POI File No. 071-616-04
April, 1994

TRAINING SUPPORT PACKAGE

FOR

COCKPIT ENVIRONMENT

This Package has been developed for use by: AH-64A Maintenance Manager/Maintenance Test Pilot Course

Proponent for this TSP is:

United States Army Aviation Logistics School
Department of Aviation Systems Training
Fort Eustis, Virginia 23604-5414

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PREFACE

This training support package provides the instructor with a standardized lesson plan for presenting instruction for:

NOTE: POI File No. 071-616-04, Cockpit Environment, supports the enabling skills necessary to perform all selected 152FG tasks.

TASK NUMBER: N/A

TASK TITLE: N/A

CONDITIONS: N/A

STANDARDS: N/A

This training support package contains a Lesson Plan and Student Handout.

Before presenting this lesson, instructors must thoroughly prepare by studying this lesson and identifying reference materials.

The proponent for this publication is the U.S. Army Aviation Logistics School. Send comments and recommendations on DA Form 2028 (Recommended Change to Publications and Blank Forms) directly to Department of Aviation Systems Training, Attn: Mr. Ken Deskins Deputy Director, DAST, Fort Eustis, Virginia, 23604-5414.

United States Army Aviation Logistics School
Fort Eustis, Virginia

APRIL 1994

THIS DOCUMENT HAS BEEN REVIEWED FOR OPSEC CONSIDERATIONS

LESSON PLAN

COCKPIT ENVIRONMENT

071-616-04

The proponent for this LP is USAALS

POI FILE LESSON PLAN WRITER:
NAME/RANK POSITION DATE

TECHNICAL CONTENT CERTIFICATION:
NAME/RANK POSITION DATE

FORMAT APPROVAL:
NAME/RANK POSITION DATE

RISK ASSESSMENT LEVEL APPROVAL:
NAME/RANK POSITION DATE

PROPONENT RESIDENT LESSON PLAN APPROVAL:
NAME/RANK POSITION DATE

071-616-04

1 April 1994

LESSON TITLE: Cockpit Environment

THIS LESSON IS USED IN THE FOLLOWING COURSE(S):

COURSE NUMBER(S)	COURSE TITLE(S)
4D-SIG6/SQIG	AH-64 Maintenance Manager/Maintenance Test Pilot

SECTION I. - ADMINISTRATIVE DATA

TASK(S) TAUGHT OR SUPPORTED:

NOTE: This lesson supports accomplishment of the following tasks:

TASK NUMBER	TASK TITLE
None	

TASK(S) REINFORCED:

TASK NUMBER	TASK TITLE
03-9410.81-2005	Perform A General Maintenance Test Flight (AH-64)
03-9410.81-2010	Analyze Flight Control Systems Malfunctions (AH-64)
03-9410.81-2015	Analyze Power Plant Systems Malfunctions (AH-64)
03-9410.81-2020	Analyze Electrical Systems Malfunctions (AH-64)
03-9410.81-2025	Analyze Hydraulics Systems Malfunctions (AH-64)
03-9410.81-2030	Analyze Powertrain Systems Malfunctions (AH-64)
03-9410.81-2035	Analyze Fuel Systems Malfunctions (AH-64)
03-9410.81-2040	Analyze Rotor Systems Malfunctions (AH-64)
03-9410.81-2045	Analyze Utility Systems Malfunctions (AH-64)
03-9410.81-2050	Analyze The Airworthiness Of The Airframe (AH-64)
03-9410.81-2055	Verify Mission Equipment Operation (AH-64)
03-9410.81-2060	Analyze APU Malfunctions (AH-64)
03-9410.81-2065	Perform Vibration Analysis (AH-64)
03-9410.81-2070	Perform Operational Checks Of The Armament Systems (AH-64)

ACADEMIC HOURS:	PEACETIME HOURS/TYPE		MOBILIZATION HOURS/TYPE	
	4.0	C	4.0	C
TOTAL HOURS 4.0	C		4.0	C

THE TERMINAL LEARNING OBJECTIVE FOR THIS LESSON IS EVALUATED DURING:

	HOURS	LESSON NO:
TEST:	4.0	9C7-505-04
TEST REVIEW: 0.0		N/A

PREREQUISITE LESSON (S):

LESSON NUMBER	LESSON TITLE:
071-600-02	Introduction
071-602-04	Technical Manuals

CLEARANCE AND ACCESS: Unclassified; international students may attend this course.

REFERENCES:

NUMBER	TITLE	PAGES	ADDITIONAL INFORMATION
TM 1-1520-238-T series	Aviation Unit And Intermediate Troubleshooting Manuals For Army AH-64A Helicopter	All	Appropriate pages for cockpit instruments and air data sensor subsystem.
TM 55-1520-238-10	Operator's Manual For Army AH-64A Helicopter	All	Appropriate pages for cockpit instruments and data sensor subsystem.
TM 55-1520-238-23 series	Aviation Unit And Intermediate Maintenance Manual For Army AH-64A Helicopter	All	Appropriate pages for cockpit instruments and data sensor subsystem.

STUDENT STUDY ASSIGNMENTS: None

INSTRUCTOR REQUIREMENTS:

One Primary Instructor, 152FG SME, ITC Qualified
One Assistant Instructor, 152FG SME

ADDITIONAL SUPPORT PERSONNEL REQUIREMENTS: None

EQUIPMENT REQUIRED FOR THE INSTRUCTION:

(1 ea) Slide Projector, 35mm random access, with extra lamp
(1 ea) Screen, portable, front projection
(1 ea) Slides

MATERIALS REQUIRED FOR THE INSTRUCTION:
INSTRUCTOR MATERIALS:

(1 ea) Instructor Lesson Plan Package
(1 ea) Visitor Lesson Plan package
(1 ea) TM 1-1520-238-T series
(1 ea) TM 55-1520-238-10
(1 ea) TM 55-1520-238-23-series

STUDENT MATERIALS:

(8 ea) Student Handout, 071-616-04 (1 per student)

CLASSROOM, TRAINING AREA:

(1 ea) General Purpose Classroom

AMMUNITION REQUIREMENTS: None

INSTRUCTIONAL GUIDANCE: None

SECTION II. - INTRODUCTION

MOTIVATOR: In order for you to perform your mission as a maintenance manager/maintenance test pilot, one of your primary responsibilities will be to maintain the AH-64A in a mission ready status. In order for you to accomplish this, you must have the knowledge to troubleshoot the cockpit instruments, cockpit warning systems, and miscellaneous cockpit systems.

TERMINAL LEARNING OBJECTIVE:

NOTE: Read the following terminal learning objective statement to the students.

At the completion of this lesson you will:

ACTION: Analyze instrument, warning, and miscellaneous cockpit systems including abnormal conditions and corrective action(s).

CONDITIONS: Given TM 1-1520-238-T series and TM 55-1520-238-23 series manuals.

STANDARDS: Determine by selecting from a list, the corrective actions for abnormal conditions of the AH-64A's engine instruments, flight instruments, flight reference instruments, navigation instruments, and miscellaneous instruments in accordance with TM 1-1520-238-T and TM 55-1520-238-23 series manuals, with a minimum of 70% accuracy.

SAFETY REQUIREMENTS: In addition to specific safety requirements of this lesson plan, aviation shop and flight line safety standards established in the technical manuals will be reinforced.

RISK ASSESSMENT LEVEL: Low

ENVIRONMENTAL CONSIDERATIONS: None

EVALUATION: This lesson will be evaluated during the practical written evaluation 9C7-505-04.

NOTE: Distribute Student Handout 071-616-04.

INSTRUCTIONAL LEAD IN: TM 55-1520-238-23 divides the instrument system into five major groups: Engine instruments, flight instruments, flight reference instruments, navigation instruments, and miscellaneous instruments. These groups will be discussed respectively.

SECTION III. - PRESENTATION

NOTE: Provide the students with 10-minute breaks at the appropriate times in accordance with the USAALS academic hour schedule.

ENABLING LEARNING OBJECTIVE 1:

NOTE: Read the enabling learning objective to the students.

After this lesson you will:

ACTION: Identify the characteristics of the AH-64A's engine instruments system.

CONDITIONS: Given TM 1-1520-238-T and TM 55-1520-238-23 series manuals, and the student handout.

STANDARDS: Identify by selecting from a list, the characteristics of the AH-64A's engine instruments system, with a minimum of 70% accuracy.

Learning Activity 1

Type of Instruction: C

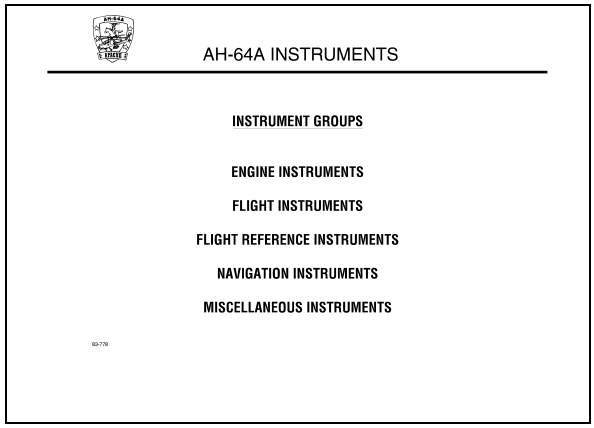
Instructor to Student Ratio: 1:Class

Time of Instruction: 0.1 Hours

Media: 35mm Slides

NOTE: Ask check questions throughout the learning activity.

NOTE: Show slide # 1 (AH-64A Instruments)



A. TM 55-1520-238-23 divides the instrument system into five major groups.

1. Engine instruments
2. Flight instruments

3. Flight reference instruments

4. Navigation instruments

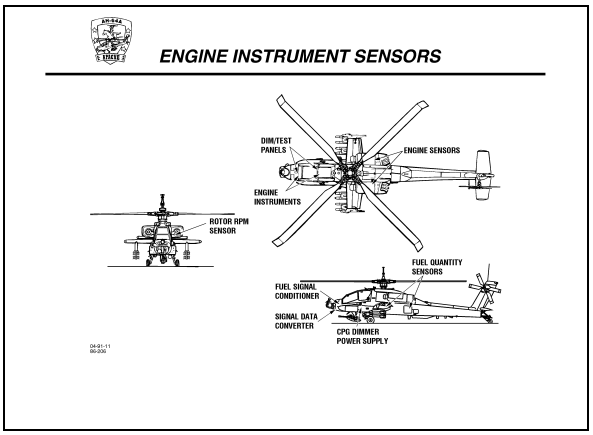
5. Miscellaneous instruments

B. Engine Instruments

1. The engine instruments display the status of engine parameters, fuel quantity, and main rotor RPM.

2. The engine instruments are located on the pilot's and CPG's instrument panels.

NOTE: Show slide # 2 (Engine Instrument Sensors)



3. Major components of the engine instruments system

a. Engine sensors

b. Rotor RPM sensor

c. Fuel quantity sensors

d. Fuel signal conditioner

e. Signal data converter

f. Engine instruments

g. Dim/Test panels

Learning Activity 2

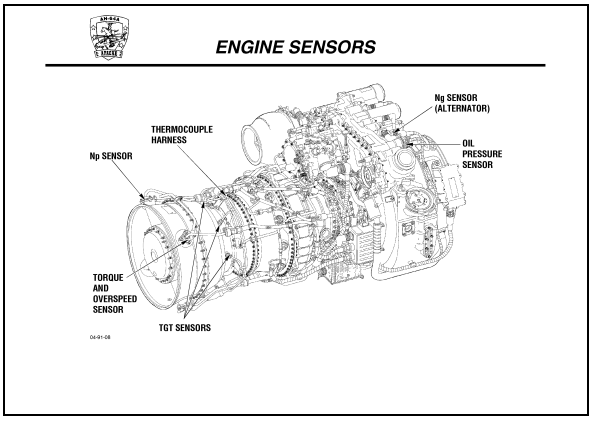
Type of Instruction: C
Instructor to Student Ratio: 1:Class

Time of Instruction: 0.1 Hours

Media: 35mm Slides

NOTE: Ask check questions throughout the learning activity.

NOTE: Show slide # 3 (Engine Sensors)



C. Engine sensors

1. Purpose: Provides electrical signals for display on the engine instruments.

2. Location: The engine sensors are mounted on the engines.

3. Engine sensor components

   a. Oil pressure sensor

   b. Thermocouple harness consisting of 7 turbine gas temperature (TGT) sensors

   c. N_P (power turbine) sensor

   d. N_G sensor

   e. Torque and overspeed sensor

4. Description and operation

   a. Oil pressure sensor. The oil pressure sensor is a variable reluctance type (a transducer in which a slug of magnetic material is moved between two coils by the displacement being monitored; this changes the reluctance of the coils, thereby changing their impedance) pressure transmitter. It supplies an electrical signal proportional to actual oil pump pressure.

   b. TGT sensors/Thermocouple harness. Each sensor is a chromel-alumel sensor that forms the TGT thermocouple harness. The harness consists of seven sensors tied into a single-plug junction box. The TGT sensors output increases

with an increase in temperature. The average value of the seven sensors is displayed on the pilot's TGT indicator.

c. N_P (power turbine) sensor. The N_P sensor is a permanent magnet monopole-type sensor. It develops a signal that is proportional to N_P speed and applies it to the engine electrical control unit (ECU), then to the N_P indicator.

d. N_G (gas generator) sensor. The N_G sensor is a three-phase 115 VAC alternator that is driven by the engine N_G gear train. The output is used as an N_G signal and is applied to the Pilot's N_G indicator.

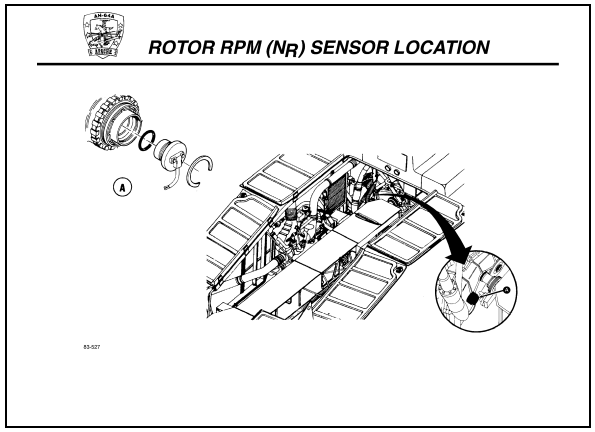
e. Torque and overspeed sensor. The torque and overspeed sensor is a monopole magnet sensor that is similar to the N_P sensor. It develops a signal that is proportional to the torque developed by the engine and applies it to the pilot's torque indicator.

Learning Activity 3

Type of Instruction:	C
Instructor to Student Ratio:	1:Class
Time of Instruction:	0.1 Hours
Media:	35mm Slides

NOTE: Ask check questions throughout the learning activity.

NOTE: Show slide # 4 (Rotor RPM [N_R] Sensor Location)



D. Rotor (N_R) sensor

1. Purpose: Provides an electrical signal to the pilot's and CPG's N_R indicators that is proportional to the main rotor speed.

2. Location: The N_R sensor is mounted on the left rear section of the main transmissions accessory gear box.

3. Description: The rotor RPM sensor is a monopole magnetic sensor.

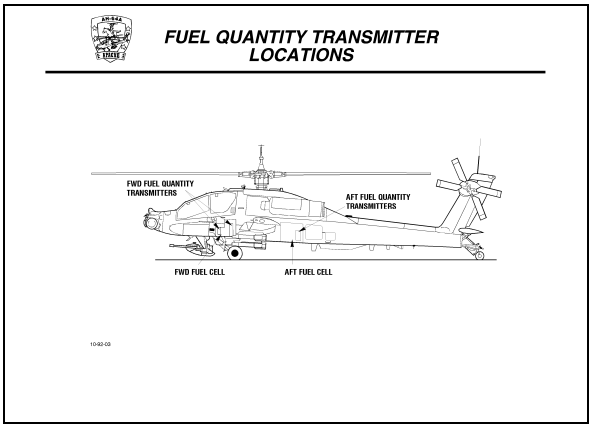
4. Operation: The N_R sensor is excited by the passage of teeth on a gear in the accessory gear box and develops a signal that is proportional to main rotor speed.

Learning Activity 4

Type of Instruction:	C
Instructor to Student Ratio:	1:Class
Time of Instruction:	0.1 Hours
Media:	35mm Slides

NOTE: Ask check questions throughout the learning activity.

NOTE: Show slide # 5 (Fuel Quantity Transmitter Locations)



E. Fuel quantity sensors

1. Purpose: Provides an electrical signal that is proportional to the fuel quantity in each cell.

2. Location: One fuel quantity transmitter is located in the aft fuel cell and two fuel quantity transmitters are located in the forward fuel cell.

3. Description: The fuel quantity transmitters are concentric capacitance-type transmitters that use fuel as a dielectric. (The term dielectric refers to a material which is an electrical insulator or in which an electric field can be sustained with a minimum dissipation in power.)

4. Operation: As the fuel level in the tank increases or decreases, the capacitive reactance of the transmitter varies. This causes a signal to be developed that is proportional to the fuel level.

Learning Activity 5

Type of Instruction: C

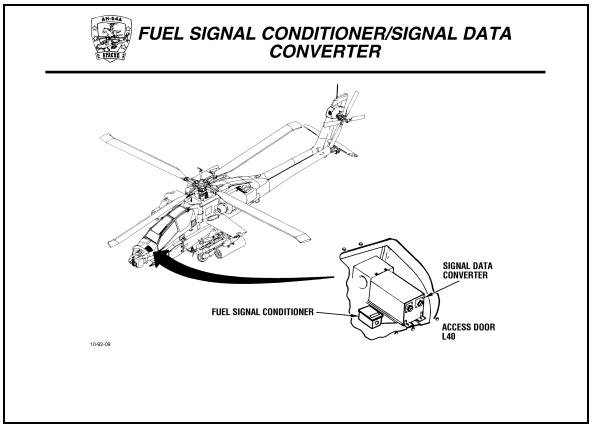
Instructor to Student Ratio: 1:Class

Time of Instruction: 0.1 Hours

Media: 35mm Slides

NOTE: Ask check questions throughout the learning activity.

NOTE: Show slide # 6 (Fuel Signal Conditioner/Signal Data Converter)



F. Fuel Signal Conditioner (FSC)

1. Purpose: The FSC converts aft and forward fuel quantity transmitter inputs into linear voltage to drive the fuel quantity indicators.

2. Location: The FSC is located on the left forward side of the helicopter behind access door L40.

3. Description: The FSC is an LRU that contains:

a. A 5 volt DC power supply.

b. An Oscillator.

c. Two signal conditioners (one for the forward and one for the aft fuel quantity transmitters).

d. Four adjustment screws.

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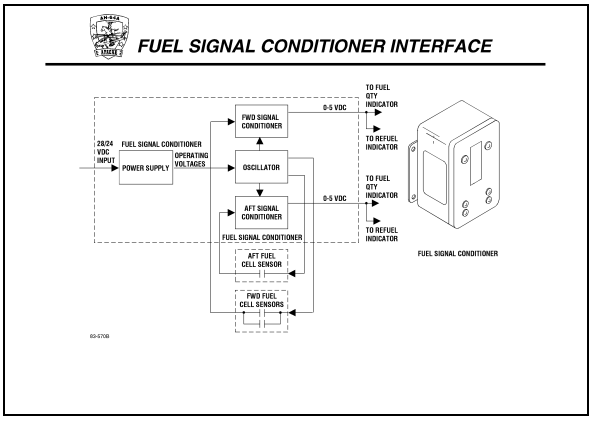
NOTE: Show slide # 7 (Fuel Signal Conditioner Interface)



4. Operation: Fuel Signal Conditioner (FSC)

   a. Emergency dc bus power is supplied to the FSC power supply from the SDC. The power supply converts the input voltage to operating voltages for the oscillator.

   b. The oscillator generates fixed low impedance "LO Z" (low impedance) signals as reference signals that are applied to the forward and aft fuel quantity transmitters.

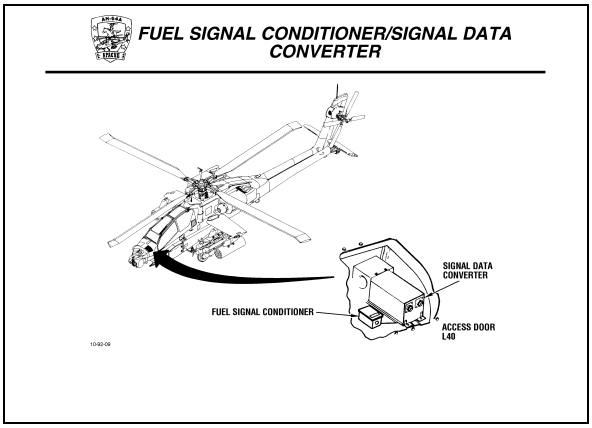
   c. Fuel quantity signals are applied to the forward and aft signal conditioners. The fuel signal conditioners develop 0 to 5 VDC signals that are proportional to fuel quantity and drive the fuel quantity indicators.

Learning Activity 6

Type of Instruction:	C
Instructor to Student Ratio:	1:Class
Time of Instruction:	0.2 Hours
Media:	35mm Slides

NOTE: Ask check questions throughout the learning activity.

NOTE: Show slide # 8 (Fuel Signal Conditioner/Signal Data Converter)



G. Signal Data Converter (SDC)

1. Purpose: The SDC provides operating voltage, lamp power supplies and overload protection for the engine instruments and operating voltage for the fuel signal conditioner.

2. Location: The SDC is located on the left forward side of the helicopter behind access door L40.

NOTE: Show Signal Data Converter bench maintenance component.

3. Description: The SDC is an LRU that contains:

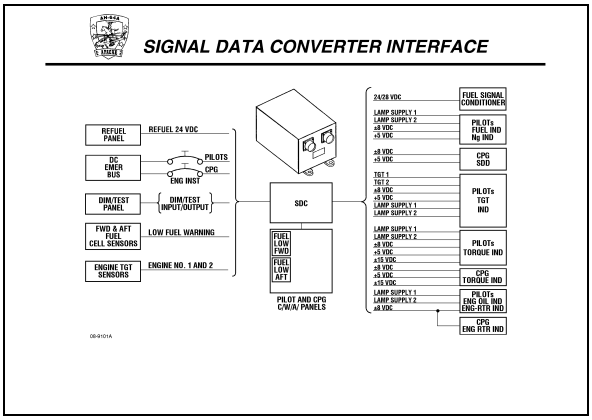
a. Two 0 to 6 VDC power supplies for instruments vertical scale lamp segments.

b. +5 VDC power supply, +/-8 VDC power supply, and a +/-15 VDC power supply.

c. A mother-board with soldered in fuses for protection of the power supply voltage outputs.

d. Printed circuit cards.

NOTE: Show slide # 9 (Signal Data Converter Interface)



4. Operation: Signal Data Converter

a. SDC inputs

(1) Refuel Panel

(2) Pilot's Dim/Test Panel

(3) Forward and Aft Fuel Sensors

(4) No. 1 and No. 2 Engine TGT Sensors

b. 28 VDC is supplied to the SDC from the emergency dc bus via the ENG INST circuit breaker in each crew station.

c. Each 28 VDC input is applied to one of two independent power supplies, each power supply produces:

(1) Lamp supply 1 - variable 0-6 VDC for scale segment dimming of the engine instruments in the pilot's station.

(2) Lamp supply 2 - variable 0-6 VDC for scale segment dimming of the engine instruments in the pilot's station.

(3) "8 VDC operating voltage.

(4) +5 VDC operating voltage.

(5) "15 VDC operating voltage.

(6) The lamp power supplies provide dimming voltage to every other segment of the scales on the Marconi instruments. The lamp power supply outputs are not paralleled. A Marconi instrument that only displays every other segment would be an indication of a Lamp supply 1 or 2 failure.

d. The operating voltages (+5 VDC, "8 VDC. and "15 VDC) are parallelled inside the SDC for redundancy and are applied to:

(1) "8 VDC operating voltage

(a) Pilot's fuel quantity indicator, N_G indicator, torque indicator, eng oil pressure indicator, engine rotor RPM indicator, and the TGT indicator.

(b) CPG's selectable digital display (SDD), torque indicator, and engine rotor RPM indicator.

(2) +5 VDC operating voltage

(a) Pilot's fuel quantity indicator, torque indicator, oil pressure indicator, engine-rotor RPM indicator, N_G indicator, and TGT indicator.

(b) CPG's SDD, torque indicator, and engine rotor RPM indicator.

(3) "15 VDC operating voltage

(a) Pilot's torque indicator

(b) CPG's torque indicator

e. The SDC also supplies 24/28 VDC operating power to the fuel signal conditioner.

NOTE: Conduct a check on learning and summarize the learning activities. Discuss the learning activities using the examples provided. Make on-the-spot corrections as necessary.

Examples:

1. What type of sensors are the TGT sensors?

Answer: Chromel-alumel sensors

2. What type of sensor is the N_G sensor?

Answer: 115 VAC engine driven alternator

3. Where is the N_R sensor located?

Answer: Main transmission accessory gearbox

4. Which component supplies power to the fuel signal conditioner?

Answer: Signal data converter

5. What is the purpose of the fuel signal conditioner?

Answer: The FSC converts aft and forward fuel quantity transmitter inputs into linear voltage to drive the fuel quantity indicators.

6. What is the purpose of the signal data converter?

Answer: The SDC provides operating voltage, lamp power supplies and overload protection for the engine instruments and operating voltage for the fuel signal conditioner.

7. Which circuit breaker protects the signal data converter?

Answer: 28 VDC is supplied to the SDC from the emergency dc bus via the ENG INST circuit breaker in each crew station.

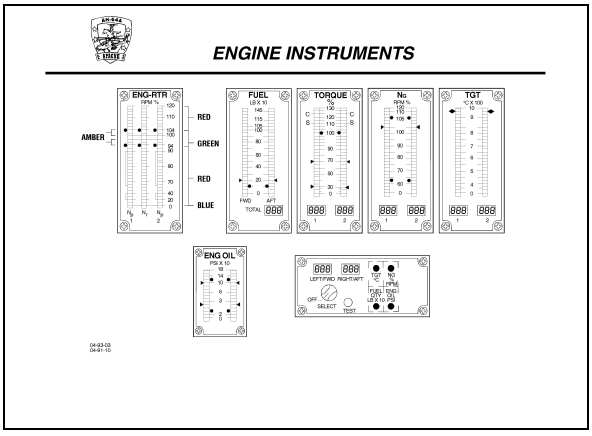
Learning Activity 7

Type of Instruction:	C
Instructor to Student Ratio:	1:Class
Time of Instruction:	0.2 Hours
Media:	35mm Slides

NOTE: Ask check questions throughout the learning activity.

H. Engine instruments

NOTE: Show slide # 10 (Engine Instruments)



1. Engine instruments - general

a. The engine instruments are self contained units with fixed numbered scales and colored columns of lamp segments that illuminate when a corresponding numeric value is reached.

b. The lamp segments are divided into color coded zones.

(1) Green - normal operating zone, indicates the safe or normal range of operation.

(2) Amber (yellow) - caution zone, indicates the range when special attention should be given to that operation covered by the instrument. Operation in the amber range is permissible, but may be time limited or cautionary.

(3) Red - danger zone, indicates the limit above or below which continued operation is likely to cause damage or shorten component life.

c. Only one colored zone will be illuminated at a time.

(1) Scales with green-coded, amber-coded, or red-coded segments above green-coded segments operate in this manner; the segment will light in normal progression and remain on as the received signal level increases. Those segments will go off in normal progression as the received signal level decreases.

(2) Scales with red-coded and/or amber-coded segments below green coded segments operate in this manner man; when the received signal level is zero or bottom scale, the segments will light in normal progression and will remain on. When the first segment above the red or amber range goes on, all red-coded or amber-coded segments will go off. These segments will remain off until the received signal level indicates a reading at or within the red or amber zone. At that time all red-coded or amber-coded segments will go on and the scale display will either go on or off in normal progression, depending upon the received signal level.

d. The bottom lamp segment of each scale is a blue segment that illuminates to indicate electrical power is applied to the instrument.

e. Some instruments have three digit digital displays that display values in numbers that are more accurate and easier to read than the vertical scales.

NOTE: Discuss optimistic scaling at this time.

f. The illuminated segments on the vertical scale instruments are referenced to the adjacent instrument indices and utilize a technique called optimistic scaling. As an example the optimistic scaling for proper indication of 100 percent N_P/N_R: The segments immediately above the instrument index line for 100 percent should be at the threshold of illumination.

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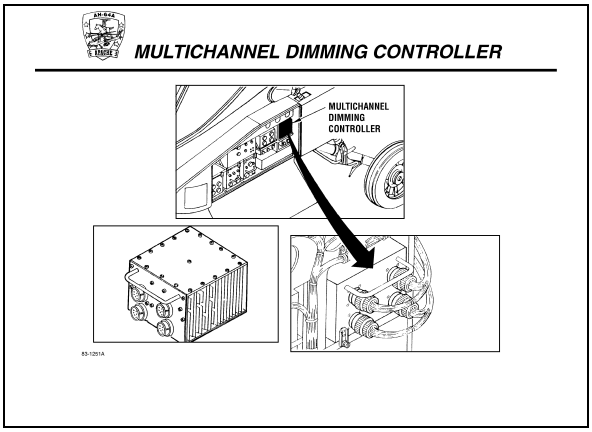
NOTE: Show slide # 11 (Multichannel Dimming Controller)



g. The Multi-channel Dimmer (located in L/H FAB) provides operating and control voltages for the engine instrument scales, cockpit lighting, and Caution/Warning/Advisory segment lights. AVIM can remove and replace the modular components of the Multi-channel Dimmer.

Learning Activity 8

Type of Instruction:	C
Instructor to Student Ratio:	1:Class
Time of Instruction:	0.5 Hours
Media:	35mm Slides

NOTE: Ask check questions throughout the learning activity.

2. The purpose of the engine instruments is to provide the crew with the means to monitor the operating parameters of the engines, drive and fuel systems.

   a. Power turbine (N_P) speed

   b. Oil pressure

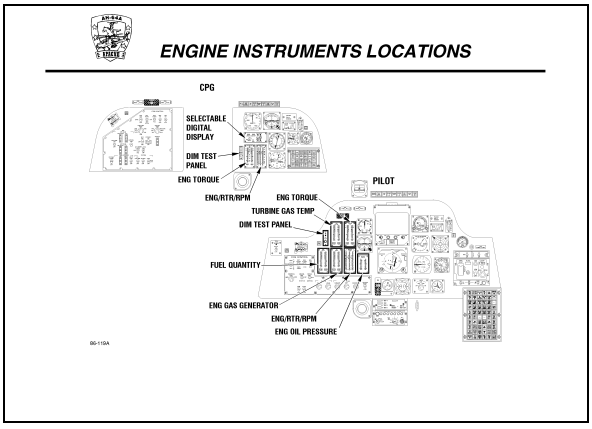
   c. Turbine gas temperature (TGT)

   d. Torque

   e. Fuel quantity

   f. Main rotor RPM

NOTE: Show slide # 12 (Engine Instruments Locations)



3. Location of the engine instruments

   a. Pilot's instrument panel

      (1) ENG-RTR RPM indicator

      (2) Fuel quantity indicator
      (3) Torque indicator

(4) N_G RPM indicator

(5) TGT indicator

(6) ENG OIL PSI indicator

(7) Dim/Test Panel

b. CPG's instrument panel

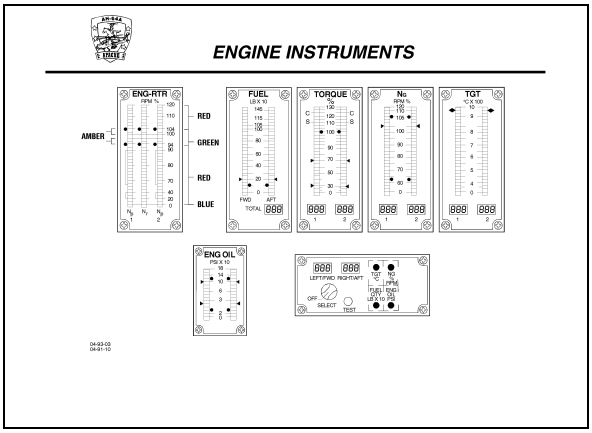
(1) ENG-RTR RPM indicator (identical and interchangeable with pilot's ENG-RTR indicator)

(2) Torque indicator

(3) Selectable Digital Display (SDD)

(4) Dim/Test panel

NOTE: Show slide # 13 (Engine Instruments)



4. Description of the engine instruments

NOTE: Show ENG-RTR RPM indicator bench maintenance component.

a. ENG-RTR RPM indicator (Pilot's and CPG's station)

(1) The ENG-RTR RPM percent indicator front face has three vertical scale displays.

(2) The left scale is marked N_P 1 and indicates the power turbine speed of the No. 1 engine in percent of RPM.

(3) The center scale indicates the main rotor RPM (N_R) in percent of RPM.

(4) The right scale is marked N_P 2 and indicates the power turbine speed of the No. 2 engine in percent of RPM.

(5) All three scales are graduated from O to 120 percent.

NOTE: Show N_G indicator bench maintenance component.

b. N_G RPM indicator (Pilot's station only)

(1) The N_G (gas producer turbine) RPM indicator front face has two vertical scale displays graduated from 0 to 120 percent and two digital displays.

(2) The left scale and digital display indicate the gas producer turbine speed of the No. 1 engine in percent of RPM.

(3) The right scale and digital display indicate the gas producer turbine speed of the No. 2 engine in percent of RPM.

(4) The last number of the digital display is always read in tenths. 99.3 percent N_G would be shown as 99.3, 100 percent N_G would be shown as 00.0, and 101.5 percent would be shown as 01.5.

NOTE: Show TGT indicator bench maintenance component.

c. TGT (turbine gas-temperature) indicator (Pilot's station only)

(1) The front face of the TGT indicator has two vertical scale displays (graduated from 0 to 1000°C) and two digital displays.

(2) The left vertical scale and digital display indicate the TGT of the No. 1 engine in degrees centigrade.

(3) The right vertical scale and digital display indicate the TGT of the No. 2 engine in degrees centigrade.

(4) The digital display indicate whole numbers only (750°C would be shown as 750).

NOTE: Show Engine Torque Indicator bench maintenance component.

d. Torque Indicator (Pilot's and CPG's station)

(1) The torque indicator front face has two vertical scale displays graduated from 0 to 120 percent and two digital displays.

(2) The left scale and digital display indicate the amount of torque developed by the No. 1 engine in percent.

(3) The right scale and digital display indicate the amount of torque developed by the No. 2 engine in percent.

(4) The digital readout is in whole numbers. 99 percent torque would be shown as 99. 101 percent torque would be shown as 101.

NOTE: Show Engine Oil PSI indicator bench maintenance component.

e. ENG OIL PSI indicator (Pilot's station only)

(1) The front face of the engine oil pressure indicator has two vertical scale displays graduated from 0 to 180 PSI.

(2) The left scale indicates the oil pressure of the No. 1 engine in PSI.

(3) The right scale indicates the oil pressure of the No. 2 engine in PSI.

NOTE: Show pilot's fuel quantity indicator bench maintenance component.

f. Fuel quantity indicator (Pilot's station only)

(1) The fuel quantity indicator front face has two vertical scale displays and one three-digit digital display.

(2) The left scale indicates the fuel quantity in the forward fuel cell in pounds and is graduated from 0 to 1050 pounds.

(3) The right scale indicates the fuel quantity in the aft cell in pounds and is graduated from 0 to 1450 pounds.

(4) The digital readout shows the total fuel quantity in both cells. The three digit read out is multiplied by 10 to obtain total fuel on board. If each cell has 675 pounds, the digital readout would be 135 ~ which is translated into 1350 pounds.

NOTE: Show Selectable Digital Display bench maintenance component.

g. Selectable digital display (SDD) (CPG's station only)

(1) The front face of the SDD contains:

(a) An OFF/SELECT rotary switch.

(b) Two digital displays marked LEFT/FWD and RIGHT/AFT respectively.

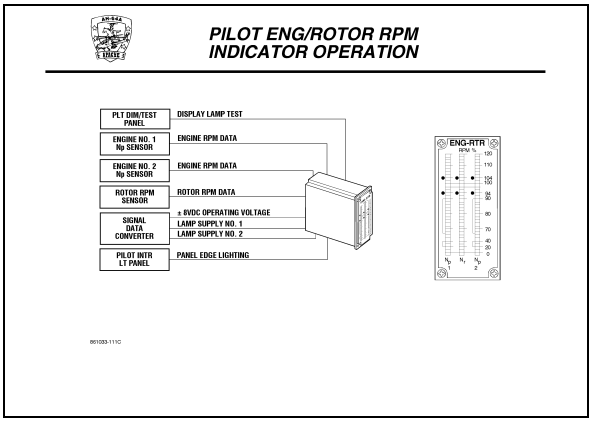
(c) Four indicator lights marked TGT, N_G% RPM, FUEL QUANTITY LBX10, and ENGINE OIL PSI.

(d) A test switch.

(2) The SDD is a repeater of the pilot's instruments.

5. Operation of the engine instruments

NOTE: Show slide # 14 (Pilot ENG-ROTOR RPM Indicator Operation)



a. Pilot's ENG-ROTOR RPM Indicator

(1) ENG/ROTOR RPM indicator inputs

(a) Ssignal DATA Converter (operating and lamp supply voltages)

(b) No. 1 and No. 2 engine N_P sensors

(c) Rotor RPM sensor

(d) Pilot's DIM/TEST Panel (automatic and manual dim/bright)

(e) Pilot Instrument Lights Panel (edge lighting dim/bright)

(2) The bottom segment of each vertical scale is a blue light that, when illuminated, indicates electrical power is applied to the indicator.

(3) As the N_P or N_R increases the lights will illuminate progressively in sequence.

(4) As the RPM increases above one color range into the next, the lower color range segments extinguish and the higher color range starts to illuminate. (N_P/N_R indicator is capable of displaying two colors at a time).

(5) Once the RPM starts to decrease from a higher color range to a lower color range the higher color range extinguishes and the entire lower color range will initially illuminate as the RPM drops into the lower range.

(6) The N_P vertical scales are color coded.

(a) Red zone - 104 to 120 percent (104 to 110 transient operation)

(b) Amber zone - 100 to 104 percent (normal operation)

(c) Green zone - 98 to 100 percent (normal operation)

(d) Amber zone - 94 to 98 percent (transient operation only)

(e) Red zone - 0 to 94 percent

(7) Modification work order (MWO) 1-1520-238-55-10 modifies the ENG-ROTOR RPM indicator front panel. The N_P vertical scales are color coded.

(a) Red zone - 110 to 120 percent (110 maximum)

(b) Amber zone - 104 to 110 percent (transient operation)

(c) Green zone - 98 to 104 percent (normal operation)

(d) Amber zone - 94 to 98 percent (transient operation)

(e) Red zone - 0 to 94 percent

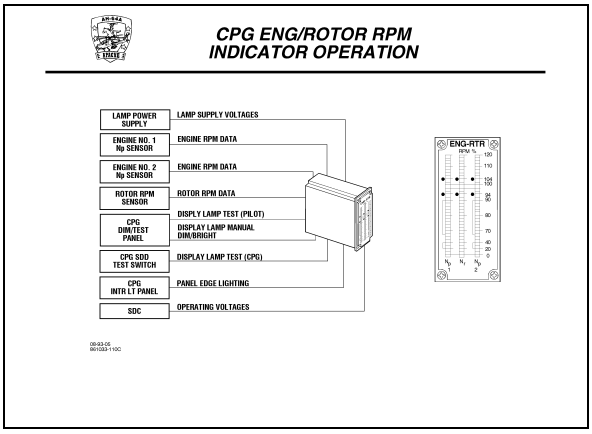
(8) The N_R vertical scale is color coded.

(a) Red zone - 104 to 120 percent (104 to 110 transient operation only)

(b) Green zone - 94 to 104 percent (normal operation)

(c) Red zone - 0 to 94 percent (transient power off)

NOTE: Show slide # 15 (CPG ENG/ROTOR RPM Indicator Operation)



b. CPG's ENG/ROTOR RPM indicator

(1) Operation and color code of the CPG's ENG/ROTOR indicator is identical to the pilot's. The instruments are identical and interchangeable.

(2) CPG's ENG/ROTOR RPM indicator inputs

(a) Lamp Power Supply 0 to 5 VDC for manual dim/bright control of the lamp segments

(b) Engine No. 1 RPM Sensor

(c) Engine No. 2 RPM Sensor

(d) Rotor RPM Sensor

(e) CPG Dim/Test Panel Dim/bright control and testing for vertical scale lamp segments

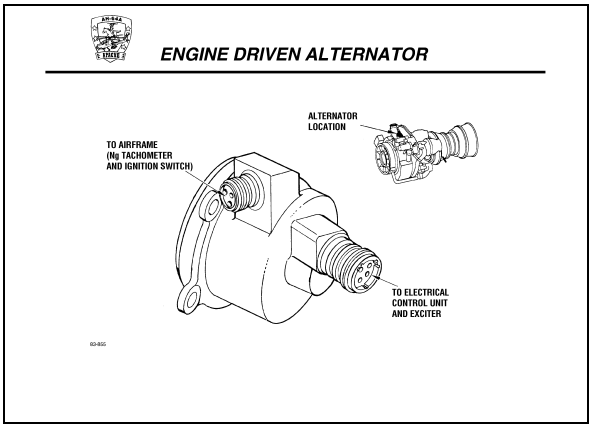
(f) CPG SDD test Switch - Vertical scale lamp segment test

(g) CPG Instruments Lights Panel edge lighting dim/bright

(h) SDC for operating voltages

c. Both pilot's and CPG's ENG/ROTOR RPM indicator systems are accurate to within " 0.5 % of actual speeds.

NOTE: Show slide # 16 (Engine Driven Alternator)



d. Engine Driven Alternator

(1) Provides a direct signal of actual engine N_G speed to the cockpit gauges.

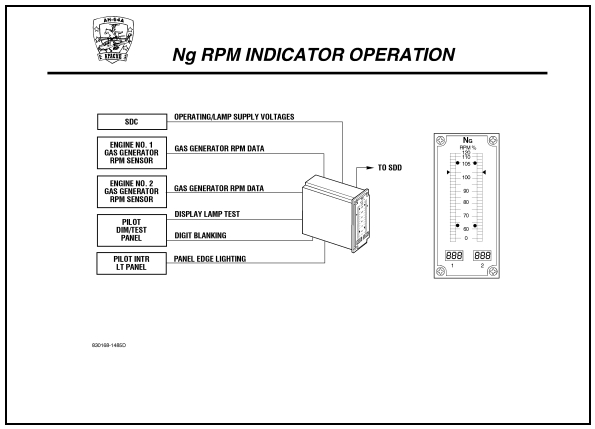
(2) Consists of three separate windings providing power for engine ignition, N_G speed and electrical control system operation.

(a) The most critical of these three windings would naturally be the one providing electrical power to the ECU's.

(b) A failure of this winding could result in uncontrolled

acceleration of the affected engine and a loss of N_P and torque indications to the cockpit.

NOTE: Show slide # 17 (Ng RPM Indicator Operation)



e. Gas producer turbine (N_G) indicator

(1) N_G indicator inputs

(a) The SDC.

(b) No. 1 and No. 2 engine driven alternators.

(c) Pilot's dim/test panel.

(d) Pilot's instrument lights panel.

(2) Each vertical scale display is color coded.

(a) Red zone - 102 to 120 percent (102 to 105 transient 12 second maximum)

(b) Amber zone - 99 to 102 percent (30 minute limit)

(c) Green zone - 63 to 99 percent (normal operation)

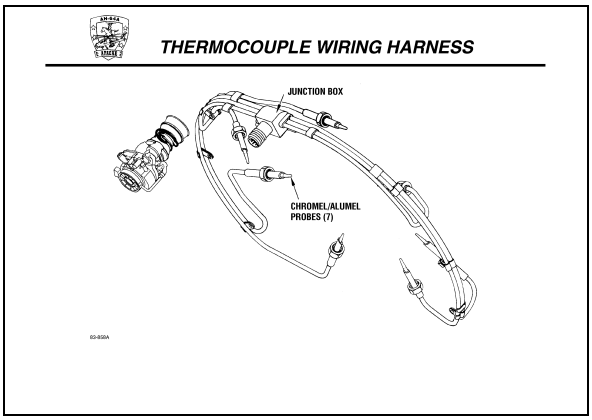
(d) Red zone - 0 to 63 percent

(3) The vertical scale light segment operation is the same as the ENG-RTR indicator.

(4) The digital displays are located under each vertical scale and each is a three-digit display with the last digit always indicating a tenth of a number. For example, 83.6% N_G would appear as 83.6. 100% would appear as 00.0.

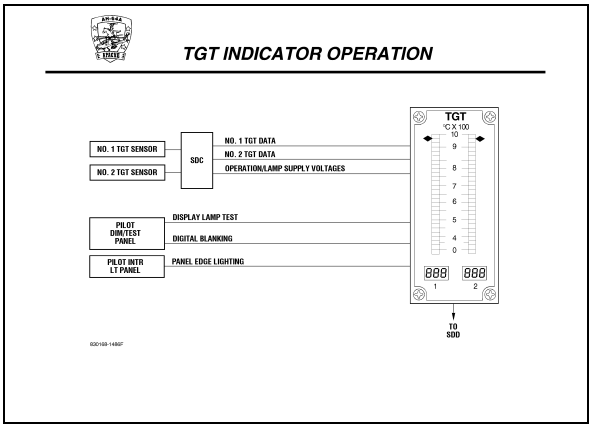
(5) The gas producer turbine (N_G) indication system is accurate to within " 0.5% of actual speed.

NOTE: Show slide # 18 (Thermocouple Wiring Harness)



f. Seven chromel-alumel sensors form a harness that tie into one junction box. The value displayed will be an average of the seven sensors. Only one sensor is required for a TGT reading to be indicated.

NOTE: Show slide # 19 (TGT Indicator Operation)



g. Turbine gas temperature (TGT) indicator

(1) TGT indicator inputs

(a) The No. 1 and No. 2 engine temperature sensors via the SDC

(b) Pilot dim/test panel

(c) Pilot instrument lights panel

(2) Each vertical scale display is color coded.

(a) Red zone - 867° to 1000°C (950 maximum, 917-950 12 second

transient, 867-917 single engine contingency 2.5 minute limit)

(b) Amber zone - 805° to 867°C (IRP - 30 minutes, 852 maximum for start)

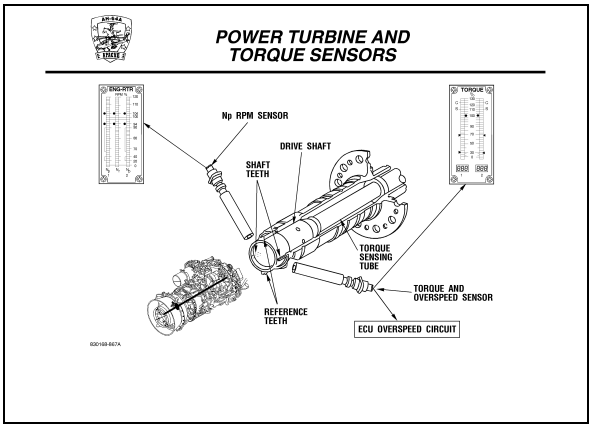
(c) Green zone - 0° to 805°C (normal operation, 805 - MCP)

(3) Vertical scale light segment operation is the same as the ENG-RTR indicator.

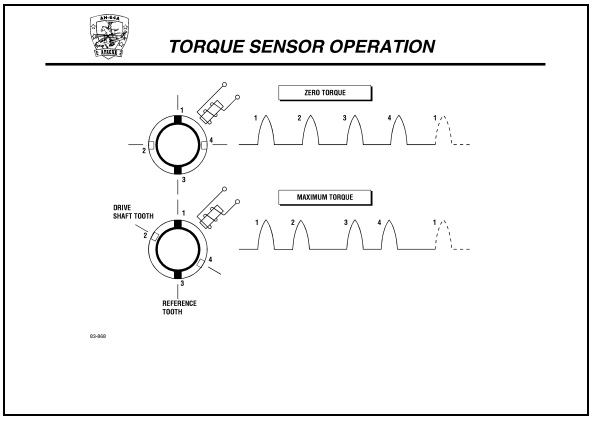
(4) The digital displays are located under each vertical scale. The digital displays show TGT in whole numbers only.

(5) The turbine gas temperature (TGT) indication system is accurate to within " 5 degrees of actual turbine gas temperature.

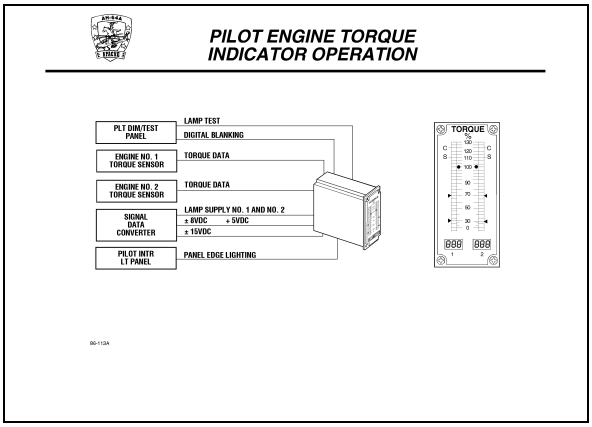
NOTE: Show slide # 20 (Power Turbine And Torque Sensors)



NOTE: Show slide # 21 (Torque Sensor Operation)



NOTE: Show slide # 22 (Pilot Engine Torque Indicator Operation)



h. Pilot's engine torque indicator

(1) Engine torque indicator inputs

(a) SDC-operating/lamp supply voltages

(b) No. 1 and No. 2 torque sensors

(c) Pilot's DIM/TEST panel - automatic and manual dim/bright

(d) Instrument lights panel for edge lighting dim/bright

(2) Each vertical scale is color coded.

(a) Red zone - 100 to 130 percent (122-125 single engine transient

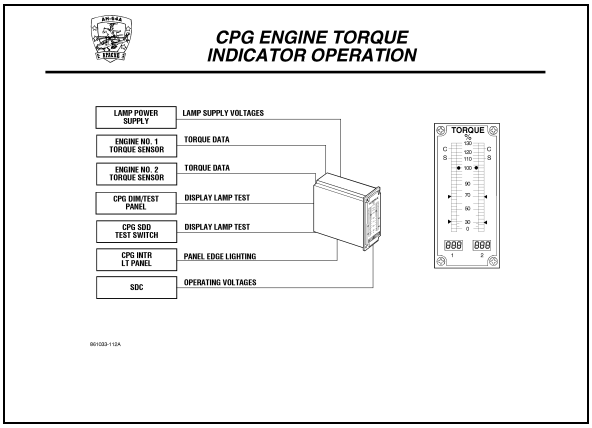
6 second limit, 122 single engine contingency power 2.5 minute limit, 100-115 dual engine transient 6 second limit)

(b) Green zone - 0 to 100 percent (normal operation)

(3) Each vertical scale has a digital display. The digital displays indicate the torque developed by the engines in whole numbers.

(4) Operation of the vertical scale lamp segments is the same as the ENG-ROTOR RPM indicator.

NOTE: Show slide # 23 (CPG Engine Torque Indicator Operation)



i. CPG's engine torque indicator

(1) Operation and color coding of the lamp segments is identical to the pilot's torque indicator.

(2) CPG's engine torque indicator inputs

(a) The Lamp power supply - 0 to 5 VDC for manual dim bright control of the lamp segments

(b) No. 1 and No. 2 engine torque sensors

(c) CPG dim/test panel - manual dim/bright control and test of lamp segments and digital readouts

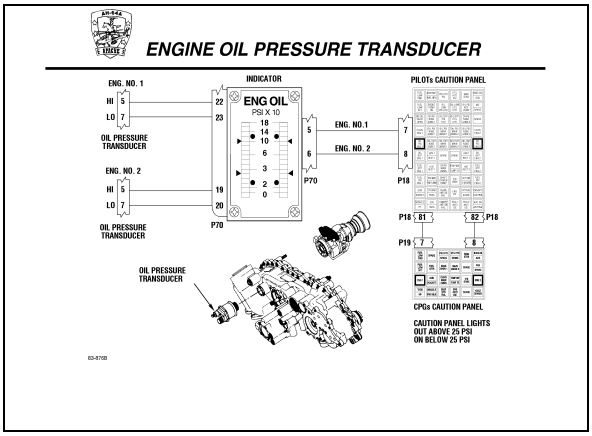
(d) SDD test switch testing of lamp segments and digital readouts

(e) CPG instrument lights panel dim/bright control of edge lighting

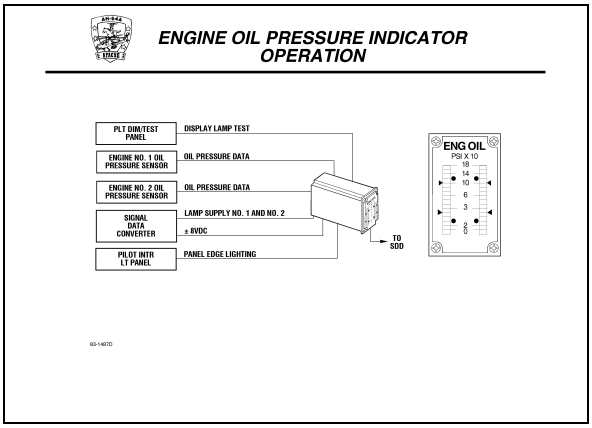
(f) SDC - operating voltages

j. Both the pilot's and the CPG's engine torque indicator systems accurate to within "0.5% of actual torque.

NOTE: Show slide # 24 (Engine Oil Pressure Transducer)



NOTE: Show slide # 25 (Engine Oil Pressure Indicator Operation)



k. Pilot's engine oil pressure indicator

(1) Engine oil pressure indicator inputs

(a) SDC

(b) No. 1 and No. 2 engine oil pressure sensor

(c) Pilot's dim/test panel

(d) Pilot's instrument lights panel

(2) Each vertical scale is color coded.

(a) Red zone - 120 to 180 PSI (120 maximum)

(b) Amber zone - 100 to 120 PSI (5 minute limit)

(c) Green zone - 28 to 100 PSI (normal operation)

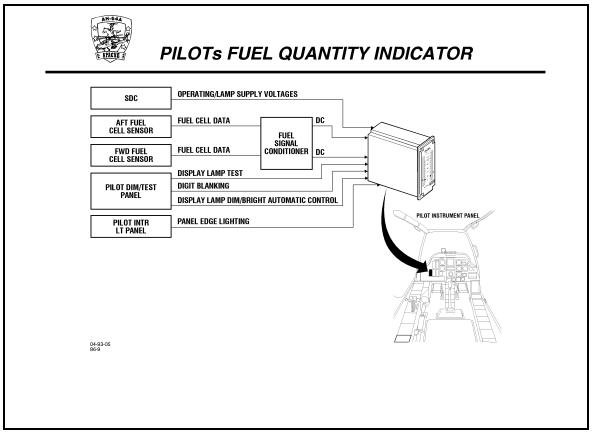
(d) Amber zone - 22 to 28 PSI (idle operation)

(e) Red zone - 0 to 22 PSI (22 minimum)

(3) The vertical scale light segment operation is the same as the ENG-RTR indicator. There are no digital displays on the engine oil pressure indicator.

(4) The engine oil pressure indication system is accurate to within " 2.25 PSI (116.35859 mmHg (torr)).

NOTE: Show slide # 26 (Pilots Fuel Quantity Indicator)



l. Pilots fuel quantity indicator

(1) Fuel quantity indicator inputs

(a) SDC.

(b) FSC (The fuel signal conditioner receives inputs from the forward and aft fuel cell sensors)

(c) Pilot's DIM/TEST panel

(d) Pilot's instrument lights panel

(2) The fuel quantity indicator has a three-digit digital display that shows the total fuel quantity of both cells.

(3) The vertical scale displays are color coded.

(a) Green - above 200 pounds

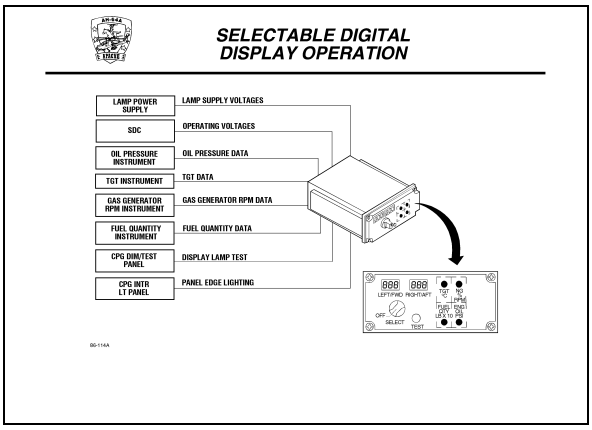
(b) Yellow - 100 to 200 pounds

(c) Red - 0 to 100 pounds

(4) Operation of the light segments is similar to that of the ENG-RTR indicator.

(5) The fuel quantity indicator system is accurate to within 4% of indicated quantity.

NOTE: Show slide # 27 (Selectable Digital Display Operation)



m. Selectable Digital Display (SDD)

(1) SDD inputs

(a) SDC

(b) Pilot's No. 1 and No. 2 oil pressure indicator

(c) Pilot's No. 1 and No. 2 TGT indicators

(d) Pilot's No. 1 and No. 2 N_G RPM indicators

(e) Pilot's fuel quantity indicator

(f) CPG's dim/test panel

(g) CPG's instrument lights panel

(2) The front face of the SDD contains:

(a) A five position OFF/SELECT switch .

(b) Two digital display windows marked LEFT/FWD and RIGHT/AFT.

(c) Four function-indicating lights.

1) TGT

2) N_G %

3) FUEL QTY LB X 10

4) ENG OIL PSI

(d) A test switch.

(3) The OFF/SELECT switch is used to turn the SDD on and off and to select which engine parameter the CPG wants to monitor.

(4) The indicating lights will illuminate when the appropriate position is selected with the OFF/SELECT switch.

(5) With the OFF/SELECT switch in the OFF position all power is removed from the SDD.

(6) OFF is the only switch position that is marked, however all positions are detented.

(7) Rotating the OFF/SELECT switch one detent clockwise from the OFF position will activate the engine oil pressure function.

(a) The LEFT/FWD digital display window will indicate the oil pressure value being displayed on the pilot's No. 1 oil pressure indicator. The RIGHT/AFT digital display window will indicate the oil pressure being displayed on the pilot's No. 2 oil pressure indicator.

(b) The digital display will indicate oil pressure in whole numbers. 50 PSI would be indicated by 050.

(c) The green ENG OIL PSI light will illuminate to indicate to the CPG that the engine oil pressure function is selected.

(8) Rotating the OFF/SELECT switch to the second detent will activate the fuel quantity function.

(a) The LEFT/FWD digital display window will indicate the pounds of fuel being displayed on the pilot's forward fuel quantity indicator. The RIGHT/AFT digital display window will indicate the pounds of fuel being displayed on the pilot's aft fuel quantity indicator.

(b) The digital display will indicate fuel quantity in pounds and must be multiplied by 10 for the correct value. 750 pounds of fuel would be indicated by 075.

(c) The green FUEL QTY LBSX10 light will illuminate to indicate to the CPG that the fuel quantity function is selected.

(9) Rotating the OFF/SELECT switch to the third detent will activate the TGT function.

(a) The LEFT/FWD digital display window will indicate the value of TGT being displayed on the pilot's No. 1 TGT indicator. The RIGHT/AFT digital display window will indicate the value of TGT being displayed on the pilot's No. 2 TGT indicator.

(b) The digital displays will indicate TGT in whole numbers.

(c) The green TGT °C light will illuminate to indicate to the CPG that the TGT function is selected.

(10) Rotating the OFF/SELECT switch to the fourth detent will activate the N_G function.

(a) The LEFT/FWD digital display window will indicate the value of the N_G RPM being displayed on the pilot's No. 1 N_G indicator. The RIGHT/AFT digital display window will indicate the value of the N_G RPM being displayed on the pilot's No. 2 N_G indicator.

(b) The N_G will be displayed in whole numbers and tenths.

(c) The green N_G RPM light will illuminate to indicate to the CPG that the N_G function is selected.

(11) The SDD lights and digital displays can be tested by pressing the TEST switch.

(a) The digital display windows will display all eights.

(b) All four green lights will illuminate.

(c) The CPG's torque and ENG-RTR RPM indicator will illuminate full scale for 3 seconds, then extinguish.

(d) The brightness of the digital displays and the green indicator lights is controlled by the CPG's dim/test panel.

Learning Activity 9

Type of Instruction: C

Instructor to Student Ratio: 1:Class

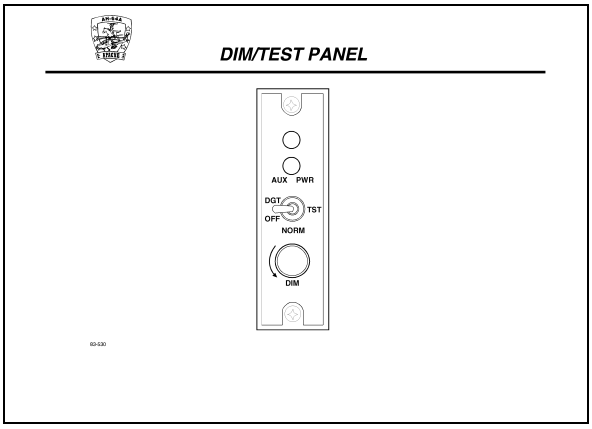
Time of Instruction: 0.2 Hours

071-616-04

Media: 35mm Slides

NOTE: Ask check questions throughout the learning activity.

NOTE: Show slide # 28 (Dim/Test Panel)



NOTE: Show Dim/Test panel bench maintenance component.

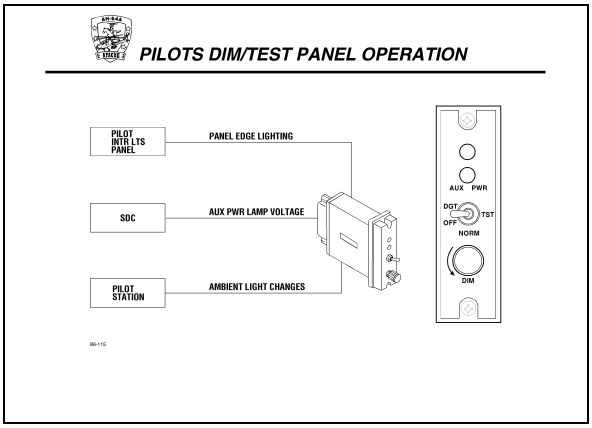
I. Dim/Test panels

1. The pilot's and CPG's Dim/Test panels are identical and interchangeable but the automatic dim and AUX PWR features are not active for the CPG's panel.

2. The Dim/test panel is an automatic dimming photocell that works in conjunction with the DIM manual adjustment to maintain a selected intensity of the Marconi instrument's vertical scale lights.

3. The front face of the Dim/Test panel contains a photocell, an AUX PWR indicator light, a mode control/test switch and a DIM adjustment knob.

NOTE: Show slide # 29 (Pilots Dim/Test Panel Operation)



4. Pilot's Dim/Test panel

a. Dim/Test panel inputs

(1) Pilot's instrument lights panel for edge lighting control

(2) SDC for SDC power supply monitoring

(3) Photocell on the dim/test panel

b. The front face of the dim/test panel contains:

(1) Automatic dimming photocell - works in conjunction with the DIM adjustment to maintain a selected level of relative intensity on all of the Marconi vertical scales in the pilot's station.

(2) AUX PWR indicator light - will illuminate if either of the lamp power supplies within the signal data converter fails or if either ENG INST circuit breakers are pulled.

(a) If the ENG INST circuit breaker in the CPG's station is opened or the SDC lamp power supply circuit fails, every other lamp segment will extinguish on all Marconi instruments in the pilot's station and all No. 2 engine digital read outs will extinguish.

(b) If the ENG INST circuit breaker is opened or the SDC lamp power supply fails, every other lamp segment on Marconi instruments in the pilot station will extinguish and all No. 1 engine digital readouts will extinguish.

(3) Mode control switch - three position switch is spring loaded from the TEST position to OFF, the functions are:

(a) NORM - the vertical tapes and digital displays indicate

normally.

(b) DGT OFF - the vertical scales indicate normally and the digital displays are disabled.

(c) TEST - pilot's Marconi instrument vertical scales will illuminate sequentially from the bottom to full scale for three seconds, then extinguish. All digital displays will display eights.

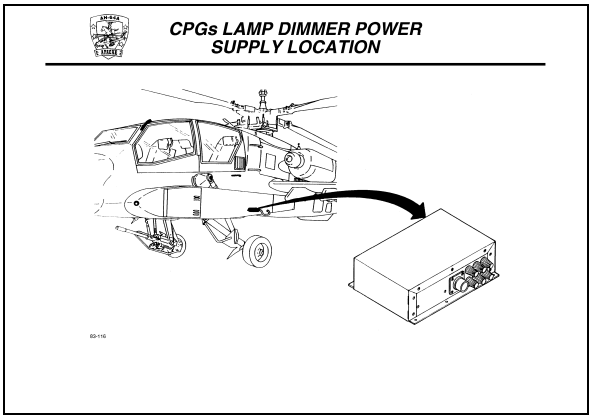
(4) DIM control - initially set to a desired intensity by the pilot.

(a) The automatic dimming photocell will maintain the selected lamp intensity relative to ambient light intensity.

(b) The DIM switch and photocell control the intensity of all Marconi instruments in the pilot's station.

5. CPG's Dim/Test panel

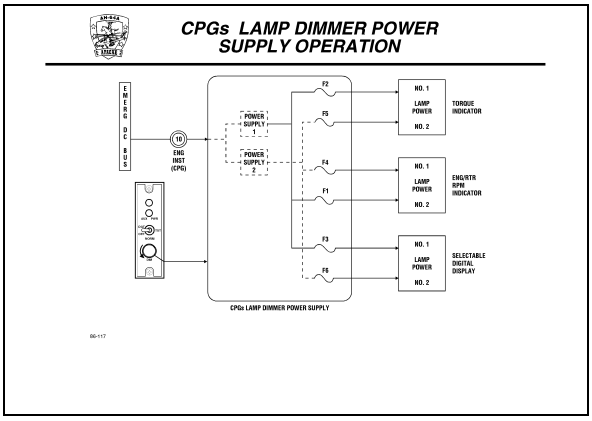
NOTE: Show slide # 30 (CPGs Lamp Dimmer Power Supply Location)



a. The Dim/Test panel in the CPG's station controls the output of the dimmer power supply for the Marconi Instruments in the CPG station.

b. The dimmer power supply is located behind access panel L140, above the left main landing gear.

NOTE: Show slide # 31 (CPG's Lamp Dimmer Power Supply Operation)



c. The Dimmer Power Supply is powered by the emergency DC bus via the ENG INST circuit breaker. The 28 VDC input is supplied to two power supplies that develop a 0-5 VDC output.

d. The CPG can adjust the brightness of the ENG-RTR RPM indicator vertical scales, the torque indicator vertical scales, the green advisory light on the SDD, and the digital readouts on the SDD by rotating the DIM knob on the Dim/Test panel.

e. The DIM knob controls the output of the power supplies in the Dimmer from 0 (off) to 5 VDC (maximum).

f. The test switch is a 3-position switch.. The center (OFF) position is spring loaded from the TEST position. When TEST is selected, all of the lamp segments, digital readouts, and indicator lights will illuminate just as they do when the SDD TEST switch is actuated.

g. The photocell and AUX PWR light have no function in the CPG station.

h. If one of the power supplies fails, every other lamp segment will extinguish and one of the digital readouts will extinguish.

i. If the ENG INST circuit breaker is opened, all scales and readouts in the CPG's station will extinguish; the engine instruments and SDD will be inoperative.

NOTE: Conduct a check on learning and summarize the learning activities. Discuss the learning activities using the examples provided. Make on-the-spot corrections as necessary.

Examples:

1. What engine instruments are in both crew stations?

Answer: The ENG-RTR RPM indicators and the torque indicators.

2. What component supplies N_G speed information to the SDD?

Answer: The pilot's N_G RPM indicator.

3. How would 102.5% N_G be displayed on the digital read-out of the pilot's N_G indicator?

Answer: 025

4. What is meant by the term optimistic scaling?

Answer: Optimistic scaling means, for example, that for proper indication of 100 percent N_P/N_R the segments immediately above the instrument index line for 100 percent should be at the threshold of illumination.

5. What does the blue light on the vertical scale instruments indicate?

Answer: Power is applied to the indicator

6. How many functional chromel-alumel TGT sensors are for a TGT reading to be indicated?

Answer: 1

7. Where does the SDD receive oil pressure, TGT, N_G RPM, and fuel quantity inputs from?

Answer: The pilot's indicators respectively

8. Are automatic dim and AUX PWR features active for the CPG's Dim/Test panel?

Answer: No

9. What will happen to the pilot's instruments if the ENG INST circuit breaker is opened?

Answer: Every other lamp segment on Marconi instruments in the pilot station will extinguish and all No. 1 engine digital readouts will extinguish.

ENABLING LEARNING OBJECTIVE 2:

NOTE: Read the enabling learning objective to the students.

After this lesson you will:

ACTION: Identify the characteristics of the AH-64A's flight instrument systems.

CONDITIONS: Given TM 1-1520-238-T and TM 55-1520-238-23 series manuals, and the student handout.

STANDARDS: Identify by selecting from a list, the characteristics of the AH-64A's flight instrument systems, with a minimum of 70% accuracy.

Learning Activity 1

Type of Instruction: C

Instructor to Student Ratio: 1:Class

Time of Instruction: 0.2 Hours

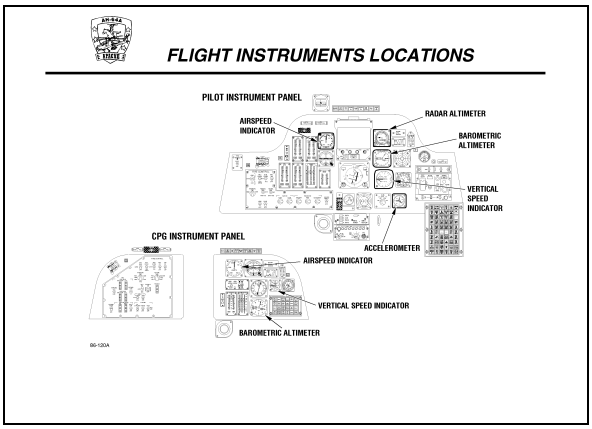
Media: 35mm Slides

NOTE: Ask check questions throughout the learning activity.

A. Flight instruments

1. The flight instruments give the crew a visual indication of airspeed, vertical speed, altitude and "g" (gravity) forces.

NOTE: Show slide # 32 (Flight Instruments Locations)



2. The flight instruments are located on the pilot's and CPG's instrument panels.

a. Pilot's flight instruments

(1) Airspeed indicator

(2) Barometric altimeter

(3) Radar Altimeter

(4) Accelerometer

(5) Vertical speed indicator

b. CPG's flight instruments

(1) Airspeed indicator

(2) Barometric altimeter
(3) Vertical speed indicator

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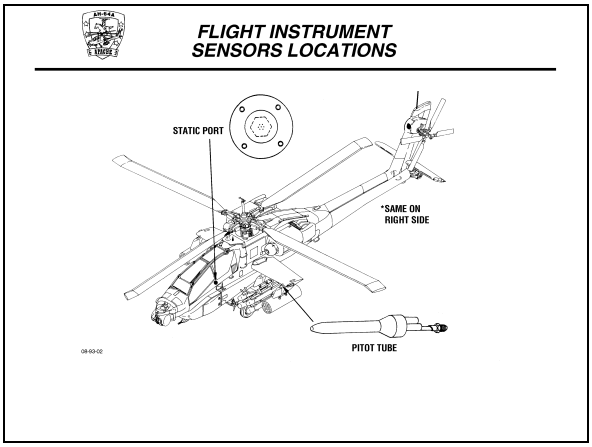
NOTE: Show slide # 33 (Flight Instrument Sensors Locations)



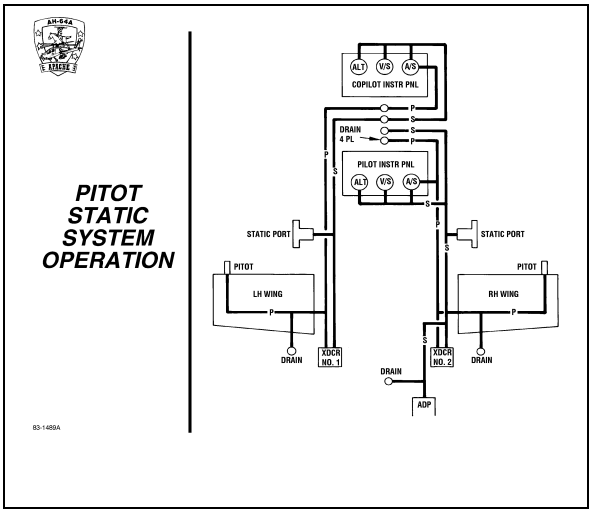
3. A pitot static system installed on the helicopter provides ram and static (outside) air for operation of selected flight instruments.

a. Pitot tubes and static ports

(1) One pitot tube is located on each wing.

(2) One static port is located on each side of the fuselage near the crew stations.

NOTE: Show slide # 34 (Pitot Static System Operation)



b. Pitot static system operation

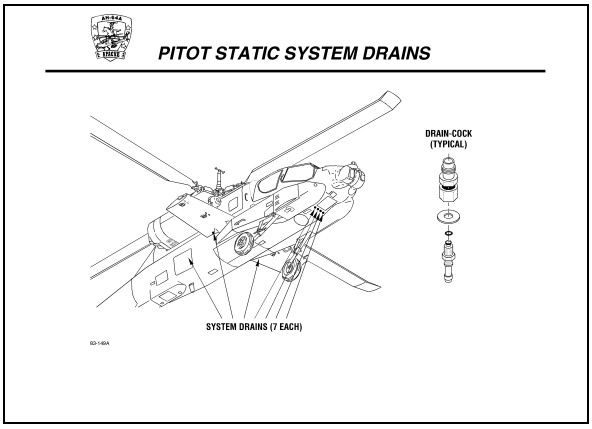
(1) The right pitot tube provides ram air to the pilot's airspeed indicator and the No. 2 airspeed transducer.

(2) The left pitot tube provides ram air to the CPG's airspeed indicator and the No. 1 airspeed transducer.

(3) The right static port is connected to the pilot's flight instruments and the No. 2 airspeed transducer.

(4) The left static port is connected to the CPG's flight instruments and the No. 1 airspeed transducer.

NOTE: Show slide # 35 (Pitot Static System Drains)



(5) Seven system drains exist to evacuate contaminates from the pitot static system.

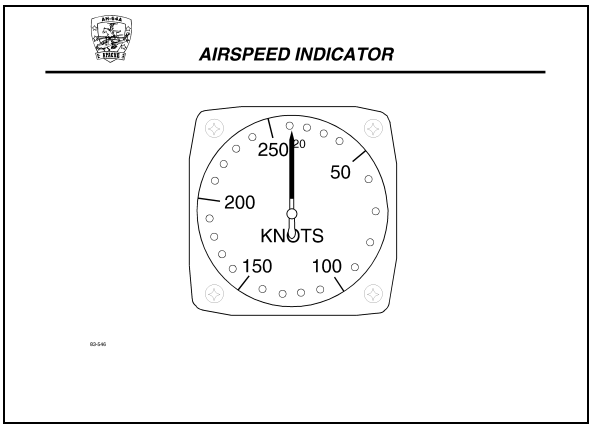
Learning Activity 2

Type of Instruction:	C
Instructor to Student Ratio:	1:Class
Time of Instruction:	0.2 Hours
Media:	35mm Slides

NOTE: Ask check questions throughout the learning activity.

B. Flight instrument system components

NOTE: Show slide # 36 (Airspeed Indicator)



1. Airspeed indicators

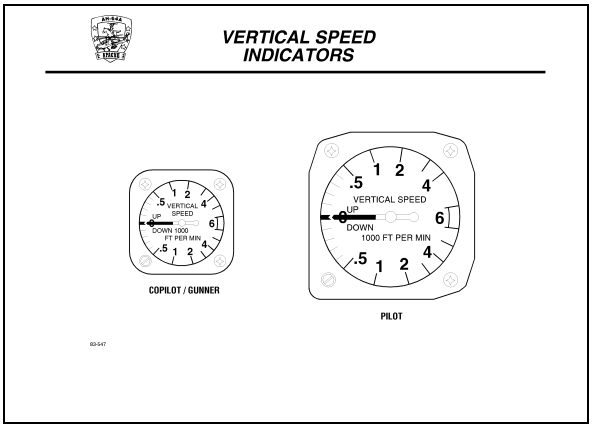
   a. The airspeed indicators have a three inch diameter face graduated from 0 to 250 knots.

   b. Each airspeed indicator consists of an airtight diaphragm and a mechanical multiplier enclosed in an airtight case.

   c. The diaphragm is connected to the pitot tube.

   d. Accuracy is " 3.5 KIAS.

NOTE: Show slide # 37 (Vertical Speed Indicators)



2. Vertical speed indicators (VSIs)

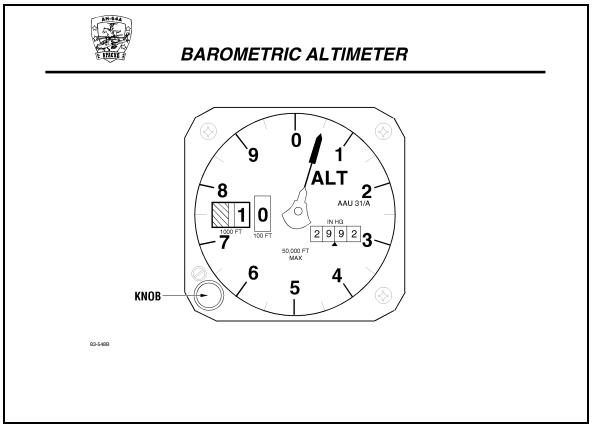
   a. The VSI displays vertical speed, either up or down, to a maximum of 6000 feet per minute.

b. The pilot's VSI has a 3-inch diameter face and the CPG's has a two-inch diameter face.

c. The pointer is adjustable by movement of the adjustment screw in the lower left side of the instrument face.

d. Accuracy is " 100 fpm.

NOTE: Show slide # 38 (Barometric Altimeter)



3. Barometric altimeter

a. The barometric altimeters display altitude from minus 1000 feet to 50,000 feet above sea level.

b. The IN HG window displays barometric pressure in inches of mercury. The pilot and CPG set current barometric pressure in the window by using the knob on the lower left corner of the case.

c. The pointer indicates hundreds of feet and makes one revolution every 1000 feet.

d. The 100 foot readout tracks the pointer. It displays altitude up to 900 feet and resets to zero every 1000 feet.

e. The 1000 FT readout records the number of times the pointer makes one revolution.

f. Accuracy is " 65 ft. of actual altitude. Replacement is required if accuracy is not within " 50 ft of actual altitude (TM 1-1500-204-23-4 table 4-11).

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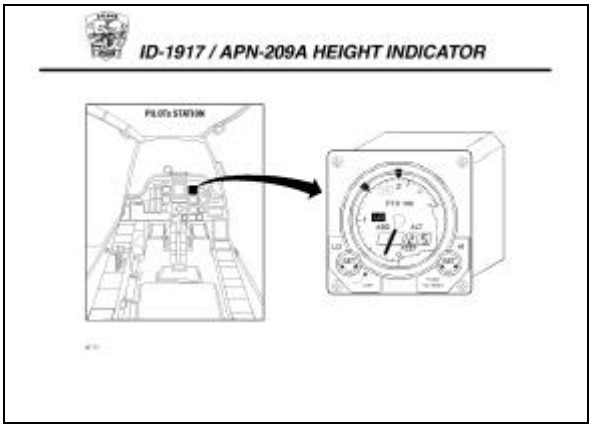
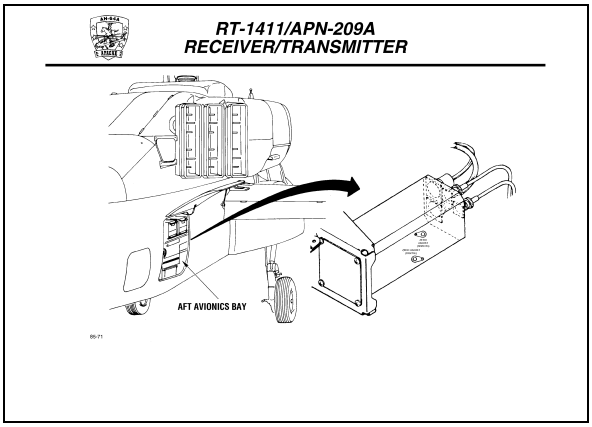
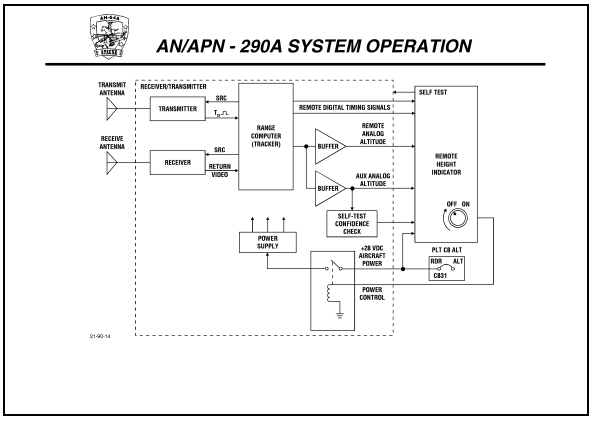
NOTE: Show slide # 39 (ID-1917/APN-209A Height Indicator)



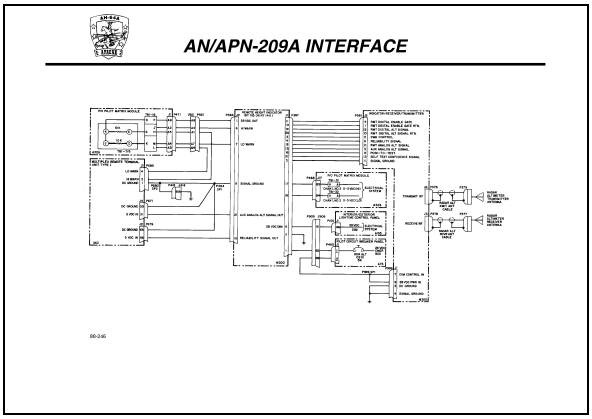
NOTE: Show slide # 40 (RT-1411/APN-209A Receiver Transmitter)



NOTE: Show slide # 41 (AN/APN-209A System Operation)



NOTE: Show slide # 42 (AN/APN-209A Interface)



4. Radar altimeter

   a. Standard AN/APN-209 Radar Altimeter installation is used.

   b. Adjustments are made at the receiver/transmitter

   c. Analog display drives symbology on H.O.D. (VDU, HDU, ORT)

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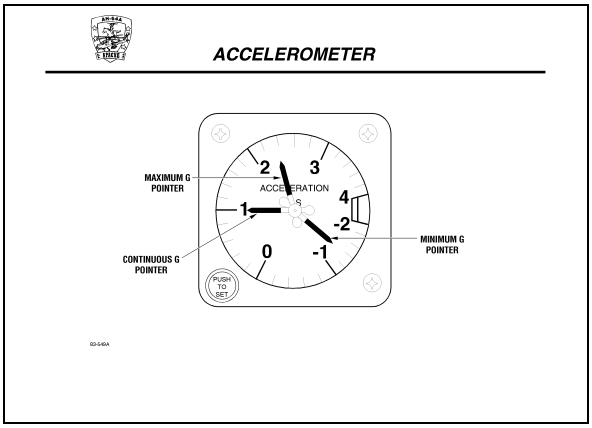
NOTE: Show slide # 43 (Accelerometer)



5. Accelerometer

a. The indicator shows positive and negative changes in gravity force.

b. Positive gravity forces can be measured up to +4g. Negative (g) forces are measured down to -2g.

c. The maximum g-reading pointer indicates positive g forces and the minimum g-reading pointer indicates negative g forces.

d. The continuous g-reading pointer shows actual g forces on the aircraft at a given moment.

e. The minimum and maximum pointers follow the continuous pointer but stop and stay at the largest reading reached. Pushing the PUSH TO SET knob resets the pointers to +lg.

NOTE: The AH-64A g-force limitations are from -0.5 to +3.5 (when maneuvering at an optimum combination of gross weight, true airspeed, and density altitude).

NOTE: Conduct a check on learning and summarize the learning activities. Discuss the learning activities using the examples provided. Make on-the-spot corrections as necessary.

Examples:

1. What components do the left pitot tube and static port connect too?

Answer: CPG's airspeed indicator and flight instruments, and No. 1 airspeed transducer

2. Where are adjustments made for the radar altimeter?

Answer: Adjustments are made at the receiver/transmitter

ENABLING LEARNING OBJECTIVE 3:
NOTE: Read the enabling learning objective to the students.

After this lesson you will:

ACTION: Identify the characteristics of the AH-64A's flight reference instrument systems.

CONDITIONS: Given TM 1-1520-238-T and TM 55-1520-238-23 series manuals, and the student handout.

STANDARDS: Identify by selecting from a list, the characteristics of the AH-64A's flight reference instrument systems, with a minimum of 70% accuracy.

Learning Activity 1

Type of Instruction: C

Instructor to Student Ratio: 1:Class

Time of Instruction: 0.1 Hours

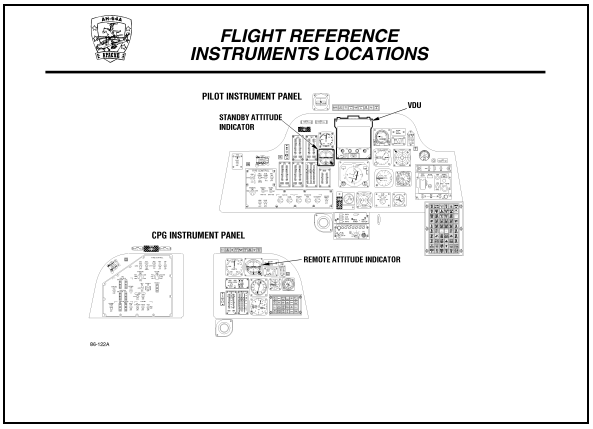
Media: 35mm Slides

NOTE: Ask check questions throughout the learning activity.

A. Flight reference instruments

1. The flight reference instruments provide visual displays of helicopter attitude and flight conditions.

NOTE: Show slide # 44 (Flight Reference Instruments Locations)



2. The flight reference instruments located on the pilot's and CPG's instrument panels.
   a. Pilot's flight reference instruments

      (1) Standby attitude indicator
      (2) Video display unit (VDU)

b. CPG's remote attitude indicator (RAI)

Learning Activity 2

Type of Instruction: C

Instructor to Student Ratio: 1:Class

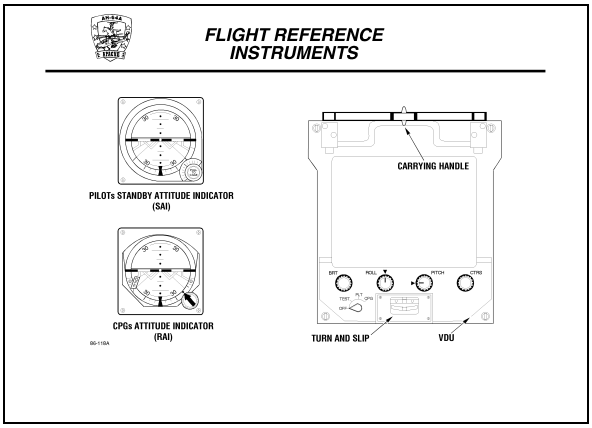
Time of Instruction: 0.2 Hours

Media: 35mm Slides

NOTE: Ask check questions throughout the learning activity.

B. Flight reference instrument system components

NOTE: Show slide # 45 (Flight Reference Instruments)



1. Standby attitude indicator (Pilot's station)

a. The standby attitude indicator is a self-contained, motor-driven gyro that is powered by the emergency DC bus and provides the pilot with an independent, continuous display of helicopter attitude.

b. The standby attitude indicator can display 360 degrees of roll, and 85 degrees of climb or dive.

c. The two-colored sphere is divided in half by a distinct white horizon line. The upper half of the sphere is grey and the lower half is black.

d. Degree of pitch is scaled and numbered on both halves and degree of roll is marked by white lines on the bottom half of the casing.

e. Helicopter attitude is read by viewing the fixed aircraft symbol against the gyroscope markings.

f. The PULL-TO-CAGE knob, when pulled, locks the sphere in the center

position. When rotated, the knob adjusts the pitch of the sphere.

g. When electrical power is lost, or the indicator is caged, the OFF warning flag will appear.

2. Remote attitude indicator (RAI)

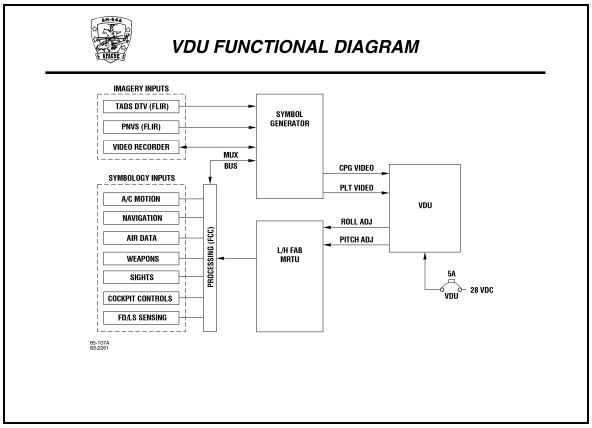
a. The remote attitude indicator provides the CPG with a display of aircraft attitude.

b. The RAI can display aircraft pitch attitude up to plus and minus 90 degrees and roll attitude up to 360 degrees.

c. The RAI is driven by HARS, with an accuracy of not less than + 1 degree for pitch and roll attitudes up to 30 degrees. (+ 2 degrees applies beyond those limits).

d. The RAI is colored, scaled, and marked similar to the pilot's SAI.

NOTE: Show slide # 46 (VDU Functional Diagram)



3. Video display unit (VDU)

a. The VDU provides the pilot with an integrated display of flight reference information or the ability to monitor the video that is selected by the CPG.

b. The VDU is a direct view cathode ray tube (CRT).

c. VDU controls

(1) Function select - OFF, TEST, PILOT, CPG.

(2) Display controls - BRT-CTRS.

(3) Attitude trim - PITCH and ROLL. Setting the pitch and roll knobs to the white reference marks will set the symbolic horizon line to the HARS horizon.

4. Turn and slip indicator

a. The Turn and slip indicator is located at the bottom of the VDU.

b. Consists of a side slip indicator and a standard rate of turn needle (turn needle driven by DASE).

c. Each index width on turn indicator represents a 3 degree per second turn.

NOTE: Conduct a check on learning and summarize the learning activities. Discuss the learning activities using the examples provided. Make on-the-spot corrections as necessary.

Examples:

1. What is the only flight reference instrument in the CPG cockpit?

Answer: RAI

2. What component drives the RAI?

Answer: HARS

3. What two conditions will cause the OFF warning flag will appear on the pilot's SAI?

Answer: When electrical power is lost, or the indicator is caged

4. What drives the turn and slip indicator's turn needle?

Answer: Turn needle driven by DASE

ENABLING LEARNING OBJECTIVE 4:

NOTE: Read the enabling learning objective to the students.

After this lesson you will:

ACTION: Identify the characteristics of the AH-64A's navigation instrument systems.

CONDITIONS: Given TM 1-1520-238-T and TM 55-1520-238-23 series manuals, and the student handout.

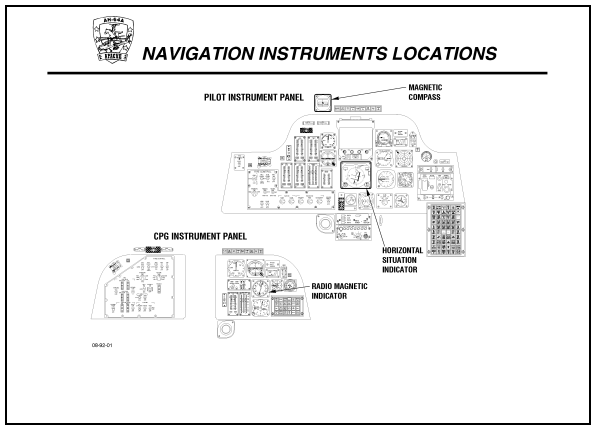
STANDARDS: Identify by selecting from a list, the characteristics of the AH-64A's navigation instrument systems, with a minimum of 70% accuracy.

Learning Activity 1

Type of Instruction:	C
Instructor to Student Ratio:	1:Class
Time of Instruction:	0.1 Hours
Media:	35mm Slides

NOTE: Ask check questions throughout the learning activity.

NOTE: Show slide # 47 (Navigation Instruments Locations)



A. Navigation instrument systems

1. The navigation instruments measure and display position, heading, and course with relation to the earth.

2. The navigation instruments are located on the pilot's and CPG's instrument panels.

a. Pilot's instrument panel

(1) Magnetic compass

(2) Horizontal situation indicator (HSI)

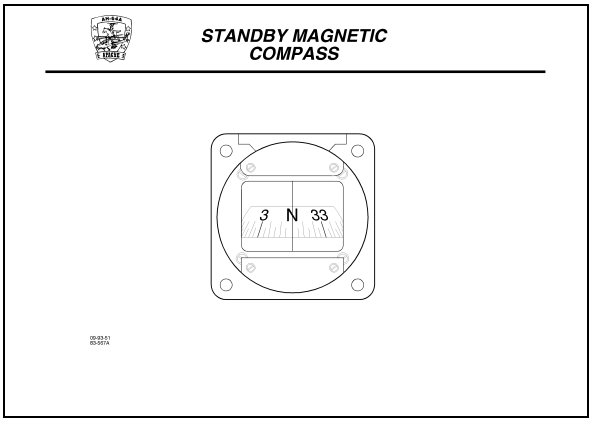
b. CPG's radio magnetic indicator (RMI)

Learning Activity 2

Type of Instruction:	C
Instructor to Student Ratio:	1:Class
Time of Instruction:	0.2 Hours
Media:	35mm Slides

NOTE: Ask check questions throughout the learning activity.

NOTE: Show slide # 48 (Standby Magnetic Compass)



B. Navigation instrument system components

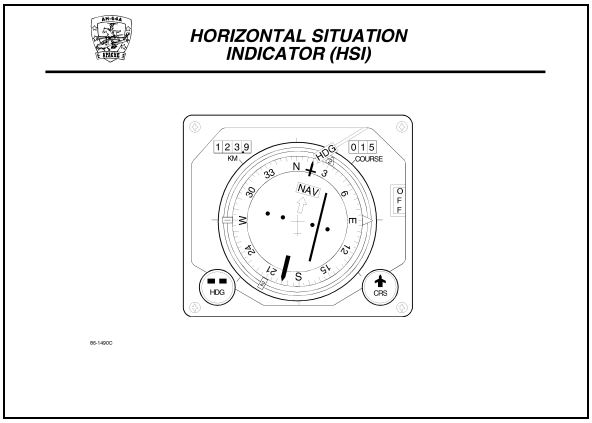
1. Magnetic compass

a. The magnetic compass displays the aircraft magnetic heading in relation to magnetic north. It displays headings from 0 through 360 degrees.

b. The magnetic compass is liquid-filled to keep vibrations from affecting its operation.

c. Calibration is required every 12 months, after engine changes or aircraft modifications that may have affected the electro-magnetic field. Calibration procedures are per TM 55-1520-204-23-4.

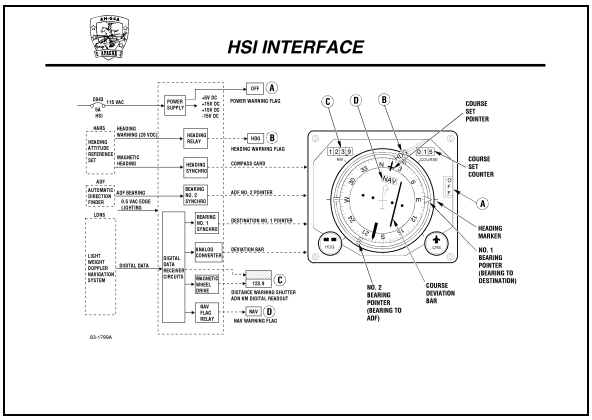
NOTE: Show slide # 49 (Horizontal Situation Indicator (HSI))



2. Horizontal situation indicator (HSI)

a. The HSI is an electro-mechanical indicator that presents position information in relation to various navigational inputs.

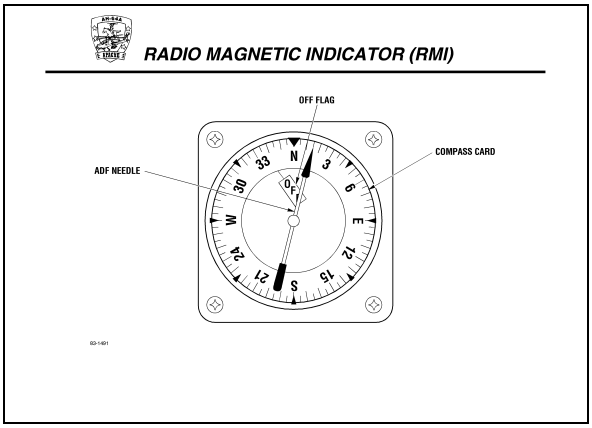
NOTE: Show slide # 50 (HSI Interface)



NOTE: Discuss the various HSI displays.

b. The HSI is driven by the HARS, LDNS and ADF systems, is accurate to within 0.5 degrees and requires no calibration.

NOTE: Show slide # 51 (Radio Magnetic Indicator [RMI])



3. Radio magnetic indicator (RMI)

a. The RMI provides the CPG with remote monitoring of magnetic heading and ADF bearing to a selected station.

b. The RMI is driven.by the HARS and ADF.

c. The front display panel contains:

(1) A compass card that is free to rotate 360 degrees.
(2) An ADF bearing pointer.

(3) An OFF warning flag.

NOTE: Conduct a check on learning and summarize the learning activities. Discuss the learning activities using the examples provided. Make on-the-spot corrections as necessary.

Examples:

1. When is calibration of the magnetic compass required?

Answer: Calibration is required every 12 months, after engine changes or aircraft modifications that may have affected the electro-magnetic field.

2. Does the HSI require calibration?

Answer: No

3. What drives the RMI?

Answer: The RMI is HARS driven.

ENABLING LEARNING OBJECTIVE 5:

NOTE: Read the enabling learning objective to the students.

After this lesson you will:

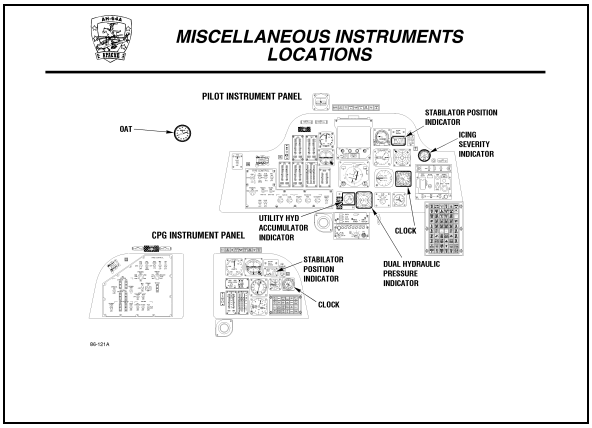
ACTION:	Identify the characteristics of the AH-64A's miscellaneous instruments.
CONDITIONS:	Given TM 1-1520-238-T and TM 55-1520-238-23 series manuals, and the student handout.
STANDARDS:	Identify by selecting from a list, the characteristics of the AH-64A's miscellaneous instruments, with a minimum of 70% accuracy.

Learning Activity 1

Type of Instruction:	C
Instructor to Student Ratio:	1:Class
Time of Instruction:	0.1 Hours
Media:	35mm Slides

NOTE: Ask check questions throughout the learning activity.

NOTE: Show slide # 52 (Miscellaneous Instruments Locations)



A. Miscellaneous instruments

1. The miscellaneous instruments display hydraulic pressure, stabilator position, icing severity, outside air temperature, and time.

2. The miscellaneous instruments are located on the pilot's and CPG's instrument panels.

a. Pilot's station

(1) Stabilator position indicator

(2) Icing severity indicator

(3) Clock

(4) Utility HYD accumulator indicator

(5) Dual hydraulic pressure indicator

(6) Outside air temperature indicator

b. CPG's instrument panel

(1) Stabilator position indicator

(2) Clock

Learning Activity 2

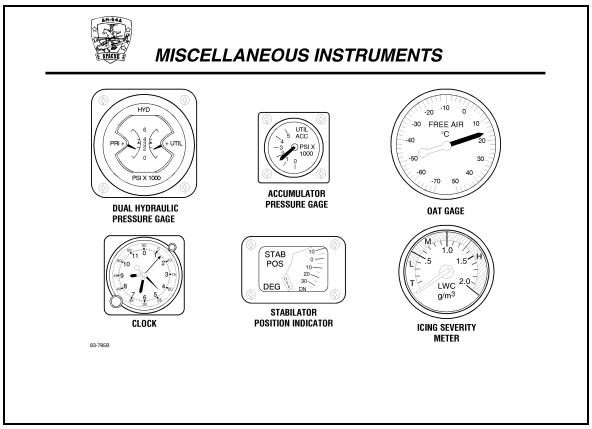
Type of Instruction: C

Instructor to Student Ratio: 1:Class

Time of Instruction: 0.2 Hours
Media: 35mm Slides

NOTE: Ask check questions throughout the learning activity.

NOTE: Show slide # 53 (Miscellaneous Instruments)



B. Miscellaneous instrument components

1. Stabilator position indicator

   a. The stabilator position indicator provides a visual indication of the stabilator position in 5 degree increments from 10 degrees (up) to 35 degrees (down).

   b. The stabilator position indicator has a scaled dial, a dial pointer and an OFF flag.

2. Icing severity indicator

   a. The icing severity indicator is divided into four sections which indicate the degree of icing severity.

      (1) Trace - 0.00 to 0.25 LWC grams per cubic meter

      (2) Light - 0.25 to 0.50 LWC grams per cubic meter

      (3) Moderate - 0.50 to 1.0 LWC grams per cubic meter

      (4) Heavy - 1.0 to 2.0 LWC grams per cubic meter

   b. A PRESS-TO-TEST switch is mounted next to the indicator. When depressed, checks the indicator for 3/4 scale deflection.

   c. The ice detector probe and the LWC Gage are not monitored by FD/LS.

3. Clock

   a. The clocks show time of day in hours, minutes, and seconds, and elapsed time in minutes.

b. The clocks are located on the pilot and CPG intrument panels.

c. The clocks are edge lighted and each clock has:

(1) An hour hand

(2) A minute hand

(3) A second sweep hand

(4) An elapsed time hand

(5) A wind/Set knob

(6) An elapsed time push-button knob

4. Utility hydraulic accumulator pressure indicator

a. The utility hydraulic pressure indicator is edge-lighted and displays hydraulic pressure from 0 to 5000 psi.

b. The indicator main parts are a numbered, scaled dial, a dial pointer, and a meter movement.

5. Dual hydraulic pressure indicator

a. The dual hydraulic pressure indicator is edge-lighted and displays primary and utility hydraulic pressure from 0 to 6000 psi.

b. The indicator has a dual scaled dial numbered 0, 2, 3, 4, and 6. Each number equals hydraulic pressure in thousands of pounds.

c. Each scale has a pointer, and each pointer is connected to a meter movement.

6. Outside air temperature indicator

a. The outside air temperature indicator has a luminous dial for night reading and shows temperature from -70°C to +50°C.

b. The indicator has:

(1) A bimetallic sensing element inside an open-ended sun shield.

(2) A mechanical movement.

(3) A numbered, scaled dial.

(4) A dial pointer.

NOTE: Conduct a check on learning and summarize the learning activities. Discuss the learning activities using the examples provided. Make on-the-spot corrections as necessary.

Examples:

1. When the icing severity indicator PRESS-TO-TEST switch is depressed, what is the proper indication?

Answer: : scale deflection

2. Does the outside air temperature indicator have edge lighting for night reading?

Answer: No, it has a luminous dial for night reading

ENABLING LEARNING OBJECTIVE 6:

NOTE: Read the enabling learning objective to the students.

After this lesson you will:

ACTION:	Identify the characteristics of the AH-64A's air data subsystem.
CONDITIONS:	Given TM 1-1520-238-T and TM 55-1520-238-23 series manuals, and the student handout.
STANDARDS:	Identify by selecting from a list, the characteristics of the AH-64A's air data subsystem, with a minimum of 70% accuracy.

Learning Activity 1

Type of Instruction:	C
Instructor to Student Ratio:	1:Class
Time of Instruction:	0.1 Hours
Media:	35mm Slides

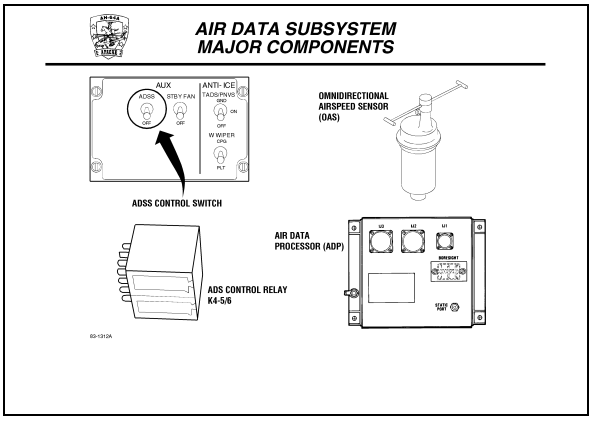
NOTE: Ask check questions throughout the learning activity.

NOTE: This lesson includes the ADSS purpose, individual component location, description, purpose, and operation, circuit protection and system interface.

A. Air data subsystem (ADSS)

1. The ADSS provides airspeed and air mass data for use by the fire control system (FCS), digital automatic stabilization equipment (DASE), stabilator system, display systems, and navigation systems.

NOTE: Show slide # 54 (Air Data Subsystem Major Components)



2. ADSS major components

   a. ADSS Control Switch

   b. ADS Control Relay (ADS CONT RLY) K4-5/6

   c. Omni-directional Airspeed Sensor (OAS)

   d. Air Data Processor (ADP)

Learning Activity 2

Type of Instruction:	C
Instructor to Student Ratio:	1:Class
Time of Instruction:	0.9 Hours
Media:	35mm Slides

NOTE: Ask check questions throughout the learning activity.

B. Air data subsystem components

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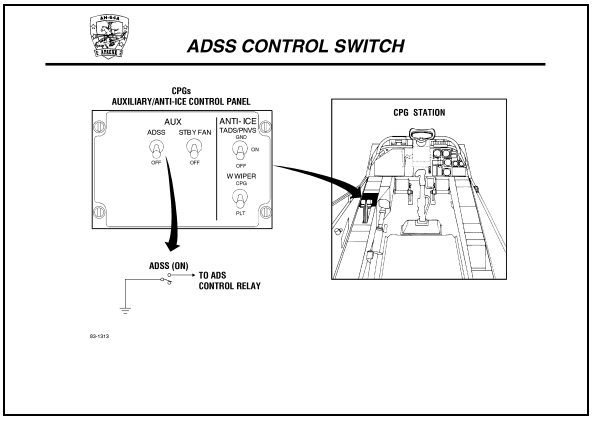
NOTE: Show slide # 55 (ADSS Control Switch)



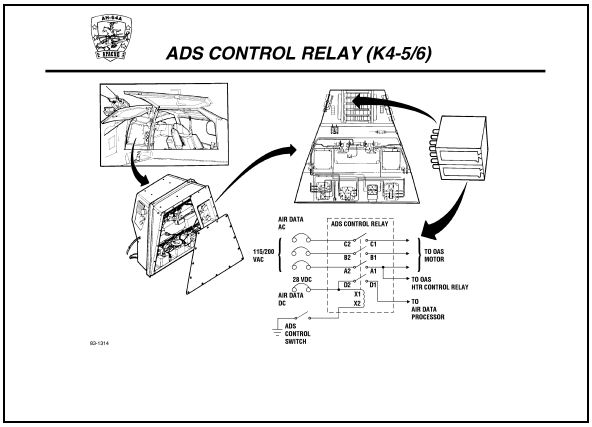
1. ADSS control switch

   a. Purpose: Allows the CPG to control the ADSS operation.

   b. Location: The ADSS control switch is located on the AUX/ANTI-ICE control panel on the CPG's left console.

   c. Description: The ADSS control switch is a single pole, double-throw, two-position toggle switch.

NOTE: Show slide # 56 (ADS Control Relay [K4-5/6])



2. ADSS control relay (K4-5/6)

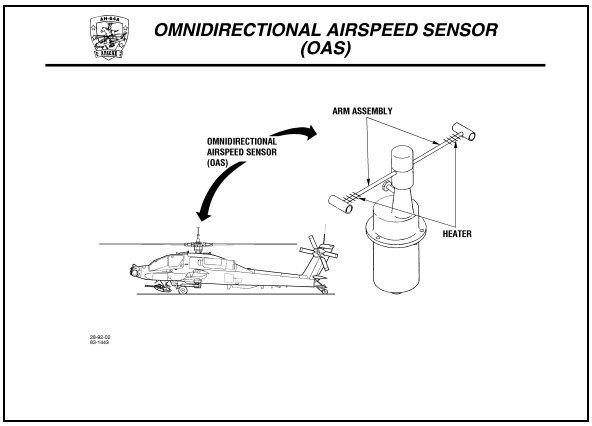
   a. Purpose: Controls AC and DC power to the omni-directional airspeed sensor and air data processor respectively.

   b. Location: Located in the electrical power distribution center behind the pilot's seat.

   c. Description: A small (1 inch x 1 inch x 1 inch), lightweight, line replaceable

unit (LRU).

NOTE: Show slide # 57 (Omnidirectional Airspeed Sensor [OAS])

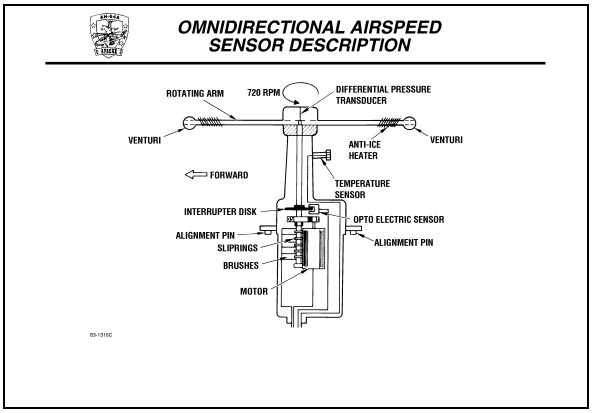


3. Omni-directional airspeed sensor (OAS)

a. Purpose: Senses airspeed and ambient temperature and provides it to the air data processor (ADP) for processing.

b. Location: The OAS is mounted above the main rotor hub on a non-rotating standpipe.

NOTE: Show slide # 58 (Omnidirectional Airspeed Sensor Description)



c. Description: OAS components

(1) Three phase induction motor. The OAS contains a three-phase, 115/200 vac motor which drives the rotating arms counter-clockwise at 720 RPM.

(2) Sensors and differential pressure transducer. The OAS consists of a pair of opposed spinning venturi like sensors with a differential pressure

transducer suspended between them.

(a) The wind/air speed adds velocity through the advancing venturi and subtracts it through the retreating venturi.

(b) Differential Pressure Transducer:

1) Is powered by + and - 15 VDC from the ADP.

2) Measures the pressure differential in the two sensors.

(3) Temperature Sensor

(a) Is mounted to the rear of the OAS body.

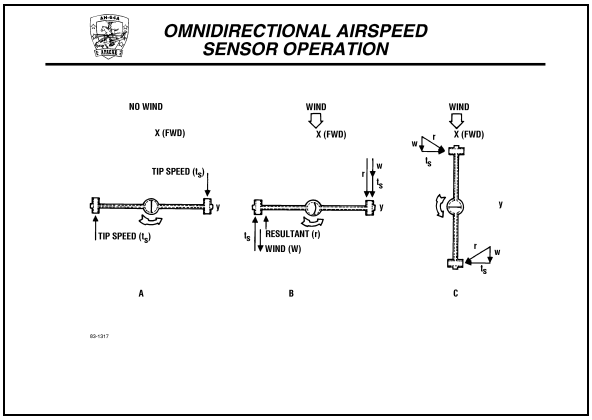
(b) Provides outside air temperature (OAT) information to the ADP. The OAT information is used by the ADP to convert measured airspeed outputs to true values.

(4) Anti-Icing

(a) Heating elements are located in the rotating arms

(b) Provides anti-ice capabilities

NOTE: Show slide # 59 (Omnidirectional Airspeed Sensor Operation)



d. Operation: OAS

(1) With three-phase, 115/200 vac applied to the OAS motor, the arms rotate 720 RPM in a counterclockwise direction.

(2) During no-wind operation (A) the air flow through both venturis is equal and no differential pressure exists between the two arms.

(3) With equal pressure in both arms, the differential pressure transducer output is 0 VDC.

(4) When wind is introduced into the plane of rotation (B) it adds to the tip speed of the advancing venturi and subtracts from the tip speed of the retreating venturi.

(5) The pressure is lower in the advancing arm than in the retreating arm.

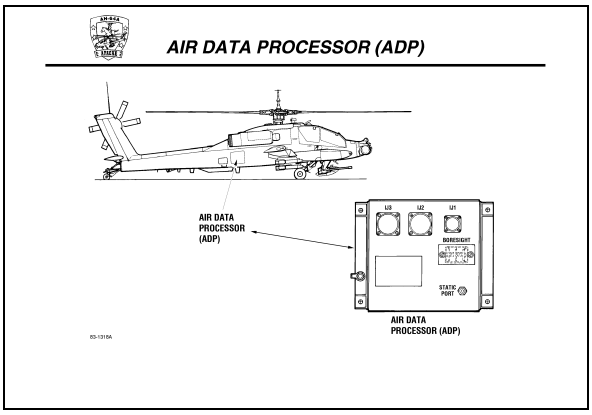
(6) The transducer develops a DC output proportional to the differential pressure.

(7) When the wind flow is at right angles to the venturi arms (C) the air flow is equal, no differential pressure exists, and electrical output is 0 VDC.

(8) As the arms rotate, the differential pressure and transducer output varies sinusoidally (a sine wave alternates from a maximum positive value, through zero, to a maximum negative value, to zero, and back to maximum positive, repeating over time).

(9) The magnitude of the sinusoid is proportional to the total airspeed. The phasing of the sinusoid is related to wind direction.

NOTE: Show slide # 60 (Air Data Processor (ADP))



4. Air data processor (ADP)

a. Purpose: Processes static system and OAS inputs for use by the fire control system, DASE, stabilator system, display systems, and navigation systems.

b. Location: The ADP is located in the right aft avionics bay.

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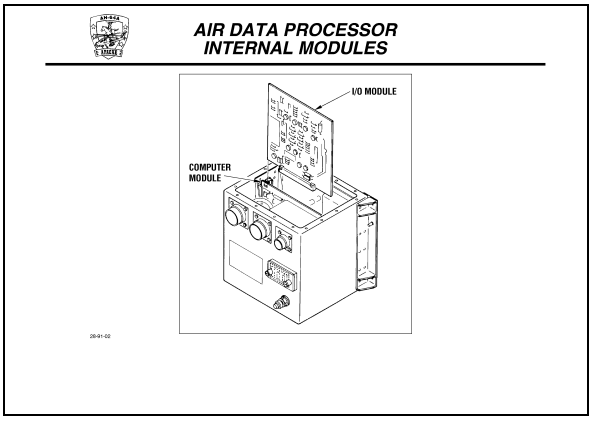
NOTE: Show slide # 61 (Air Data Processor Internal Modules)



c. Description:

(1) The ADP is a small, lightweight, microprocessor based analog input/output LRU and provides the Fire Control System with:

(a) Total true airspeed (Vt).

(b) Longitudinal airspeed (Vut).

(c) Lateral airspeed (Vvt).

(d) Ambient temperature (Ta).

(e) Ambient pressure (Pa).

(f) Air density ratio (P/Psl).

(g) Angle of sideslip (B).

(2) The ADP also supplies (Vut) and (B) information to the DASEC and Stabilator control Units.

(3) The front face contains:

(a) Three quick disconnect receptacles

1) J1 - provides input power

2) J2 - provides various input and output signals

3) J3 - provides various input and output signals

(b) A static port fitting that connects to the right static system.

(c) BORESIGHT thumbwheel switches used to electrically adjust

the ADSS for mechanical errors in OAS alignment.

(4) Internal modules

(a) I/0 Module - converts the AC sensor signals to DC analog and multiplexes these signals into the computer module.

(b) Computer Module:

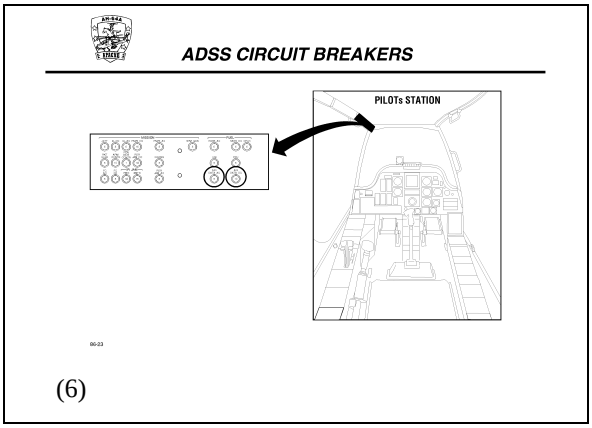
1) Is a microprocessor based computer which converts the multiplexed analog signals into digital format.

2) Computes the air data values and converts the digital air data values into analog format.

(c) Power Supply Module - is a DC/DC converter which provides the "15V and +5V operating power for the ADSS.

(5) The ADP is powered by 28 VDC from the NO. 3 DC bus via the ADS control relay.

NOTE: Show slide # 62 (ADSS Circuit Breakers)



(6)

5. Circuit Protection

a. AIR DATA DC Circuit Breaker (CB69)

(1) Provides DC circuit protection for the ADP

(2) Located on the pilot's forward circuit breaker panel

(3) Rated at 28 VDC, 10 amps

(4) Powered by the NO. 3 dc bus

(5) Supplies 28 VDC for ADP operation via the ADS control relay

(6) Supplies 28 VDC to energize the OAS Heater Control Relay

b. AIR DATA AC Circuit Breaker (CB84)

(1) Provides AC circuit protection for the OAS motor and anti-icing circuitry

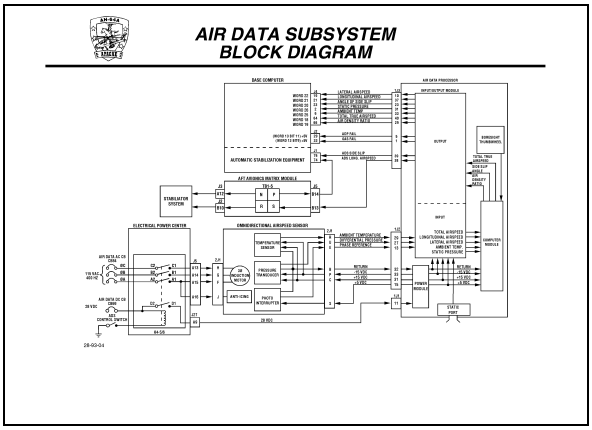
(2) Located on the pilot's forward circuit breaker panel

(3) Three phase 115/200 vac ganged circuit breaker rated at 5 amps

(4) Powered by the NO. 1 AC bus

(5) Supplies three phase, 115/200 VAC to the OAS motor via the ADS control relay (K4/5-6), and single phase 115 VAC OAS heater power to the OAS heater control relay

NOTE: Show slide # 63 (Air Data Subsystem Block Diagram)



6. ADSS operation

a. System Power. With 28 VDC applied to the ADP (ADSS control switch to the ADSS position), the ADP activates and supplies DC operating voltage to the OAS.

(1) Opto-electric sensor (+ 5 VDC)

(2) Temperature sensor (+ and -15 VDC)

(3) Differential pressure transducer (+ and - 15 VDC)

b. ADP Outputs. Signals from the differential pressure transducer, opto-electric sensor, and temperature sensor are routed back to the ADP. These signals, along with the static pressure transducer signal (internal to the ADP) are used to compute air data signals.

(1) Air Data Signals

(a) Total true airspeed

(b) Longitudinal airspeed

(c) Lateral airspeed

(d) Ambient temperature

(e) Ambient pressure

(f) Air density ratio

(g) Angle of sideslip

c. Signal Routing

(1) Digital Automatic Stabilization equipment (DASE) interface

(a) Angle of Sideslip - used by the DASE computer (DASEC) to augment aircraft stabilization.

(b) Longitudinal Airspeed - used by the DASE computer (DASEC) to augment aircraft stabilization.

(2) Stabilator System interface. Longitudinal Airspeed is monitored by the Stabilator Control Units (SCU's) to obtain optimal positioning of the stabilator at given airspeeds.

(3) Fire Control, Display, and Navigation Systems interface. The DASEC contains a type IIIA Multiplex Remote Terminal Unit (MRTU) which routes the ADP signals to the appropriate aircraft systems using the multiplex data bus.

(4) Fire Control interface. Signals from the ADP are routed via the DASEC MRTU to the Fire Control Computer (FCC) for computation of ballistic solutions. These computations are used to direct the aircraft weapon systems positioning.

(a) Point Target Weapon System (PTWS) - uses Total True Airspeed (in order to check if pylons are in flight stow).

(b) Aerial Rocket Control System (ARCS) - uses Air Density Ratio, Ambient Temperature, and Relative Wind Computations.

(c) Area Weapon System (AWS) - uses Air Density Ratio, Ambient Temperature, and Relative Wind Computations.

(5) Display Systems interface. The Total True Airspeed signal is sent from the DASEC MRTU to the FCC. The FCC routes the signal to specific display system components (designated below) to allow airspeed information to be displayed to both the pilot and the CPG.

(a) On the pilot's Video Display Unit (VDU) via the Symbol Generator

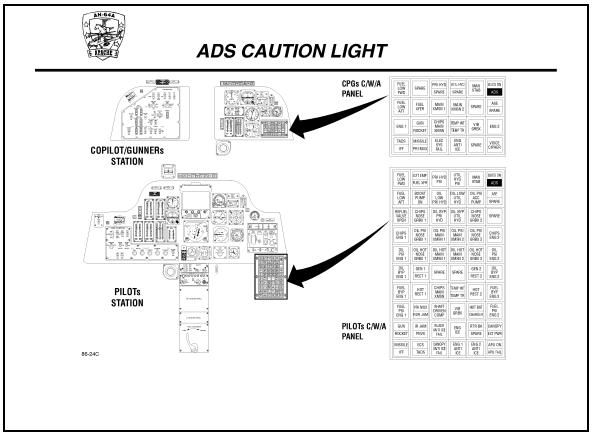
(b) The CPG's Optical relay Tube (ORT - or heads down display) via the Symbol Generator

(c) Both crew members' Integrated Helmet and Display Sight System (IHADSS) via the Symbol Generator

(6) Navigation System interface. The total True Airspeed and Angle of Sideslip are provided to the Lightweight Doppler Navigation System (LDNS) for use in aircraft navigation.

(7) ADP / OAS Failure interface. In the event of an ADP or OAS failure, the DASEC MRTU will detect the failure and inform the FCC. The FCC passes the information to the Back-up Bus Controller (BBC) which provides 28 VDC to the CAUTION/WARNING/ ADVISORY PANELS (CWA) located in both the pilot and CPG crew stations.

NOTE: Show slide # 64 (ADS Caution Light)



7. ADS Caution Light

a. Alerts both crew members in the event of an ADS failure.

b. Located on the CWA panel in both crew stations.

NOTE: Conduct a check on learning and summarize the learning activities. Discuss the learning activities using the examples provided. Make on-the-spot corrections as necessary.

Examples:
1. What is the purpose of the OAS?

Answer: To sense airspeed and ambient temperature that will be provided to the ADP for processing.

2. What is the purpose of the Boresight Thumbwheels located on the ADP?

Answer: Used to electrically adjust the ADSS for mechanical errors in the OAS alignment.

3. Where is the ADSS control relay located?

Answer: Located in the electrical power distribution center behind the pilot's seat

4. What is the purpose of the OAS differential pressure transducer?

Answer: Measures the pressure differential in the two sensors

5. What powers the ADP?

Answer: The ADP is powered by 28 VDC from the NO. 3 DC bus via the ADS control relay.

6. Is ADSS monitored by FD/LS?

Answer: Yes

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SUMMARY

Type of Instruction:	C
Instructor to Student Ratio:	1:Class
Time of Instruction:	0.1 Hours
Media:	None

REVIEW/SUMMARIZE:

During the past four hours you have received instruction on the cockpit environment. Your understanding of instrument systems will enhance your ability to perform aircraft troubleshooting, maintenance test flights, and maintenance operational checks.

CHECK ON LEARNING:

A. Solicit student questions.

B. Questions and answers.

C. Correct student misunderstandings.

TRANSITION TO NEXT LESSON:

This concludes this period of instruction on cockpit environment. Your retention of this material will be tested during evaluation 9C7-505-04 on _____. Your next period of instruction will be _____ at _____ on _____ .

STUDENT EVALUATION

TESTING REQUIREMENTS:

A. Performance test: N/A

B. Written test: This lesson will be evaluated during Practical Written Evaluation 9C7-505-04.

FEEDBACK REQUIREMENT:

A. The instructor will provide feedback on the Practical Written Evaluation any information to help answer students' questions about the test.

B. Provide remedial training as needed.