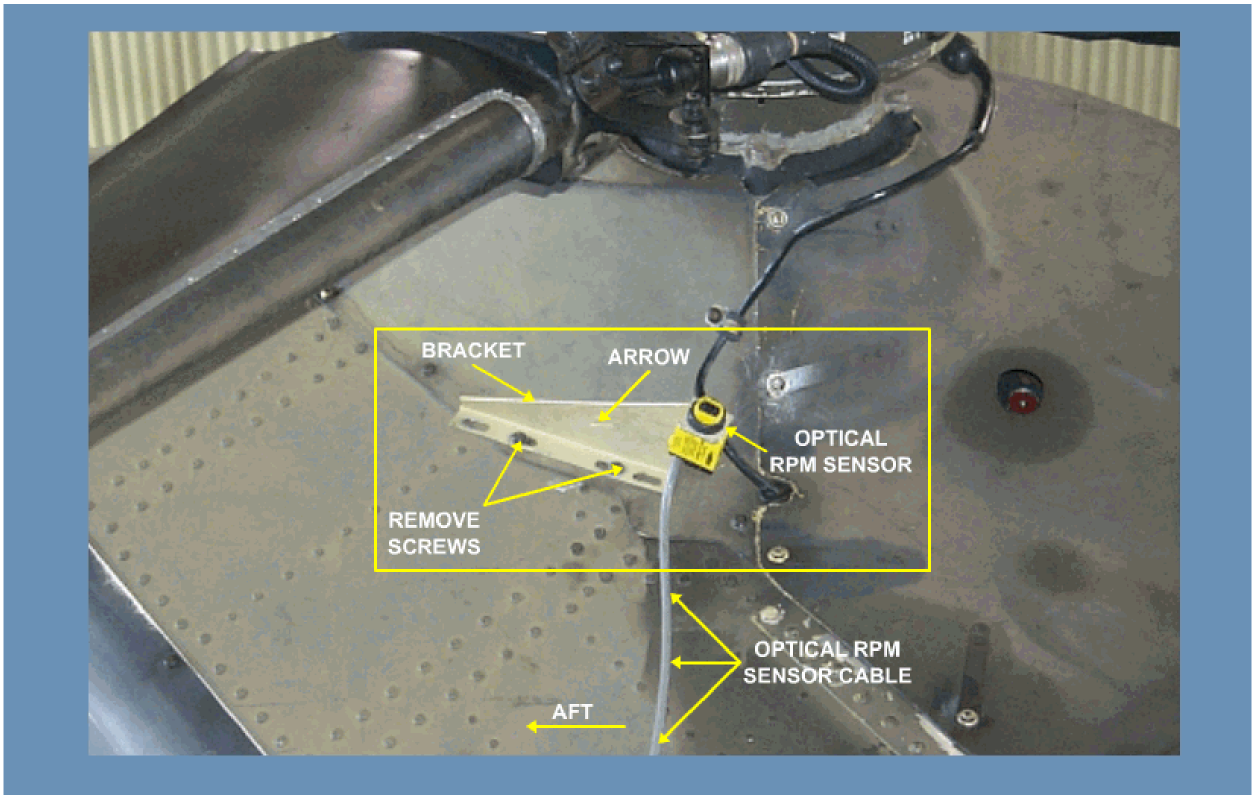
6 Connect the magnetic RPM sensor cable to the magnetic RPM sensor, routing the cable down and along the main transmission, through the drip pan and into the cabin.

2) Tail Rotor Optical RPM Sensor

Frame #1535 (Tail Rotor Optical RPM Sensor FLASH)

a) The tail rotor optical RPM sensor and bracket are installed under the right hand side of the aft tail rotor gear box fairing.

Frame #1535 (Tail Rotor Optical RPM Sensor FLASH)



1 To install the optical RPM sensor and bracket, remove the third and fourth screws from the right side of the aft tail gearbox fairing.

2 Remove the outer jam nut on the optical RPM sensor and install the optical RPM sensor on the tail rotor bracket.

3 The body of the optical RPM sensor should be resting against the bracket.

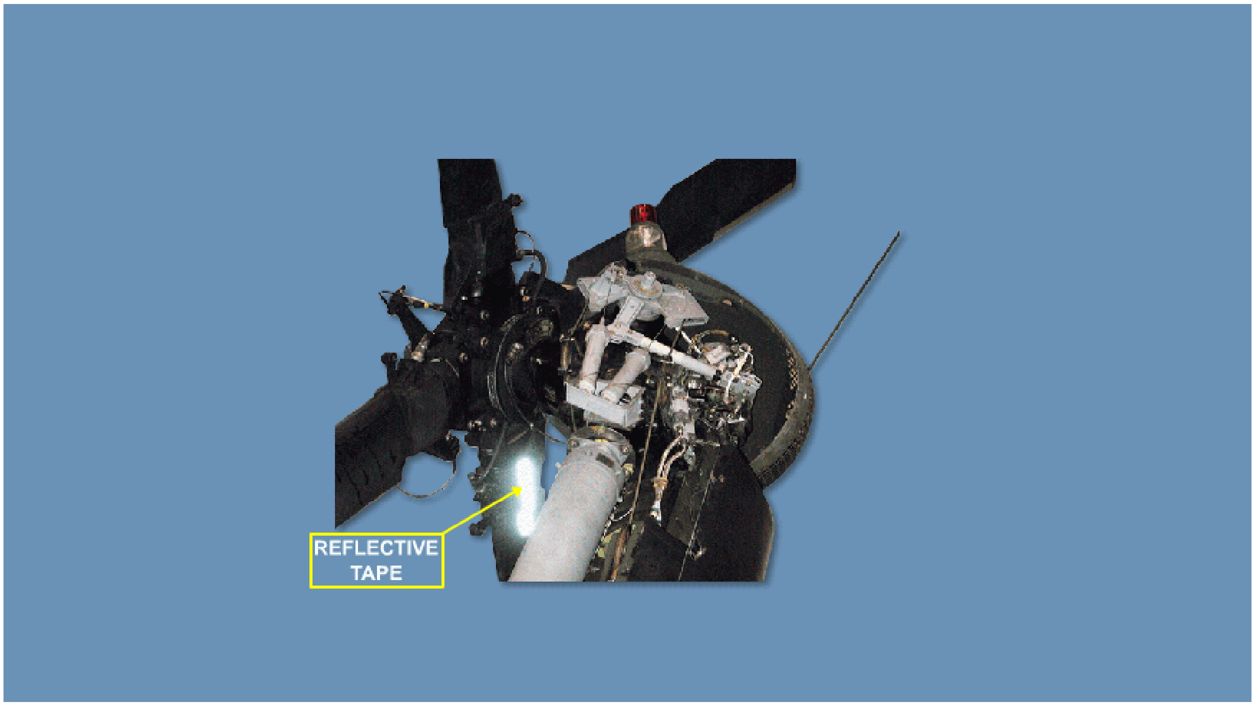
4 Reinstall the outer jam nut, but, do not tighten.

5 Mount the bracket on the tail pylon using the panel screws.

6 The optical RPM sensor and bracket will be slightly upside down with the arrow on the bracket pointing aft and up when installed correctly.

7 Hand-tighten jam nut on optical RPM sensor.

Frame #1535 (Tail Rotor Optical RPM Sensor FLASH)



8 Place a 4-inch strip of reflective tape on the inside of the target tail rotor blade, at the same approximate location as the beam of the optical sensor.

9 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.

Frame #1535 (Tail Rotor Optical RPM Sensor FLASH)

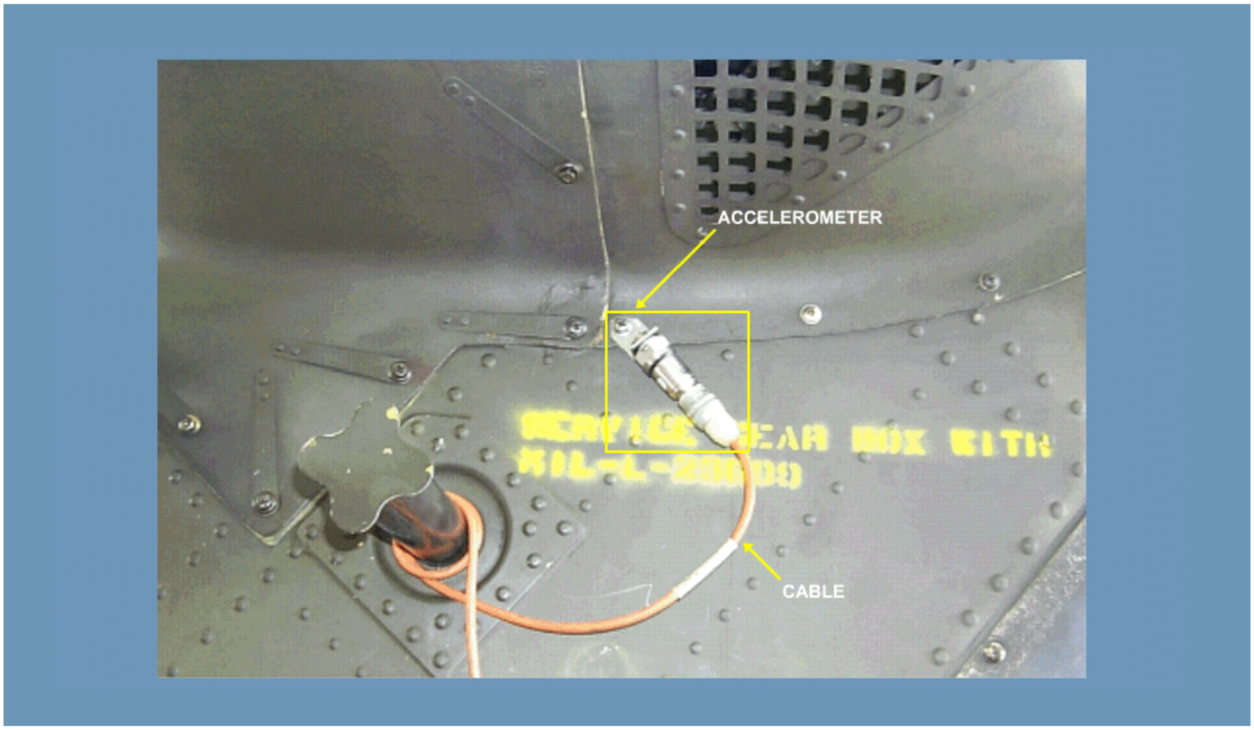
10 Route the optical RPM sensor cable along the tail rotor pylon.

3) Tail Rotor Accelerometer

Frame #1530 (Tail Rotor Accelerometer FLASH)

a) The accelerometer, bracket and cable are mounted on the left hand side of the aft tail rotor gear box fairing.

Frame #1530 (Tail Rotor Accelerometer FLASH)



1 When installing the accelerometer, bracket, and cable for balancing of the tail rotor, remove the screw from the left side of the pylon at the bottom of the tail gearbox aft fairing.

2 Mount the accelerometer bracket on the tail pylon with the screw 90 degrees to leading edge of the pylon. Install the accelerometer on the accelerometer bracket.

3 Ensure the connector of the accelerometer is facing down and to the rear, connect the cable to the accelerometer.

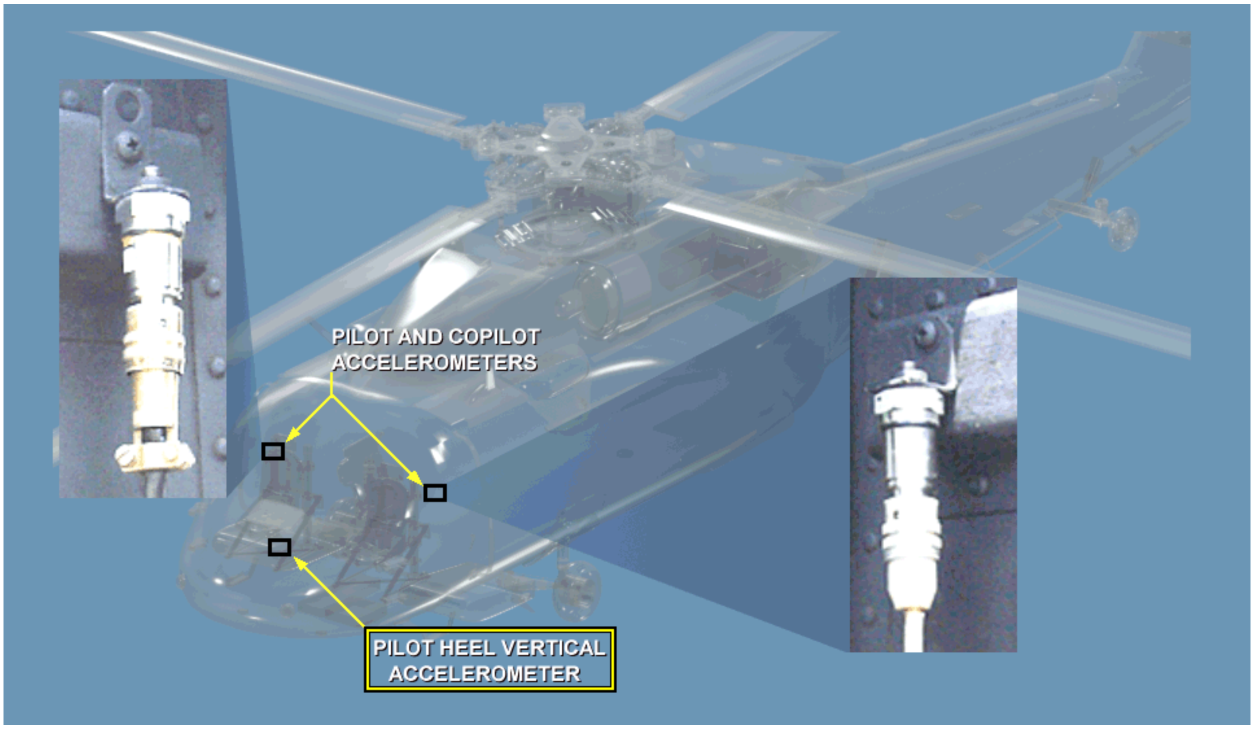
Frame #1530 (Tail Rotor Accelerometer FLASH)

4 Route the cable down the left side of the pylon.

5 Secure the cable to the extended steps on the pylon and continue routing the cable through the tie-down ring located on the right side of the tail cone.

4) Cockpit Accelerometers

Frame #1525 (Cockpit Accelerometers)



a) When installing the pilot and copilot accelerometers, mount the pilot and copilot accelerometer brackets to the bulkhead behind pilot and copilot seats.

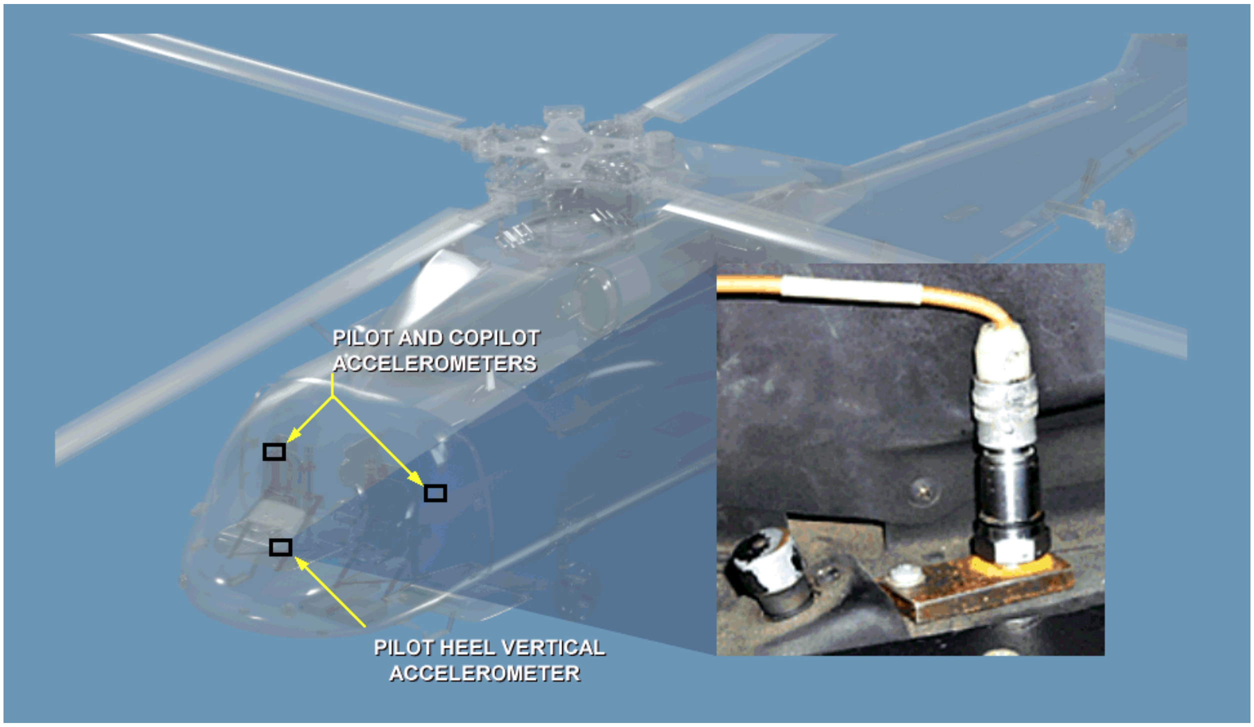
b) Install accelerometers on accelerometer mounting brackets, with accelerometer facing down.

c) Arrange armor plating adjustment cable so that it does not interfere with the accelerometer during vibration testing.

d) 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.

e) These accelerometers will be used for main rotor track and balancing

Frame #1525 (Cockpit Accelerometers)



f) To install the PHV accelerometer mounting plate, remove one screw from the pilot's right ICS switch at station 205, butt line 20, and install the PHV accelerometer mounting plate with the original screw or an equivalent 1-inch long, 10/32 screw.

g) Install washers between the accelerometer and PHV mounting plate, and install the accelerometer.

h) Use enough washers to prevent the accelerometer from extending beyond the mounting plate into floor.

i) Connect the accelerometer cable from the accelerometer PHV to the DAU receptacle marked ACC3.

5) Control and Display Unit

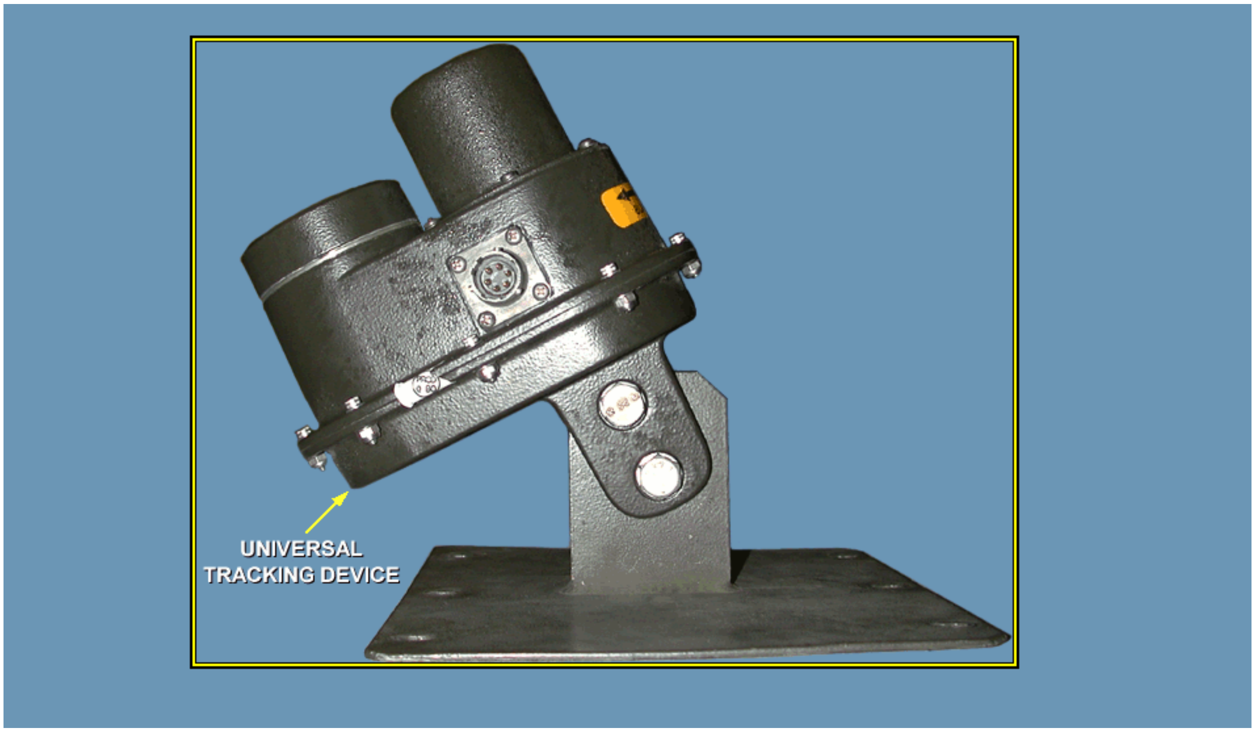
Frame #1540 (Control and Display Unit)

a) The CADU should be placed in an easily accessible location, but not in a position where it will interfere with operation of the aircraft.

b) Connect the CADU to DAU cable to the electrical connector and route the cable through the cabin of the aircraft to the DAU.

6) Universal Tracking Device

Frame #1520 (Universal Tracking Device)



a) When installing the Universal Tracking Device, ensure the red lens is down and the arrow points in the direction of the blade rotation.

Frame #1520 (Universal Tracking Device)

b) Remove the forward nose avionics bay access door vent screen and route the UTD cable through the vent ducting leaving one foot of cable outside the aircraft.

Frame #1520 (Universal Tracking Device)

c) Connect the electrical connector of the cable to the receptacle on the UTD.

d) Route the remaining cable through the avionics bay, along the left side of the cockpit center console, making sure the cable is secure and does not interfere with the flight controls.

7) Data Acquisition Unit

Frame #1545 (Data Acquisition Unit)

a) The DAU cable installation for the UH-60 begins with the 28 Vdc power cable.

b) The 28 Vdc power cable connects to the connector labeled 28 Vdc.

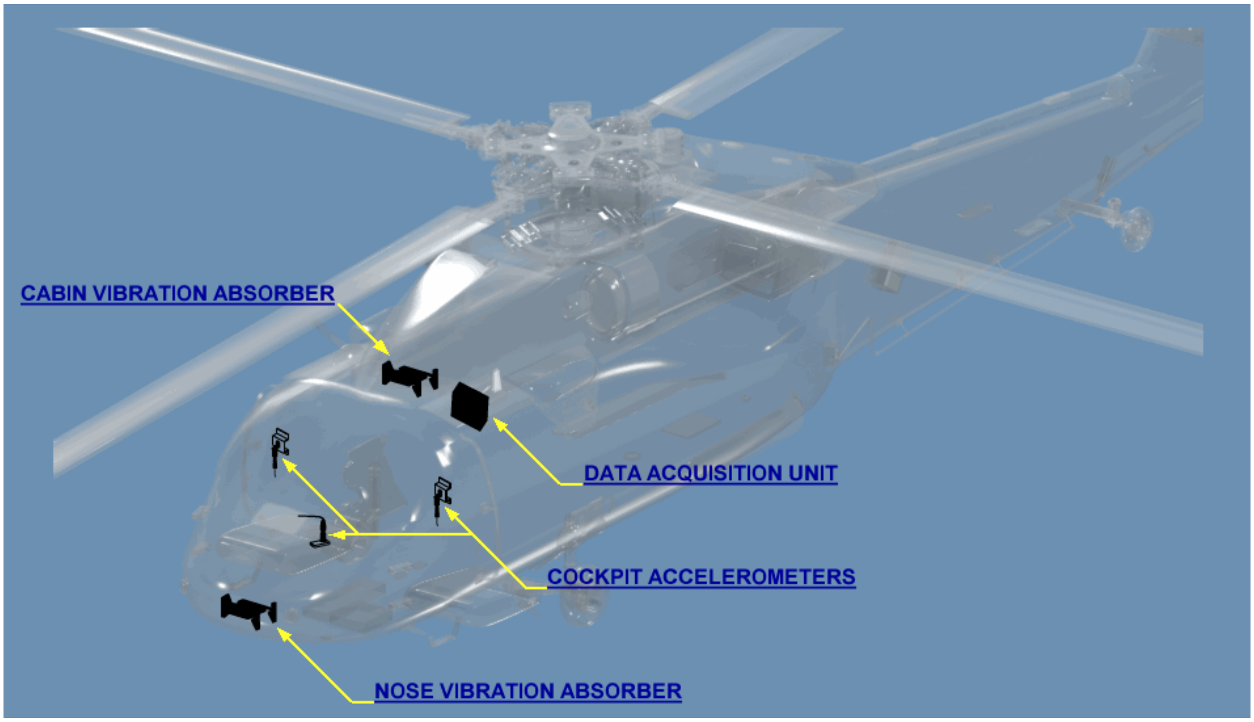
c) The magnetic pickup cable connects to the connector labeled TACHO 1. Connected to TRACKER 1 is the UTD cable.

d) ACC 1 is the connecter for the left side accelerometer from the cockpit while ACC 2 is the connecter for the right side accelerometer.

e) The tail rotor accelerometer cable connects to the connecter labeled ACC 4 and TACHO 2 is the connecter for the tail rotor RPM sensor.

(2) Vibration Absorber Tuning

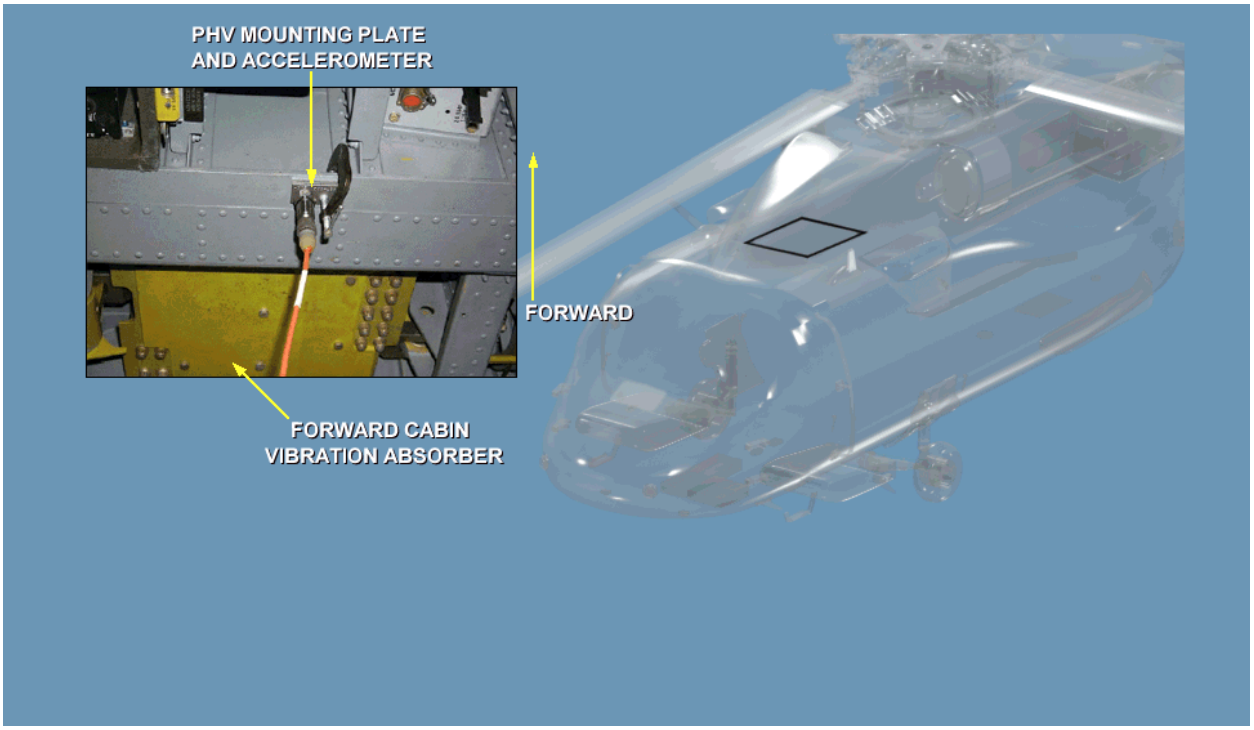
Frame #1550 (Vibration Absorber Tuning)



(a) The UH-60 has two vibration absorbers, nose and cabin, that may require adjustment (tuning) when conducting main rotor balancing.

1) Cabin Vibration Absorber

Frame #1565 (Cabin Vibration Absorber)



a) Installing the equipment to tune the cabin vibration absorber, lower the cabin soundproofing.

b) Attach the accelerometer to the Pilot Heel Vertical (PHV) accelerometer mounting plate and add washers as necessary between the accelerometer and mounting plate to prevent the accelerometer stud from extending beyond the plate.

c) Clamp the plate horizontally to the overhead frame at station 308, butt line 0, just forward of the absorber location using a C-Clamp.

d) Connect the accelerometer cable to the accelerometer and to DAU receptacle marked ACC 4.

2) Data Acquisition Unit

Frame #1567 (Data Acquisition Unit)

a) The DAU cable installation for the UH-60 begins with the 28 V dc power cable.

b) The 28 V dc power cable connects to the connector labeled 28 V dc.

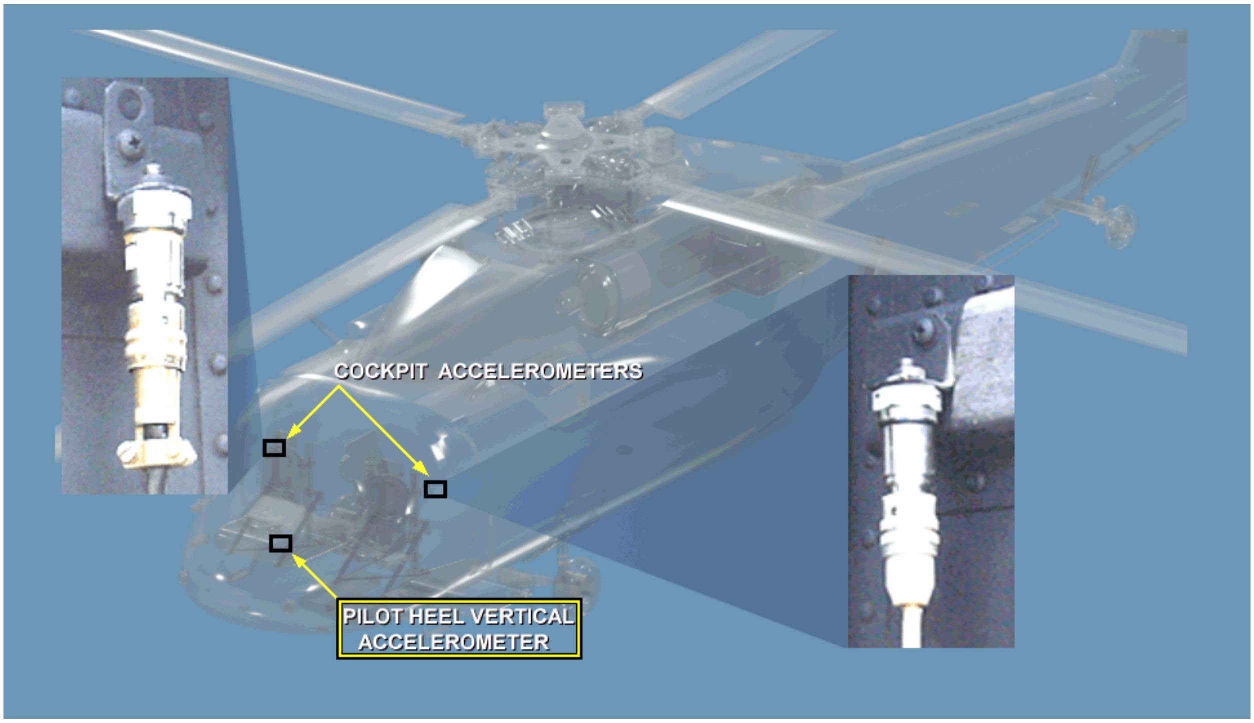
c) ACC 1 is the connecter for the left side accelerometer from the cockpit while ACC 2 is the connecter for the right side accelerometer.

d) The pilot heel accelerometer cable is connected to the ACC 3 connector.

e) The cabin vibrating absorber accelerometer cable connects to the connecter labeled ACC 4 and CADU cable is the connected to the CADU connector.

3) Cockpit Accelerometers

Frame #1560 (Cockpit Accelerometers)



a) When installing the cockpit accelerometers for vibration absorber tuning, mount the accelerometer brackets to the bulkhead behind pilot and copilot seats.

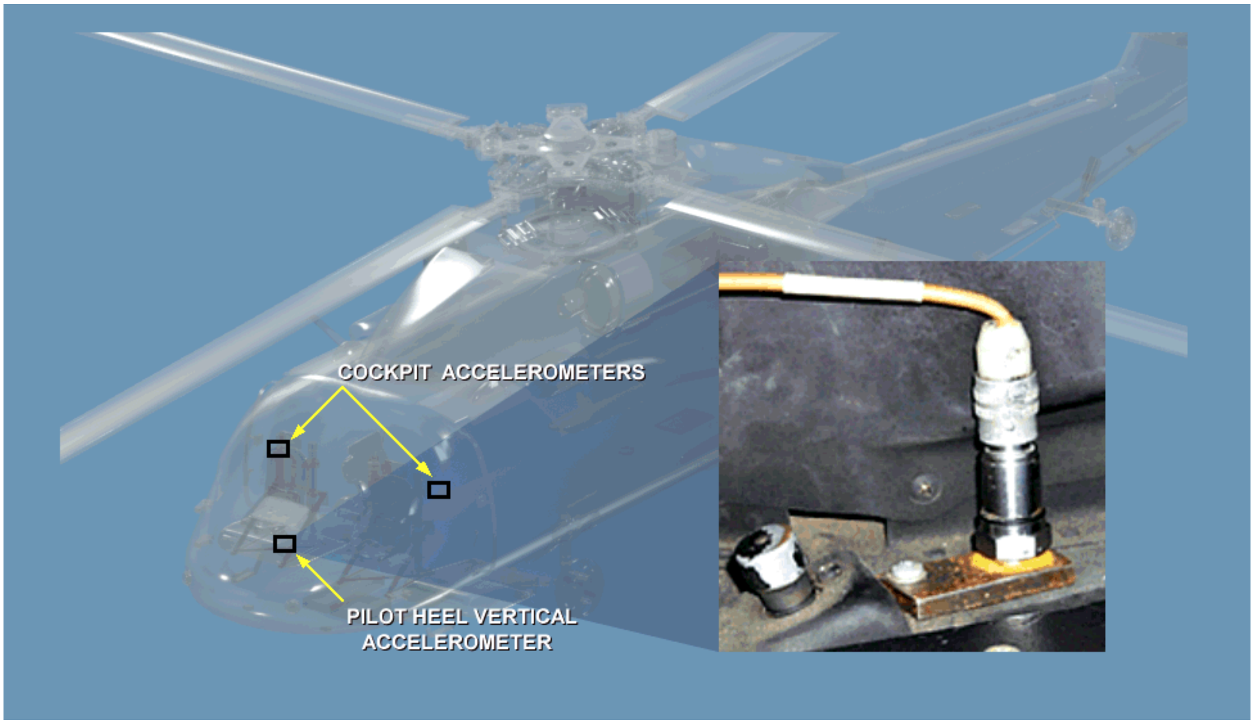
b) Install accelerometers on accelerometer mounting brackets, with accelerometer facing down.

c) Arrange armor plating adjustment cable so that it does not interfere with the accelerometer during vibration testing.

d) 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.

e) These accelerometers will be used for tuning both the nose and cabin vibration absorbers.

Frame #1560 (Cockpit Accelerometers)



f) To install the PHV accelerometer mounting plate and accelerometer for nose vibration absorber tuning, remove one screw from the pilot's right ICS switch at station 205, butt line 20, and install the PHV accelerometer mounting plate with the original screw or an equivalent 1-inch long, 10/32 screw.

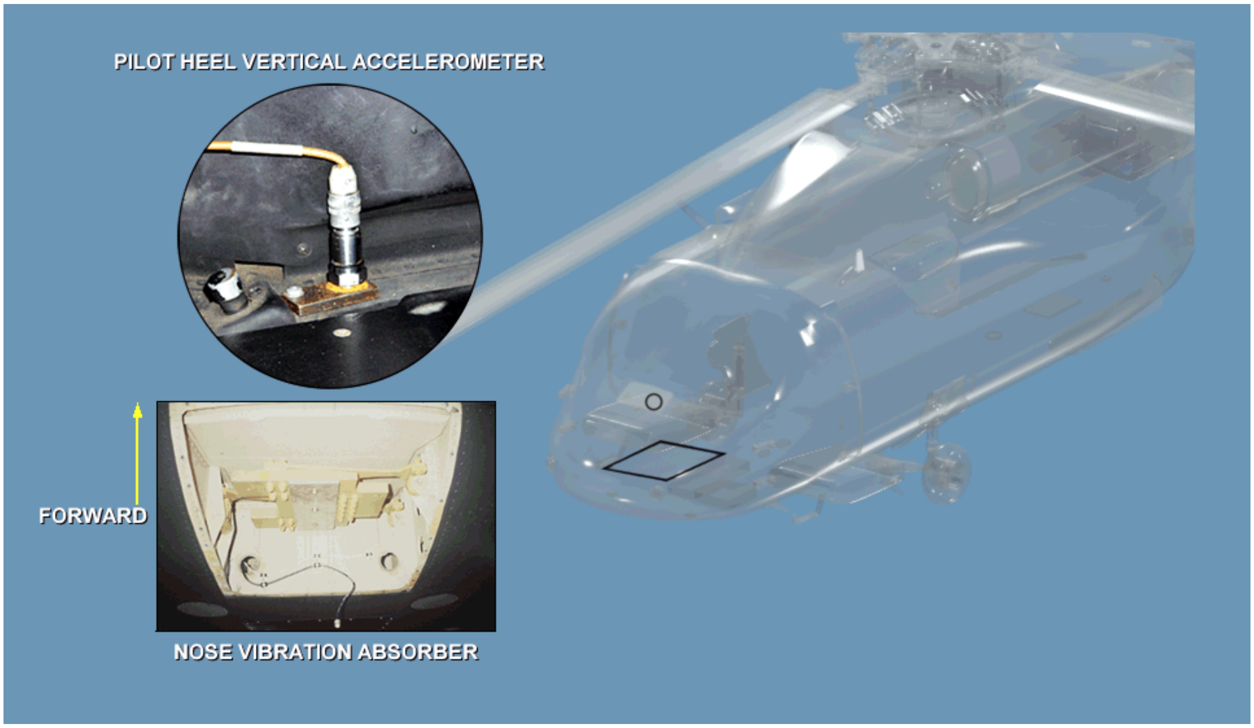
g) Install washers between the accelerometer and PHV mounting plate, and install the accelerometer.

h) Use enough washers to prevent the accelerometer from extending beyond the mounting plate into floor.

i) Connect the accelerometer cable from the accelerometer PHV to the DAU receptacle marked ACC3.

4) Nose Vibration Absorber

Frame #1555 (Nose Vibration Absorber)



a) The installation process for tuning of the nose vibration absorber begins with the removal of one screw from the pilots right Internal Communication System (ICS) switch.

b) Install the Pilot Heel Vertical (PHV) accelerometer mounting plate the original screw or an equivalent 1-inch long, 10/32 screw.

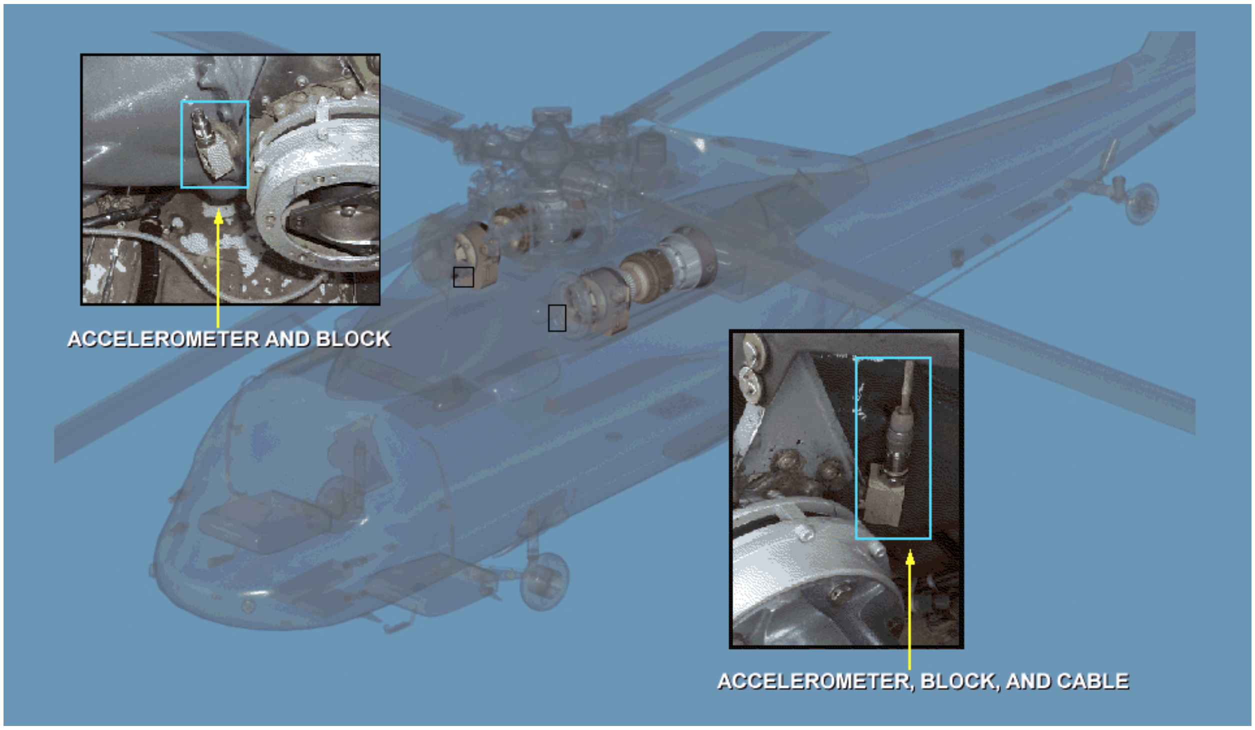
c) Install washers between the accelerometer and mounting plate and install the accelerometer.

d) Use enough washers to prevent the accelerometer from extending beyond the plate into the floor.

e) Connect the accelerometer cable from the accelerometer PHV to the DAU receptacle marked ACC 3.

(3) Engine High Speed Shaft

Frame #1570 (Engine High Speed Shaft)



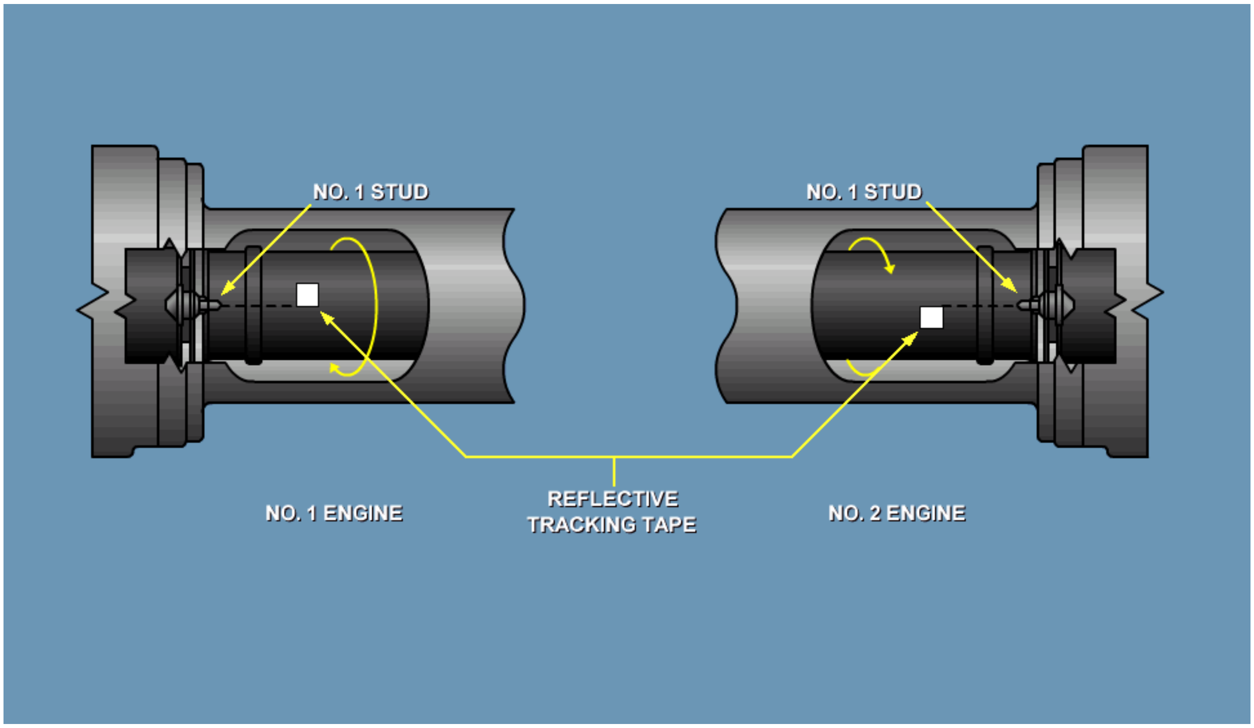
(a) For each engine high speed shaft being balanced, install an accelerometer on the accelerometer block on the input module of the engine high speed shaft being balanced.

(b) Mount the accelerometer vertically to the input module with the accelerometer connector end facing up.

(c) The engine air inlet does not need to be removed to install the accelerometer.

(d) Connect the accelerometer cables to the accelerometers and route the cables over the top of input module, under the engine cowling, under the forward edge of the engine air inlet (if installed), through the tie down ring, and in the window.

Frame #1575 (Engine High Speed Shaft)



(e) Check the engine high speed shaft for the reflective tracking tape.

(f) If it is installed incorrectly or not at all, install one piece of reflective tape, 1 inch by 1 inch square, on the engine output shaft.

(g) For the No. 1 engine, the bottom edge of the reflective tape is installed centered with the stud labeled No. 1.

(h) For the No. 2 engine, the top edge of the reflective tape is installed centered with the stud labeled No. 1.

(i) Rub the tape with a clean, wooden spatula, item 386, Appendix D of the TM 1-1520-237-23 series.

(j) Do not use your fingers when installing the reflective tape.

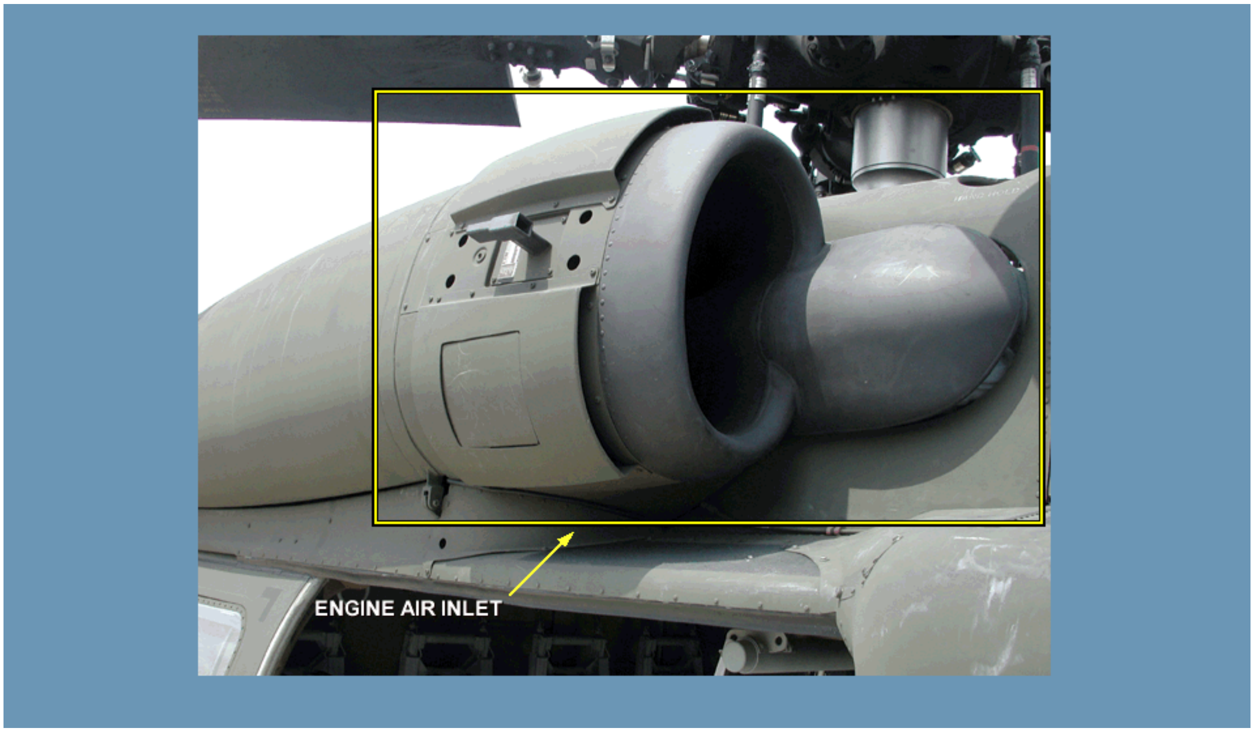
(k) Reflective tape is installed in a different location on each engine output shaft.

(l) Measurement failure during engine output shaft balancing can result if reflective tape is dirty.

(m) Do not use fingers to rub reflective tape.

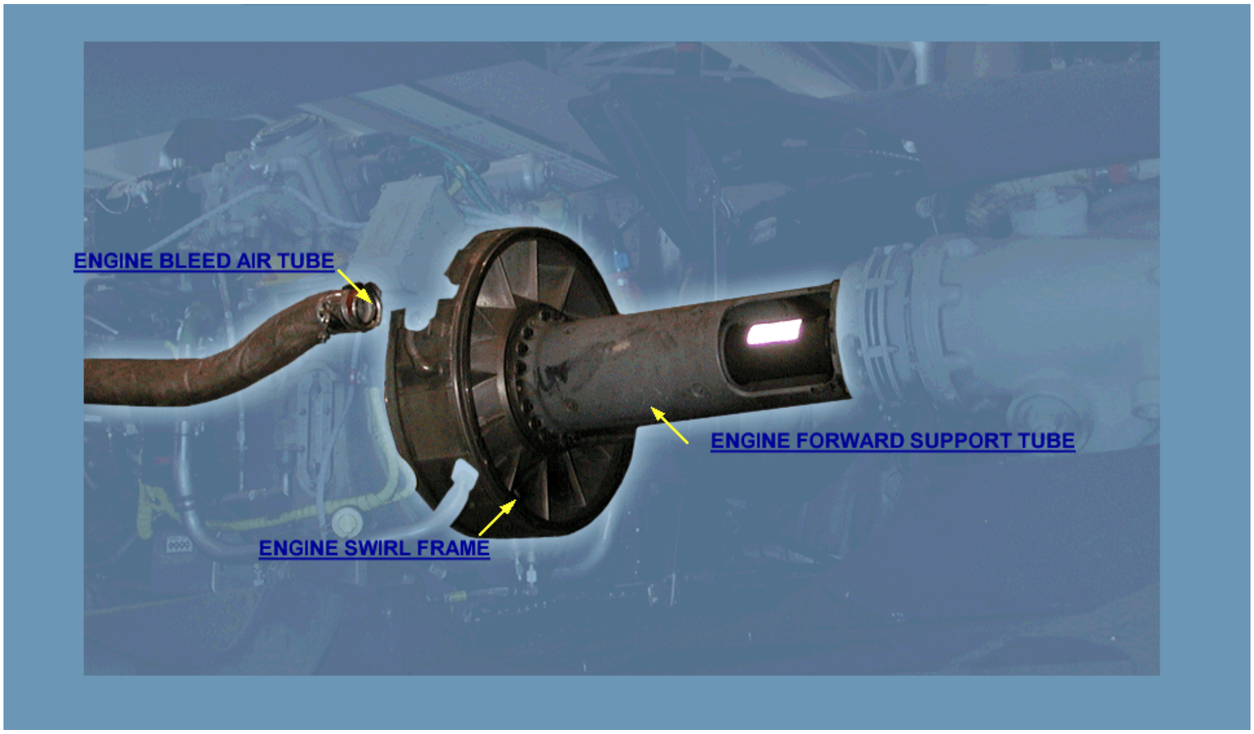
(n) Keep the reflective tape clean.

Frame #1580 (Engine High Speed Shaft)



(o) Before installing the rest of the engine high speed shaft AVA kit components, the engine air inlet must be removed.

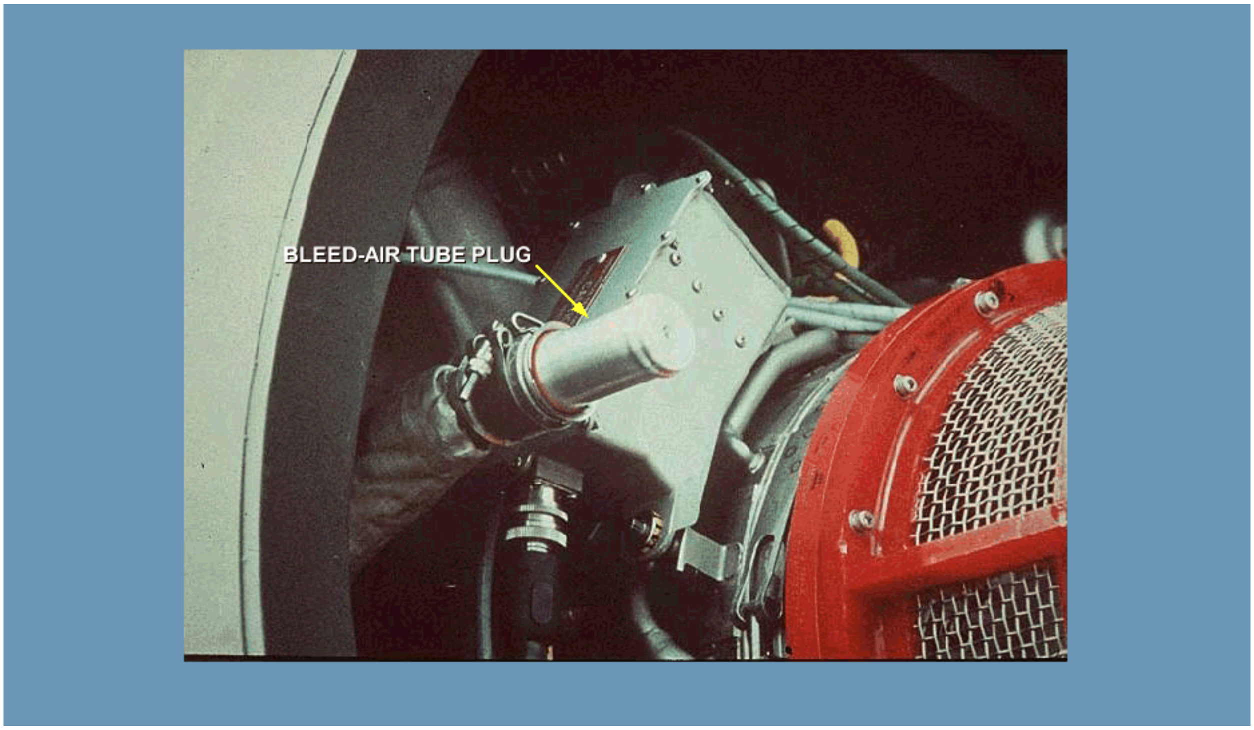
Frame #1585 (Engine High Speed Shaft)



(p) Once the engine air inlet has been removed, the plug (engine bleed air tube), swirl cage (engine swirl frame), and optical rpm sensor and bracket (engine forward support tube) can be installed.

1) Engine Bleed Air Tube

Frame #1590 (Engine Bleed Air Tube)

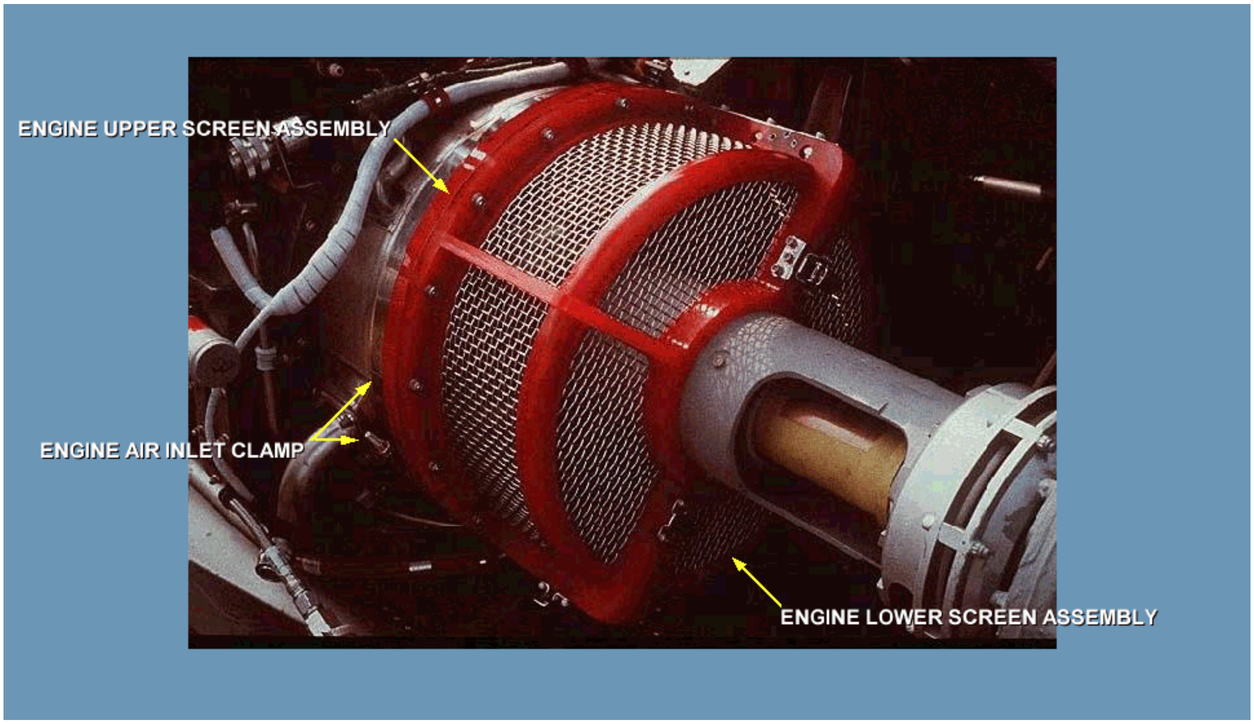


a) Plug the engine bleed-air tube with the bleed-air tube plug.

b) Install the plug using the existing coupling and sleeve from the engine bleed air tube.

2) Engine Swirl Frame

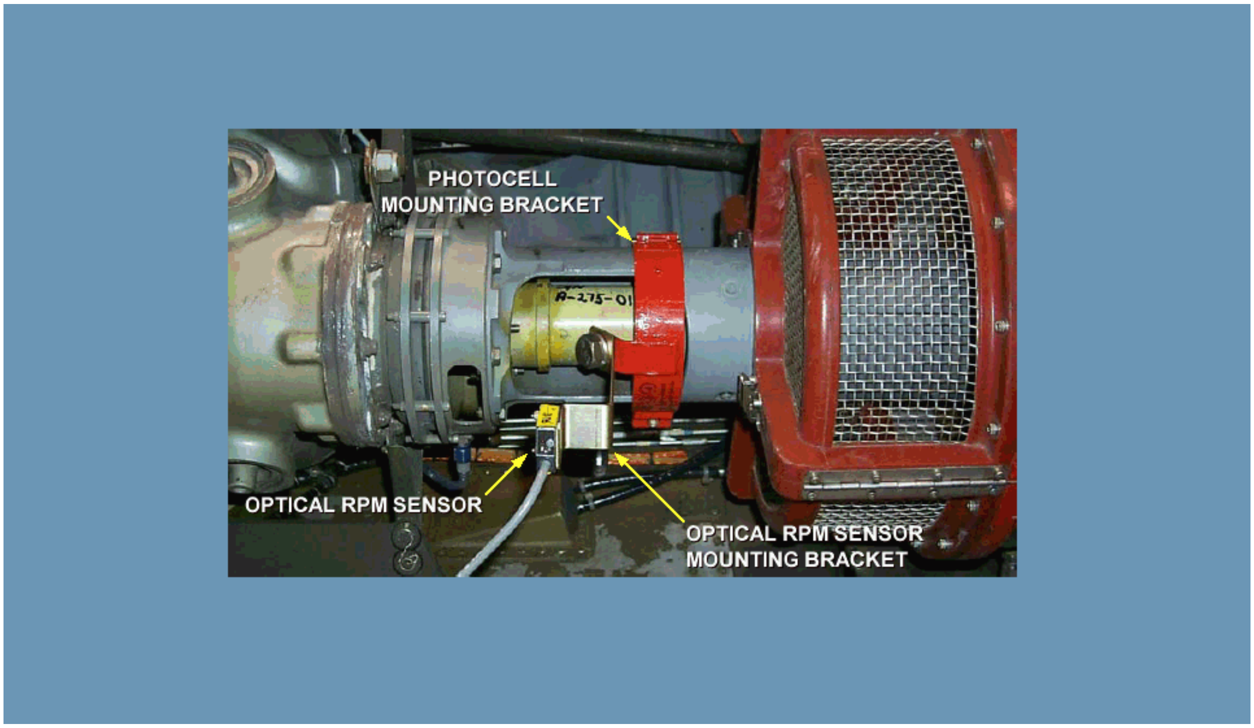
Frame #1595 (Engine Swirl Frame)



a) Install the engine upper screen assembly and lower screen assembly using the clamp from the engine air inlet.

3) Engine Forward Support Tube

Frame #1600 (Engine Forward Support Tube)



a) Install the optical RPM sensor into the optical RPM sensor mounting bracket.

b) Lock wire the sensor to the mounting bracket.

c) Install the photocell-mounting fixture over the forward support tube.

d) Locate the dowel pins of the mounting bracket in the support tube cutout and slide the bracket to the aft end of shaft support tube cutout.

e) Make sure the photocell bracket ear is pointing forward.

f) Attach the high speed shaft optical RPM sensor mounting bracket to the photocell mounting fixture using one bolt.

g) Torque the bracket to bracket mounting bolt.

h) Adjust the position of the photocell mounting bracket until the optical RPM sensor is centered on the reflective tape. Make sure the optical RPM sensor is still centered on the tape after tightening the bracket.

i) Route the 20 foot long cable through the tiedown ring and in the gunner's/crew chief's window.

j) Secure the cables with tiedown straps.

4) Data Acquisition Unit

Frame #1587 (Data Acquisition Unit)

a) The DAU cable installation for the UH-60 begins with the 28 V dc power cable.

b) The 28 V dc power cable connects to the connector labeled 28 V dc.

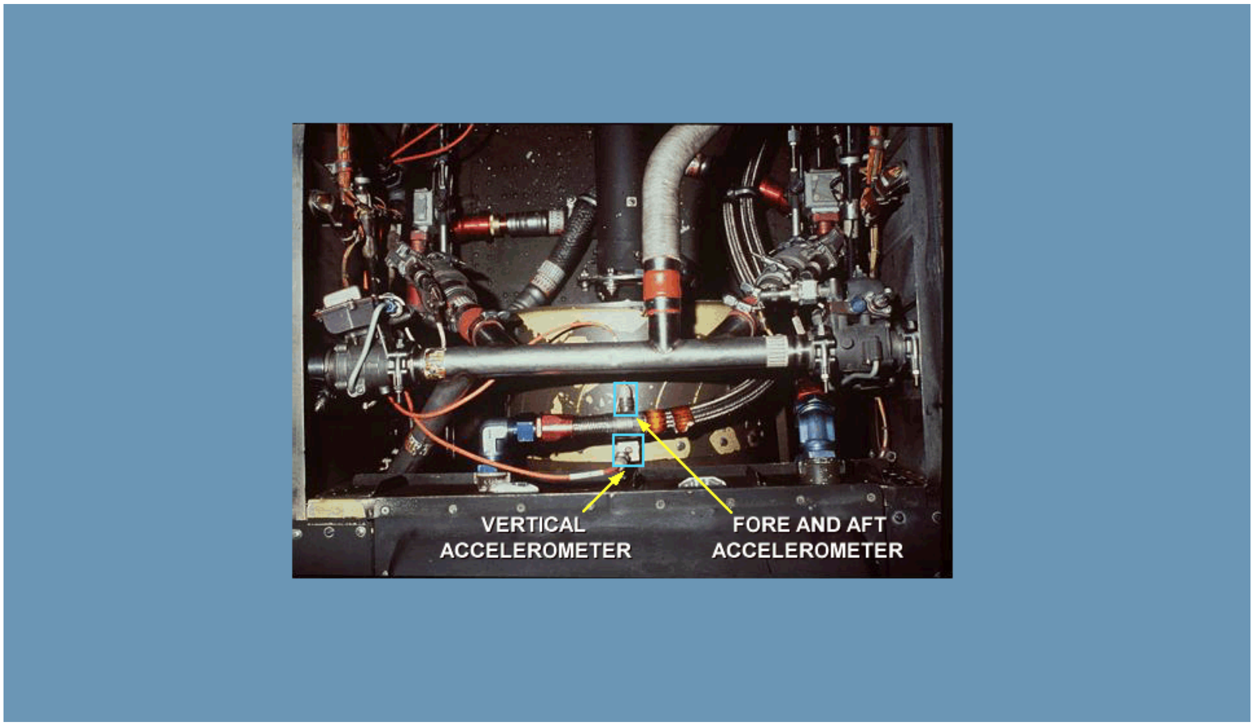
c) The No. 1 engine optical rpm sensor cable connects to the connector labeled TACHO 1, while the No. 2 engine optical rpm sensor cable connects to the connector labeled TACHO 2.

d) ACC 1 is the connecter for the No. 1 engine accelerometer from the right hand input module, while ACC 2 is the connecter for the No. 2 engine accelerometer from left hand input module.

e) The CADU cable connects to the connector labeled CADU.

(4) Oil Cooler

Frame #1605 (Oil Cooler)



(a) When installing the accelerometer cables to the oil cooler bracket, ensure each cable is identified with its proper location, vertical or fore and aft.

(b) Make sure the cables have adequate clearance from any moving or hot parts.

(c) Route the accelerometer cables through the oil cooler compartment and into the cabin.

(d) Secure the cables tightly at several places in the oil cooler compartment with tiedown straps.

1) Oil Cooler

Frame #1610 (Oil Cooler)

a) The DAU cable installation for the UH-60 begins with the 28 V dc power cable.

b) The 28 V dc power cable connects to the connector labeled 28 V dc.

c) ACC 3 is the connecter for the vertical accelerometer from the oil cooler bracket, while ACC 4 is the connecter for the fore and aft accelerometer from the oil cooler bracket.

d) The CADU cable connects to the connector labeled CADU.

CHECK ON LEARNING

1. For installation of the Magnetic Pickup, position the main rotor blades with the _______.

2. When installing the cockpit accelerometers for vibration absorber tuning, _______.

3. When installing the cockpit accelerometers for vibration absorber tuning, mount the accelerometers on accelerometer mounting brackets, _______.

4. When installing cables, never install cables where they can be damaged, and never bundle tie the cables to _______.

5. When inspecting the reflective tape on the engine output shaft, if it is installed incorrectly or not at all, install one piece of reflective tape, _______, on the engine output shaft.

SECTION V. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the aviation Vibration Analysis kit installation
The key points to remember are:

- Installing the AVA kit incorrectly will create false readings resulting in incorrect adjustments.
- When installing the magnetic rpm sensor, position the main rotor blades with the black (target) blade over the nose of the aircraft.
- Check the clearance between the magnetic rpm sensor and the interrupter mounted to the rotating swashplate.
- The tail rotor optical rpm sensor and bracket are installed under the right hand side of the aft tail rotor gear box fairing with the optical rpm sensor and bracket slightly upside down with the arrow on the bracket pointing aft and up.
- A 4 inch strip of reflective tap is placed on the inside of the target tail rotor blade, at the same approximate location as the beam of the optical rpm sensor.
- The accelerometer, bracket, and cable are mounted on the left hand side of the aft tail rotor gear box fairing at a 90º angle to the leading edge of the tail pylon.
- The PHV mounting plate, when installed in the cockpit, is mounted next to the pilot ICS switch.
- The PHV mounting plate, when installed for the forward cabin vibration absorber, is mounted using a C-clamp horizontally to the overhead frame at station 308, butt line 0, just forward of the absorber.
- For accelerometer installation, when balancing the engine high speed shaft, the accelerometer is mounted on the input module accelerometer block of the engine high speed shaft being balanced.
- A 1 inch by 1 inch square piece of reflective tape is installed on the engine high speed shaft inline with the optical rpm sensor.
- After removing the engine air inlet, the bleed air tube plug must be installed using the existing coupling and sleeve from the engine bleed air tube.
- After removing the engine air inlet, the engine upper and lower screen assemblies must be installed using the existing clamp from the engine air inlet.

D. ENABLING LEARNING OBJECTIVE ELO No.4

ACTION: Identify the characteristics of the Control And Display Unit (CADU)

CONDITION: As a UH-60 maintenance test pilot

STANDARD: IAW TM 1-6625-724-13&P

a. CADU Characteristics

Frame #2005 (CADU Characteristic)

(1) There are seven basic characteristics used by the CADU: key pad layout, rebooting, main menu set-up, F1 measure, F2 display, F3 diagnostics, and F4 measure.

(a) Key Pad Layout

Frame #2010 (Key Pad Layout)

1) The key pad of the CADU has twelve types of button located on the face of the CADU:

a) Power ON/OFF

1 The OFF position opens the circuit and shuts off the electrical power supply to the unit.

2 The ON position provides electrical current to the unit when the power source is connected.

b) LAMP

1 LAMP Key. The LAMP key controls the backlighting of the CADU display.

2 When externally powered, pressing the LAMP key will toggle the lamp OFF or ON, which will provide display lighting in darkened environments.

3 When the CADU is operating on battery power the LAMP key must be pressed and held for display lighting.

c) CTRST

1 CTRST Key. The Contrast key controls the readability of the CADU display.

2 Pressing and holding the CTRST key will cause the display to change in contrast gradually.

3 Release the CTRST key when the desired contrast is obtained.

d) QUIT

1 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.

2 In the MEASURE mode, the QUIT key is used to abort or cancel whatever operation is being conducted.

e) DO

1 DO Key. The DO key, located on the right-hand side of the CADU front panel, executes the operator selected menu item.

f) LABEL

1 LABEL Key. Optional remote control display enable.

g) HELP

1 HELP Key. The HELP key provides additional information in certain restricted cases.

h) PRINT

1 PRINT Key. Pressing the PRINT key will print out the screen currently displayed on the CADU.

2 If there is no printer currently attached, the CADU will store or "spool" the screen into memory for output when a printer is attached.

3 The CADU will spool up to twenty screens.

4 If more than twenty displays are spooled, the first display spooled will be discarded to make room for the next.

i) ARROW

1 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.

2 Execution of the highlighted menu selection is accomplished by pressing the DO key.

j) F1-4

1 Function Keys. The four function keys (F1, F2, F3, and F4) provide the operator with the ability to select functions from within each menu.

2 Functional keys are also used to enter alphanumeric in tail number menus.

k) ALPHA NUMERIC

1 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.

(b) Rebooting

Frame #2015 (Rebooting)

1) Rebooting the CADU is done for two reasons: to get to the Start-Up Selection Menu, or should the CADU lock up during operation.

2) To accomplish a reboot, you must understand the methods of rebooting available.

3) To reboot there are two methods, hard (cold) and soft (warm).

4) To perform a hard reboot, which is the preferred method, the CADU must be off.

5) Press and hold the HELP button, then press the ON button and release both buttons.

6) A message will appear on the display advising you to "Please Wait...".

7) When the message goes away, the Start-Up Selection Menu will appear.

Frame #2020 (Rebooting)

8) The second method of rebooting, soft reboot, is not the preferred method but is used when the CADU has locked up during operation.

9) To accomplish the soft reboot, press the DO and QUIT buttons simultaneously and release both buttons.

10) Again, the "Please Wait..." prompt will appear on the display followed by the Start-Up Selection Menu.

Frame #2025 (Rebooting)

11) The Start-Up Selection Menu screen provides the user with five options: 1 to proceed with normal operation, 2 to go into the host communication to use the Rotor Analysis Diagnostic System-Advanced Technology Communication Program (RADSCOM) interface, 3 to load the aircraft setup files from the Credit Card Memory (CCM), 4 to perform a modem setup, or 5 to select the Help menu.

12) If there is no default, this screen will remain on the display until one of these five numerical buttons have been pressed for the appropriate selection.

Frame #2025 (Rebooting)

13) If the operator selects option 1, normal operation will begin and the Diagnostic Program Language (DPL) booting window will be displayed.

14) After booting is completed, the first Main Menu will appear with the most current software enhancement level code.

Frame #2025 (Rebooting)

15) If the operator selects option 2, instructional text will be displayed directing the operator through the process of loading data to and from an IBM compatible computer.

Frame #2025 (Rebooting)

16) If the operator selects option 3, and a Credit Card Memory (CCM) is installed in the system, a menu of selections will be displayed.

17) The actual aircraft that are displayed may vary depending on the configuration of the CCM.

18) The CCM capacity is smaller than the CADU memory.

19) If no aircraft setup file are currently stored on the CCM, this menu will not appear.

Frame #2025 (Rebooting)

20) If the operator selects option 4, instructional text will be displayed guiding the operator through the process of a modem connections.

21) This connection allows two CADUs to be connected and exchange data or viewed via a phone line.

Frame #2025 (Rebooting)

22) If the operator selects option 5, additional instructions will be displayed through the HELP MENU.

23) This selection will assist the operator by explaining selections 1-4.

Frame #2030 (Rebooting)

24) To reboot the DAU move the power switch to the OFF position for two seconds or more, then move the power switch back to the ON position.

25) The green power indicator lamp should illuminate if the external power is connected.

26) During reboot, the DAU software is initialized and an internal self-test will be run automatically.

(c) Main Menu Set-Up

Frame #2040 (Main Menu Set-Up)

1) Setting up the AVA for a particular aircraft is done from the Main Menu screen.

2) The AVA requires aircraft-specific setup files in order to make the required measurements and analysis to correct vibration and track problems.

3) The Aircraft Type menu is selected by using the UP/DOWN arrow keys to move the cursor over the Aircraft Type selection in the Main Menu, and pressing the DO key.

4) The Main Menu is removed from the display and the Aircraft Type menu appears.

Frame #2040 (Main Menu Set-Up)

5) If the AVA is configured for the aircraft under test, the following set-up section is applicable.

6) If the aircraft type does not appear on the Aircraft Type menu, it will need to be created and installed.

7) Using the DOWN ARROW key to select the Aircraft Type and selecting DO.

8) The Main Menu will reappear with the Tail Number selection highlighted for selecting the next category in the setup function.

9) The QUIT key can be employed at any time to return to the Main Menu.

Frame #2040 (Main Menu Set-Up)

10) Selecting the DO key at this stage will remove the Main Menu from the display and the Tail Numbers menu will appear.

Frame #2045 (Aircraft Type)

11) Using the arrow keys, place the cursor over the appropriate tail number and press the DO key to enter the selection.

12) The Main Menu will reappear with the Flight Plan selection highlighted for selecting the next category in the setup function.

13) The QUIT key can be employed at any time to return to the Main Menu.

Frame #2045 (Aircraft Type)

14) If the tail number of the aircraft is not in the list, a new tail number can be entered by selecting NEW from the Tail Numbers menu and pressing the DO key.

Frame #2045 (Aircraft Type)

15) A numeric tail number can be entered using the numeric keypad.

16) Entering an alphanumeric tail number is done using the F1 and F2 function keys.

17) 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.

18) 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.

19) After the tail number has been entered, press DO to store the new tail number and return to the Main Menu.

20) The Main Menu will reappear with the Flight Plan selection highlighted for selecting the next category in the setup function.

21) By selecting the QUIT key you can cancel the tail number entry and return to the Main Menu.

Frame #2050 (Flight Plan)

22) A Flight Plan must be entered in order to identify the set of measurements to be taken.

23) Flight Plans are categorized into flight, ground, tail, or power spectrums.

24) Within each category are the test states particular to the category selected.

25) The Flight Plans menu is selected by placing the cursor over the Flight Plan selection in the Main Menu, using the arrow keys and pressing the DO key to execute the selection.

26) The Main Menu is removed from the display and the Flight Plans menu appears.

Frame #2050 (Flight Plan)

27) The Flight Plans menu contains the set of pre-stored Test States for the selected aircraft type.

28) Test states are the flight conditions at which measurements are taken.

29) Select the desired Flight Plan by using the arrow keys to move the 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).

30) When the DO key is pressed, the selected Flight Plan is stored and the display returns to the Main Menu.

31) The Main Menu will reappear with the Flight Identification (ID) selection highlighted for selecting the next category in the setup function.

32) The QUIT key can be employed at any time to cancel the Flight Plan entry and return to the Main Menu.

Frame #2055 (Flight ID)

33) Selection of a Flight ID is required to display data or run diagnostics on data previously stored in the AVA.

34) 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.

35) By selecting the DO key, the Flight ID menu will appear with a list of existing Flight IDs for the aircraft type selected.

Frame #2055 (Flight ID)

36) By placing the cursor over the desired Flight ID and pressing the DO key, the Main Menu will reappear with the Aircraft Type selection highlighted.

37) The QUIT key can be employed at any time to cancel the flight ID entry and return to the Main Menu.

Frame #2055 (Flight ID)

38) Once the main setup selections have been completed, the Main Menu reappears, containing the entered data.

39) The options available from this menu are: MEASURE, DISPLAY, DIAGNOSTIC, and MANAGER.

(d) F 1 Measure

Frame #2060 (F 1 Measure)

1) The measurement operation is started by pressing the F1 key under the Main Menu.

2) A sub-menu will appear listing all of the test states that are associated with the particular aircraft selected earlier.

3) 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 at.

4) This kind of information is directly linked from the Flight Plan chosen for this aircraft.

Frame #2060 (F 1 Measure)

5) From the list of test states, a test state can be selected by placing the cursor over the selection using the arrow keys.

6) The screen display output can be modified by using the four function keys (F1 - 4).

7) The current display state is set opposite the function key label.

8) To toggle between modes, press the desired function key: DISPLAY, STROBE, SETUP, and LMT OFF.

9) 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.

10) 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.

Frame #2060 (F 1 Measure)

11) Displays here are the same ones that can be selected from the DISPLAYS section for one test state.

12) Pressing the QUIT key will cause the displays to terminate and the main measurement screen to be re-displayed.

13) Selection of a test state is accomplished by positioning the cursor over the desired test state for tracking and pressing the DO key.

14) When the setup is completed, (*) will appear next to the selected test state.

Frame #2060 (F 1 Measure)

15) The label STROBE above the F2 function key is an option that executes the strobing measurement mode for the selected test state.

16) Pressing the F2 function key will enter the strobed data for the Flight Plan previously selected.

17) If more than one rotor or component can be strobed for the selected test state, then a menu will appear where you will need to choose the rotor or component to strobe.

18) Then you will be able to strobe the blades and enter strobed based track data into the database.

Frame #2060 (F 1 Measure)

19) A Track Entry menu will appear allowing the blade values to be entered in inches.

20) The LEFT/RIGHT arrow key is used to change the values displayed over a decreasing/increasing value range.

21) Pressing the QUIT key will abort the strobe mode without causing the entered values to be added to the database.

22) Pressing the DO key, when finished, will add the entered values for track, for the selected test state, and the strobing to be discontinued.

23) At this time, the main measurement screen will be re-displayed.

Frame #2070 (F1 Measure)

24) The label SETUP above the F3 function key is an option that allows the displaying of the aircraft setup configuration data.

25) Select this option by pressing the F3 function key and a paged menu display will appear.

26) To exit the display press the QUIT key, which will then bring back the main measurement menu.

Frame #2070 (F1 Measure)

27) This screen contains information for setting up the chosen Flight Plan, such as accelerometer locations, blade ID, and any test installation information.

28) To exit this screen press the QUIT key.

Frame #2070 (F1 Measure)

29) The label LMT OFF above the F4 function key indicates that limits checking is currently disabled during the measurement mode.

Frame #2070 (F1 Measure)

30) To enable limits checking during measurement, press the F4 function key to toggle to the LMT ON label.

31) 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).

Frame #2070 (F1 Measure)

32) By selecting the DO key, the measurement for the selected Test State will begin or QUIT to exit this screen.

(e) F2 Display

Frame #2100 (F2 Display)

1) 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.

2) From these results, the operator can select a variety of graphic or tabular displays.

3) The displays are grouped by: One Test State, Complete Flight, Trend Flights, View Limits, and Summary Displays. To initiate the DISPLAY mode, press the F2 function key below the Main Menu.

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

Frame #2100 (F2 Display)

5) One Test State displays present the results from each of the specific measurements made in a specific Test State.

6) 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.

Frame #2100 (F2 Display)

7) A sequence of screens will allow the operator to select the Test State of interest and then pick the measurement to be viewed.

Frame #2100 (F2 Display)

8) A further Test State break down is displayed by selecting the DO key.

Frame #2100 (F2 Display)

9) The results will first be displayed graphically.

10) The results can also be seen in tabular form by pressing the F3 function key below the label TABLE.

11) The results will first be displayed graphically.

Frame #2100 (F2 Display)

12) To display another measurement or Test State, press the QUIT key until the appropriate screen (Display or Test State) reappears.

13) Make the new selections and proceed through the process as before.

14) The graphic and tabular form of displays will also appear for the Main Rotor measurements of Track and Lag.

Frame #2100 (F2 Display)

15) Once you have returned to the Display Mode Menu, a new topic may be selected by moving the cursor with the arrow keys to the selected topic.

Frame #2105 (F2 Display)

16) Complete Flight displays present the results from a single measurement taken in each Test State of the flight.

17) Select Complete Flight from the display mode menu by placing the cursor over the Complete Flight selection and pressing DO.

Frame #2105 (F2 Display)

18) The Displays screen will appear with the list of measurements whose results can be compared relative to the other Test States.

19) Select the measurement of interest, for example, the 1 Per Revolution (1/R) vertical (A+B) measurement.

Frame #2105 (F2 Display)

20) A graphic display appears next.

21) To navigate to the next screen, select the DO key.

Frame #2105 (F2 Display)

22) An entry form will allow the operator to select the number of Test States to be displayed on a polar chart for the 1/R A+B measurement.

23) The same comparison can be done for the rotor track measurements for each Test State in graphic or tabular form.

Frame #2105 (F2 Display)

24) To exit the polar display and return to the DISPLAY MODE select the QUIT key.

Frame #2105 (F2 Display)

25) Trend Flight displays may be selected by using the arrow key to move the cursor over the desired Display Mode.

Frame #2110 (F2 Display)

26) Trend Flights displays present the results from a single measurement that was taken on other flights on this particular aircraft.

27) To select the Trend Flights display mode, place the cursor over the Trend Flights selection and press DO.

Frame #2110 (F2 Display)

28) A screen of measurements will appear from which to choose for comparison with the same measurement data from the other flights on this aircraft.

29) The trend information from each measurement listed can then be evaluated.

Frame #2110 (F2 Display)

30) An entry form will allow the operator to select the number of Test States to be displayed on a polar chart for the 1/R A+B measurement.

Frame #2110 (F2 Display)

31) 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.

Frame #2110 (F2 Display)

32) The View Limits displays may be selected by using the arrow key to move the cursor over the desired Display Mode.

Frame #2115 (F2 Displays)

33) The limits display presents the results from limit checking on measured data.

34) This holding of data is done to determine if adjustments will be required on the aircraft.

35) To select the limits display, place the cursor over the View Limits selection and press the DO key.

Frame #2115 (F2 Displays)

36) The purpose of the limits checking software is to notify the user that measured data has exceeded specific limits.

37) The limit monitoring system allows for a range of checking measured vibration data for a specific limit and allows the calculation and display of the maximum track spread.

38) The maximum track spread is the difference between the highest and lowest flying blades.

39) All limits may be viewed by using the UP or DOWN ARROW keys.

Frame #2115 (F2 Displays)

40) The ALL LIMITS screen displays all the manufacturers acceptable limits for the specified aircraft type that has been selected.

41) To return to the previous screen, select the UP or DOWN ARROW key.

Frame #2115 (F2 Displays)

42) When the LIMITS screen reappears, you may return to the DISPLAY MODE screen by selecting DO or QUIT.

Frame #2115 (F2 Displays)

43) The Summary Display is the next option in the Display Mode screen.

44) To select the Summary Display mode, place the cursor over the Summary Displays selection and press DO.

Frame #2115 (F2 Displays)

45) 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.

46) Track and lag data are also available as Summary Displays.

Frame #2115 (F2 Displays)

47) 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.

48) The Summary Displays are set up by aircraft type.

49) The Flight Plan, and flight ID over all acquisitions are specified.

50) They are presented as one menu that the user can quickly page through to view each display setup for the Flight Plan.

51) All data is displayed in a tabular format.

52) To view the next page of the displayed screen select the RIGHT ARROW key.

Frame #2115 (F2 Displays)

53) Once the data in this screen has been reviewed, to return to the DISPLAY MODE screen select QUIT.

Frame #2115 (F2 Displays)

54) When you are finished with the DISPLAY MODE screen, select QUIT to return to the MAIN MENU screen.

Frame #2115 (F2 Displays)

(f) F3 Diagnostics

Frame #2080 (F3 Diagnostics)

1) The Diagnostics function executes the diagnostics routine of the selected Flight Plan data.

2) 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.

3) The Diagnostic operation is started by pressing the F3 function key from the Main Menu.

4) The aircraft setup script must have been previously configured with diagnostic coefficients and weighting factors for the diagnostics to function.

5) The diagnostic operation is executed on data from the currently selected flight ID.

6) These corrections are the optimum set of adjustments that shall be made to reduce the vibration levels to the lowest possible level.

7) If a reduced or modified set of adjustments is required or desired, the diagnostic editing functions must be used.

Frame #2080 (F3 Diagnostics)

8) Upon pressing the F3 function 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.

9) If multiple pages exist, the LEFT and RIGHT arrow keys can be used to scroll through the displays.

10) 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.

Frame #2080 (F3 Diagnostics)

11) The second screen (optional, dependent on the script file configuration) is a display of the system's current record of absolute adjustment values.

12) In the case of a new aircraft being measured for the first time with this system, all values will be zero.

13) In all other cases, the display shows a cumulative record of the adjustments already performed.

14) 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.

15) Pressing DO will continue the diagnostics calculation with any manual changes entered. Pressing QUIT will continue without the changes being saved.

Frame #2080 (F3 Diagnostics)

16) The Diagnostics operation will display a corrections screen indicating the desired corrections.

17) To scroll through the corrections list, use the LEFT and RIGHT arrow keys on the CADU keypad.

18) To print the entire screen, press the PRINT key.

19) Pressing the DO key will advance to the Diagnostics Menu screen.

Frame #2080 (F3 Diagnostics)

20) The Diagnostic Menu will provide the option to select one of several areas used throughout the diagnostic process.

21) By using the UP or DOWN ARROW keys, highlight View Predictions and press DO.

Frame #2080 (F3 Diagnostics)

22) This screen can be viewed by selecting the view predictions options from the Diagnostics Menu.

23) This screen shows a table of predicted responses for the various vibration and track measurements at each test condition.

24) If additional test states were performed there, predicted vibration and track levels would also be displayed.

25) The predicted response allows a user to use the diagnostic editor to eliminate a particular adjustment or families of adjustments and view the predicted response.

26) Another useful aspect is to monitor the effectiveness of the diagnostic solution.

27) The predicted response should be close to the actual response caused by the corrections.

28) 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.

29) The predicted responses can be used to identify what the vibration and track levels would be after implementing the suggested corrections.

Frame #2080 (F3 Diagnostics)

30) The Edit Adjustables can be selected by using the UP or DOWN ARROW keys and pressing DO.

Frame #2080 (F3 Diagnostics)

31) Edit Adjustable is a very powerful feature of the AVA.

32) It allows the elimination of a single correction, a family of corrections, or corrections on a specific blade or adjustment position.

Frame #2085 (F3 Diagnostics)

33) 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.

34) The editor works by eliminating a correction type for a particular adjustment position.

35) The editor, figure 2, consists of a table with the adjustment position labeled horizontally across the top of the screen (YEL, BLU, RED and BLK) and the adjustment type displayed along a vertical column at the left of the screen (Hub Weight, Pitch Link, Tab).

36) For each adjustment position/adjustment type intersection, a "Y" or an "N" is displayed.

37) A "Y" indicates that a correction is acceptable for that position and type defined by the intersection.

38) An "N" indicates that no correction is to be included for that adjustment position/adjustment type.

39) The four function keys provide a mechanism to edit the correction matrix.

40) The following is a description of some of the functions of the Edit Adjustables.

Frame #2085 (F3 Diagnostics)

41) The View Corrections option can be selected by using the UP or DOWN ARROW keys and pressing DO.

Frame #2085 (F3 Diagnostics)

42) The View Corrections option allows the user to view the corrections to be made in the diagnostic process.

Frame #2085 (F3 Diagnostics)

43) The Diagnostics operation will display a corrections screen indicating the desired corrections.

44) To scroll through the corrections list, use the LEFT and RIGHT arrow keys on the CADU keypad.

45) To print the entire screen, press the PRINT key.

46) Pressing the DO key will advance to the Diagnostics Menu screen.

Frame #2085 (F3 Diagnostics)

47) The Complete Flight option can be selected by using the UP or DOWN ARROW keys and pressing DO.

Frame #2085 (F3 Diagnostics)

48) Complete Flight displays present the results from a single measurement taken in each Test State of the flight.

Frame #2085 (F3 Diagnostics)

49) The Displays screen will appear with the list of measurements whose results can be compared relative to the other Test States.

50) For example, to select the measurement of interest, the 1/R A+B measurement, the UP and DOWN ARROW keys would be used until the measurement desired is highlighted, then press the DO key to make the selection.

Frame #2085 (F3 Diagnostics)

51) The select the Summary Display mode, place the cursor over the Summary Displays selection and press DO.

Frame #2090 (F3 Diagnostics)

52) 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.

53) Track and lag data are also available as Summary Displays.

Frame #2090 (F3 Diagnostics)

54) 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.

55) The Summary Displays are set up by aircraft type.

56) The Flight Plan, and flight ID over all acquisitions are specified.

57) They are presented as one menu that the user can quickly page through to view each display setup for the Flight Plan.

58) All data is displayed in a tabular format.

59) To view the next page of the displayed screen select the RIGHT ARROW key.

60) To display a select specific display, highlight the desired selection and press DO, or press QUIT to exit the screen.

Frame #2090 (F3 Diagnostics)

61) To select the limits display, place the cursor over the View Limits selection and press the DO key.

Frame #2090 (F3 Diagnostics)

62) The limits display presents the results from limit checking on measured data.

63) This holding of data is done to determine if adjustments will be required on the aircraft.

Frame #2090 (F3 Diagnostics)

64) The purpose of the limits checking software is to notify the user that measured data has exceeded specific limits.

65) 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.

66) The maximum track spread is the difference between the highest and lowest flying blades.

67) All limits may be viewed by using the UP or DOWN ARROW keys.

68) To review the diagnostics press DO, or press QUIT to return to the diagnostics menu.

Frame #2090 (F3 Diagnostics)

69) To select the Edit Defaults mode, place the cursor over the Edit Defaults selection and press DO.

Frame #2090 (F3 Diagnostics)

70) When using the Edit Defaults it is important to have a thorough understanding of its features before attempting to employ them in real world situations. It is also important to note that each of the diagnostic tools described below:

a) Operate in conjunction with the Edit Adjustable screen. Any modifications made in the edit adjustable page will further constrain the functions listed below:

1 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.

2 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 as necessary to correct the rotor.

Frame #2095 (F3 Diagnostics)

71) Setting the 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.

72) 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.

73) 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).

74) Each time a new solution is presented, a new set of predicted results are calculated as well.

75) Careful observation of the predictions will indicate if the recent reduction in adjustment count still provides an effective solution.

76) 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.

Frame #2095 (F3 Diagnostics)

77) While it is possible to manually edit out specific adjustments using the Edit Adjustable 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.

78) Manually turning off the smallest adjustment (in terms of quantity or size of the adjustment) may not be the best course of action.

79) Using maximum number of adjustments will allow the algorithm to select an adjustment based on its effectiveness rather than size.

Frame #2095 (F3 Diagnostics)

80) The Resolve To Limit option is intended to act as an automatic best maximum number of adjustments with one major difference.

81) 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).

82) This is often the most rapid method to get the aircraft within limits with as little maintenance activity as possible.

Frame #2095 (F3 Diagnostics)

83) Aircraft mission, type of rotor system, and repeatability or effectiveness of adjustments at certain Test States determines the weighting structure (Weighting Mode).

84) 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.

85) One possible reason is that the default weighting has been "de-tuned" or reduced in priority at that particular data point for the benefit of others.

86) Selecting the weighting mode to AUTO will instruct the system to review the vibration and track profile of the current data set or modify the default weighting structure to the measured data.

87) This will allow the system to have more flexibility when calculating the optimal set of adjustments.

Frame #2095 (F3 Diagnostics)

88) The Adjustment Sequencing setting, when used, employs a recognition that some types of adjustment are more difficult to install than others.

89) A sequencing scheme enables the system to selectively enable an adjustment type based on an effectiveness versus preference.

90) 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.

91) 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.

92) 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.

Frame #2095 (F3 Diagnostics)

93) To select the Main Menu, place the cursor over the Main Menu selection and press the DO key.

Frame #2095 (F3 Diagnostics)

94) Some key DOs and DON'Ts to remember:

a) DO compare the previous predicted response vs. the actual response.

b) DO monitor the track spread.

c) DO stop making corrections when within acceptable levels.

d) DO make the corrections properly.

e) DO use the Edit Adjustable to limit the number of corrections.

f) DO monitor the vibration/track convergence.

g) DO verify that the aircraft needs corrections.

h) DON'T follow the recommendations blindly.

i) DON'T keep making corrections without an improvement in levels.

(g) F4 Manager Menu

Frame #2120 (F4 Manager Menu)

1) The MANAGER is initiated from the Main Menu by pressing the F4 function key.

Frame #2120 (F4 Manager Menu)

2) The MANAGER function encompasses five separate functions (Data Maintenance, Data Transfer, Status, Setup, and Test) that allow the user to change, control, or test.

3) The five functions appear in the Manager Menu screen and can be accessed by highlighting the desired function and pressing DO.

Frame #2120 (F4 Manager Menu)

4) Compressing data records will recover disk space that is allocated, but currently unused.

5) Use this operation after data has been deleted to get maximum usage of the disk to store flight results.

6) At times it will be necessary to run the compress option.

7) 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.

8) 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.

9) 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.

10) At this point it is necessary to run the Compress utility.

11) Compress basically frees all the old structures and recopies data into new clean files.

Frame #2120 (F4 Manager Menu)

12) This operation will delete data from the database.

13) The deletion operation allows deletions based on aircraft type, tail number, and flights.

14) If an aircraft is deleted, all setup data and flight results will be removed.

15) If a flight or tail number is chosen, then the flight results will be deleted.

16) Tail numbers and aircraft can be deleted whether or not flight results exist.

17) Deletion by Flight ID is a more discriminating way of removing data and freeing space.

18) Remember, the Flight ID is a unique number that is assigned to a particular flight.

19) For instance, if a measurement is desired on the flight line and a database full error occurs, it will be necessary to delete data.

20) 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.

Frame #2120 (F4 Manager Menu)

21) Place the cursor over the Data Transfer selection from the Manager Menu and press DO.

Frame #2120 (F4 Manager Menu)

22) Data Transfer will provide three options to backup and restore current data.

Frame #2120 (F4 Manager Menu)

23) The three data transfer options available in this screen are Backup to CCM, Restore from CCM, and Transfer to PC.

24) Backup to CCM transfers stored data in the AVA to a transportable memory that looks like a credit card.

25) To execute transferring data to the CCM, place the cursor over the Backup to CCM option and press DO.

26) 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.

27) The last screen asks if data backup is really desired and whether to delete the original data stored in the CADU.

Frame #2120 (F4 Manager Menu)

28) Restore from CCM is the downloading of data from the CCM to the CADU memory.

29) The restore procedure requires identifying the data needing to be restored.

30) The data to be restored has to be identified by Tail number, Aircraft type, or Flight ID number via a set of five screens.

Frame #2120 (F4 Manager Menu)

31) The Transfer to PC is the downloading of data directly from the CADU to an external computer.

32) The data to be transferred has to be identified by Tail number, Aircraft type, or Flight ID number via a set of screens.

33) The last screen, Entry Form, will ask if data back up is still desired.

34) A YES answer is followed by two screens with explicit instructions to follow in making the transfer to the PC.

35) 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.

36) The RADSCOM communication package can be used on the PC to simplify the backup to PC operation.

Frame #2120 (F4 Manager Menu)

37) Placing the cursor over the Status Selection From the Manager Menu and Pressing DO will allow you to access the available information contained in this function.

Frame #2120 (F4 Manager Menu)

38) The Status option provides the user with a status report of six categories (General Setup, Available Aircraft Type, Printer, Measured Results, Current Units, and Required Installation) loaded into the CADU operating memory.

Frame #2125 (F4 Manager Menu)

39) Selecting the Setup function will provide a Setup Menu containing all the operations to change the current system's setups.

Frame #2125 (F4 Manager Menu)

40) The six functions of the Setup Menu (Printer, Set Time & Date, Accelerometer, Units, Tail Number, and Format CCM) will allow the basic system setup to be adjusted for the requirements of the current operation.

41) The AVA contains a print spooler that is capable of storing up to twenty selected screen images and sending them to the printer with interfaces for both parallel and serial printers.

42) The serial interface is used with the AVA printer or a serial printer with Epson graphics.

43) The parallel interface is used with printers containing a Centronix parallel interface with Epson graphics.

44) In order to change the number of screen images that can be stored, refer to ENABLE command.

45) The CADU is designed to control several different serial interface type printers, such as Epson compatible printers and the AVA printer.

46) Place the cursor over the Printer selection and press DO.

Frame #2125 (F4 Manager Menu)

47) Changing Printer Types:

a) To change the printer type, position the cursor over the Change Type selection in the Printer Control and press DO.

b) A list of available printer types will be displayed.

c) Position the cursor over the desired type and press DO.

d) The new printer type will be installed.

Frame #2125 (F4 Manager Menu)

48) Changing Printer Ports:

a) To change the printer port type, position the cursor over the Change Ports selection in the Printer Control Menu and press DO.

b) 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.

Frame #2125 (F4 Manager Menu)

49) Enabling/Disabling Print Spooler:

a) The print spooler buffers screen images for printing while the printer is not hooked up.

b) Once the printer is hooked up, the screens will be printed out in the order that the screens were spooled to the buffer.

c) When the spooler is enabled, screens are printed.

d) When the spooler is disabled, screens are just buffered in the CADUs internal memory.

e) After the CADU is rebooted, the print spooler is returned to the enabled state.

f) To enable or disable the print spooler, position the cursor over the desired selection in the Printer Control menu and press DO.

g) It is recommended to leave print spooling enabled.

Frame #2125 (F4 Manager Menu)

Frame #2125 (F4 Manager Menu)

50) Flushing Print Spooler Buffer:

a) 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.

b) To delete old buffered screens, position the cursor over the Flush Queue selection and press DO.

Frame #2125 (F4 Manager Menu)

51) To select the Set Time & Date option, use the UP/DOWN ARROW and press DO.

Frame #2125 (F4 Manager Menu)

52) Setting System Time and Date Function:

a) This function allows the current time and date to be changed.

b) To select this function, place the cursor over the Set Time & Date option and press the DO key.

c) An Entry Form for setting the time and date will appear.

Frame #2125 (F4 Manager Menu)

53) Use the UP and DOWN arrow keys to move through the selections.

54) Use the HELP key on a chosen selection (highlighted) for specific information on that choice.

55) Use the numeric keypad to enter the values.

56) 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.

57) To save changes and exit the menu press the DO key, or to cancel changes, press the QUIT key to exit anytime.

Frame #2125 (F4 Manager Menu)

58) To select the Accelerometer function, place the cursor over the Accelerometer option and press the DO key.

Frame #2130 (F4 Manager Menu)

59) An entry form will appear after selecting DO from this screen displaying the current accelerometer in use for the selected aircraft.

Frame #2130 (F4 Manager Menu)

60) Changing accelerometer types will generally require a different cable.

61) Ensure an applicable cable is available prior to making an accelerometer change.

62) This function allows the changing of the current type of accelerometers in use.

63) Use the LEFT and RIGHT arrow keys to change accelerometer types.

64) Use the UP and DOWN arrow keys to move to another choice.

65) When the changes have been made, press the DO key to accept changes and exit.

66) To cancel changes, press the QUIT key to exit anytime.

Frame #2130 (F4 Manager Menu)

67) To modify the selected display Units, place the cursor over the Units selection and press DO.

Frame #2130 (F4 Manager Menu)

68) After selecting DO an entry screen will appear.

Frame #2130 (F4 Manager Menu)

69) The AVA is capable of changing units used for display by using a simple menu.

70) It is possible to display vibration in units of ips, mils or g's.

71) Phase can be displayed in units of degrees, clock hours, radians, or Chadwick-Helmuth clock hours.

72) Track can be displayed in units of mm, meters, feet, inches, or mils.

73) Once the units are set, they remain installed until they are changed using this menu or the system is reformatted.

74) The entry screen will appear.

75) Use the UP and DOWN arrow keys to select the type of unit to be modified.

76)	Use the LEFT and RIGHT arrow keys to toggle between the possible unit choices.

77)	One or all of the unit types can be modified while in the Entry Form.

78)	Once the choices have been made, press the DO key to install the choices in the database.

79)	To cancel changes, press the QUIT key to exit anytime.

Frame #2130 (F4 Manager Menu)

80)	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.

Frame #2130 (F4 Manager Menu)

81) After selecting DO an entry screen will appear.

Frame #2130 (F4 Manager Menu)

82) 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.

83) F1 will toggle forward through the alphabet one character at a time and F2 will toggle backward.

84) The RIGHT and LEFT arrow keys can be used to select a specific character position.

85) After the desired number has been entered, press the DO key to store the result in the database.

86) To cancel changes, press the QUIT key to exit anytime.

Frame #2130 (F4 Manager Menu)

87) To select and format a CCM the, move the cursor over the Format CCM function and press DO.

Frame #2130 (F4 Manager Menu)

88) After Selecting Do a Format CCM screen will appear.

Frame #2130 (F4 Manager Menu)

89) Once the format has been completed, any key may be pressed to continue with the Manager operations.

Frame #2135 (F4 Manager Menu)

90) Once all the functions in the Setup Menu have been completed, the Manager Menu may be accessed by pressing QUIT.

Frame #2135 (F4 Manager Menu)

91) To select the Test function, rove the cursor over the Test function and press DO.

Frame #2135 (F4 Manager Menu)

92) After selecting DO a System Tests screen will appear.

Frame #2135 (F4 Manager Menu)

93) The Test selection of the Manager Menu allows the operator to select either testing of the CADU keypad or the CADU display screen.

94) 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.

Frame #2135 (F4 Manager Menu)

95) When the operations in the Manager Menu are complete, the Main Menu can be accessed by pressing QUIT.

Frame #2135 (F4 Manager Menu)

CHECK ON LEARNING

1. What is one of the basic characteristics used by the CADU?

2. What is the preferred method used to reboot the CADU?

3. What method is used to reboot the CADU when it locks up during operation?

4. During a reboot of the DAU, the software is initialized and _______.

5. What function allows the operator to 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, and to a post-flight review in the office?

6. Which is one of the five functions accessed from the MANAGER menu?

SECTION VI. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the characteristics of the Control and Display Unit (CADU) topic. The key points to remember are:

- There are seven basic characteristics used by the CADU: key pad layout, rebooting, main menu set-up, F1 measure, F2 display, F3 diagnostics, and F4 manager.
- Rebooting the CADU is done for two reasons: to get to the Start-Up selection menu, or should the CADU lock up during operation.
- The two methods used to reboot are the hard (the preferred method), and soft (not the preferred method).
- The Start-Up selection menu screen provides the user with five options:
    - to proceed with normal operation
    - to go into the host communication to use the RADSCOM interface
    - to load the aircraft setup files from the CCM
    - to perform a modem setup
    - to select the Help menu
- The AVA requires aircraft-specific setup files in order to make the required measurements and analysis to correct vibration and track problems.
- If the tail number of the aircraft is not in the list of availables, a new tail number can be entered using the numeric keypad and the F1 and F2 function keys.
- A flight plan must be entered in order to identify the set of measurements to be taken.
- Flight plans are categorized into flight, ground, tail or power spectrums.
- Test states, from the flight plan menu, are the flight conditions at which measurements are taken.
- The flight ID is a time and date stamp associated with a particular set of collected data identifying when that set of data was collected.
- There are four functions available in the main menu: display, strobe, setup, and limit off.
- The display function enables the display mode for measured test states after data has been collected.
- The strobe function executes the strobing measurement mode for the selected test state.
- The setup function is an option that allows the displaying of the aircraft setup configuration data.
- The limit off function indicates that the limits checking is currently disabled during the measurement mode.
- A diagnostics function will typically calculate the required mass balance, pitch rod and tab adjustments necessary to reduce system vibration and track to acceptable levels.
- Predicted responses are displayed in the view predictions screen, assuming the correction indicated in the corrections screen are fully implemented.
- Edit adjustables allows the user to eliminate a single correction, a family of corrections, or a specific blade or adjustment position.
- The complete flight display presents the results from a single measurement taken in each test state of the flight.
- View corrections is an option that allows the user to view the correction to be made in the diagnostics process.

- Providing 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 is the purpose of the summary display.
- Some key DOs to remember when using the AVA are:
    - compare the previous predicted response versus the actual response
    - monitor the track spread
    - stop making corrections when within acceptable levels
    - make the corrections properly
    - use the edit adjustable to limit the number of corrections
    - monitor the vibration/track convergence
    - verify that the aircraft needs corrections
- Some key DON'Ts to remember when using the AVA are:
    - follow the recommendations blindly
    - keep making corrections without an improvement in levels

APPENDIX A

ILLUSTRATION LISTING

1575	Engine High Speed Shaft
1580	ENGINE HIGH SPEED SHAFT
1585	Engine high Speed Shaft
1590	Engine Bleed Air Tube
1595	Engine Swirl Frame
1600	Engine Forward Support Tube
1587	DATA ACQUISITION UNIT
1605	Oil Cooler
1610	Oil Cooler
2005	CADU Characteristics
2010	Key Pad Layout
2015	Rebooting
2020	Rebooting
2025	Rebooting
2030	Rebooting
2040	Main Menu Set Up
2045	Aircraft Type
2050	Flight Plan
2055	Flight ID
2060	F1 Measure
2070	F1 Measure
2100	F2 Display
2105	F2 Display
2110	F2 Display
2115	F2 Display
2080	F3 Diagnostics
2085	F3 Diagnostics
2090	F3 Diagnostics
2095	F3 Diagnostics
2120	F4 Manager Menu
2125	F4 Manager Menu
2130	F4 MANAGER MENU
2135	F4 Manager Menu

APPENDIX B

TEST AND TEST SOLUTIONS

1. This appendix is only used when the test and solutions are internal to the POI file.

2. When the test and solutions are internal to the POI file, then the POI file becomes a FOR OFFICIAL USE ONLY document.