Research Product 85-04

HUMAN FACTORS ENGINEERING DESIGN CRITERIA FOR FUTURE SYSTEMS, REPORT NO. 2: DESIGN CRITERIA EVOLVING FROM THE FIRE SUPPORT TEAM VEHICLE (FIST-V) OPERATIONAL TEST II

ARI Field Unit at Fort Hood, Texas
Systems Research Laboratory

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U. S. Army Research Institute for the Behavioral and Social Sciences

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Human factors engineering (HFE) design problems reported in the FIST-V Operational Test II were compared with criteria in MIL-STD-1472C and MIL-HDBK-759A to determine criteria adequacy. Where problems occurred and the related current criteria were adequate, it is recommended that greater emphasis be given these criteria in future programs. New criteria are proposed for inadequate or missing criteria. HFE problems were distributed across 27 different equipment components. Current criteria were judged adequate (Continued)

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20. (Continued)

for 25 features and inadequate for 2. Thus, adequate guidance was available in the current FIST-V partly due to design constraints inherent in the vehicles since the FIST-V is a modification of the M901 Improved TOW Vehicle.

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Human Factors in Training and Operational Effectiveness

FOREWORD

A major research project of the Army Research Institute (ARI) Field Unit at Fort Hood, TX, is "Evaluating Human Factors Considerations and Concepts in an Operational Environment" (Army Project 2Q263739A793). This project is primarily concerned with evaluating the human factors (man-machine interface) aspects of systems in an operational environment; the purpose is to optimize performance of existing systems and provide design criteria for future similar systems. One of these evaluations was the human factors evaluation of the M981 Fire Support Team Vehicle (FIST V) during Operational Test II. This report describes the results of an analysis of data from the OT II, the identification of important current criteria, and development of new criteria. These criteria provide the design guidance necessary for: (1) resolving current human factors engineering problems with the FIST V, and (2) preventing the recurrence of such problems in future FIST V type systems. The report does not address current design criteria which are adequate and which were properly considered during the RDT&E process, i.e., design criteria relating to system aspects where no man-machine interface problems were found.

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HUMAN FACTORS ENGINEERING DESIGN CRITERIA FOR FUTURE SYSTEMS, REPORT NO. 2: DESIGN CRITERIA EVOLVING FROM THE FIRE SUPPORT TEAM VEHICLE (FIST-V) OPERATIONAL TEST II

EXECUTIVE SUMMARY

Requirement:

The objective of this analysis is to specify current human factors engineering (HFE) related design criteria that are associated with current M981 Fire Support Team Vehicle (FIST V) deficiencies and to stipulate new design criteria, where needed, in order to prevent a recurrence of these problems in future FIST V type systems.

Procedure:

The procedure involved comparing individual HFE design problems identified in the FIST V Operational Test II with relevant criteria statements containing the information for avoiding such problems in the design process. The criteria in MIL-STD-1472C and MIL-HDBK-759A were evaluated to determine if they provided adequate guidance for making informed design judgments. Criteria judged as adequate were viewed as critical criteria that should be given greater emphasis in future programs. In comparisons in which the criteria were judged as inadequate or missing, revised or new criteria were proposed.

Findings:

The HFE problems were distributed across 27 different equipment components. Current criteria are available for all of them; they were judged to be adequate for 25 features and inadequate for 2. Thus adequate design guidance is available in current criteria to avoid most of these problems in future FIST V systems. Seventy-four percent of the problems were concerned with design of the crew stations: problems with workspace, seating, location, and arrangement of controls and displays, etc. Apparently, the results were due partly to design constraints inherent in the vehicle since the FIST V is a modification of the highly developed M901 Improved TOW Vehicle. The freedom of action of the designers may have been severely restricted regarding major modifications of the M901 crew stations for FIST V requirements.

Utilization of Findings:

These findings are intended for use in improving and updating HFE design criteria for FIST V type systems. The critical, revised and new criteria presented in this report provide much of the information necessary for correcting the current HFE problems in the FIST V and preventing the recurrence of similar problems in future generation systems.

HUMAN FACTORS ENGINEERING DESIGN CRITERIA FOR FUTURE SYSTEMS, REPORT NO. 2: DESIGN CRITERIA EVOLVING FROM THE FIRE SUPPORT TEAM VEHICLE (FIST-V) OPERATIONAL TEST II

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INTRODUCTION

The Fort Hood Field Unit of ARI has an active program of human factors research with new and improved equipment in the system acquisition process. The research is characterized by assessment of systems in an operational environment when these systems are manned by regular FORSCOM troops for the first time. This report is the second in a series on developing design criteria for future systems. The first report (Earl, 1983) presented criteria from an analysis of human factors problems which occurred in the M1 tank operational test III.

PURPOSE AND OBJECTIVE

One of the primary functions of the ARI human factors research program is to provide human factors engineering (man-machine interface) design criteria for future systems. This is achieved by an analysis of human factors engineering (HFE) problems identified in user tests of similar current systems. Problems identified in current systems, therefore, serve as the basis for establishing critical design criteria for future similar systems - a process that involves: (1) detecting relevant existing design criteria which have not been met, and (2) identifying and developing new criteria for unanticipated problems not covered by current standards.

The objectives of this current analysis are limited to: (1) specifying current HFE related design criteria that are associated with current M981 Fire Support Team Vehicle (FIST V) deficiencies; and (2) stipulating new design criteria, where needed, in order to prevent a recurrence in future systems of HFE problems reported in: Fire Support Team Vehicle (FIST V) Operational Test II (November 1983). The report does not address current design criteria which are adequate and which were properly considered during the RDT&E process, i.e., design criteria relating to systems aspects where no man-machine interface problems were found.

PROCEDURE

The approach involved comparing the individual HFE problems described in the above report with the applicable criteria statements containing the rules for avoiding the problems. The problems were first identified with the related hardware components and arranged accordingly. The criteria reference sources used in the search were the current issues of MIL-STD-1472 and MIL-HDBK-759, namely, MIL-STD-1472C (1981) and MIL-HDBK-759A (1981). During the period of M981 FIST V development in the 1970's, however, it is likely that prior editions, MIL-STD-1472B (1974) and MIL-HDBK-759 (1975), were the versions available for contract application and guidance.

The latest editions were used in this analysis because the main purpose was to produce information to update and revise current standards. Both references were examined to identify those criteria that are pertinent for each problem. Criteria that were judged to be relevant to some degree were included in the selections. The selected criteria were then evaluated to determine whether or not they provided unequivocal and specific guidance for making informed design judgements. In cases where the criteria were judged as adequate in providing sufficient guidance, these were defined as critical criteria that should be given greater consideration or emphasis in future programs.

In cases where the existing criteria were judged as relevant but providing inadequate guidance, the comparisons revealed the need for revision to include guidance covering the HFE considerations involved in the design problem. Revised design criteria were then formulated for these cases.

RESULTS

Design criteria data are presented in a table made up of three columns. The first column presents HFE problems described in succinct statements indicating the identity of the hardware components involved and the specific design features causing the problems. In the second column, adjacent to the statements of the HFE problems, are presented relevant current criteria. Each design criterion is presented in a short statement and paraphrased where necessary to include only the parts relevant to the problem. Each criterion statement ends with a number in parenthesis. This number refers to a specific paragraph in the reference sources. Numbers beginning with the letter "S" indicate MIL-STD-1472C and the specific paragraph therein. Numbers beginning with the letter "H" indicate MIL-HDBK-759A and its paragraph number.

The third column presents the proposed new or revised criteria. In cases where the relevant criteria were judged as adequate, no new criteria are presented and the statement "No change" is entered in the column. In other cases where the relevant criteria were judged as inadequate, new or revised criteria are included.

The results are presented in Table 1 which addresses the hardware components in the FIST V OT II report judged to have significant HFE problems causing substantial decrements in operational performance.

Table 1

Comparisons of Significant HFE Design Problems in the FIST V OT II Report with Current and Proposed Design Criteria

FIST V OT II HFE DESIGN PROBLEM	CURRENT HFE DESIGN CRITERIA	PROPOSED CHANGE TO CRITERIA
Section A. Targeting Station		
1. Seat		
1.1. The seat is not equipped with a backrest.	The gunner's seat should have an adjustable backrest (H 7.5.10.1.3.2).	In MIL-HDBK-759A the section on crew stations in combat vechicles (7.5) covers only battle tanks. There is a need to broaden the scope to cover crew stations for all types of armored vehicles. All crew members in armored vehicles may be confined to their seats for long time periods and will require special seating considerations. Among these should include a comfortable seat pan and an adjustable backrest. The seat should adjust to provide optimum interface with controls, displays and optical equipment (H 7.5.13.1).
2. Workspace		
2.1. Workspace and head clearance are inadequate.	Workspace design and sizing shall insure accomodation, compatibility, operability and maintainability by at least 90 percent of the user population (S 5.6.1). Anthropometric data for the design	No change.

Table 1 (continued)

FIST V OT II HFE DESIGN PROBLEM	CURRENT HFE DESIGN CRITERIA	PROPOSED CHANGE TO CRITERIA
	and sizing of workspaces are presented in Table XIX (S 5.7.4). Workspace dimensions should follow the data presented in Table 2-15 (H 2.12).	
2.2. Obstacles and protrusions are present in the station.	All sharp corners and protrusions, which may catch clothing or impede crew performance, should be eliminated or minimized (H 7.5.6.3). All exposed edges and corners shall be rounded to a minimum of .75 mm (.03 in) radius (S 5.13.5.4).	No change.
3. Heater and fan		
3.1 The heater failed frequently.	The crew compartment shall be provided with a heating system capable of maintaining temperatures above 20 degrees C (68 degrees F) when personnel are not wearing Artic clothing and exposure is for extended duration (i.e., more than 3 hours) (S 5.12.6.1). The heaters should be capable of maintaining a reference temperature of not less than 5 degrees C at the minimum ambient design temperature with vehicle moving at two-thirds maximum speed and the defrosters operating at maximum capacity (H 3.4.2).	No change.
3.2 Ventilation is inadequate in the targeting station.	Outside fresh air shall be supplied at a minimum rate of 0.57 m3 (20 ft3)/ min./person (S 5.12.6.2). Each crew position within the vehicle compartment must be ventilated	No change.

Table 1 (continued)

FIST V OT II HFE DESIGN PROBLEM	CURRENT HFE DESIGN CRITERIA	PROPOSED CHANGE TO CRITERIA
	properly. Crew ventilation must be separate from engine ventilation and should function properly when the vehicle is stationary or in motion (H 7.5.10.1.2.1).	
4. Stowage boxes		
4.1 The target head blocks opening of the covers on the stowage boxes.	Where accessibility depends upon removal of panels, cases and covers, measures shall be taken to insure that such items are not blocked by structural members or other items (S 5.9.4.1). If covers are hinged, allow space equal to the sweep volume of the cover so the body frame, brackets, etc., will not obstruct its opening (H 5.2.5.3.1).	No change.
5. Intercom control unit		
5.1 The intercom control unit is located in a position difficult to reach.	Control box locations should be chosen so that operators have easy access to controls (H 7.3.8.a). The most important and frequently used controls shall have the most favorable position with respect to ease of reaching and grasping (S 5.4.1.3.3).	No change.

Table 1 (continued)

FIST V OT II HFE DESIGN PROBLEM	CURRENT HFE DESIGN CRITERIA	PROPOSED CHANGE TO CRITERIA
6. Turret base		
6.1 The opening around the turret base is a safety hazard. Crewmen can get their feet entangled in the gears and loose items can fall into the opening damaging machinery.	A guard shall be provided on all moving parts of machinery and transmission equipment on which personnel may become injured or entangled (S 5.13.7.2.1). If it is not possible to adequately separate personnel from moving equipment, appropriate guards or shields should be provided so that fingers (or other body parts), clothing and equipment are protected during vehicle operation (H 7.5.6.2).	No change.
7. Noise level		
7.1 Ambient noise levels are too high in the targeting station.	Personnel should be provided an acoustical environment which will not cause personnel injury, interfere with voice or any other communications, cause fatigue or in any other way degrade overall system effectiveness (S 5.8.3.1, H 3.6.1). The noise levels within crew compartments should not exceed the limits described in the current edition of MIL-STD-1474 (H 7.5.6.4).	No change.

Table 1 (continued)

FIST V OT II HFE DESIGN PROBLEM	CURRENT HFE DESIGN CRITERIA	PROPOSED CHANGE TO CRITERIA
8. GLLD designate-range switch		
8.1 The toggle switch has inadequate throw and position feedback.	Dimensions, resistance, displacement and separation shall conform to the criteria in Figure 13. Resistance should gradually increase, then drop when the switch snaps into position (S 5.4.3.1.4.3). Toggle switches should "snap" into position with an audible "click" to provide positive feedback that the switch has been activated properly. The switch should not be capable of being stopped between positions (H 1.1.13.1.4).	No change.
9. Other switches		
9.1 The switches and their status displays located at the operator's lower right side are not illuminated. The operator cannot perceive which status positions the switches are in.	When the degree of dark adaptation required is not maximum, low brightness white light adjustable as appropriate, shall be used for display illumination; however, when complete dark adaptation is required, low luminance red light shall be provided (S 5.2.1.1). All displays should be properly illuminated , coded and labled (including symbols) by their functions (H 1.2.1.g). The full range of operational conditions should be taken into account in designing display illumination, etc. (H 1.2.1.1).	No change.

Table 1 (continued)

FIST V OT II HFE DESIGN PROBLEM	CURRENT HFE DESIGN CRITERIA	PROPOSED CHANGE TO CRITERIA
10. Targeting head control switches		
10.1 The switches controlling the head up/down movement are exposed to accidental activation which endangers crewmembers when performing maintenance tasks around the targeting head and other crewmembers are in the station.	A fail safe design shall be provided in those areas where failure can disable the system or cause injury to personnel (S 4.5). When the prevention of accidental activation is of primary importance (i.e., hazardous conditions would result), channel guards, lift-to-unlock switches, or any other equivalent means will be provided (H 1.1.13.1.2).	No change.
11. Circuit breakers		
11.1 The circuit breakers mounted on the turret base are exposed to accidental activation causing power failure to the system.	Same as above (S 4.5 and H 1.1.13.1.2).	No change.
12. Braces on the traverse ring		
12.1 The braces tear the crewmembers' gloves when operating the laser/designator rangefinder.	Same as Section A-2.2 (H 7.5.6.3 and S 5.13.5.4).	No change.

Table 1 (continued)

FIST V OT II HFE DESIGN PROBLEM	CURRENT HFE DESIGN CRITERIA	PROPOSED CHANGE TO CRITERIA
13. Targeting head		
13.1 Mounting the targeting head is difficult because the lock mechanism binds in the mount.	Equipment shall be designed to enhance the ease with which it can be assembled and disassembled (S 5.9.1.7). Parts, subassemblies, assemblies, etc., should be mounted so that mounting is compatible with the size and weight of the part, to prevent lead breakage or similar damage from fatigue under personnel handling stress (H 5.18.2.c).	No change.
Section B. Observation Station		
1. Seat		
1.1 The seat is poorly designed. It does not provide adequate seat padding or back support.	The gunner's seat should be 380 to 460 mm deep and not less than 380 mm wide. It should have an adjustable backrest. It should adjust to provide optimum interface with controls and optical equipment (H 7.5.10.1.3).	Same as Section A-1.1 (H 7.5.13.1).
2. Turret base		
2.1 The opening around the turret base is a mechanical safety hazard to the observer.	Same as Section A-6.1 (S 5.13.7.2.1 and H 7.5.6.2).	No change.

FIST V OT II HFE DESIGN PROBLEM	CURRENT HFE DESIGN CRITERIA	PROPOSED CHANGE TO CRITERIA
3. Work surface		
3.1 The work station is not equipped with adequate writing surface for handling documentation and map materials.	A lateral work surface width of at least 760mm (30 inches) wide and 400mm (16 inches) deep shall be provided whenever practicable. (S 5.7.3.1). Workspace dimensions for the length and width of work surface areas should follow the data presented in Table 2-15 (H 2.12).	No change.
4. Observation periscope		
4.1 The periscope is poorly located for operation in conjunction with the mapboard and commo station.	Controls and displays within functional groups shall be located according to operational sequence or function, or both (S 5.1.2.3). Controls and displays should be organized in a manner that will minimize operator effort, confusion and error, by means of functional grouping, sequential arrangement, accessibility to the nominal using limb or hand, and/or nominal viewing axis of the operator (H 1.3.6.1.3).	No change.
4.2 The periscope's forward field-of-view is obstructed by the targeting head and defilade positioning because it cannot be raised high enough above the vehicle to attain the necessary clearance.	Field-of-view shall be compatible with intended use and optical-mechanical design limitations (S 5.11.3.5 and H 7.7.3.2).	No change.

Table 1 (continued)

FIST V OT II HFE DESIGN PROBLEM	CURRENT HFE DESIGN CRITERIA	PROPOSED CHANGE TO CRITERIA
5. Entry/exit access		
5.1 Access to the observation station is blocked by obstructions and protrusions.	There should be a clear path from each hatch to the crew position(s) it serves (H 7.5.1.1.2). All sharp corners and protrusions which may catch clothing or impede crew performance, should be eliminated or minimized (H 7.5.6.3).	No change.
Section C. Communications Station		
1. Seat		
1.1 The upper limit for vertical seat adjustment is too low for many crewmen.	Provision shall be made for vertical seat adjustment from 380 to 535 mm (15 to 21 inches) (S 5.7.3.4.2). Seat height dimensions should follow the data presented in Table 2-15 (H 2.12).	No change.
1.2 Leg, arm and body room are inadequate in the communications station.	Same as Section A-2.1 (S 5.6.1, S 5.7.4 and H 2.12).	No change.
2. Station layout		
2.1 The locations of the intercom control unit and intercom distribution unit are in opposite positions based on frequency of use.	The most important and frequently used controls shall have the most favorable position with respect to ease of reaching and grasping (particlarly rotary controls and those requiring fine settings) (S 5.4.1.3.3 and H 1.1.1.3.1).	No change.

Table 1 (continued)

FIST V OT II HFE DESIGN PROBLEM	CURRENT HFE DESIGN CRITERIA	PROPOSED CHANGE TO CRITERIA
2.2 The mapboard is located in a poor position for its functional use.	Displays shall be arranged in relation to one another according to their sequence of use or the functional relations of the components they represent (S 5.2.1.4.7). Controls and displays should be organized in a manner that will minimize operator effort, confusion and error, by means of functional grouping, sequential arrangement, accessibility to the nominal using limb or hand, and/or nominal viewing axis of the operator (H 1.3.6.1.3).	No change.
3. Mapboard		
3.1 The mapboard design is poor; it is too large for efficient use in the communications station.	The design of military equipment shall reflect human engineering factors that affect human performance including design features to assure rapidity, safety, ease and economy of operation in normal and adverse environments (S 4.4.m).	No change.
4. Noise level		
4.1 The ambient noise levels in the communications station are too high. It increases the difficulty of performing communications operations.	Same as Section A-7.1 (S 5.8.3.1, H 3.6.1 and H 7.5.6.4).	No change.

Table 1 (continued)

FIST V OT II HFE DESIGN PROBLEM	CURRENT HFE DESIGN CRITERIA	PROPOSED CHANGE TO CRITERIA
5. Ventilation		
5.1 Ventilation in the communications station is unsatisfactory.	Same as Section A-3.2 (S 5.12.6.2 and H 7.5.10.1.2.1).	No change.
6. Radio channel capacity		
6.1 The procedure of using one frequency for both voice and digital communication caused interference which degraded the reliability of the digital communications.	Design shall reflect allocation of functions to equipment to achieve required reliability of system performance (S 4.3.b).	No change.
7. Radio assets		
7.1 Proposed tactical organizations requiring the FIST chief to leave the FIST V with a radio cannot be executed effectively because the radio is needed in the FIST V. Thus communication capability is inadequate for executing required tactics.	Design shall reflect allocation of functions to personnel-equipment combinations to achieve required performance in a cost-effective manner (S 4.3.d).	No change.

Table 1 (continued)

FIST V OT II HFE DESIGN PROBLEM	CURRENT HFE DESIGN CRITERIA	PROPOSED CHANGE TO CRITERIA
Section D. Vehicle Interior		
1. Stowage space		
1.1 Stowage space is very inadequate. There is not enough space to stow much of the prescribed basic issue items, additional authorized items, expendable supplies and materials, and TA-50 and personal equipment.	The design of military systems shall reflect human engineering factors that affect human performance including adequate space for personnel and their equipment (S 4.4.d). Unused space should be utilized to the maximum extent possible to provide suitable stowage for items (H 5.2.5.1).	No change.
1.2 Removing and restowing equipment used in the dismounted mode at tactical positions was a serious problem. Both tasks were difficult to perform because of lack of adequate stowage space. This resulted in reducing the FIST V's capability to rapidly setup and leave FO posts which also directly reduceses its serviveability capacity.	Items of mission-critical nature should be stowed in a manner to permit rapid access by crew members (H 5.2.1.e). Stowed items should be capable of being removed and replaced without having to remove or replace other stowed items or components of the system (H 5.2.3.1).	No change.

Table 1 (continued)

FIST V OT II HFE DESIGN PROBLEM	CURRENT HFE DESIGN CRITERIA	PROPOSED CHANGE TO CRITERIA
2. Ambient illumination		
2.1 Ambient lighting levels at all the crew stations were judged to be too low. The interior compartment was painted with a low reflectance pale green color which absorbs much of the ambient light.	For efficient performance of the various tasks which vehicle fighting compartment crews must perform, certain minimum amounts of light are required. The tasks of each crew member should be carefully appraised to determine how much illumination they require. Map reading undoubtedly requires the highest level of illumination. See Table 3-2 for data on specific task illumination requirements (H 3.5.3.1). Auxillery lighting should be provided for such difficult tasks as map and instrument panel reading (H 3.5.3.2). Generally recommended surface reflectance values for work places such as power stations, control rooms, offices and maintenance areas are indicated in Figure 3-7 (H 3.5.7.2).	The crew compartment of fire support team vehicles should be painted a non-glossy matte white color with a high surface reflectance value (80 - 95%) to provide high ambient illumination in each crew station; this is necessary for performing the numerous tasks involving map reading. (H 7.5.13.2).

The HFE problems listed in Table 1 were distributed across 27 different design features or equipment components. Current criteria are available for all of them. The criteria were judged to be adequate for 25 features and inadequate for two. The result suggests that adequate design guidance is available in current criteria to provide designers the information necessary for avoiding most of these problems in future FIST V systems.

The two cases in which criteria were judged as inadequate were concerned with seating and illumination problems. There is extensive information on both subjects in MIL-HDBK-759A, but none of it is addressed specifically to the unique requirements of crew stations in FIST V's. There is a section on crew stations in combat vehicles but it covers only battle tanks; no other combat vehicles are considered. The seating criteria most relevant for FIST V needs were found under criteria for tank gunners. The most pertinent illumination criteria are those addressing the needs of crews in vehicle fighting compartments. These crew station conditions are similar to FIST V conditions. They differ, however, in some important details. The differences are reflected in some divergent criteria specifications which must be modified for FIST V requirements.

Examination of the type of HFE problems gives some understanding of the causitive factors which were present in the design of the FIST V. If the problems are grouped according to a common source, the overall majority can be assigned to one catagory involved with the design, layout and arrangement of the crew stations. Fully 20 of the 27 components, 74 percent, had problems directly concerned with design configuration of the crew stations: problems with workspace, seating, location and arrangement of controls and displays, visibility or illumination of displays, and safety considerations. This finding raises the question: why was there such difficulty in designing the crew stations in the FIST V?

The answer may be found in the evolution of the vehicle. The FIST V is not a newly designed system, but rather a modification of the M901 Improved TOW Vehicle which itself is a rationalized version of the M113A2 Armored Personnel Carrier. Thus the freedom of action of the designers was severely restricted as to the volume of space available in the crew compartment and its general configuration. This is particulary evident in the retention, almost unchanged, of the M113A2 hull and the M901 TOW turret, cupola and launcher module mounted in the forward section of the crew compartment. As a result, the designers had to design the crew stations for the FIST V within a crew compartment configured for the M901. Apparently, the M901 configuration presented serious problems for adapting FIST V crew stations into it.

In order to deal with the restrictive design variables rationalized vehicles pose, much greater emphasis should be given to HFE considerations in the design of crew stations in programs using vehicles originally designed for other missions. The problems is pervasive and requires a substantial commitment of design effort to avoid the types of problems present in the FIST V.

SUMMARY

This report has identified current (previously existing) criteria and developed new and revised criteria critical for the HFE design of future FIST V or similar systems. These criteria emerged from the analysis of HFE problems identified in the OTEA test report: Fire Support Team Vehicle (FIST V) Operational Test II (November 1983).

Most of the HFE problems identified in the FIST V were related to poor design decisions made in the layout and arrangement of the crew stations. This outcome resulted mainly from the severe constraints placed on the designers' freedom by having the M901 Improved TOW Vehicle as the system to modify into the FIST V.

The two cases in the report in which existing design criteria were judged as inadequate pointed out the need to expand Section 7.5, Crew Stations in Combat Vehicles, in MIL-HDBK-759A beyond merely battle tanks to include all classes of armored vehicles that operate in the battlefield environment. As the variation in types of armored vehicles continues to proliferate in Army development programs, new HFE criteria requirements will emerge to define the unique characteristics of these novel crew station and fighting compartment designs. The sections in MIL-STD-1472 and MIL-HDBK-759 on crew stations of combat vehicles should be revised and expanded in order to stay abreast in this growing area of development.

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