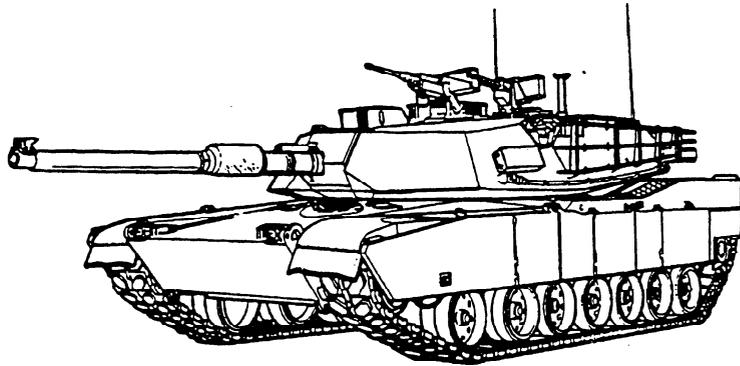


TM 9-6920-716-10

TECHNICAL MANUAL



OPERATOR'S MANUAL

**ABRAMS
FULL-CREW INTERACTIVE SIMULATION
TRAINER**

AFIST

TRAINING DEVICES: 17/162 A
17/162 B

Industrial Data Link Corporation
Contract No. N61339-93-C-0035

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Operator's Manual for AFIST

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WARNINGS, CAUTIONS AND NOTES

WARNING highlights an essential operating or maintenance procedure, practice, etc. which if not strictly observed, could result in injury or death of personnel, or long term health hazards. Warnings are boxed as shown below:



CAUTION highlights an essential operating or maintenance procedure, practice, etc., which if not strictly observed could result in damage to, or destruction of equipment, or loss of mission effectiveness. Cautions are boxed as shown below:



NOTE highlights an essential operating or maintenance procedure, condition, or statement. Notes are as shown below:

NOTE

WARNINGS, CAUTIONS, AND NOTES SHOULD NEVER BE IGNORED

CHAPTER 1

INTRODUCTION

SECTION I. GENERAL INFORMATION

1.1 SCOPE

1.1.1 Type of Manual. This operator's manual provides installation, operation, and maintenance information for the ABRAMS Full-crew Interactive Simulation Trainer- Armor (AFIST).

1.1.2 Purpose and Type of Equipment. AFIST supports individual and full-crew training in M1/M1A1 tank tactical gunnery skills. AFIST is designed to be appended to a powerless, stationary, sheltered tank. A high level of training environment realism is achieved because the crew members train at their crew stations, using the actual tank system controls. AFIST simulates selected performance characteristics of M1/M1A1 main battle tanks and permits all crew members (Tank Commander (TC), Gunner, Driver, and Loader) to participate in the tank gunnery tasks. Crew members observe appropriate visual and aural effects while at their respective crew stations. The crew also uses the on-board intercommunication system and tank controls to simulate tank operation. Training tasks involve simulated travel over terrain and engagements with enemy forces. Crew performance is continuously monitored by an Instructor/Operator (I/O), who provides comprehensive After Action Reviews (AARs). AFIST is designed to be appended to a stationary, powerless (battery disconnected) M1/M1A1 tank of the using unit inside a building or aboard ship.

1.2 SAFETY, CARE, AND HANDLING.

Warnings and precautions which pertain to handling, installing, training with, and disassembling AFIST are summarized at the front of this manual.

1.2.1 Guidelines for Handling Equipment. Adhering to simple precautions when handling AFIST components will help prevent damage to the simulator trainer. Preventing damage will save training time. Basic guidelines for handling equipment follow:

WARNING

Observe lifting requirements for two or more crew members. Many AFIST components are bulky and awkward to handle with one person. Use the appropriate number of people to ensure personnel safety and prevent damage to equipment.

CAUTION

Do not force any cable connections. Use caution when connecting cables. If properly aligned, all plugs and connectors will connect with moderate pressure. The Red, Green and Blue (RGB) connectors on monitors and the Instructor/Operator Station (IOS) are easy to connect. The connectors on the inside of the tank may be slightly stiff, but will connect easily with the sensor receptacles when lined up properly.

CAUTION

Route cable assemblies in sheathed bundles on tank surfaces so that the cables will not be walked on. Walking on cables damages them.

CAUTION

Handle electronic components and optical assemblies carefully. The simulator includes sophisticated electronics and optical assemblies. Rough handling will affect the performance of these items, possibly resulting in lost training time. Avoid dropping items or placing them on their side or upside down.

1.2.2 Guidelines for Supervising Installation. A certified I/O, crew, and turret mechanic can append the AFIST to the tank, calibrate, and run the self-test on the simulator trainer system within 3 hours. The I/O should observe the following procedural guidelines when briefing, organizing, and supervising the installation of the simulator trainer.

- a. Organize to **install** components inside and outside the tank at the same time.
- b. The installation **team** should work together to unpack the components and place the components at installation points on the tank.
- c. Run the turret interface cables to the turret before beginning to install any components.
- d. Begin installing interior and exterior components at the same time.
- e. The I/O should check all work, especially inside the turret; the I/O checks the entire installation procedure against the checklist in Chapter 2 before installation is considered complete.

- f. Detailed installation, Daily Readiness Check (DRC), and calibration instructions are in Chapter 2, Section III.

1.2.3 Guidelines for Supervising DRC and Calibration.

- a. Perform a DRC or Calibrate only those items which require a DRC or calibration, in accordance with the calibration instructions. Watch for unusual responses **from** control inputs, and recalibrate to try to correct any errors.
- b. Select an experienced Senior I/O, if available, to assist with the DRC and calibration inside the tank. He should be knowledgeable of the location of all components being checked or calibrated.
- c. Check the connection of all sensors before beginning DRC and calibration. This will help prevent false starts.
- d. Follow the sequence provided in Chapter 2, Section III. This will help prevent overlooking any item.

1.3 REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS.

If your AFIST training device needs improvement, let us know. Send us an Equipment Improvement Recommendation (EIR). You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Product Quality Deficiency Report). Mail it to us at Simulation, Training and Instrumentation Command (STRICOM), ATTN: AMSTI, 12350 Research Parkway, Orlando, FL 32826-3276. We will send you a reply.

1.4 LIST OF ACRONYMS AND ABBREVIATIONS.

Acronyms and abbreviations used in this document are defined in Appendix E.

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SECTION II. EQUIPMENT DESCRIPTION

1.5 EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES.

1.5.1 Characteristics. AFIST is a training device designed to support individual and full-crew tactical gunnery skills training in an M1/M1A1 tank. AFIST is portable and designed to be appended to a stationary, powerless (battery disconnected) M1/M1A1 tank of the using unit.

All crew members (TC, Gunner, Driver, and Loader) participate in the gunnery tasks. The system combines computer-generated sounds and images with input from sensors mounted on tank controls at each crew station, allowing crew members to train at their own stations. The trainer provides the crew an interactive simulation in a wide variety of tasks from the tank gunnery tables. Training tasks involve simulated travel over terrain and engagement by enemy forces.

The training is managed and continuously monitored by an I/O at an external IOS. The I/O conducts crew training, monitors crew performance, and provides comprehensive After Action Reviews (AARs).

1.52 Capabilities. The AFIST permits the crew to conduct gunnery training tasks using actual tank controls to simulate tank operations. Crew position capabilities include the following:

- a. The TC uses the TC's controls (TC's Handle, Gunner's Primary Sight Extension (GPSE), Commander's Weapon Station (CWS) Power Control Handle, and vision blocks in the CWS) to acquire targets, determine range, and fire the main gun and coaxial machine gun. (Tasks for the .50-caliber machine gun are not simulated.)

CAUTION

The Gunner's manual control handles and the CWS manual controls are not sensed and should not be used. Activating these controls can damage the simulator trainer.

- b. The Gunner employs the Gunner's Primary Sight (GPS), GPS Control Panel, Thermal Imaging System (TIS), Gunner's Auxiliary Sight (GAS), Laser Range Finder (LRF), and Gunner's Power Control Handles to locate targets, select ammunition, determine range, and fire the main gun and coaxial machine gun.
- c. The Driver uses the Steer-Throttle Control, Shift Control, Service Brake, Master Panel controls, and Driver's vision block to control simulated tank movement.
- d. The Loader selects and simulates loading rounds for the main gun and arms the main gun. (Tasks for the Loader's machine gun are not simulated.)

15.3 Features.

1.5.3.1 Operating and Maintenance Features.

- a. Ballistically accurate.
- b. Uses actual tank controls.
- c. Automatically scores engagements.
- d. Simple installation and calibration, requires no special tools.
- e. Low operating costs, since no fuel or ammunition is consumed in training.
- f. Requires no special computer skills.
- g. Transportable.
- h. Requires minimal maintenance.

1.5.3.2 Training Management Features.

- a. Measures crew performance in increasingly difficult exercises.
- b. Reflects crew proficiency over time.
- c. Identifies crew and unit training shortfalls.
- d. Facilitates tailored training to strengthen deficient areas.
- e. Permits determining proficiency-based crew

- f. Facilitates cross-training.
- g. Supports sound training management decisions.

1.5.4 Differences Between Models. Both AFIST Training Devices, the 17/162A and the man transportable 17/162B, operate on M1, M1IP, and M1A1 tank configurations. The M1A1 configuration employs an adapter cable for the TC Control Panel. The rest of the AFIST system equipment is the same for all tank configurations.

1.6 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS.

The AFIST 17/162A, shown in Figure 1-1 appended to an M1A1 tank, consists of the three basic components discussed in the following sections. The man portable AFIST 17/162B, appended to an M1A1, is depicted in Figure 1-la.

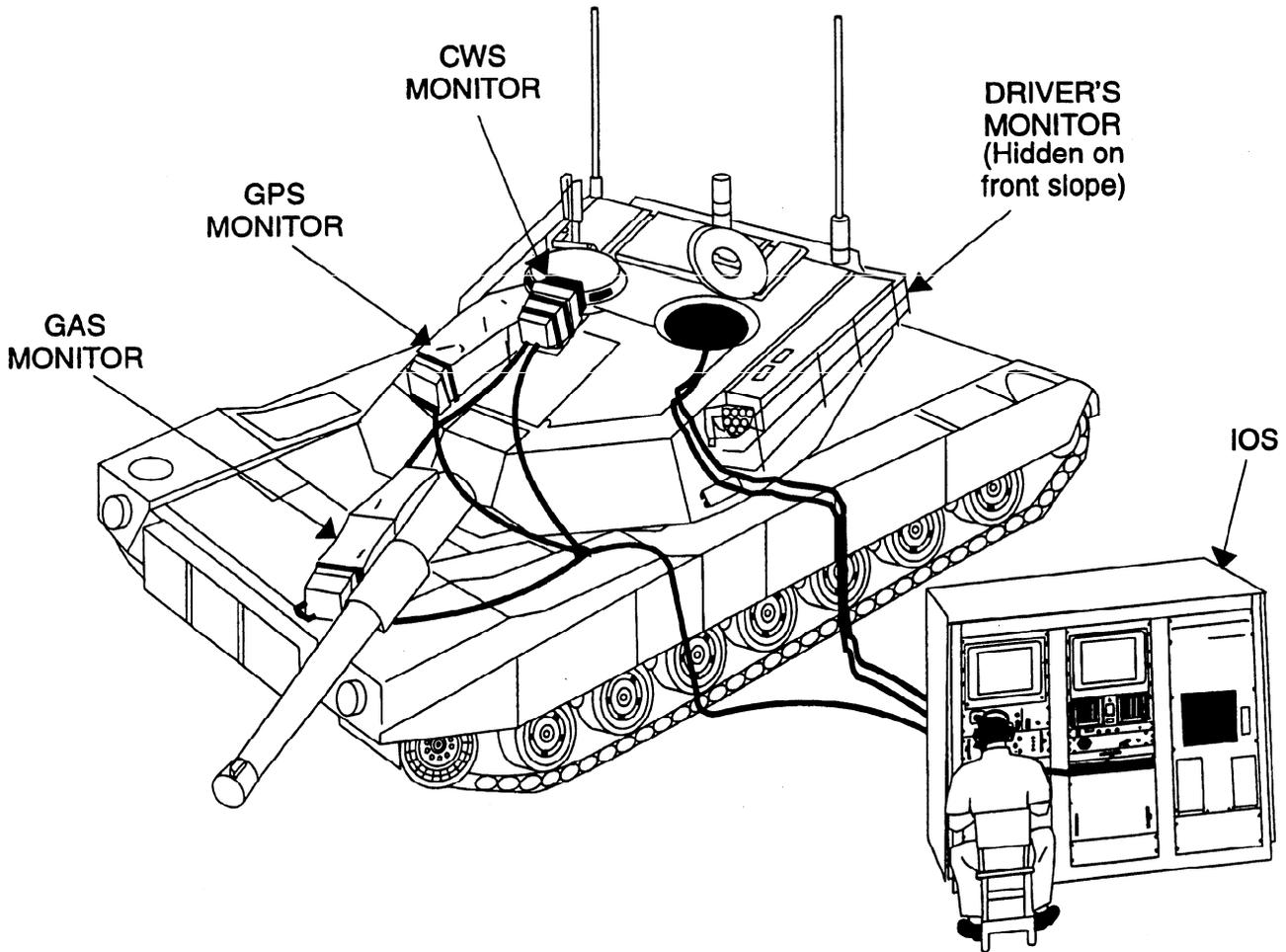


Figure 1-1. Location of Major Components (TD 17/162A)

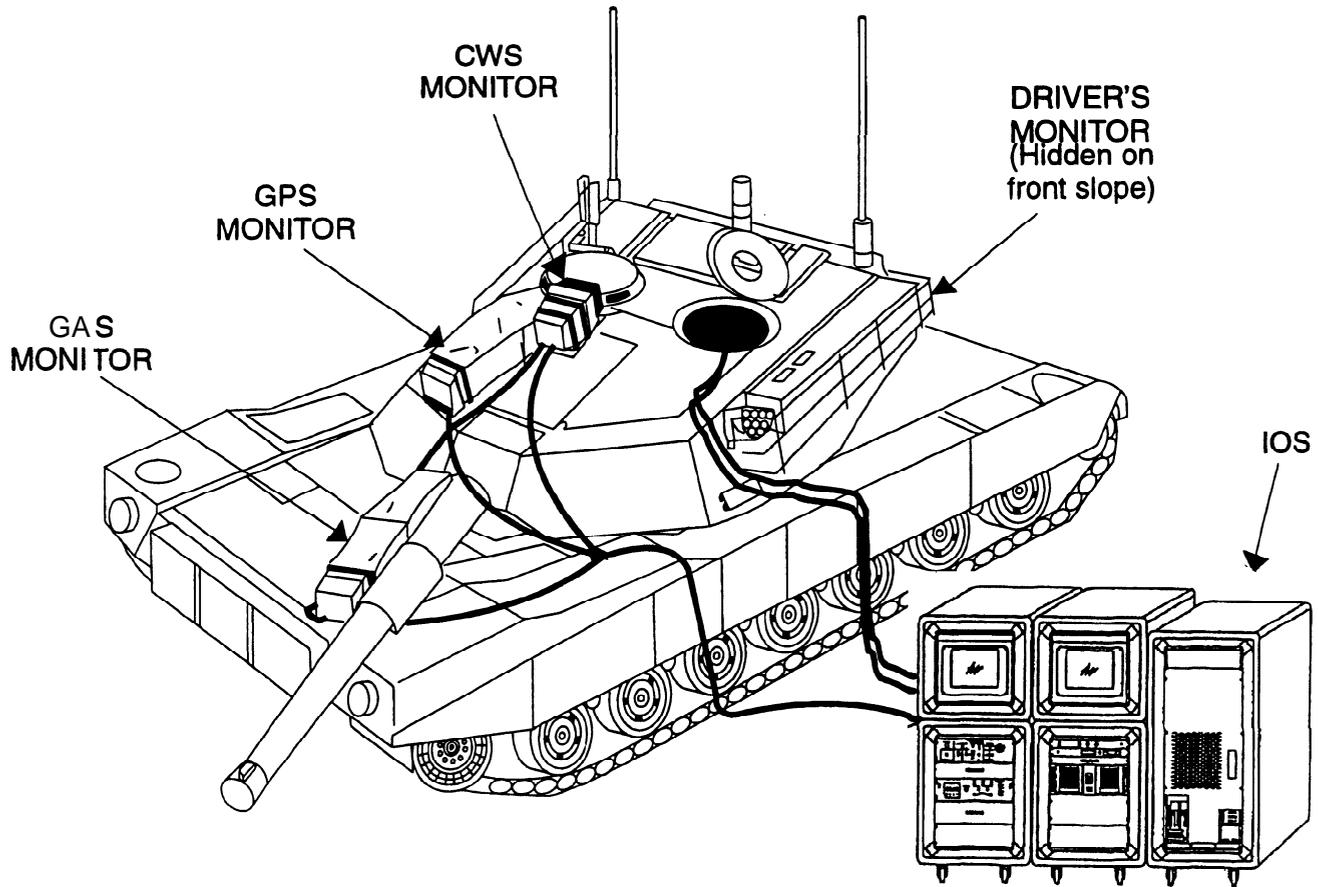


Figure I-1a Location of Major Components (TD 17/162B)

1.6.1 Instructor/Operator Station (IOS): The IOS provides simulator control and collection/display of crew performance data. The IOS is external to the tank and has a control panel from which the I/O controls all training tasks. The IOS Training Device 17/162A consists of a three rack cabinet. The IOS Draining Device 17/162B consists of five man portable transit cases. Each IOS configuration consists of a three-rack cabinet containing the following equipment:

- a. System controller (host computer).
- b. Standard alphanumeric Glidepoint keyboard.
- c. Two video monitors.
- d. Power supply assembly.
- e. Dot matrix printer.
- f. Speaker assembly.
- g. Video distribution amplifier.
- h. Video switch assembly.
- i. Data Acquisition Unit, consisting of the following:
 - (1) Card rack assembly.
 - (2) Dome light cable connectors.
 - (3) Tank Interface cable connectors.
 - (4) Transducer assembly.
- j. Audio generation system, consisting of the following:
 - (1) A synthesizer and sample playback unit.
 - (2) Audio distribution mixer with amplifier, microphone amplifier.
 - (3) I/O headphone/microphone.
- k. Image Generator (IG). The IG generates visual images which are presented to the crew through the video monitors at their respective crew stations. These visual images are high-resolution graphic portrayals of terrain and military equipment. The visual scenes change in response to the crew's actions in controlling the tank's movement and in engaging targets. The IG is external to the tank and resides in the IOS three-rack cabinet or in the case assembly 1A5 of the deployable AFIST 17/162B.

1.6.2 Optical Assemblies. Four optical assemblies appended to the exterior of the tank direct video imagery into the tank gun sights and vision blocks. These assemblies include custom lens assemblies and the video monitors on which the crew members observe simulated terrain and action, cables connecting the monitors to the IG and IOS, and the mounts used to append these to the tank. The following optical assemblies are appended at the TC's, Gunner's, and Driver's vision ports and/or gun sights:

- a. CWS monitor mount, monitor, and mirrors.
- b. GPS monitor mount, monitor, and collimator lens.
- c. GAS monitor mount' monitor, and collimator lens.
- d. Driver's monitor mount and monitor.

1.6.3 Sensors and Control Facades. This component comprises sensors attached to actual tank controls, mock-ups (facades) of actual controls attached at or near actual tank controls inside the turret, and the cables connecting these to the Tank Interface Assembly. This component allows sensing of the controls and provides the crew control of the tank during simulation. The following sensors and control facades are appended to the tank:

- a. TC station:
 - (1) Commander's Crew Station cable.
 - (2) TC's remote keypad assembly.
- b. Gunner's station:
 - (1) Gunner's Crew Station cables.
 - (2) GPS MAGNIFICATION Lever facade.
 - (3) GAS RETICLE Select Switch facade.
 - (4) GPS FLTR/CLEAR/SHTR Switch facade.
 - (5) LRF (RANGE) Switch facade.
 - (6) GAS Proximity Sensor.
 - (7) GPS RETICLE Intensity Knob facade.
- c. Loader's station:
 - (1) Loader's Crew Station cable.
 - (2) Breech Switch facade assembly.
 - (3) AMMUNITION SELECT facade.

- d. Driver's station:
 - (1) Driver's Crew Station cable.
 - (2) Brake sensor assembly.
 - (3) Steering sensor assembly.

- (a) Height: 33.75 inches.
- (b) Depth: 35.5 inches.
- (c) Width: 27 inches.

1.7 EQUIPMENT DATA.

- a. Environmental requirements:

Condition	Operating	Storage
Temperature	40°F - 90°F	-4°F - 125°F
Relative Humidity	30% - 90%	0% - 95%

- b. Space requirements: TBD.
- c. Electrical Requirements: One dedicated 120-Vac, 20-amp, 60-Hz (±2 Hz) circuit, one dedicated 220-Vac, 20-amp, 60-Hz (±2 Hz) circuit.
- d. 10s:

- (1) Power requirements: One dedicated 120-Vac, 20-amp, 60-Hz (±2 Hz) circuit, one dedicated 220-Vac, 20-amp, 60-Hz (±2 Hz) circuit.

- (2) (a) Training Device 17/162A dimensions (total).

- (1) Height: 61 inches.
- (2) Depth: 32 inches.
- (3) Width: 72 inches.

- (b) Training Device 17/162B dimensions (per transit case).

- (1) Case A1
 - (a) Height: 25 inches (add 4.75 inches if casters attached).
 - (b) Depth: 34.75 inches.
 - (c) Width: 27 inches.

- (2) Case A2

- (3) Case A3
 - (a) Height: 25 inches.
 - (b) Depth: 34.75 inches.
 - (c) Width: 27 inches.

- (4) Case A4
 - (a) Height: 33.75 inches (add 4.75 inches if casters attached).
 - (b) Depth: 35.5 inches.
 - (c) Width: 27 inches.

- (5) Case A5
 - (a) Height: 55.5 inches (add 4.75 inches if casters attached).
 - (b) Depth: 33 inches.
 - (c) Width: 29 inches.

- (3) (a) Training Device 17/162A weight (total): 1,200 pounds (with IG installed).

- (b) Training Device 17/162B weight (per transit case).

- (1) Case A1: 121 pounds.
- (2) Case A2: 167 pounds.
- (3) Case A3: 121 pounds.
- (4) Case A4: 152 pounds.
- (5) Case A5: 335 pounds.

- (4) Printer: Citizen GSX-190, 9-wire dot matrix.

- (5) Host computer:

- (a) Dual Pentium 100 Mhz Single board CPU.
- (b) 32 MB RAM (Pentium).
- (c) 100 Mhz (Pentium).
- (d) 20 percent or more spare input/output capacity for each input/output channel.
- (6) Standard (QWERTY) Glidepoint keyboard with 12 function keys, alphanumeric keypad and touch pad mouse.
- (7) Audio components:
 - (a) Peavey DPM Sampler/Playback (S/P) unit.
 - (b) OP-AMP-LAB S H-5/MES audio mixer with preamplifier and audio distribution amplifier.
 - (c) Acoustic Research Powered Partner 570 Speaker/Amplifier.
 - (d) IOS Speaker/Amplifier.
 - (e) Headset.
- (8) Two monitors, 14/15 inches with 1280 by 1024 resolution, .28-millimeter (mm) dot pitch.
- e. IG:
 - (1) (a) 17/162A: Evans & Sutherland ESIG 2000™
 - (b) 17/162B: Evans & Sutherland ESIG 2000HD™
 - (2) Standard 6U, five-slot Virtual Memory Extension (VME) unit.
 - (3) 14 multilayer printed circuit board configuration.
 - (4) Standard Ethernet link.
 - (5) Custom IG interface card.
 - (6) 850 MB hard disk (configuration dependent).
 - f. One monitor, 14/15 inches with 1280 by 1024 resolution, .28-mm dot pitch spacing.
 - g. Three monitors, 17 inches with 1280 by 1024 resolution, .26-mm dot pitch.
 - h. Appended Components: See Appendix III and IIIa For a complete list of appended components, transit cases and weights.
 - i. Shipping information.
 - (a) 17/162A: IOS requires a forklift to transport.
 - (b) 17/162B: Man transportable.
 - j. Set-up time (with a trained SI/O, crew, and turret mechanic): 3 hours.

SECTION III. PRINCIPLES OF OPERATION

1.8 INSTRUCTOR/OPERATOR STATION (IOS).

With the Instructor/Operator's Passkey engaged and the I/O passkey off (Primary Operating Mode), the I/O controls the training simulation from the IOS. At the keyboard, the I/O initiates training by selecting the crew members to be trained and reviewing their past performance. The I/O then selects the training exercise, which causes the components of the simulator to respond with the variations of the selected exercise. The I/O monitors the training via two IOS monitors, one with a continuous Gunner's view, the other selectable between a menu/real-time status screen and a split screen of the TC and Driver's views. The I/O communicates with the crew through his headset, which is connected to the tank intercommunications system. A speaker at the IOS allows the I/O and observers to hear crew conversations and the same sound effects the crew hears. The system does not save performance data for tasks run in Secondary Operating Mode.

1.9 TC'S KEYPAD.

With the Tank Commander's Passkey engaged (Secondary Operating Mode), the TC can control the training simulation from his remote keypad in the tank. All functions available to the I/O through the IOS (except Records Management functions) are available to the TC through the remote keypad. AFIST does not save performance data of tasks run in Secondary Operating Mode.

1.10 IMAGE GENERATOR (IG).

Based on the task selected by the I/O or TC, the IG generates the visual images and sends them to the tank crew via the optical assemblies and to the I/O via an IOS monitor. The crew has the ability to simulate a full 360 degrees of tank, turret, and CWS rotation to scan for and engage targets. Task presentation is randomized, so that tank crews cannot memorize gunnery task progression. Depending upon the tank crew's actions, appropriate weapons effects, target destruction, enemy tank fire, and enemy hit on own-tank are portrayed visually.

1.11 AUDIO GENERATION.

The operational sounds of the tank automotive and weapons systems are replicated by the audio S/P unit in the IOS. These replications are in direct response to crew actions. Sounds are transmitted to the crew via a speaker under the main gun breech. Crew members communicate with each other via the tank intercommunications system as they would during normal tank operations. The crew also communicates with the I/O via the intercommunications system, which is connected to the headset at the IOS. A speaker on the IOS broadcasts

the crew intercommunications and the sound effects so that the I/O and observers can hear what the crew hears.

1.12 OPTICAL ASSEMBLIES.

The visual scenes generated by the simulator are presented to the tank crew through optical assemblies. The images generated are transmitted via video cables from the IG to monitors attached to the outside of the tank at the TC's, Gunner's, and Driver's vision ports and/or gun sights. Each member sees the scene from a different perspective, just as he would in the M1/M1A1 tank on actual terrain. The Gunner's Primary and Auxiliary Sight views are projected through custom lens assemblies to replicate his view through the gun sights.

1.13 SENSORS.

A series of sensors is placed on or near the tank controls at each crew station. These sense, and convey to the I/O, the action that each crew member takes. The majority of these sensors are attached to the actual tank control used by the crewmen. In selected areas, facades are used. All sensors provide feedback via cable directly to the computer at the IOS every 30 milliseconds. This feedback allows the I/O to observe the action of each crew member on the real-time display monitor at the IOS. Selected information can be recorded as part of the performance record, if desired.

1.14 RECORDS MANAGEMENT FUNCTION

The Records Management function provides trainers and training managers a powerful relational training database which they can query for crew or unit information. These records provide training managers an accurate basis on which to make training decisions, allocate resources, and assess readiness.

The training records are derived from crew performance on training exercises conducted under the direction of the I/O (Primary Operating Mode) in the Training and Evaluation Exercise Modes. These results are automatically saved to the performance database.

Records of exercises conducted in the Orientation Exercise Mode are saved. Exercises conducted under the direction of the TC (Secondary Operating Mode) are discarded at the end of each exercise session. However, the I/O or TC may obtain a printout of performance data for a permanent record at the end of each task conducted in these modes.

1.15 FUNCTIONAL CONFIGURATION

The AFIST functional configuration is illustrated in Figure 1-2 and discussed in the following:

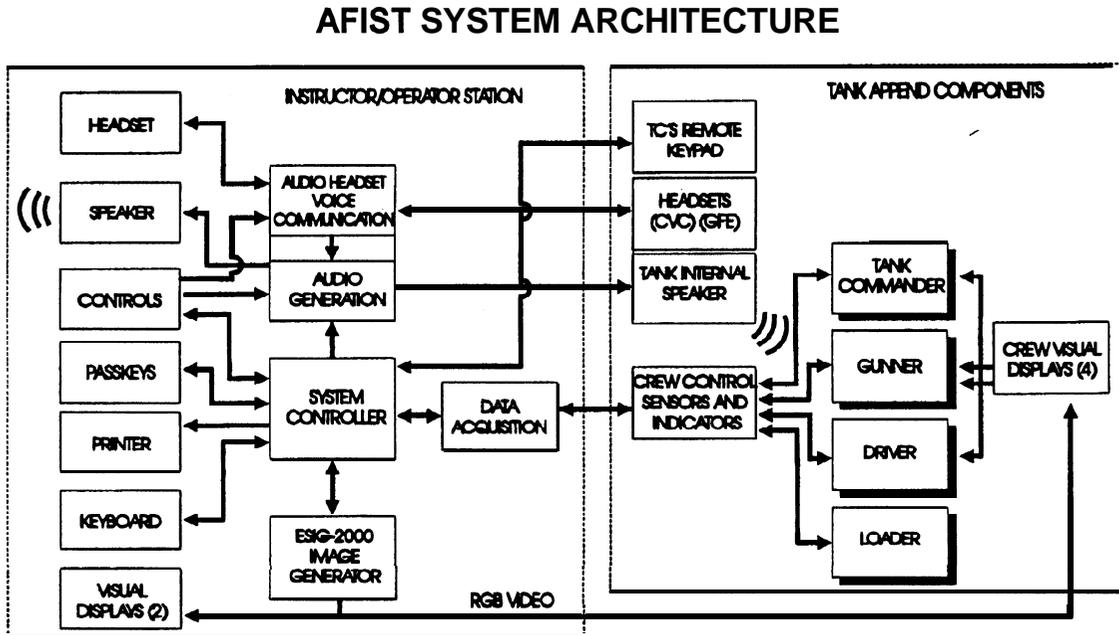


Figure 1-2. AFIST Functional Configuration Block Diagram

- a. The I/O starts an exercise by using the controls at the IOS.
 - (1) The system controller directs the IG to produce a specified visual display.
 - (2) The IG sends visual signals to the crew visual displays and to the IOS visual displays.
- b. The crew makes control inputs to:
 - (1) Drive and move the tank.
 - (2) Traverse the turret and scan for targets.
 - (3) Engage targets.
 - (4) Take evasive action.
- c. Based on the crew's control inputs and sensor and indicator readings:
 - (1) The crew station controls transmit control inputs through the data acquisition system to the system controller.
 - (2) The system controller sends inputs to the IG.
 - (3) The IG responds to inputs, adjusts visual displays accordingly, and provides the same information to the system controller.
 - (4) The system controller simultaneously sends messages to the Audio Generator, which provides output to the crew through the speaker under the main gun breech and to the I/O and observers through the IOS speaker.
 - (5) Voice communications between the crew and between the crew and the I/O are exchanged through the Audio Generator.

- d. The system controller records the results of crew performance.
- e. When the I/O directs (through the keyboard), the printer prints out the crew's performance.
- f. The system controller updates readings from and provides updated information to:
 - (1) IG, thirty times per second.
 - (2) Sensors, twelve and one half times per second.
 - (3) Audio Generator, once per second.

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