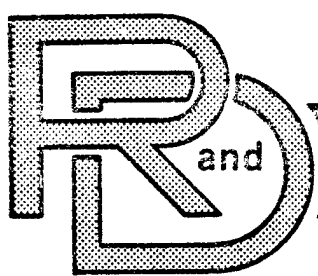


0387

1020



TACOM

MAINTENANCE DIRECTORATE

TECHNICAL REPORT

NO. 13086

ACQUISITION STUDY/ECONOMIC ANALYSIS OF A  
US ARMY HEATER TEST STAND



APRIL 1985

**Final Report**

**CONTRACT NO.**

**by**

Charles Fleetham  
US Army Tank Automotive Cmd  
ATTN: AMSTA-MCB  
Warren, MI 48090

Approved for public release;  
distribution unlimited.

**U.S. ARMY TANK-AUTOMOTIVE COMMAND  
Warren, Michigan 48090**

Reproduced From  
Best Available Copy

20010820 044

AM-43500

## NOTICES

This report is not to be construed as an official Department of the Army position. It conforms to AR 11-28 and was validated by TACOM's Systems and Cost Analysis Directorate.

Mention of any trade names or manufacturers in this report shall not be construed as an official indorsement or approval of such products or companies by the U.S. Government.

This report does not conform to MIL-STD-847B as required for engineering and scientific technical reports. cursory editorial support was provided the author to provide a cover and report number to facilitate dissemination of the document. Questions and comments, as well as requests for copies, should be directed to the author.

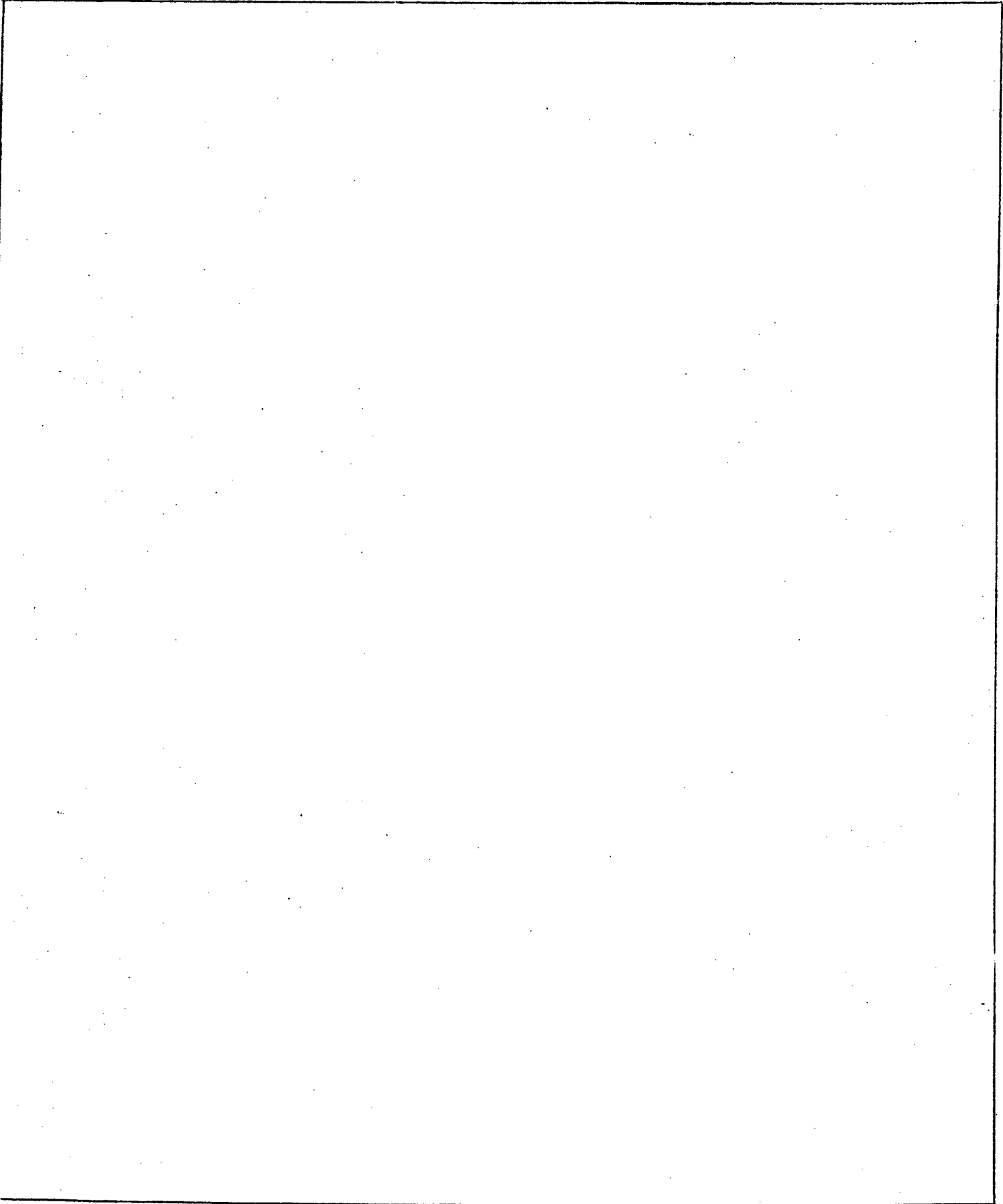
Destroy this report when it is no longer needed. Do not return it to the originator.

**REPORT DOCUMENTATION PAGE**

1a. REPORT SECURITY CLASSIFICATION Unclassified		1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for Public Release; Distribution Unlimited	
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE		5. MONITORING ORGANIZATION REPORT NUMBER(S)	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) 13086		7a. NAME OF MONITORING ORGANIZATION	
6a. NAME OF PERFORMING ORGANIZATION U.S. Army Tank-Automotive Command	6b. OFFICE SYMBOL (If applicable) AMSTA-MCC	7b. ADDRESS (City, State, and ZIP Code)	
6c. ADDRESS (City, State, and ZIP Code) Warren, Michigan 48397-5000		9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8a. NAME OF FUNDING / SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (If applicable)	10. SOURCE OF FUNDING NUMBERS	
8c. ADDRESS (City, State, and ZIP Code)		PROGRAM ELEMENT NO.	PROJECT NO.
		TASK NO.	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) Acquisition Study/Economic Analysis of a U.S. Army Heater Test Stand			
12. PERSONAL AUTHOR(S) Charles Fleetum Fleetham			
13a. TYPE OF REPORT Final	13b. TIME COVERED FROM _____ TO _____	14. DATE OF REPORT (Year, Month, Day) April 1985	15. PAGE COUNT 71
16. SUPPLEMENTARY NOTATION			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	Heaters	
		Heater Test Stands	
19. ABSTRACT (Continue on reverse if necessary and identify by block number) This study supports acquisition and fielding of a heater test stand (HTS). It examines current Army heater maintenance methods, explores the potential impact of HTS on heater maintenance, and describes the heater test stand. It examines acquisition strategies for a HTS program, analyzes the cost of Army heater maintenance and estimates the impact of HTS acquisition.			
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL Brenda J. Lewis		22b. TELEPHONE (Include Area Code) (313) 574-5924	22c. OFFICE SYMBOL AMSTA-TSE

unclassified

SECURITY CLASSIFICATION OF THIS PAGE



~~unclassified~~  
SECURITY CLASSIFICATION OF THIS PAGE

## PREFACE

The author wishes to acknowledge the significant contributions of the many Defense Logistics Agency item managers who provided demand data and the TACOM LAR's who conscientiously participated in the TACOM LAR Personnel Heater Survey. Mr. Jerry Schuetz provided timely engineering support. Additionally, Mr. Jack Tidwell, Chief of AMSTA-MCB, who wisely supported the objectives of the Heater Working Group from the onset, deserves much appreciation for giving the author the encouragement and latitude needed to complete this report. Finally, many thanks to Ms. Patsy Kruse for giving outstanding typing and clerical support.

THIS PAGE LEFT BLANK INTENTIONALLY

## TABLE OF CONTENTS

Section	Page
1.0. INTRODUCTION . . . . .	7
2.0. OBJECTIVE. . . . .	9
3.0. CONCLUSIONS. . . . .	9
4.0. RECOMMENDATIONS. . . . .	10
5.0. DISCUSSION . . . . .	11
5.1. <u>The Current Predicament.</u> . . . . .	11
5.2. <u>Future Predicaments.</u> . . . . .	12
6.0. THE PROPOSED HEATER TEST STAND . . . . .	12
7.0. PROPOSED HTS TECHNICAL DESCRIPTION . . . . .	13
7.1. <u>Official Nomenclature.</u> . . . . .	13
7.2. <u>Functional Description</u> . . . . .	13
7.3. <u>Items Supported.</u> . . . . .	13
7.4. <u>Design/Operational Characteristics</u> . . . . .	14
7.5. <u>On Board Test Equipment.</u> . . . . .	14
7.6. <u>Measurement Characteristics.</u> . . . . .	15
7.7. <u>Power Supply</u> . . . . .	15
7.8. <u>Fuel Supply.</u> . . . . .	15
7.9. <u>Safety</u> . . . . .	15
8.0. HTS LIFECYCLE MANAGEMENT . . . . .	15
8.1. <u>Major Item Management.</u> . . . . .	15
8.2. <u>System Peculiar Item Management.</u> . . . . .	17
8.3. <u>Product Improvement Program (PIP) Management</u> . . . . .	17
8.4. <u>Repair Part/Special Tool Management.</u> . . . . .	17
8.5. <u>AMCCOM Management.</u> . . . . .	18
8.6. <u>Recommended HTS Acquisition Strategy</u> . . . . .	18
8.7. <u>Proposed TACOM HTS Management Plan</u> . . . . .	18
8.8. <u>USAOCS AND HTS</u> . . . . .	20
8.9. <u>Proposed HTS Schedule of Events.</u> . . . . .	20
9.0. PROJECTED HTS ACQUISITION/LIFECYCLE COSTS. . . . .	22
9.1. <u>Assumptions.</u> . . . . .	22
9.2. <u>Production Costs</u> . . . . .	23
9.3. <u>Initial Logistics Support.</u> . . . . .	24
9.4. <u>Transportation Cost Estimate</u> . . . . .	25
9.5. <u>Acquisition/Initial Support Cost</u> . . . . .	25
9.6. <u>Life Cycle Support Costs</u> . . . . .	25
9.7. <u>Total HTS Program Cost for 20 Years.</u> . . . . .	25
10.0. ECONOMIC BENEFITS OF HTS ACQUISITION . . . . .	25
10.1. <u>Heater Removal/Replacement From/In Vehicles.</u> . . . . .	26
10.2. <u>Estimation of HTS on Heater Repair/Repair Part Costs</u> . . . . .	29
10.3. <u>Estimation of HTS Impact on Heater Supply Costs.</u> . . . . .	31

TABLE OF CONTENTS (Continued)

Section	Page
11.0. ALTERNATIVES . . . . .	34
11.1. <u>Preserve the Status Quo.</u> . . . . .	34
11.2. <u>Depot Repair of Personnel Heaters.</u> . . . . .	40
11.3. <u>Make Personnel Heaters Non-Repairable Items.</u> . . . . .	40
11.4. <u>Distribute HTS Fabrication Instructions.</u> . . . . .	40
11.5. <u>Maintaining Heaters with the Direct Support Electrical System Test Stand (DSESTS).</u> . . . . .	41
APPENDIX A. . . . .	A-1
APPENDIX B. . . . .	B-1
APPENDIX C. . . . .	C-1

LIST OF ILLUSTRATIONS

Figure	Title	Page
1-1.	Working Model of U.S. Army Heater Test Stand . . . . .	8

LIST OF TABLES

Table	Title	Page
10-1.	1984 Personnel Heater Supply Costs . . . . .	33
10-2.	1984 Heater Repair/Repair Parts Cost . . . . .	35

THIS PAGE LEFT BLANK INTENTIONALLY

## 1.0. INTRODUCTION

In June 1982, TACOM's Deputy Commanding General, David Stallings, established a command management team, the Heater Working Group (HWG), to solve problems associated with personnel heaters.<sup>1</sup> Personnel heaters are fuel-fired and warm vehicle interiors.<sup>2</sup> Heater problems, which from most accounts have plagued our soldiers since WWII, include shortages of both heaters and repair parts, poor quality and low reliability, inadequate technical information, and lack of standardized test, measurement, and diagnostic equipment (TMDE). The bottom line with heaters is this: they don't work in the field. TACOM has received hundreds of inquiries in the last three years from the field on heater problems:

"I appreciate your letter and the information booklet on the heater problem. Enclosed is a memorandum on the M1 Heater Status in the 3rd Bn, 63d Armor. The unreliable heater is a major problem which needs to be addressed, since the heater not only keeps the soldiers warm and able to effectively operate the equipment, but also is the best way to keep moisture out of the turret..."

(LTC J. Mountcastle; 3rd Inf Div, Dec 83)

"Thanks, Thanks, Thanks for the heater book. Long time in coming, but worth the wait. Fire control is great; mobility is wonderful; protection and survivability is wunderbar...but when your freezing your --- off you can't fight at your best."

(LTC S. Cherrie, 11th Ar Cav, Nov 83)

"The reason I am writing you is that in my unit, we have a problem with operator maintenance on personnel heaters. The reason is that no one really knows that much about personnel heaters except a few mechanics...It would enhance this unit's mission capability greatly if you could send me as many copies of the above-mentioned manual as you can spare..."

(SGT D. Waters, 1st Inf Div, Jan 85)

"Your Hot Tips on the 60,000 BTU Heater have proven most valuable on more than one task. At this time, we are in great need of a means to test personnel heaters. I request of you the simple plans for fabricating a safe heater test stand. Your technical assistance on this matter will be extremely motivating to our maintenance program."

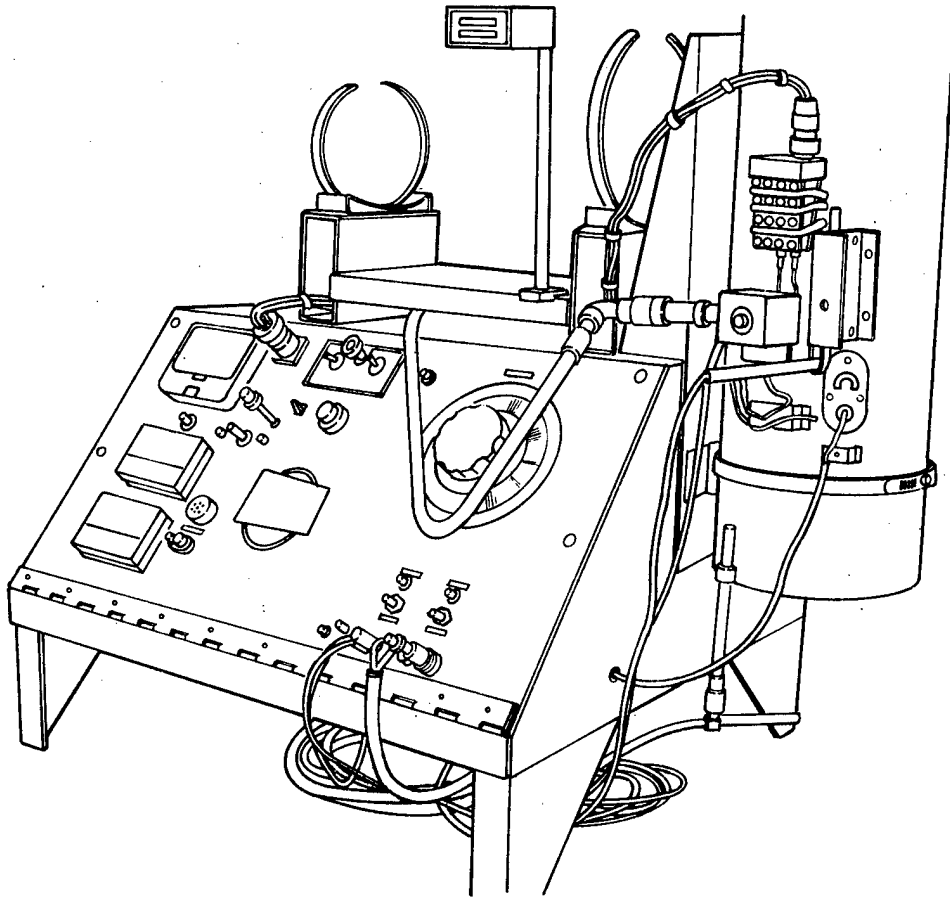
(SSG D. Waters, 1st Inf Div, Jan 85)

"Request you send me a copy of plans required to fabricate a test stand. It is my intent to pass it on, and one copy of the "Hot Tips" book to my DSU. My tankers are fighting over the book. In fact, they want me to keep it in the unit safe just to make sure it doesn't walk away..."

(CPT J. Kueffer, 3rd ACR, Dec 83)

<sup>1</sup> See Appendix A, DCG's Heater Working Group Charter.

<sup>2</sup> See Appendix A, cutaway of a typical personnel heater.



1-1. Working model of U.S. Army  
Heater Test Stand.

"I'm writing referencing a problem I'm having with vehicle personnel heaters... please send me information on how to build a heater test stand. Also, please send me all the information you have on vehicle heaters...I will pay any cost for material or postage. Please bill me if any...my unit's readiness is being affected."

(MSG H. Holden, 2nd AD, JAN 85)

The Heater Working Group (HWG) tackled these immense heater problems from several perspectives: engineering, quality control, product assurance, research and development, and maintenance.<sup>3</sup> On the maintenance front, the HWG, after field surveys, investigation, and data reviews, identified two major deficiencies--lack of technical information and lack of standardized TMDE. To eliminate the first shortfall, we wrote and distributed reams of the latest words on heater maintenance. Also, TM 9-2540-205-24&P, devoted solely to personnel heaters, was published in Dec 84. Unfortunately, despite our best efforts, the second deficiency still remains uncorrected. The lack of standardized TMDE, specifically an Army issue heater test stand, makes it very difficult for our soldiers to repair heaters.

## 2.0. OBJECTIVE

This study seeks to support acquisition and fielding of a heater test stand (HTS). Such an undertaking would require command level approval and emphasis, funding commitments, and the coordinated efforts of several Army organizations. For the affected organizations this study intends to do the following:

- Examine current Army heater maintenance methods.
- Explore the potential impact of HTS on heater maintenance.
- Propose a technical description of HTS.
- Examine acquisition strategies for an HTS program.
- Analyze the cost of Army heater maintenance and estimate the impact, in dollars, of acquisition of HTS.

## 3.0. CONCLUSIONS

In 1984, the U.S. Army spent almost \$7 million on personnel heaters and heater maintenance. This figure does not include the vast numbers of heaters installed in production vehicles, depot overhauled vehicles, and winterization kits. The \$7 million expenditure breaks down as follows: \$200 thousand for heater removal/replacement, \$3.1 million for heater maintenance, and \$3.6 million for heaters.

<sup>3</sup> See Appendix A, for a list of major HWG accomplishments.

The U.S. soldier lacks reliable, supportable, and safe test equipment for maintaining personnel heaters. This deficiency contributes to our substantial heater costs.

Acquisition and distribution of a HTS to DS/GS maintenance units would significantly reduce heater costs, both supply and maintenance. Conservative estimates show that HTS could save, in the first year, almost \$900 thousand. In four years, HTS could save enough funds to pay for its projected 20-year lifecycle cost.

Simple, reliable heater test stands can be built for less than \$5,000 each. HTS can be acquired, distributed, and initially supported for \$1.74 million, with an annual support cost of \$82 thousand thereafter.

HTS can be fully fielded three years after program initiation.

TACOM has a working model of HTS that can serve immediately as a reliable production prototype.

TRADOC has acknowledged that the US soldiers need HTS and pledges cooperation throughout an acquisition program.

An HTS program cannot be launched without TACOM command or major PM support.

#### NOTE

The cost projections/estimates made in this report have been validated by the TACOM Comptroller in accordance with AR 11-28, "Economic Analysis and Program Evaluation for Resource Management."

#### 4.0. RECOMMENDATIONS

TACOM should task a major project manager's office with the responsibility of managing the HTS Acquisition Program.

All TACOM PM's should share the cost burden of HTS, since it benefits all TACOM tactical/combat vehicles.

TACOM NMP and Readiness Engineering should be tasked to support the acquisition with expertise, initial support (technical documentation and provisioning), and with the working model of HTS.

If a HTS program is not approved, for the field's safety, TACOM should discontinue support of all heater maintenance upon fielding of the upcoming generation of personnel heaters.

## 5.0. DISCUSSION

### 5.1. The Current Predicament

Every winter, thousands of broken heaters pulled from tanks, howitzers, armored personnel carriers, etc., pour into fuel and electric (F&E) shops throughout the Army. There, soldiers wrestle with the flood. Many visitors returning from winter trips to Germany report seeing heaters stacked to the rafters in maintenance shops. The facts verify these impressions. The M60 Sample Data Collection (SDC) program consistently shows that heaters fail more often than any other component on M60A3 tanks fielded in Europe.<sup>4</sup> The Ft. Knox Directorate of Industrial Operations (DIO) reported that in 1984, over 1,000 heaters were used; a figure which equates to a failure rate of one-to-one (vehicle to personnel heater). This flood of heaters comes every winter. F&E shops cannot keep up with the flow.

Most shops realized long ago that they needed something upon which to troubleshoot, repair, and test heaters. Mechanics needed a stand to support the heater, fuel and power supplies for operation, and exhaust tubing for combustion gases. They fabricated homemade stands from angle iron.<sup>5</sup> Because the Army does not supply a test stand, the soldier must make do with what he can--no matter how primitive.

To get a clearer picture of the equipment F&E shops use, we conducted a survey with the TACOM Logistics Assistance Representatives (LAR's).<sup>6</sup> LARs serve worldwide in the field helping soldiers pull better maintenance. They identified many shortcomings in the homemade stands:

- The stands lack inboard diagnostic capabilities, e.g. voltage, current, fuel flow, or temperature measuring devices.
- They are not authorized by Table of Equipment (TOE) or Table of Distribution and Allowances (TDA).
- They are not portable for field maintenance.
- They are not designed for safety. Electric circuits are adjacent to fuel supplies and lines. Fuel is improperly stored. Exhaust gases are not thoroughly vented.
- The stands have no repair parts, manuals, or wiring diagrams. Mechanics rely on word-of-mouth when pulling maintenance.
- Inefficient stands reduce output and waste manhours.
- Different stands from installation to installation make it impossible to thoroughly train mechanics.

<sup>4</sup> TACOM Technical Report No. 12769, "Final Test Report M60 Tank Personnel Heater Comparison Test," May 83, p.7.

<sup>5</sup> See Appendix A, for a picture of a typical homemade heater test stand in Germany.

<sup>6</sup> See Appendix B for a detailed analysis of the TACOM LAR Survey.

Mechanics in the 63G10 MOS series (DS Fuel and Electric Repairman) learn most of their heater repairing skills from on-the-job training in the field. The Ordnance School at Aberdeen Proving Grounds provides 9 hours of instruction, 5 hours for repair, 3 hours for testing, and the remaining hour for a performance exam. Heaters are not combat essential components; and 63G10's must concentrate on items crucial for maintaining combat readiness. The relatively low stature of heaters, in terms of combat essentiality, does not stop soldiers from wanting them desperately in the winter. Frostbite is not a pleasant experience and commanders with frostbitten soldiers tend to complain about heater shortages. A lot of pressure falls upon the 63G10 mechanic. He does not receive enough training nor the right test equipment to do the job.

Currently in the field, there are far too many heaters failing and too few resources allocated to repair them. Maintenance resources must be targeted primarily at combat essential repairs. This logic, however sound, does not factor in the incredible demand for heaters and their intolerable failure rate. As this study will show, the above logic costs the Army millions of dollars a year for an item with a \$600 price tag and 30-year-old technology. It's a problem crying for a solution. A small investment in HTS now is the answer.

## 5.2. Future Predicaments

Advanced engineering is useless in the field, unless maintenance stays abreast. As a result of HWG encouragement, manufacturers are now shipping the Army heaters with state-of-the-art fuel regulation componentry. These heaters should be more reliable, but mechanics will have difficulty repairing them. The heater requires filtered current, with not more than one percent ripple. In DS shops, most homemade stands powered by rectified AC, do not filter the current enough to meet the one percent ripple requirement. Mechanics can solve the problem by increasing the capacitance of their stands. TACOM cannot prescribe solutions because we don't know the configurations of the homemade stands. Having a standardized design like HTS would allow us to keep up with engineering advances.

HTS will be needed even more in the future if recent engineering proposals become reality. Under the auspices of the HWG, Williams International was contracted to develop a universal heater to replace our hodgepodge of models, sizes, and capabilities.<sup>7</sup> This heater, which will be based on turbine technology, is scheduled for fielding in 1989. A maintenance concept for the heater has not been proposed. If fielded, HTS could be modified through Army Product Improvement Programs to test the universal heater. We don't have a similar option with the current crop of homemade stands.

## 6.0. THE PROPOSED HEATER TEST STAND

TACOM possesses a working model of HTS. It was built at Letterkenny Army Depot (LEAD) with TACOM funds. In December 1982, LEAD requested funding and engineering design assistance for a stand to repair heaters used on

<sup>7</sup> See Appendix B, for a concept drawing of the universal heater.

overhauled vehicles. TACOM agreed to help, providing that LEAD build two stands--one for LEAD, the other for TACOM, to use in validation/verification of TM 9-2540-205-24&P, the recently published manual devoted solely to personnel heaters. Using the \$10,000 TACOM allotted, LEAD finished the stands after numerous delays in May 1984. Preliminary tests attended by several Army representatives showed that the test stand would meet field needs with minor modifications. This result occurred largely because TACOM had carefully researched field requirements before laying down the design to LEAD. The HTS working model was influenced by the following concerns:

- Safety was the paramount issue. Safety features include: separation of fuel and electric functions, strong mounting structure, fire-proof structure for internal components, and tight exhaust system.
- Personnel heater failure modes were identified. The stand will diagnose all common failures and will verify correct heater operation. It goes far beyond the homemade stands currently in the field.
- The top of the stand lifts out on hinges to allow access to components and wiring for ease of maintenance.
- The meters are of the simple analog variety for ease of operation. The design matches the complexity of the heaters--they're both simple. (Not surprisingly, LEAD has operated its stand on a daily basis through this winter without any breakdowns.)
- Portability: two side handles allow lifting.
- The test stand was designed to meet a production cost goal of \$3,000.

## 7.0. PROPOSED HTS TECHNICAL DESCRIPTION

### 7.1. Official Nomenclature

Test Set, Heater.

### 7.2. Functional Description

The heater test stand troubleshoots, tests, and verifies operational characteristics of fuel-fired personnel heaters. The stand supplies fuel, power, and starter circuitry for heater operation, and provides a solid structure for mounting heaters and discharging exhaust gases.

### 7.3. Items Supported

Fuel-fired compartment heaters used to warm vehicle interiors for military personnel. With field applied modifications, the stand will support fuel-fired engine coolant heaters.

<u>NSN</u>	<u>PN</u>	<u>APPLICATION</u>
2540-01-083-0691	11669496	Most Combat Vehicles
2540-01-013-0846	11668862	Most Combat Vehicles
2540-00-854-4449	7748716	Most Combat Vehicles
2540-01-169-5159	11669489-1	Most Combat Vehicles
2540-01-071-0651	11669489	Most Combat Vehicles
2540-01-162-3834	11669490-1	Most Combat Vehicles
2540-00-930-8938	11601809	Most Combat Vehicles
2540-01-114-7688	12300343	Multiple Launch Rocket Sys
2540-00-113-4180	MIL-H-46952	Most Tactical Vehicles
2540-00-997-1532	11601698 (Coolant Heater)	Most Combat Vehicles

#### 7.4. Design/Operational Characteristics

- Shock and Vibration - To be determined.
- Transportability - Must fit into M10 shop van environment.
- Size and Weight - 38" x 26" x 24" (wdh) - Must weigh less than 150 lbs.
- Calibration: The heater test stand will not require calibration.
- Mean Time Between Failure: 800 hours.
- Mean Time to Repair: 3 hours.
- Operator MOS: 63G10 (DS Fuel and Electric Repairman).
- Usage Factor: 8 hours per day, Sep through Apr, approximately 1300 hours a year.

#### 7.5. On Board Test Equipment

- Analog Voltmeter
- Analog Ammeter
- Reed Tachometer
- Burette
- Pyrometer
- Digital Clock

## 7.6. Measurement Characteristics

<u>PARAMETER</u>	<u>RANGE</u>	<u>ACCURACY</u>
Fuel Rate	0-50-me/min	+ 1 ome
Outlet Temp	0-500°F	+ 10°F
Volts	0-50 DC volts	+ 1%
Current	0-25 DC Amps	+ 1%
Motor Speed	3000-7500 RPM	+ 20%
Time	1-3600 sec	+ 1 sec
Fuel Seal	up to 15 p.s.i.	+ ½ p.s.i.

## 7.7. Power Supply

24 VDC converting 115 VAC or 220 VAC at 50 Hz with no more than 1 percent ripple. The stand will also operate off 24 VDC from batteries.

## 7.8. Fuel Supply

Three fuel pumps built IAW MIL-SPEC 51321. Two pumps deliver fuel at 4 p.s.i., the other pump delivers 7 p.s.i.

## 7.9. Safety

Fuel and electric functions must be separated. Fuel storage and exhaust venting must meet OSHA requirements.

## 8.0. HTS LIFECYCLE MANAGEMENT

HTS is a piece of maintenance significant TMDE. Acquisition is governed by AR 750-43, "Test, Measurement, and Diagnostic Equipment." According to AR 750-43, "new items will be introduced into the Army inventory only when supported with a valid requirement, economically justified, and validated for performance, durability, and supportability." There are three ways to supply new TMDE:

- As general TMDE (major item applicable to more than one end item).
- As system peculiar TMDE applicable to one end item.
- With an AMC waiver.

## 8.1. Major Item Management

As a major item, HTS would be managed like a tank or an armored personnel carrier.

- The combat developer generates a requirements document. For HTS, a Letter Requirement (LR) would suffice in lieu of a Required Operational Capability (ROC), because it will cost less than \$12 million to procure.

- At DA/DARCOM levels, decisions are made on funding and prioritization.
- AMCCOM, the traditional manager of TMDE such as HTS, assumes management responsibility. Acquisition approval is requested from U.S. Army Central TMDE Activity. An economic analysis and a valid requirement must accompany the request.
- Per the Deputy Chief of Staff for Operations and Plans (DCSPOS), Tables of Equipment (TOE) are updated.
- Before fielding, HTS is Type Classified, assigned a Line Item Number, National Stock Number, Logistic Control Code, and entered into SB 700-20.

8.1.1. Major Item Advantages. Major item management seemingly ensures, by regulation, compliance with the multitude of regulations governing acquisition management:

- AR 11-28, "Economic Analysis and Program Evaluation for Resource Management."
- AR 70-1, "Army Research, Development and Acquisition."
- AR 70-61, "Type Classification of Army Materiel."
- AR 700-127, "Integrated Logistics Support."
- AR 1000-1, "Basic Policies for Systems Acquisitions."

8.1.2. Major Item Management Disadvantages. Generation of requirements documentation does not guarantee HTS will be funded by DA. Indeed, the USAOCS has stated that higher level prioritization of combat support equipment has been historically so low, that it is doubtful HTS will receive funding.

"It must be noted that funding decisions are not within the purview of this headquarters. The Ordnance School recommends priorities for equipment acquisition, but the recommendations must then compete with all other requirements in the TRADOC priorities list. Decisions are related to funding allocations, but quantities, timing (FY), etc., are made at the DA level. Historically, however, the priorities for Combat Service Support have been very low. Consequently, the probability of funding for acquisition, even with approved requirement documentation, is also very low." (Letter, USAOCS to TACOM, AMSTA-GBW, 8 Nov 84, subject; Draft Organizational and Operational (O&O) Plan for Air-Hydraulic Power Brake Cylinder Test Stand for 2- and 5-ton tactical vehicles.)

In upcoming years, we expect a resource crunch. HTS supports non-combat essential components-personnel heaters. Certainly, other programs freighted with much more political/military clout will compete with HTS for these scarce dollars. We predict HTS will never become a reality, if major item management is relied upon.

## 8.2. System Peculiar Item Management

Numerous weapons systems have TMDE designed, acquired, and fielded for support. Tanks, tactical vehicles, and light combat vehicles all have personnel heaters that would be directly supported by HTS. TACOM Project Managers (PM's) routinely express their concern about the high costs, political and financial, of unreliable heaters. They fund heater field tests nearly every year, and similarly, engage heater manufacturers to improve their products. It would only be logical that PM's should support HTS with funds and management. The process begins by updating the weapon system ROC to include HTS. Then, the PM manages the program like any other of its numerous pieces of TMDE per AR 750-43.

### Advantages:

- PM's ensure compliance with governing regulations listed previously.
- PM intensive management can accelerate the program.
- Funding approval rests at PM level.
- PM's can tailor management in proportion to HTS complexity.

### Disadvantages:

- Updating vehicle ROC's requires lengthy coordination/approval process.
- If more than one PM agrees to support HTS, philosophical differences will cause conflicts and delays.

A PM will probably not alone assume full responsibility.

## 8.3. Product Improvement Program (PIP) Management

AR 750-43 also authorizes modification or replacement of existing TMDE. Currently, the Army does not issue or support a heater test stand; therefore, a PIP is not possible. However, in the 1960's, the Army distributed heater test sets manufactured by Sun, Inc. of Chicago, IL. The Sun test sets functioned like HTS and were authorized until 1982 in TDA units--stationary outfits like depots and DIO's. Many DIO's still use the Sun test set today according to the TACOM LAR survey. It is not supported by repair parts or manuals. According to Sun, Inc., the last test set was manufactured in 1967, and they have no plans to develop a replacement.

## 8.4. Repair Part/Special Tool Management

Several proposals have been advanced to acquire HTS as a repair part of a special tool. These proposals ignore the nature of HTS. It requires ILS management, including repair part, a manual, training plans, etc. Presumably, funding would be generated from the Army Stock Fund; however, this clearly contradicts normal acquisition procedure. Management would become "catch as catch" can. Finally, DARCOMR 700-12, Management of Sets, Kits, and Outfits (SKO), clearly states maintenance significant TMDE will not be included or managed as SKO components, i.e., repair parts. Component management of HTS is not a viable option.

## 8.5. AMCCOM Management

HTS will likely become an item of the Fuel and Electric Systems Shop Set, LIN T30414. AMCCOM manages this shop and would, therefore, manage HTS if it is acquired as a major item. It has been suggested that AMCCOM be "given" the HTS program. Adopting this suggestion will doom HTS for the following reasons:

- Unlike TACOM, AMCCOM has no vested interest in HTS.
- Major item management of HTS will pose obstacles as described previously.
- AMCCOM has already declined to manage the program (see Appendix B).

## 8.6. Recommended HTS Acquisition Strategy

A program cannot succeed without a manager. Therefore, TACOM must assume management responsibility for HTS. To date, TACOM organizations, in particular the National Maintenance Point (NMP) and Readiness Engineering, have achieved two crucial goals: development of a working model, and the complete cooperation of the combat developer, the USAOCS. However, these organizations, for all their good intentions, cannot deliver the most important thing: money. Neither organization can legally fund procurement of end items for field distribution. The NMP frequently funds procurement of depot test equipment with Depot Maintenance Production Equipment (DMPE) money, and in fact, the HTS working models were DMPE funded. But DMPE money cannot be used because HTS will be distributed to DS/GS units. As mentioned previously, maintenance significant TMDE cannot be funded with Army Stock Funds. The only legitimate monies for HTS are Procurement Appropriations (PA). The most abundant sources of PA monies are PM offices. This fact drives the acquisition strategy below:

- Using this economic analysis as source material, briefings will be sought with TACOM CG, DCG, and TACOM PMO's (Light Combat Vehicle, Tanks, and Tactical Vehicles).
- TACOM CG assigns management to the NMP TMDE Office, a PM, or the National Inventory Control Point (NICP), or one of the PMOs assumes responsibility. In either case, the probable funding source is with the PM's on a sole or shared basis.
- Readiness Engineering develops a military Description for Purchase (DFP) based largely on aforementioned technical description. Using the DFP, the HTS manager begins acquisition process per AR 750-43.

## 8.7. Proposed TACOM HTS Management Plan

8.7.1. Requirement. Coordinate an update or actually update a vehicle ROC to show HTS requirement. This may require an additional documentation or a validated interpretation that the ROC already subsumes as an HTS requirement. If this task is not completed, HTS will not be acquired per the TMDE acquisition stipulated by AR 750-43.

8.7.2. Funding. Plan and program for funds using estimate in Section 9.0, as a guideline. Either a sole PM or combination of PM's may provide funds.

8.7.3. Acquisition Approval. Seek TMDE acquisition approval from U.S. Army Central TMDE Activity (USACTA) by furnishing DA Form 4062-R, TMDE Item Technical Description, DA Form 4062-1-R, TMDE Requirements Review, and an economic analysis. This study will serve as the economic analysis, written and validated in accordance with AR 11-28, "Economic Analysis."

8.7.4. Type Classification. Initiate type classification per AR 70-61. (Note: Per AR 70-61, HTS is not exempt from type classification.) Type classification could be eased if it is coupled with new vehicle type classification. For example, the M113A3 RISE is scheduled for materiel release in late 1986. Possibly, HTS type classification could be tied to it.

8.7.5. Authorization Documents. Verify that The Army Authorization Documentation System (TAADS) has been updated to show HTS requirement. The driver for this task is the ROC change described above. Furnish TAAD's status to USACTA.

8.7.6. Description for Purchase. Given USACTA acquisition approval, the HTS manager initiates procurement. A suitable commercial heater test stand has not been found. A Canadian firm, VALCOM, Inc., produced some test stands for the Canadian military in 1982. TACOM HTG representatives inspected and tested the VALCOM stand, but it would not meet Army requirements without serious modification. A thorough industry survey has not been conducted. After the HTS DFP is completed, it will be sent to the USAOCS and interested companies for comment. Then, acquisition process can officially begin. NOTE: Stewart Warner, Inc., one of the largest personnel heater manufacturers, and LEAD, have expressed interest in building HTS.

8.7.7. Testing. HTS can be tested for survival in a military environment. The existing working model can undergo an operational test (OT) per USAOCS requirements, since the production HTS should be quite similar to the working model. No research and development money has been used for HTS; a developmental test (DT) is not necessary.

8.7.8. Logistics Support. The HTS manager will ensure accomplishment of Integrated Logistics Support (ILS). Three ILS elements have been targeted: technical manuals, provisioning, and training. The training requirement should be met by including a training package with HTS fielding. Most experienced 63G10's now work with homemade test stands; they should be able to teach themselves how HTS operates within hours, with proper instructions.

8.7.9. Fielding. The USAOCS estimated a one time requirement of 375 stands. In coordination with the USAOCS, the HTS manager develops a Materiel Fielding Plan. A technical manual and initial provisioning support must be available before fielding.

8.7.10. Lifecycle Management. Transition management to TACOM Readiness; that is the NICP. The NICP supports HTS, as necessary, through the lifecycle including configuration control, logistics support, asset management, and disposal.

## 8.8. USAOCS and HTS

In April 1983, TACOM requested the USAOCS to establish a requirement for HTS.<sup>8</sup> The USAOCS responded positively and their eventual role in HTS acquisition cannot be understated. Their current position vis-a-vis HTS is as follows:<sup>9</sup>

- An urgent need exists to provide maintenance units capability to test heaters.
- Format requirements documentation, that is, a ROC or a LR, are not necessary. The USAOCS is willing to prepare such documentation; however, they believe, for reasons already mentioned, that HTS will not become a viable program, if they pursue that course.
- A USAOCS point of contact has been appointed to coordinate management efforts.

8.8.1. HTS and the Fuel and Electric Systems Shop Set. Since the HTS effort began, we advocated inserting HTS as a component in the Fuel and Electric Systems Shop Set. The USAOCS controls the makeup of the set, and had agreed to change the documentation, SC 4910-95-CL-A01, to include the test stand. Then, SC 4910-95-CL-A01 would authorize the DS and GS units to have HTS. Also, as a set component, HTS would not require separate type classification, an arduous process at best. However, this course of action violates DARCOMR 700-12 which states maintenance significant TMDE will not be included as set components. Unless further investigation shows this regulation does not apply to HTS, we do not recommend pursuing an update of SC 4910-95-CL-A01.

### 8.8.2. Proposed USAOCS/HTS Interface.

- Provide for training on HTS at the Ordnance School for MOS 63G10.
- Coordinate, as necessary, update of vehicle ROC to include requirement for HTS.
- Participate in type classification actions.
- Evaluate tests, as necessary, and execute HTS Operational Test, if required.
- Assure that training packages are addressed during HTS acquisition.

## 8.9. Proposed HTS Schedule of Events

HTS can be fielded with full logistics support within three years after program initiation.

<sup>8</sup> Appendix B.

<sup>9</sup> Message 2513057 Oct 84, USAOCS, ASTL-CD-MS to TACOM, AMSTA-M, subject: Heater Test Stand Requirement.

<u>MAJOR MILESTONE OR ACTION</u>	<u>EVENT DATES</u>	
	<u>BEGIN</u>	<u>END</u>
● Assignment/assumption of HTS management	5/85	6/85
● Update vehicle ROC	6/85	9/85
● Plan/obtain funding	6/85	--
● Industry/government review of draft DFP	7/85	9/85
● Finalize DFP	10/85	11/85
● Modify HTS Working Model to meet DFP	10/85	1/86
● Obtain USACTA approval for acquisition	10/85	2/86
● Initiate TOE update	10/85	3/86
● Initiate type classification	10/85	3/86
● Establish test requirements	2/86	5/86
● Initiate/finalize procurement	2/86	5/86
● Conduct physical teardown/maintenance evaluation with HTS working model	6/86	6/86
● Conduct operational test with HTS working model	8/86	10/86
● Initiate provisioning for Long Lead Items	9/86	11/86
● Prepare draft equipment publication	9/86	3/87
● Prepare training package	11/86	3/87
● Receive HTS First Article	1/87	--
● Start production of 375 stands	2/87	2/88
● Initiate provisioning	1/87	4 /87
● Prepare Basis of Issue Plan	3/87	7/87
● Verify draft TM/training package	4/87	5/87
● Prepare Materiel Fielding Plans	7/87	10/87
● Deliver HTS units to TRADOC schools with training packages	12/87	--
● Complete Type Classification	12/87	

● Repair parts available	3/88	--
● Revise and publish new TOE	4/88	---
● Published TM available	4/88	--
● Equip U.S. Army Units	5/88	--

#### 9.0. PROJECTED HTS ACQUISITION/LIFECYCLE COSTS

An accurate estimate of HTS acquisition/lifecycle costs is one of the most important facets of this economic analysis. Program estimates include production, transportation, initial ILS support, configuration control, and lifecycle logistics support.

#### 9.1. Assumptions

- Costs are in constant FY85 dollars.
- Sunk costs are omitted.
- Operational and maintenance costs are omitted because most units now operate "homemade" stands and, thus, pour fuel, electricity, and manhours into them. HTS will not increase U.S. Army operational costs.
- Training costs are omitted for Army Schools. Current program of instructions (POI) already include personnel heater maintenance. Expanding the POI for HTS will incur negligible costs.
- The Army requirement is for 375 stands for Army DS/GS units; a figure established by the combat developer, USAOCS.
- HTS lifecycle will last 20 years.
- Logistics support costs through HTS lifecycle will equal the acquisition cost. For major weapons systems, lifecycle logistics costs usually equal twice the acquisition cost; a figure provided by the Army Logistic Management Center (ALMC), while this writer attended an ILS management course. For HTS, the equation has been halved for the following reasons: HTS requires no preventative or hard time maintenance, depot rebuild, vast piles of manuals to update, drawing packages to maintain, or costly product improvement programs.
- HTS will feature no technological breakthroughs. Every effort will be made to use parts already in the DOD system. In other words, standardization will be a top priority during acquisition.
- Research and development monies are not required for HBTS.
- Except for provisioning and technical documentation, TACOM will provide Integrated Logistics Support.

- A profit of 10 percent will be allotted to the HTS manufacturer.

## 9.2. Production Costs

In 1983, TACOM allotted LEAD \$10 thousand for fabrication of two heater test stands. LEAD purchased most of the parts from local vendors--similar parts in the DOD supply may cost more, others less. What follows is an exhaustive listing of almost all HTS parts, accompanied by costs rounded to the nearest dollar. Estimates are given for new parts resulting from modification.

### CONFIGURATION ESTIMATE

<u>ITEM</u>	<u>COST</u>	<u>ITEM</u>	<u>COST</u>
Ammeter	51.00	Labor (est)**	1280.00
Binding Post	18.00	Lamps	4.00
Bridge Rectifier	5.00	Lamp Fixtures	3.00
Box control	38.00	Misc Wire/Hardware	200.00
Burette (est)	50.00	Mounting Brackets	10.00
Capacitor (2)	84.00	On/Off Switch	36.00
Casing, Aluminum (est)*	1500.00	Pyrometer	72.00
Circuit Breaker	50.00	Relay	15.00
Clock	19.00	Tachometer (est)	250.00
Filter, Choke	40.00	Terminals	4.00
Fuel Pressure Gauge	34.00	Test Leads	5.00
Fuel Pumps (3)	78.00	Toggle Switch	11.00
Fuse Holder	4.00	Transformer	10.00
Heat Sink	38.00	Voltmeter	39.00
Hose Connectors	26.00		

\*Includes cost of material, stamping, and welding. Estimate provided by LEAD.

\*\*LEAD estimated eight man-hours to wire HTS. We estimate an additional 32 man-hours for preassembly, fabrication, and testing. Estimated man-hour cost including overhead is \$36 per hour (current U.S. Army depot rate).

9.2.1. Production Cost Estimate (PCE).

$$\begin{aligned} \text{PCE} &= \$3974 + 10 \text{ percent profit} \\ &= \$4371 \\ &= \$4400 \end{aligned}$$

9.2.2. Acquisition Cost Estimate (ACE).

$$\begin{aligned} \text{ACE} &= 375 \text{ stands} \times \$4400 \\ &= \$1.65 \text{ million} \end{aligned}$$

9.3. Initial Logistics Support

This cost consists of the technical documentation, training package, and repair parts needed to support HTS upon fielding.

9.3.1. Technical Manual Cost. The TM will cover operation, maintenance, and repair parts listings for DS units. It will be intertwined carefully with TM 9-2540-205-24&P, the current manual for personnel heaters. The below cost estimates are derived from latest independent government cost estimates (IGCE's) used for major item logistics contracts.

$$\begin{aligned} \text{TM cost} &= 120 \text{ pages} \times 12 \text{ man-hours per page} \\ &\quad \times \$40 \text{ per man-hour} \end{aligned}$$

$$\text{TM cost} = \$64,400$$

9.3.2. Training Package. This study assumes HTS will not require New Equipment Teams (NET) upon fielding. HTS can be fielded with on-site assistance of TACOM LAR's, and with a training package linked to the TM for on the job (OJT) education.

$$\begin{aligned} \text{Training Package} &= 25 \text{ pages} \times 12 \text{ man-hours per page} \times \\ &\quad \$40 \text{ per manhour} \\ &= \$12,000 \end{aligned}$$

9.3.3. Initial Provisioning. Initial provisioning amounts to buying enough repair parts before HTS fielding, to support HTS for 2 years until accumulation of a demand history allows for regular supply. HTS will introduce very few components without national stock numbers--ten at the most. This study estimates the ten parts will cost an average of \$33, the average cost of a component on HTS.

Furthermore, it is estimated that six each of these ten parts will fail per 100 heater test stands:

$$\begin{aligned} \text{Initial Provisioning} &= \$33 \times 2 \text{ years} \times 6 \text{ failure} \times \frac{375 \text{ stands}}{100} \\ &= \$1485 \end{aligned}$$

#### 9.4. Transportation Cost Estimate

HTS, after acquisition, will be transported throughout the Army. The USAOCS provided a preliminary distribution schedule, and the TACOM shipping office estimated the transportation cost.

Transportation Cost = \$10,100

#### 9.5. Acquisition/Initial Support Cost

HTS can be acquired, distributed, operated, and maintained by trained personnel for 2 years for the following cost:

Acquisition/Initial Support Cost = \$1.74 million

#### 9.6. Life Cycle Support Costs

After acquisition, logistics support and configuration control funds will be required to support HTS. We estimate one modification to HTS will be required to support the new Army heater at a cost of \$100,000. Life cycle logistics support costs were earlier assumed to equal the acquisition costs through the life of HTS. This amounts to \$220 per stand per year for 20 years. (Field experience with the Sun Heater Test Stand would indicate this is an extremely high figure.)

Life cycle Support Cost = \$1.65 million + \$100,000  
= \$1.75 million

#### 9.7. Total HTS Program Cost for 20 years

\$3.53 million.

#### 10.0. ECONOMIC BENEFITS OF HTS ACQUISITION

An estimate of the economic impact of HTS acquisition, upon Army operations and maintenance costs, will be determined using latest data and test results.

- Sample Data Collection (SDC).
- Army Master Data File (AMDF).
- National Stock Number Master Data File (NSNMDR).
- Final Test Report, M60 Tank Personnel Heater, Technical Report No. 12769.
- Defense Logistics Agency Item Managers.
- 1985 TACOM LAR Survey.

- Over one hundred letters/reports/suggestions from field personnel.
- TM 9-2540-205-24&P, Personnel Heater Maintenance and Parts Manual, Oct 84.

Accurate estimating requires focusing on the support functions most potentially affected by HTS acquisition.

- Heater removal/replacement from/in vehicles.
- Heater repair.
- Heater procurement.

This section estimates how much money it costs the Army to accomplish these support functions. It also estimates the economic impact of HTS upon each function. From these figures, we total the benefits of HTS acquisition. Finally a benefit analysis is prepared by comparing HTS lifecycle costs with the projected benefits of acquisition.

#### 10.1. Heater Removal/Replacement From/In Vehicles

For the M60 tank, the SDC data show that personnel heaters fail more often than any other component, except the periscope seal assembly. To a cold soldier, this means one thing: he will spend a lot of time removing and replacing heaters if he wants to stay warm. Many heaters fail due to operator error, but we know significant numbers of improperly repaired heaters are unwittingly installed in vehicles by organizational maintenance.

They constantly receive heaters that won't start when they're put in the vehicle, or heaters that fail prematurely. Improper maintenance happens all the time, even in the finest shops, but the problem is acute with heaters.

It surfaces frequently in field reports: "Recently installed heater--wouldn't start." It surfaced during the Ft. Carson M60 heater test, when soldiers returned inoperative heaters that had checked out "okay" on the antiquated, homemade heater test stand. Improper maintenance even surfaced at Red River Army Depot at the vehicle test track, where scores of recently overhauled heaters failed to operate in the vehicles. What can HTS do to reduce heater removal/replacements? HTS gives the soldier his best shot at doing the job right the first time.

10.1.1. Assumptions. Organizational maintenance removes and replaces heaters; direct support or general support repairs them. Thus, fielding HTS at DS/GS unit can impact heater maintenance appreciably.

Organizational maintenance personnel earn \$857 per month (E4, Pay Grade 3). Applying cost escalators from AR 11-28 (17 percent for retirement, 23 percent for personnel, and 20 percent for TDY), the labor rate equals \$8.55 per hour.

Heater failures occur at the same rate throughout the combat vehicle fleet, i.e. heater failures are not system peculiar.

Combat vehicles operate for either 1,200 miles annually or for equivalent number of hours (engine running, vehicle halted).

All combat vehicles have heaters; 75 percent of them operate in winter conditions, 5 months a year.

Lack of SDC data on tactical vehicles restricts the estimate to the combat vehicle fleet.

10.1.2. Methodology. The following method will be used for determining heater removal/replacement (Htr R/R) costs:

- Estimate how many times a year heaters are removed and replaced - Heater Removal/Replacement Frequency (Htr R/R Frequency). This estimate will be based upon an adjusted Mean Miles Between Heater Repair factor derived from M60 SDC data.
- Estimate the combat vehicle fleet size and the average time it takes to remove/replace a heater.
- Multiply the above estimates by the assumed organizational maintenance labor rate to obtain Combat Fleet Htr R/R cost.

10.1.3. Heater Removal/Replacement Frequency (Htr R/R). According to the M60 SDC data (60 months, 286 tanks, CONUS and USAREUR locations), a heater is removed every 1,741 miles.

- MMBHR = 1,741 mi/htr
- Htr R/R = 1,741 mi/htr. 1,200 mi/yr (assumed combat vehicle usage)
- Htr R/R = 1.45 years/htr

Heaters fail in the winter; whereas, the above Htr R/R spreads seasonal failures over an entire year. What we need to know is how often will a heater fail when the soldier needs it? The MMBHR must be adjusted to reflect the seasonal usage of heaters.

- $MMBHR^{Adj} = 1,741 \text{ mi/htr} \times \frac{5 \text{ months}}{12 \text{ months}}$  (assumed seasonal usage)
- $MMBHR^{Adj} = 725 \text{ mi/htr}$
- Htr R/R = 725 miles 1,200 miles/yr
- Htr R/R = .628 yr/htr

This Htr R/R indicates a soldier must replace his heater almost every winter. Two independent sources corroborate this estimate.

- During the 1983 Ft. Carson M60 heater test, the Stewart Warner 10560C heater had a Mean Hours Between Failure of only 2 hours; roughly one week of continuous operation in the field (Final Test Report, M60 tank).

- From 1 Jan 84 thru 31 Dec 84, the Directorate of Industrial Operations (DIO) at Ft. Knox, KY, reported that 1,057 personnel heaters were used, a figure which equated to a failure rate of one to one (vehicle to personnel heater).

10.1.4. Average Heater Removal/Replacement Time (Htr R/RT). It has been assumed that heaters fail at the same rate, either per miles or hours in all combat vehicles. To derive Htr R/RT, combat vehicle size is estimated and a weighted average for Htr R/RT is calculated. Combat vehicle quantities are unclassified approximations--nothing more. Removal/Replacement times are from the applicable maintenance allocation charts in the organizational maintenance TM's.

HTR R/RT TABLE

<u>VEHICLE</u>	<u>QUANTITY</u>	<u>REMOVE/REPLACE (APPROX)</u>	<u>TIME (HRS)</u>
M1 Abrams Tank		2,000	.5
M2/M3 Bradley		1,000	2.2
M48A5/M60 FOV Tank		7,500	2.0
M88A1 Recovery		1,500	2.5
M109 Self-Propelled Howitzer		2,000	2.0
M110 Self-Propelled Howitzer		1,000	2.0
M113 FOV Armored Personnel Carrier		20,000	.4
M548 Cargo Carrier		4,500	1.0
M578 Tank Retriever		1,600	5.0
M667 Missile Carrier		500	1.0
M730 Missile Carrier		500	1.0
		<u>46,600</u>	<u>1.04</u>
			Weighted Average = 1.04 Man-hours

10.1.5. Combat Fleet Heater Removal/Replacement Cost.

- Combat Fleet Htr R/R = 46,600 vehicles x .628 yr (Htr R/R )  
x .75 (assumed percent vehicles used in winter)
- Combat Fleet Htr R/R = 21,948 heater/year\*
- Combat Fleet Htr R/R cost = 21,948 htr/yr x 1.04 manhours  
x \$8.55 (assumed organizational labor rate)

\*If this figure seems high, just imagine that one installation, Ft. Knox, reported removing/replacing over 1,000 heaters in 1984.

- Combat Fleet Htr R/R cost = \$195,161  
\$200,000

10.1.6. HTS Impact on Combat Fleet Htr R/R Cost. HTS will reduce removal/replacement costs three ways:

- By providing improved diagnostic/testing capability. HTS will prolong heater life after repair.
- HTS can verify heater operation before heater installation by simulating vehicle environment.
- The portability of HTS will allow DS to perform field maintenance, eliminating much transit damage. It is estimated HTS will reduce heater removal/replacement cost 10 percent annually.
  - HTS R/R savings =  $.10 \times \$200,000 = 20,000$
  - HTS R/R savings (4 yr) = \$80,000

#### 10.2. Estimation of HTS on Heater Repair/Repair Part Costs

During the cold season, DS/GS fuel and electric shops cope with tremendous quantities of heaters. Yet, the soldiers manning those shops do not have the right equipment for high volume repair. This deficiency costs money: in scrapped heaters (see Section 10.3.), and in unnecessary repairs. Much like the shade tree mechanics who automatically replace the spark plugs whenever their cars act up, heater repairmen routinely replace good parts with more good parts.

Anyone in the field familiar with heaters knows this problem is particularly acute with ignitors and flame detector switches. However, shop environments are not immune from this waste. For example, the overheat switch, the safety switch that shuts down the heater when it overheats, has high replacement rates. Mechanics have no way to make sure this switch will actually shut off a red-hot heater. Even relatively sophisticated "homemade" stands lack this capacity. What does the mechanic do? He puts a new overheat switch in the heater, whether or not it needs one because he wants to be safe. The mechanic faces a similar predicament when he encounters flooded heaters. His homemade stand won't have a fuel flow meter. Since he can't adjust the fuel rate, he installs a new, factory-calibrated fuel regulator. Mechanics apply expensive "I'd rather be safe than sorry" logic whenever they repair heaters.

Inadequate test equipment also increases man-hour expenditures. In the TACOM LAR survey, a majority of the LAR's stated that a standardized test stand would save labor. The homemade stands or the Sun stand that many DIOs use are not supported with repair parts or manuals. When these stands fail, the "line" goes down until someone jury-rigs a repair. These stands don't have school-trained operators or even on-the-job-training instruction guides. So mechanics have difficulty working with unfamiliar stands as they transfer throughout the Army. But the biggest problem with the homemade stands is that they do not have the capacity to fully diagnose, troubleshoot, and test broken heaters. Mechanics waste time doing things the hard way, the long way, any way they can, whenever they repair heaters. This is wrong, dead wrong. Our soldiers deserve the right test equipment.

10.2.3. Army DS/GS Heater Repair Expenditures.

- Annual Heater Parts Replacement Cost: Heater Repair Manhours x Assumed Labor Cost (Table 1)  
= 27072 man-hours x \$10.64  
= \$288,046

Annual Heater Parts Replacement Costs: \$290,000\*

- Total Annual Heater Repair Costs:

It was assumed that the heater mechanic spends 50 percent of his time troubleshooting, servicing, cleaning, and testing. Therefore, the total GS/DS heater repair outlays is twice the heater parts replacement cost.

Total Annual Heater Repair Costs: \$580,000

10.2.4. HTS Impact on Heater Repair Costs. It is estimated HTS will reduce man-hour outlays by 25 percent annually for the following reasons:

- Reduce test equipment downtime.
- Increase mechanic proficiency by multiplying training opportunities.
- Increase repairs per man-hour by multiplying diagnostic and testing capabilities.

The above estimate was derived from the TACOM LAR survey, and from the opinions of experienced TACOM heater engineers and equipment specialists:

- Annual HTS heater repair savings = .25 x \$580,00  
= \$145,000

Annual HTS heater repair savings \$150,000

- HTS heater repair savings (4 yr) \$600,000

10.2.5. Army DS/GS Heater Repair Parts Cost.

Annual heater repair parts cost = \$1,868,008  
(Table 1)

Annual Heater Repair Parts Cost \$1.87 million\*\*

\*Including Organizational Maintenance Labor cost. The total Army heater repair man-hour outlays are worth over \$700,000 a year.

\*\*Including organizational repair parts cost, the total Army heater repair part outlays are worth over \$2.4 million a year.

10.2.6. HTS Impact on Heater Repair Parts Costs. The TACOM LAR surveys estimated HTS would save between 10 percent and 50 percent of heater repair parts per year. This study accepts the lower figure in the belief that heater mechanics do a correct job, most of the time, and that HTS could cause, through its array of diagnostic equipment, slight increases in the demand of some parts.

- Annual HTS repair parts savings = .10 x \$1.87 million

\$187,000

- HTS repair parts savings (4 yr) = \$748,000  
\$750,000

### 10.3. Estimation of HTS Impact on Heater Supply Costs

Soldiers throw away repairable heaters for many good reasons: repair parts shortages, lack of storage space, lack of manpower, inadequate training, inadequate technical information, and most importantly, lack of standardized test equipment. Test equipment plays a critical role in a soldier's maintenance performance with heaters. To see how, a short overview of the life and death of a heater may be instructive.

A manufacturer builds our heater for a government contract and ships it to a depot like Red River Army Depot (RRAD).

Division supply at a major installation, such as Ft. Carson, requisitions a quantity of heaters in the fall to meet projected winter requirements. TACOM receives the requisition and directs RRAD to ship our heater, with many others, to Ft. Carson, CO.

At Ft. Carson and most other installations, the heater is a Direct Exchange (DX) item. An inoperative DX item can be exchanged for a replacement (new or repaired) by organizational maintenance at Direct Support (DS) level. Therefore, our RRAD heater is stocked at a DS supply unit.

A company (PLL) clerk turns in an inoperative heater and receives our heater in exchange. At the unit, organizational maintenance or the crew installs the heater in a M60A3 tank. The heater runs for 2 weeks and fails to start. Organizational maintenance removes the heater and returns it to DS and receives another.

In the Fuel and Electric Repair Section of the DS shop, our heater rests in a bin with ten other heaters, next to seven similarly located bins. The dedicated 63G mechanic who was trained for 2 weeks by an NCO, who left for Germany 3 months ago, struggles to fix the heaters flooding into his shop.

After 6 weeks, the mechanic finally mounts our heater on his "homemade" test stand, which was fabricated by an enterprising NCO who left for Germany 6 years ago. The stand keeps breaking. The mechanic thinks there's a short in the power supply, but he doesn't have a wiring diagram, let alone an operator/repair manual to work with. General Support is sick of coming over to troubleshoot the thing.

The mechanic reads the DX tag on the heater. "Won't start," the tag says. Not much help, thinks the mechanic. Before mounting the heater on the stand,

he made sure it wasn't flooded. Now, he checks the ignitor, flame detector switch, and the ignition control with a hand-held volt-ohm-meter (VOM). They look good, but he replaces the ignitor just to be sure. The motor runs and fuel flows into the combustion chamber. Still the heater won't start. Then he notices one new part on the fuel regulator. Never seen one of them before, he thinks.

He tinkers with the heater for a few more minutes and then decides, after concluding the heater was too new to throw away, to put it in his "I'll get back to it when I have time" pile. His boss wants him to fix as many heaters as he can this week; DX supply is running low. He figures he can find ten heaters that only need deflooding and a new ignitor.

Three months go by into early summer. Time to clean the Fuel and Electric repair section. Big inspection coming up. The section chief yells at the mechanic to "do something with those stupid heaters." The mechanic thinks a bit, pulls a couple dumpsters into the shop, and tosses thirty-five heaters, our heater included, into the trash.

10.3.1. Methodology. Accurate demand data for personnel heaters is available from the National Inventory Control Point and is presented in Table 10-1, 1984 Personnel Heater Supply Costs. The 6,599 demands originated in the field from Army customers. These do not include the thousands of new heaters flowing into the field in new and overhauled vehicles and in winterization kits. The estimate will be calculated by multiplying the annual heater supply cost by an estimated HTS impact factor.

#### 10.3.2. Assumptions.

- The vehicle fleet size is relatively constant in terms of heaters. New vehicles enter the field with heaters; therefore, the field demands represent the number of heaters needed to replace failed heaters, that is, scrapped heaters, in 1984.
- Heater supply costs will remain constant over the next 4 years.

#### 10.3.3. Heater Supply Cost.

Annual Heater Supply Cost = \$3,631.751

\$3.63 million

10.3.4. HTS Impact on Heater Supply Costs. The many benefits of HTS on heater maintenance have been listed throughout this study, yet one more factor must be noted. The bottom line for HTS and our beleaguered mechanics in the field is time. Nothing plagues maintenance people more than lack of time. They are under constant pressure to get that thing--whatever weapon it may be--rolling again. Even though personnel heaters are not combat essential, don't ever tell a tank crewman in Germany in January he doesn't need one. Soldiers want heaters that work now, and it's up to the DS mechanic to keep the shelves stocked. HTS purchases his most precious commodity: time. Time to cut the backlog, to carefully troubleshoot, to learn new wrinkles, to fix the stand, and time to do the job right. Over 6,000 heaters were scrapped in 1984. Of course, numerous quantities die from fair wear and tear, and even HTS won't keep all repairable heaters from the trash heap. Even so, it is estimated HTS will reduce annual heater scrappage by 15 percent.

TABLE 10-1. 1984 Personnel Heater Supply Costs

<u>Heater NSN</u>	<u>Model</u>	<u>Part Number</u>	<u>Manufacturer</u>	<u>Cost (\$)</u>	<u>Field Demands</u>	<u>Annual Cost (\$)</u>
2540-01-083-0691	10560C24	11669496	Stewart Warner	596	2925	1,743,300
2540-01-071-0651	10560M24-3	11669489	Stewart Warner	545	823	448,807
2540-01-169-5159	10560M24B1	11669489-1	Stewart Warner	545	12	6,540
2540-01-162-3834	MF510C	11669490-1	Hupp	678	662	448,836
2540-00-930-8938	MF510A	11601809	Hupp	466	420	195,720
2540-00-997-1532	939J	11601698	Stewart Warner	509	164	83,476
2540-00-113-4180	10530A24	MIL-H-46792/2-1	Stewart Warner/ Atlantic Indus.	444	1588	705,072
Totals						3,631,751

Heater Savings = .15 x \$3.63 million

\$540,000

Heater Savings = \$2.16 million  
(4 yr)

## 11.0. ALTERNATIVES

This study has identified several alternatives to a HTS program.

### 11.1. Preserve the Status Quo

The current annual cost to support and supply personnel heaters for the field is almost \$7 million. The HWG has initiated programs that should reduce this figure in the upcoming years. The heater specifications, MIL-H-62315 and MIL-H-46792, have been rewritten with tighter test requirements.

- New heaters must now pass tough 800-hour First Article Tests (FAT) before TACOM purchase. Previously, FAT's were quite simple; worse yet, TACOM usually waived the FAT's in order to stock heaters before "the winter set in." These expediencies allowed some very poor heaters into field-- usually without repair parts or technical documentation. Thanks to command level support, the HWG has eliminated the procurement of unreliable, unsupportable heaters.
- Heater manufacturers are now required to perform acceptance tests on every heater they ship for TACOM. Previously, TACOM only required control/batch tests, which did not ensure a high rate of reliability. Numerous field reports have described starting problems with new heaters "just from the box."

The HWG produced an advanced specification, ATPD-2090A, in hopes that manufacturers would attempt to build state-of-the-art heaters. To date, Stewart Warner has developed a heater, their model 10660A, that performed extremely well during a field test at Fort Carson in 1983. The 10660A is undergoing a FAT at Stewart Warner with release expected by early 1986. Other manufacturers are pursuing this advanced specification too.

As previously mentioned in Section 5.2., Williams International is developing concepts for a turbine heater to replace the hodgepodge of models and capacities in the field. The most significant feature of the universal heater is that TACOM will own the entire technical data package, virtually guaranteeing the standardization of all heaters and their repair parts.

It is too early to estimate the impact of these programs. Certainly, they will reduce Army heater costs significantly, if a manufacturer produces a state-of-the-art heater and if Williams International develops a reliable universal heater. However, the achievement of cost reductions through these efforts would not preclude further savings by introduction of HTS, nor do they meet the soldier's need for safe, supportable test equipment.

TABLE 10-2. 1984 Heater Repair/Repair Parts Cost

<u>NOMENCLATURE</u>	<u>NSN</u>	<u>PN (FSCM)</u>	<u>HEATER</u>	<u>ANNUAL DEMAND</u>	<u>TASK TIME (HRS)</u>	<u>COST \$</u>	<u>ANNUAL LABOR</u>	<u>ANNUAL COST</u>
Switch, Flame Detec	5930-00-475-5537	8376101 (19207)	Hupp 510A,B,C	2976*	.3	23.87	892	71,037
Relay	2540-00-893-5458	8737694-1 (19207)	Hupp 510A,B,C	696	.3	19.30	208	13,342
Relay	2540-00-055-2813	8737832 (19207)	Hupp 510A,B,C	1080	.3	8.64	324	9,331
Relay, Thermal	5945-00-968-7785	8737699 (19207)	Hupp 510A,B,C	1800	.3	9.61	540	17,298
Thermostat, Assy	2590-00-941-8680	52876G1 (46522)	Hupp 510A,B,C	492	.5	3.54	246	1,741
Valve, Solenoid	4810-00-818-4451	C52848G1 (46522)	Hupp 510A,B,C	104	.5	126.51	52	13,157
Element, Assy	2540-00-968-7782	A52850G1 (46522)	Hupp 510A,B,C	264	.5	6.69	132	1,766
Reservoir, Assy	2540-01-133-5293	B54302G1 (46522)	Hupp 510A,B,C	12	.5	24.90	6	298
Overheat Switch	6680-00-443-9839	B52845G1 (46522)	Hupp 510A,B,C	528	1.0	10.36	528	5,470
Plate, Burner	2540-00-994-0983	52820-62 (46522)	Hupp 510A	1564	1.0	32.26	1564	50,454
Ignitor	2540-01-115-1805	54733G1 (46522)	Hupp 510A,B	2440*	.3	32.00	732	78,080
Motor, Direct Current	6105-00-557-2591	C16971G2 (46522)	Hupp 510A	528	.5	105.81	264	55,867

TABLE 10-2. 1984 Heater Repair/Repair Parts Cost (Cont'd)

<u>NOMENCLATURE</u>	<u>NSN</u>	<u>PN (FSCM)</u>	<u>HEATER</u>	<u>ANNUAL DEMAND</u>	<u>TASK TIME (HRS)</u>	<u>COST \$</u>	<u>ANNUAL LABOR</u>	<u>ANNUAL COST</u>
Voltage Regulator	6110-01-097-3342	11669574 (19207)	10560C	153	.7	40.96	107	6,266
Impeller	2540-00-763-1228	G489276 (57733)	10560C	104	.7	34.85	72	3,624
Blower Assy	2540-01-136-8712	G705294 (78385)	10560M, M24B1	92	.7	411.50	64	37,858
Motor, Direct Current	6105-01-075-2839	G705319 (78385)	10560M	240	.5	203.71	120	48,890
Regulator, Voltage	6110-01-075-2799	G705320 (78385)	10560M	160	.7	24.16	112	3,865
Mounting, Assy, Diode	2540-01-136-8714	G705315 (78385)	10560M	58	.7	17.47	40	1,013
Heat Exchanger	2540-01-136-8705	G705341 (78385)	10560M, M24B1	2.0	1.5	279.10	3	15,568
Motor, Direct	6105-01-158-3198	C55310-G1 (46522)	Hupp 510B,C	250	.5	102.67	125	25,667
Resistor, Assy	5905-01-075-2798	B54845G1 (46522)	Hupp 510B,C	103	1.0	4.67	103	481
Assembly, Thermostat	2540-01-136-0981	55102-G2 (46522)	Hupp 510B,C	216	.8	31.50	172	6,804
Valve, Assy	4810-00-968-7786	C52847-G1	Hupp 510B,C	1760	1.0	116.62	1760	205,251
Valve, Assy	2540-00-854-4450	G701247	8460C	492	1.0	91.03	492	44,786
Rod, Glass	9340-00-621-1422	8735914	8460	324	.4	12.64	129	4,105

TABLE 10-2. 1984 Heater Repair/Repair Parts Cost (Cont'd)

NOMENCLATURE	NSN	PN (FSCM)	HEATER	ANNUAL DEMAND	TASK TIME (HRS)	COST \$	ANNUAL LABOR	ANNUAL COST
Element, Assy, Preheat	4540-00-456-1575	11601789 (19207)	Hupp 510A	588	1.0	9.70	588	5,703
Burner Assy, Replac	2540-00-255-0775	G704528 (78385)	10560C, M, M2481	1836	1.0	69.34	1836	127,308
Burner Repair, Kit	2540-00-255-0777	G704529 (78385)	10560, M, M2481	1059	1.0	25.68	1059	27,195
Housing, Heater Blower	2540-01-077-7724	G705102 (78385)	10560C	4	.7	26.33	3	105.32
Switch, Flame Det	2540-00-049-4199	G489095 (5773)	8460C	589*	.4	17.95	235	10,572
Igniter	4520-00-790-8417	7324355 (17769)	84606	1100*	.3	11.91	330	13,101
Overheat, Switch	5930-00-322-9441	G486332 (78385)	8460C	984	.3	16.06	295	15,803
Resistor, Fired Wire	5905-00-610-3290	G489068 (78385)	8460C	1824	.6	9.18	1094	16,744
Wick	5330-00-752-0346	7520346 (19207)	8460C	400	.5	1.36	200	544
Cable Assy	2590-00-628-1246	G700117 (78385)	8460C	20 (Est)	.4	4.87	8	97
Guard Assy	2540-01-041-0900	G701250 (78385)	8460C	12	.2	30.21	2	362
Motor, Direct Current	6105-00-049-4212	487739 (57733)	8460C	300	.5	88.92	150	26,676
Blower, Assy	2930-00-792-3233	G700682 (78385)	8460C	588	.7	307.97	411	181,086

TABLE 10-2. 1984 Heater Repair/Repair Parts Cost (Cont'd)

NOMENCLATURE	NSN	PN. (FSCM)	HEATER	ANNUAL DEMAND	TASK TIME (HRS)	COST \$	ANNUAL LABOR	ANNUAL COST
Ventilator, Air	2540-00-608-8102	488773 (78385)	8460C	80	.3	26.76	24	2,140
Housing, Heater	2540-01-077-7722	G704618 (78385)	10560C	52	1.0	51.94	52	2,700
Ignition Control	2590-01-102-6857	G705223 (78385)	10560C	2460*	.3	20.84	738	51,266
Ignition Control	2540-01-079-4637	G705353 (78385)	10560M, M24B1	1260	.3	19.78	378	24,922
Overheat Switch	5930-00-234-1390	G704410-1 (78385)	10560C, M, M24B1	2040	.3	12.12	612	24,724
Flame Detector	5930-00-283-6562	G704526 (78385)	10560C, M, M24B1	2772*	.3	30.33	831	84,074
Red, Flame Detector	2540-00-216-5722	704225 (78385)	10560C, M, M24B1	1260	.4	5.88	504	7,408
Ignitor	4520-00-217-5782	704372 (78385)	10560C, M, M24B1	8060*	.3	17.45	2418	140,647
Valve, Fuel Reg	4810-00-269-8221	G704060 (78385)	10560C, M, M24B1	1596	1.0	79.54	1596	126,945
Switch, Thermostat	5930-01-077-7793	704401 (78385)	10560C, M, M24B1	45	.5	16.85	22	758
Part Kit, Valve, Fuel Reg	2540-00-198-2478	5704064 (19207)	10560C, M, M24B1	697	1.0	9.77	697	6,809
Kit, Solenoid Coil	5950-01-058-4741	G705126 (78385)	10560C, M,	52	1.0	29.09	52	1512
Semi Conductor	5961-01-037-0687	G705241 (78385)	10560C	633	.7	16.52	443	10,457
Motor, Direct Current	6105-00-234-1278	G704557 (78305)	10560C	271	.5	110.57	135	29,964

TABLE 10-2. 1984 Heater Repair/Repair Parts Cost (Cont'd)

<u>NOMENCLATURE</u>	<u>NSN</u>	<u>PN (FSCM)</u>	<u>HEATER</u>	<u>ANNUAL DEMAND</u>	<u>TASK TIME (HRS)</u>	<u>COST \$</u>	<u>ANNUAL LABOR</u>	<u>ANNUAL COST</u>
Blower, Assy S9C	2540-01-008-1501	6704554 (78385)	10530A24	8	.7	154.98	6	1,239
Switch, Flame Detec S9E	5930-00-974-8757	G704025 (78385)	10530A24	1656*	.3	30.00	496	49,680
Ceramic Rod S9C	2540-00-216-5722	704225 (78385)	10530A24	1344	.4	5.88	537	7,902
Burner Replacement S9C	2540-00-201-3474	5704051 (78385)	10530A24	360	1.0	110.43	360	39,754
Burner Repair Kit	2540-00-200-4249	G704425 (78385)	10530A24	93	1.0	60.41	93	5,618
Overheat Switch S9E	5930-00-679-5925	G700791 (78385)	10530A24	1500*	.3	15.93	450	23,895
Fuel Control Valve	4810-00-248-1635	G704030 (78385)	10530A24	574	1.0	87.23	574	50,070
Ignition Control S9E	5905-00-251-7145	G704031 (78385)	10530A24	312	.3	51.44	93	16,049
Ignitor S9C	(4520) Changed 2540-00-312-2017	7700170 (78385)	939J	210*	.3	2.47	63	518
Fuel Valve S9C	2920-00-052-0033	10947615	939J	88	1.0	109.98	88	9,678
Resistor S9E	5905-00-089-1111	10947609 (19207)	939J	64	1.0	5.65	64	361
Thermostat S9G	6680-00-075-2392	700220 (78385)	939J	84	.5	18.03	42	1,514
Resistor S9C	2590-00-997-1530	11621186 (19207)	939J	12	.5	7.45	6	89
Total							27,072	1,868,008

### 11.2. Depot Repair of Personnel Heaters

Army depots are frequently used as last resorts for resolving field maintenance problems. It has been suggested many times that TACOM ship "all the heaters" back to the depots for repair (Mainz Army Depot, Anniston Army Depot, Red River Army Depot, and Letterkenny Army Depot). This suggestion is definitely not feasible:

- Usually, the Army does not repair an item if it costs more than 66 percent of the item's purchase price. As heaters cost less than \$600, shipping costs alone would consume 20-30 percent of the total repair, particularly those heaters shipped overseas requiring upgraded packaging.
- Because of their extremely high failure rate, heaters would overwhelm Army transportation resources and seriously reduce heater availability in the field.
- Most heater failures could be detected and corrected at the field level with proper test equipment and training. Shipping heaters to depots for repair violates the intent of the Army's Fix Forward policy.
- TACOM has thoroughly reviewed current depot heater repair programs. They suffer from the same problems that plague the field: lack of test equipment, training, and manpower. For example, Red River Army Depot had so many troubles repairing heaters for overhauled vehicles, they established their own Heater Working Group.

### 11.3. Make Personnel Heaters Non-Repairable Items

Terminating field heater maintenance could be accomplished easily by changing the current Source Maintenance Recoverability (SMR) Code from PAOFH to PAOZZ. This would allow organizational maintenance to throw away the heater whenever they removed it from the vehicle. (A few vehicle programs adopted this policy in the past--particularly the M60 tank.) Terminating heater maintenance would eliminate some repair parts and man-hour expenditures. It is unlikely all units would suspend heater repair simply because a SMR Code changes. Maintenance people naturally tend to fix what can be fixed. Even so, some reduction of heater maintenance outlays would certainly result; however, heater procurement costs would increase dramatically. Using the estimate developed in Section 10.1.5., over 20,000 heaters are removed from vehicles each year. Procuring these heaters at an average cost of \$550 each, would increase Army heater supply costs to \$11 million a year, a 25 percent increase over the current costs. This increase is not acceptable; however, terminating Army heater maintenance may be advisable within the following scenario:

- Heaters supplied to the field in the future should have lower failure rates. If these failure rates are reduced by 50-75 percent, field maintenance becomes too costly. This will hold true if the heater procurement cost remains below \$600. Unfortunately, all indications point to a ticket price of over \$1000 for the new generation of heaters.

### 11.4. Distribute HTS Fabrication Instructions

For the past 3 years, the TACOM NMP has sent heater test stand fabrication instructions written by the USAOCS (Fabricating a Personnel Heater Test Stand

and Personnel Heater Test Procedures), ST9-194, Jul 79, to soldiers requesting information on building heater test stands. These instructions are for an extremely simple stand--\$100 parts, 16 hours labor. Unfortunately, this stand does not offer much more than a mount for heater operation. It suffers from all the drawbacks itemized in Section 5.1., and for these reasons, it would seem logical that HTS fabrication instructions should be provided to the field. This approach takes the monkey off TACOM's back and puts it on the field. They will have to supply parts and labor. How many units can spare \$5,000 for building a heater test stand? What happens when the stands break? Who will supply repair parts and manuals? If HTS is not approved, it would be better for the field to keep their simple home made stands instead of embarking on costly fabrication programs. The USAOCS has unequivocally endorsed this position--no HTS fabrication instructions will be distributed. The Army should not introduce yet another unauthorized piece of test equipment into the field.

#### 11.5. Maintaining Heaters with the Direct Support Electrical System Test Stand (DSESTS)

DSESTS is a microprocessor-based automatic test system fielded at Direct Support to provide testing capability for Line Replaceable Units (LRU's) on the M1 tank and the BFVS. The LRU's currently tested include such items as the control box driver's master panel, vehicle distribution box, etc. DSESTS provides a program for each LRU that instructs the operator through the test on a 60-character display. DSESTS can be expanded to accommodate additional LRU's. Currently, the DSESTS contractor is examining the feasibility of using DSESTS on heaters. However, DSESTS cannot provide hardware for operating heaters, nor can it provide fuel flow measurement or overheat switch verification. As these capabilities are vital to heater maintenance, DSESTS will probably not reduce heater maintenance costs significantly.

THIS PAGE LEFT BLANK INTENTIONALLY

APPENDIX A  
PERSONNEL HEATER WORKING GROUP



# DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL

DRSTA-GBM

SUBJECT

Formation of Personnel Heater Working Group

TO

FROM DCG for Readiness  
(DRSTA-CD)

DATE

7 JUN 1982

CMT 1

DRSTA-G

DRSTA-Q

DRCPM-M113


DRSTA-M ✓

DRCPM-M60

DRCPM-FVS

1. There is a continuing need for improving reliability and availability of personnel heaters in TACOM vehicles. The seriousness of the "heater problem" and the number of actions required necessitate a more intensively managed and tightly coordinated effort within the Command. For this reason, I am chartering a Personnel Heater Working Group and specifically designating those individuals as members who are actively involved with heater problems.
2. The attached Charter contains the essential instructions for operation of the Working Group. The first order of business should be to set a firm course of action and milestones. I expect to meet with the Group periodically for consultation and status reports. Mr. Donald Burkhardt, my designated Group Leader, will schedule the first meeting mid-June 1982.

1 Incl  
as

  
DAVID W. STALLINGS  
Brigadier General, USA  
Deputy Commanding General  
for Readiness

CF:

DRCPM-GCM

DRSTA-R

DRSTA-F

DRSTA-I

DRSTA-Q

A-3

CHARTER  
PERSONNEL HEATER WORKING GROUP

I. Designation of a TACOM Heater Working Group (HWG)

A Heater Working Group is hereby established to centralize all investigations and actions associated with investigating and solving US Army personnel heater problems. Mr. Donald Burkhart (DRSTA-GBT) is designated as Group Leader (GL). The initial composition of the working group is as follows:

*BURKHART-4-6112*

Participating Members

DRCPM-M60-E, Stan Cag  
DRCPM-FVS-SEV, Walter Storrs  
DRCPM-M113-T, Ed Kowalczyk  
DRSTA-MCB, Charles Fleetam  
DRSTA-QKL, Keith Rosser  
DRSTA-GBM, Gary Robbins  
DRCPM-GCM-SM, Willard Harju

Advisory Members

DRSTA-RSC  
DRSTA-IBA  
DRSTA-F  
DRSTA-QRT

II. Mission

The working group will provide a centralized effort to:

- /a. Improve heater/system durability and reliability.
- /b. Establish actions necessary to provide the troops with heaters capable of acceptable operation during CY 82/83 winter.
- /c. Establish actions necessary to standardize for the future all personnel heaters and their interface for system/kit application.

III. Authorization and Authority

a. Authority

The HWG through the Group Leader (GL) is designated as the TACOM principal and primary point of contact for all heater-related matters. The GL is delegated and will exercise tasking authority for coordination and execution of the approved plan of action.

b. Responsibilities of HWG and GL

(1) GL will present an initial scope of required tasks and tentative assignments to the HWG for approval.

(2) The HWG members will review the proposed scope of work from the standpoint of their own functional involvement and will collectively approve the plan and establish milestones. Any revisions to the GL's proposed scope and assignments will be justified and recorded in HWG meeting minutes.

(a) Within 30 days after Charter approval, the DCG will chair an IPR to ensure that the plan addresses the major systemic heater problems.

(b) IPR members will be the Directors/PMs of the offices listed under Participating Members of the Working Group (Paragraph I).

(c) Plan and milestones will be approved by HWG members within 60 days after Charter approval.

(d) IPRs will be called thereafter at the DCG's discretion.

(3) GL will serve as primary Command POC for heaters. He will be advised of all actions dealing with personnel heaters - field operation and maintenance problems, procurement and technical data problems, and inquiries from outside activities -- and will monitor progress toward their completion.

(4) GL will provide periodic reports to the Command Group, and outside activities as required, on efforts, results and problem areas. This requires the GL to be prepared at all times to address both the technical aspects and status of programs.

(5) HWG members will respond to requests from the GL for data, technical information or consultation as required to provide above reporting.

#### IV. Resource Control

a. The funding requirements to accomplish the above will be provided by the functional organizations assigned.

b. Required actions and programs will be accomplished through participating organizational elements. The GL and functional directors, or their representatives, will provide for necessary coordination and resolve matters of resources or priorities to accomplish the mission and responsibilities. Issues not mutually resolved will be referred by the GL to the Director of Readiness Engineering, if necessary, for resolution.

#### V. Location

The GL is assigned to the Readiness Engineering Directorate on the second floor of Bldg. 200A. Communications should be addressed to DRSTA-GBT.

VI. Supervisory and Communication Channels

a. The GL is supervised by the Chief, Systems Engineering Division, Readiness Engineering Directorate. He has direct access to the Director of Readiness Engineering for the purpose of reporting progress or status and identification of problems warranting high level attention.

b. The GL will schedule regular meetings of the HWG, and serve as chairperson, for the purpose of communicating activities within the command, planning and identifying/resolving problems.

c. All correspondence/reports originating in TACOM related to personnel heater problems will be coordinated with the GL.

VII. Semi-Annual Review

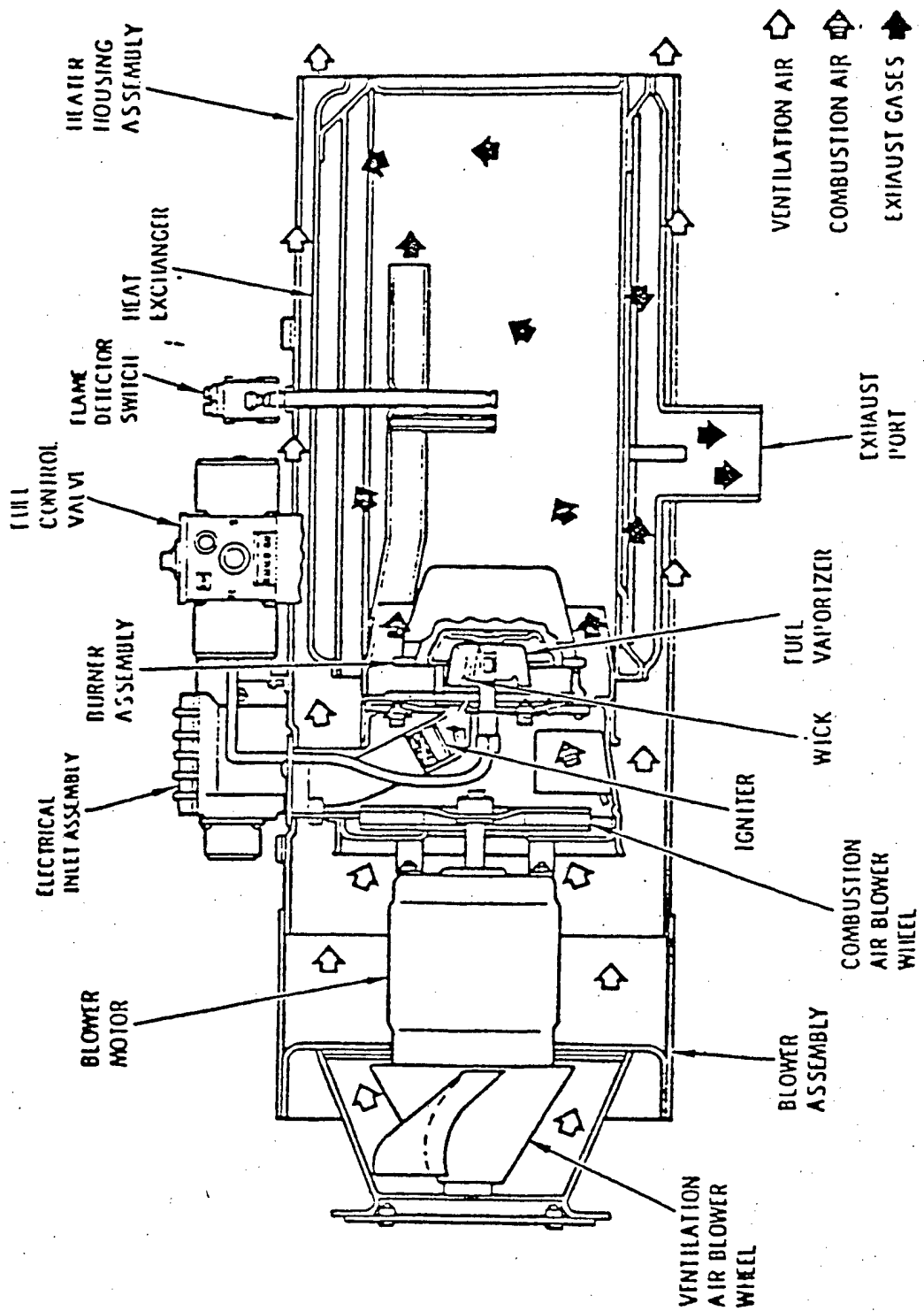
This charter will be reviewed and revisions recommended as required by the GL. Continuation of the working group will be reconfirmed every six months by the DCG.



DAVID W. STALLINGS  
Brigadier General, USA  
Deputy Commanding General  
for Readiness

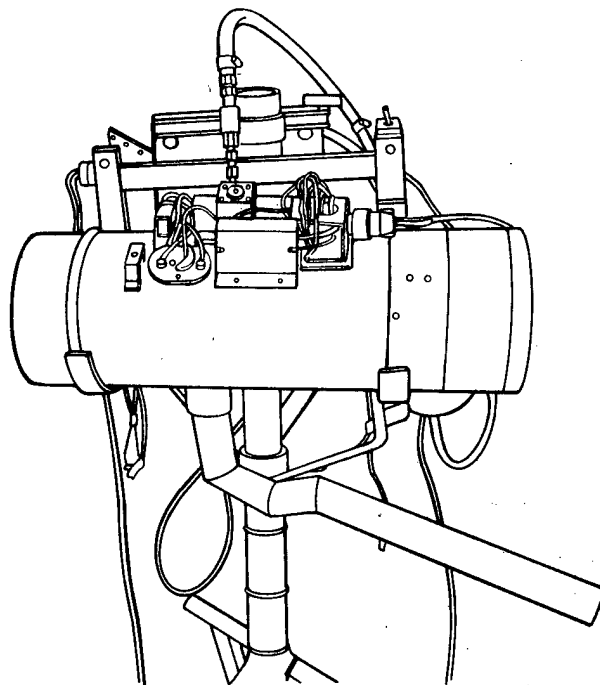
● BACKGROUND

# STEWART WARNER MODEL C HEATER



SIGNIFICANT ACTIONS TAKEN BY HEATER WORKING GROUP

- ESTABLISHED FIRM REQUIREMENT THAT HEATERS MUST PASS QUALIFICATION OR IPT TESTING PRIOR TO ACCEPTING ANY HEATERS FROM A MANUFACTURER.
- ALL CURRENT 60,000 BTU HEATERS MUST MEET REQUIREMENTS OF MIL-H-62315(AT).
- REVISED REQUIREMENTS OF MIL-H-46792 FOR 30,000 BTU HEATERS TO UPGRADE REQUIREMENTS. THE NEW SPECIFICATION IS MIL-H-0046792(AT).
- REVISING REQUIREMENTS OF MIL-H-3177 FOR FUEL FIRED COOLANT HEATERS.
- RELEASED ATPD 2090A FOR NEAR FUTURE 60,000 BTU HEATER REQUIREMENTS.
- R & D CENTER HAS GENERATED AND FUNDED A LONG RANGE HEATER DEVELOPMENT PROGRAM.
- GENERATING A NEW -24 MANUAL COVERING ALL CURRENT COMBAT VEHICLE HEATERS. SCHEDULED FOR PRINTING PRIOR TO 84/85 WINTER SEASON.
- DEVELOPED A HEATER TEST STAND FOR FIELD USE.
- ESTABLISHED A HEATER HOT LINE TELEPHONE TO SUPPLY THE FIELD DIRECT ASSISTANCE ON HEATER PROBLEMS.
- PUBLISHED VARIOUS DOCUMENTS ON HEATER OPERATION AND REPAIR.
- PUBLISHED AND DISTRIBUTED HEATER & INSTALLATION REQUIREMENTS TO ALL VEHICLE PROGRAM AREAS.



APPENDIX A. Typical homemade  
heater test stand.

Mar 85

DRAFT  
ACQUISITION STUDY/ECONOMIC ANALYSIS  
OF  
A  
US ARMY HEATER TEST STAND

<u>TACOM SYSTEM &amp; COST ANALYSIS DIRECTORATE</u>	
<u>VALIDATED</u>	
CECDC Control <u>VA 162-85</u>	Validation Level <u>II</u>
Validation Date <u>7-1-85</u>	Expires <u>7-1-86</u>
Analyst: <u>J. Morrison</u>	Phone <u>574-5671</u>
Supervisor's Sign. _____	
Remarks: _____	

A-10

By Charles Fleetham  
TACOM  
AMSTA-MCB

APPENDIX B

THE TACOM LAR PERSONNEL HEATER SURVEY



## 12.0. INTRODUCTION

Throughout the world, TACOM LAR's help soldiers do their jobs. The LAR's are experienced logisticians with extensive supply and maintenance expertise who work hand-in-hand with the troops maintaining vehicles, training personnel, collecting data, interfacing with TACOM, and solving supply snafus. Because of their close relationship to the field, the LAR's are one of the best sources of data. However, this data should be seen more as a barometer of field conditions, not as accurate collection of statistics like a SDC study.

In January 1985, the TACOM NMP requested the TACOM LAR office to survey the LAR's on personnel heater maintenance:

The Acting Director of Maintenance has asked this office to prepare a decision briefing for the CG on heater test stand acquisition. One of the most important issues will be the matter of cost justification. In other words, will a heater test stand save enough personnel heaters from the junk yard to pay for itself.

Obtaining data on the scrappage rate of personnel heaters is very difficult. The Defense Logistics Agency, the managers of the property disposal mission, does not collect data on the scrappage of components like heaters.

In many locales, LAR's have established good working relationships with PDO Managers. Request your office query LAR's world wide for the following information:

a. Approximately how many personnel heaters are scrapped a year? All personnel heaters have item identification plates on the shell. Although we do not require the data by NSN, the applicable NSN's and PN's are as follows:

NSN	PN
2540-01-854-4449	7748716
2540-01-013-0846	11668862
2540-01-083-0691	11669496
2540-01-071-0651	11669489
2540-01-169-5159	11669489-1
2540-01-930-8938	11601809
2540-01-071-0652	11669490
2540-01-162-3834	11669490-1
2540-01-113-4180	MIL-H-46792-2

b. How many heaters could a standardized test stand save? We know many units have fabricated an obsolete testing apparatus. But this equipment is not supported with repair parts/TM's. What do the DS/GS fuel and electric personnel think? How many repair parts/man-hours/heaters would a standardized, supportable test stand save?

c. How many heaters are unnecessarily removed from vehicles? Conversely, how many inoperable heaters are installed in vehicles for lack of adequate testing/repair?

Your written feedback from field personnel to these questions can play an extremely important factor in whether or not TACOM approves a test stand acquisition program.

The LAR office responded to the survey request by distributing the following questionnaire attached to the survey request:

The following questions concerning personnel heaters installed in TACOM managed vehicles must be answered to the best of your knowledge and/or estimate. Completed questionnaire must be returned to C, Tech Asst Br, TACOM. (Please do not use the term unknown, make an experienced estimate.)

TACOM LAR NAME: \_\_\_\_\_  
(PLEASE PRINT)

LOCATION: \_\_\_\_\_

1. Approximately how many personnel heaters were scrapped in your area during 1984? \_\_\_\_\_.
2. How many heaters could have been saved if a heater test stand was available?  
\_\_\_\_\_.

Heater Test Stand was available? Parts \_\_\_\_\_ Manhours \_\_\_\_\_.

4. Within the past 6 months, how many heaters have been unnecessarily replaced at your location? \_\_\_\_\_.

5. Within the past 6 months, how many inoperable heaters were installed in vehicles which could have been prevented if a test stand was available?  
\_\_\_\_\_.

6. What is your opinion (positive or negative) about acquiring a standardized personnel heater test stand for DS/GS level organizations at your locations?  
\_\_\_\_\_.

7. Do you have any other information concerning the subject that may help in the decision to acquire heater test stands or not? \_\_\_\_\_.

NOTE: This is a one time report only. Some of the information necessary to complete this report may be obtained from local property disposal offices. Use additional paper if additional space is required.

12.1. TACOM LAR Survey Results:

<u>ITEM NO.</u>	<u>RESULTS</u>
1. Responses:	45
2. Responses with Data:	35
3. a. Number of Scrapped Heaters:	1599
b. Percentage Estimates of Scrapped Heaters: 50%, 5%.	
4. a. Number of Heaters Saved:	See Comments
b. Number of Parts Saved:	See Comments
c. Number of Manhours Saved:	See Comments
5. a. Number of Heaters Unnecessarily Replaced:	222
b. Percentage Estimates: 50%, 50%, 30%, 30%.	
6. a. Number of Inoperable Heaters Installed:	53
b. Percentage Estimates: 95%, 50%, 50%, 10%.	
7. Positive to HTS Acquisition:	29
8. Negative to HTS Acquisition:	6

12.2. Comments (by Item No.):

1-2. Many respondents work at installations that neither repair heaters nor deploy combat vehicles in quantity. Of the LARs providing data, many complied their numbers/estimates carefully, referencing meetings with Army heater maintenance personnel.

3. The LARs provided more hard data on heater scrapage than any other question. Many estimates ended in non zero digits indicating the figures came directly from maintenance records. The quantity of 1600 does not tell the whole tale (see Section 10.3); however, it definitely supports the conclusion that thousands of heaters are scrapped yearly.

4. The intent of this question was to obtain a feel for the potential impact of HTS. Unfortunately, most of the LARs stated "test stand available" and provided manhour/parts usage data. Several LARs estimated the heaters saved by their home made stands.

5-6. Data for these two questions is scarce. Only 1/3 of LARs responded. Several LARs marked N/A. Getting soldiers (or anybody else!) to reveal their mistakes is not an easy task. The data indicates mistakes occur (One LAR estimated 95 percent of the heaters installed in vehicles are inoperable!) But the LARs are not close enough to the points when/where heaters are lifted from

vehicles. Most LARs support far more complex components in the field - engines, transmissions, launchers, etc.

7. Almost all LARs reported seeing locally fabricated test stands. Still the LARs overwhelmingly supported HTS acquisition. All significant comments are provided below:

"This would be the best thing the Army could do, in order to save money or repair parts and downtime. We need a standardized test stand." L. Pichardo, 8ID SUPCOM, USAREUR.

"Recommend development of a standardized test stand for safety and time savings (20 minutes). Presently, fabricated systems have uncoded wires, drip pans under the unit for excess fuel and no exhaust provisions." J. Robinson, Ft. Bliss, TX.

"The 4th Spt BN has a fabricated test stand which is inadequate but not portable. A portable standard test stand could be utilized in field locations. Approximately 480 manhours could be saved if units had a portable stand." M. Shawley, 4th Spt BN, USAREUR

"DIO Maintenance has a "home made test stand which is used everyday and stated if they had another test stand production could be increased and customers wouldn't have to wait 6-7 weeks for test and repair." R. Maattala, Ft Polk, LA

"During my military career most of the heater testing apparatus were locally fabricated. Personnel were not trained to perform services on them and no repair parts were available to repair them. From past experience the heater washout rate would be decreased by approximately 30 to 40 percent, if a standardized heater test stand was procured and supported with repair parts and TMs." S. Hicks, Ft Gordon, GA

"In my experience in working with these heaters I have come to the conclusion that the present testing equipment that I have is quite insufficient, costly, and time consuming. Therefore, I am strongly in favor of my department acquiring one of the new testing units for the heaters. I will give you an example of why I feel it will be less time consuming and less costly: I am allotted 5 hours to test and repair a heater, with the present testing unit I cannot determine whether or not I am getting a correct reading which may lead to my going over the allotted 5 hours: Therefore, it defeats the purpose." R. Medina, Combat Vehicle Shop, Ft. Sill, OK

"A standardized test stand issued to the Fuel and Electric Sections of DS and GS units should present a tremendous savings to the US Army." D. Blessenger, Taegu, Korea

"We would like to see a standard personnel heater test stand used across the board. The one we have, NSN 4910-671-6613 (the Sun Stand. ed note) is a very good piece of equipment...but it is inactive and has no spare repair parts in the system." B. Cashion, Ft. Carson, CO

"The reliability of the fabricated test apparatus is questionable and from what I observed, very poorly assembled, in some cases creating a fire hazard." C. Foster, Ft Lewis, WA

"I feel that a standardized test stand would be a big help in troubleshooting and proper repair of heaters. At present there is a lot of guess work at the DS level of maintenance." Z. McPherson, 3rd Inf Div, USAREUR

"The acquisition of a standardized heater test stand would save thousands of manhours/repair parts." R. Miley, 51st Maint Bn, USAREUR

"2nd Support and 4th Support feel that a test stand would be a great help over makeshift ones they now have." J. Runion, USAREUR

8. LARs opposing HTS commonly believed the home made stands at their installations performed adequately.

"I would think a handy troubleshooting chart (that troops can read and understand) with parts needed to make repairs listed by NSN would be of more use than a test stand. Most heater problems are of a minor nature but troops cannot troubleshoot these problems." C. Iott, Ft Irwin, CA

"Most LARs at Ft Hood expressed the opinion that a "store bought" test stand should not be acquired for DS/GS level repair, as most DSU and GS level maintenance facilities at Ft Hood do have a test stand for heater which most use approximately 60 percent of the time." S. Purvis, Ft Hood. TX

"TACOM LARs with duty station at Ft Bragg are in agreement that it is unnecessary to procure an elaborate test stand for testing personnel heaters when a simple fabricated one is all that is required." S. Pope, Ft Bragg, NC

"Negative opinion. All DS/GS support shops I have seen have assembled sufficient test items. Mechanics use clip leads, fuel pumps, and wiring for testing and diagnosis." M. Prater, Ft. Devens, MA

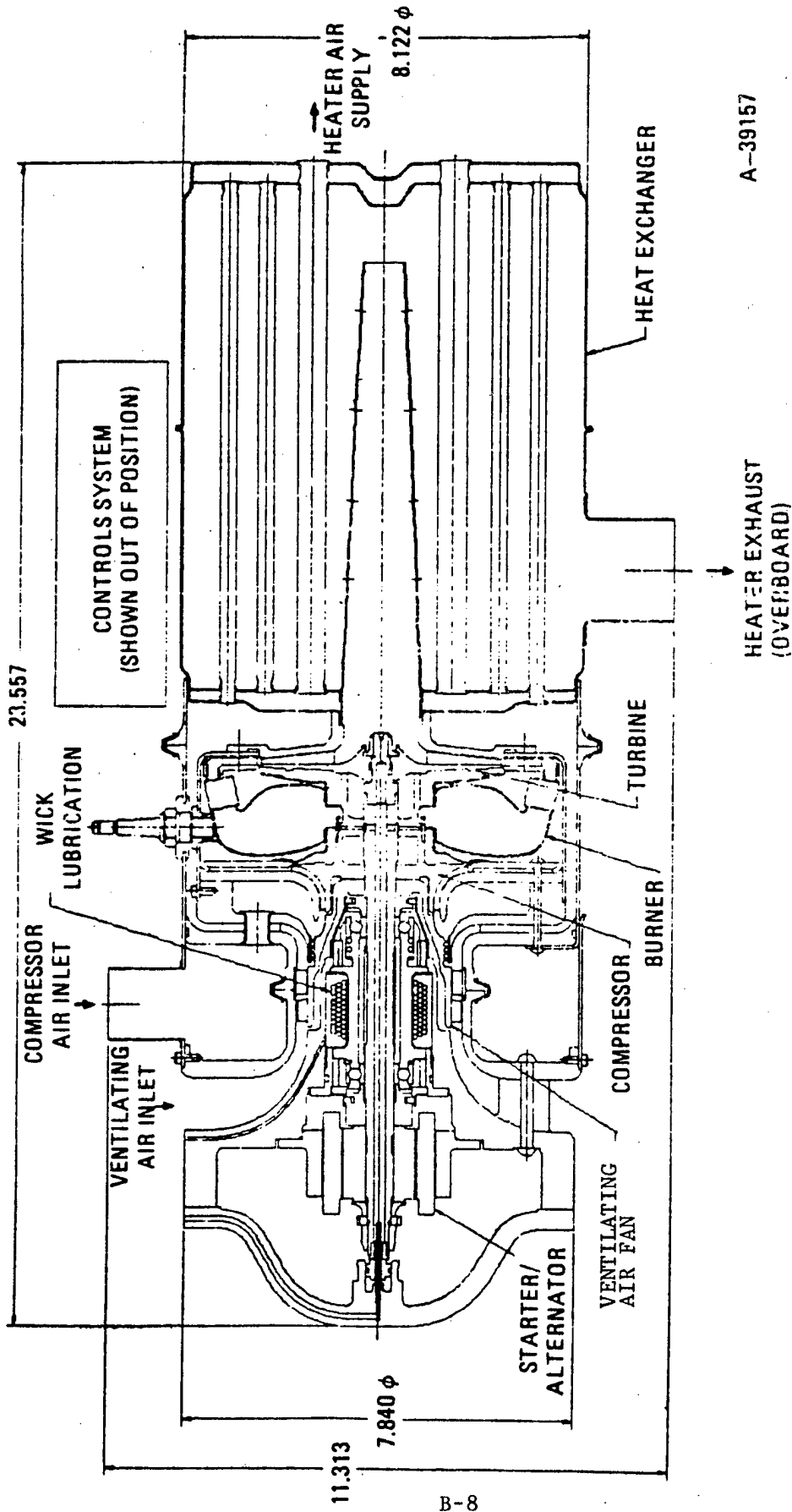


Figure 1-1. Preliminary Heater Concept.

*Fleetham*



DEPARTMENT OF THE ARMY Mr. Holland/kc/AUTOVON  
HEADQUARTERS. US ARMY ARMAMENT MATERIEL READINESS COMMAND 793-6313  
ROCK ISLAND, ILLINOIS 61299

2509

REPLY TO  
ATTENTION OF:

19 MAY 1983

DRSAR-LEE-A

SUBJECT: Heater Test Stand Requirements

Commander  
US Army Tank Automotive Command  
ATTN: DRSTA-MCB  
Warren, MI 48090

1. Reference:
  - a. Letter DRSTA-MCB, HQ, TACOM, 14 Apr 83, SAB.
  - b. Letter ATSL-CD-MS, USAOC&S, 8 Mar 83, SAB.
  - c. FONECON between TACOM (DRSTA-MCB, Mr. Fleetham) and HQ, ARRCOM (DRSAR-LEE-A, W. Nelson), 17 May 83.
2. Per reference 1c, a copy of ARRCOM Tool & Equipment Engineering Description for Purchase (DFP) 102 is attached for your information, and only as an example.
3. It is the opinion of HQ, ARRCOM that the development of a heater test stand is too far advanced at HQ, TACOM and Letterkenny Army Depot to be undertaken by this command. The familiarization period required by HQ, ARRCOM would hamper the timely fielding of this item which reference 1a states is greatly needed. Since a prototype is already under construction at Letterkenny under this direction of TACOM, it is felt the project should be carried to completion by the initiator, to include item mission management and logistic/field support.

FOR THE COMMANDER:

*W. E. Nelson*

W. E. NELSON

Chief, Industrial Items Engr Br

1 Encl

as

CF:

Cdr, USAOC&S

ATTN: ATSL-CD-MS

DRSTA-MCB

14 APR 1983

SUBJECT: Heater Test Stand Requirement

Commander  
Army Ordnance Center and School  
ATTN: ATSL-CD-M  
Aberdeen Proving Ground, MD 21005

1. This Command is dedicated to providing field units with reliable, maintainable personnel heaters. To this end, in June 1982, the Deputy Commander established a Heater Working Group (HWG) to resolve problems associated with heaters. The HWG identified the lack of standardized heater test stands in the field as a major factor contributing to improper/insufficient heater maintenance.
2. This Command believes the following logic justifies development of a standardized heater test stand:
  - a. A heater test stand will save the Army money by reducing the number of heaters washed out unnecessarily. During the last two years, TACOM supplied the field about 24,000 combat and tactical heaters costing the Army over twelve million dollars. A significant percentage of these 24,000 heaters are washed out unnecessarily, that is, thousands of unserviceable/repairable, and possibly serviceable heaters are condemned each year. There are many reasons for this waste, but most of them center around the Direct Support (DS) Maintenance shop, the location for most heater maintenance. Heaters pour into DS shops in the winter, but DS personnel are not set up for high volume repair. They do not receive enough heater maintenance training; they lack technical information on several heaters, and they experience chronic shortages of vital parts like igniters. If DS personnel have a heater test stand, they or their predecessors fabricated it from spare parts. Their homemade stand will not have repair procedures or even operating instructions. If the stand breaks, no one can repair it. Given the above factors, one can easily understand why DS personnel condemn unserviceable/repairable, and possibly serviceable heaters. A heater test stand accompanied with its own TM and a TM devoted to heaters enumerating heater checkout/troubleshooting procedures would substantially increase successful heater maintenance actions.
  - b. Without a heater test stand, the field will not have the capability to repair heaters currently undergoing development and testing. For example, this winter TACOM tested new Stewart Warner heaters at Ft Carson,

14 APR 1983

DRSTA-MCB


SUBJECT: Heater Test Stand Requirement

that will not operate off source AC current unless that current is converted to DC and filtered to 1% ripple. Probably few if any fabricated test stands in the field even filter the power supply. The new Stewart Warner heater is also undergoing qualification test per MIL-H-62315, the specification for 60,000 BTU personnel heaters. If the heater passes the test, it will surface in the field in huge quantities. DS shops will discover quickly that they cannot start the heater on their homemade stands unless they run the stand off batteries. As batteries are in short supply and not nearly as reliable as converted AC, DS personnel will face another roadblock to repairing heaters. Undoubtedly, many new serviceable heaters will be unnecessarily condemned.

c. A heater test stand would significantly improve safety conditions in the field. For example, representatives from this Command found a homemade test stand at an installation creating more than one safety hazard. An extremely short exhaust pipe did not reach the door; fumes poured into the shop during heater testing. The exhaust seals at the base of the stand leaked fumes. The fuel supply consisted of a tube inserted into an open can on the floor. This particular stand is typical of the field's homemade stands.

3. In view of these compelling justifications for introduction of heater test stand to field units, request your office act to establish a standardized requirement for a heater test stand and an outline for securing expeditious delivery of the stand to the field. Request your office respond NLT 13 May 83. POC this Command, Mr. C. Fleetham, AUTOVON 786-7379.

FOR THE COMMANDER:

  
B. LEE REEVES  
Act Dir of Maint(NMP)

CONCURRENCES:

- Mr. Fleetham C. Fleetham 1 APRIL 83
- DRSTA-MCB J. Sudwell 16 Apr 83
- DRSTA-MC J. Larkin 4 APR 83
- DRSTA-MS Charles C. Nahn 5 APR 83
- DRSTA-GBM H.P. Harris 11 Apr 83
- DRSTA-GBT.5 Donald J. Burchard 11 Apr 83
- DRSTA-G E. L. Clark 11 Apr 83

*CWO Lator 4-5-83*  
*G. Robbins 4-11-83*

*4/11/83*  
B-11

APPENDIX C  
FIVE YEAR SAVINGS SUMMARY



13.0. FIVE YEAR SAVINGS SUMMARY

13.1. Objective: To reduce personnel heater supply/maintenance costs.

13.2. Description: Currently, field maintenance personnel lack test, measurement, and diagnostic equipment necessary to effectively repair heaters. This deficiency seriously increases frequency of personnel heater failure as well as personnel heater repair time.

13.3. Improvement Expected: Current personnel heater Mean Time Between Failure (MTBF) is estimated at 960 hours (see Section 10.1.3.) With HTS the MTBF will be increased to 1125 hours.

13.4. Savings

13.4.1. Quantity of operational personnel heaters per season = 34,950.

13.4.2. Operational rate per heater: 600 hours per winter season.

13.4.3. Operation Rate Per Quantity of Personnel Heaters = 600 hours X 34,950 = 20.9 million hours.

13.4.5. Present Failure Rate: 20.9 million  $\div$  960 = 22,000 heaters/year.

13.4.6. Predicted Failure Rate:

13.4.7. Maintenance Man-Hour Savings:

a. Average time to replace = 1.04 man-hours.

b. Est Man-Hour Cost = \$8.55.

c. Repair Cost Per Unit Failure (inc parts, labor, washout) = \$184.

d. Total Cost Per Failure

1.04 man-hours X \$8.55/hr	=	\$8.89
Repair Cost Per Unit Failure	=	\$276
Cost Per Failure		\$280

13.4.8. Total Annual Cost at Current MTBF:

20.9 million X  $\frac{\$280}{960}$   $\approx$  \$6.1 million

13.4.9. Total Annual Cost at Predicted MTBF:

20.9 million X  $\frac{\$280}{1125}$   $\approx$  \$5.2 million

13.5 HTS Acquisition Costs:

- a. Cost of Test Stands (375 X \$4400) = \$1.65 million.
- b. Logistics Costs (5 yrs) = \$500K.
- c. Total HTS Acquisition Cost = \$2.15 million.

13.6 NET Savings:

- a. Yearly Savings (\$6.1 million - \$5.2 million) = 900K.
- b. 5 Year Savings = \$4.5 million.
- c. Total 5 Year Savings = (\$4.5 million - \$2.15 million ) = \$2.35 million.

DISTRIBUTION LIST

	Copies
Commander US Army Tank-Automotive Command ATTN: AMSTA-MCC Warren, MI 48090	33
Commander US Army Tank-Automotive Command ATTN: AMSTA-TSL Warren, MI 48090	2
Commander Defense Technical Information Center Bldg. 5, Cameron Station ATTN: DDAC Alexandria, Virginia 22314	12
Manager Defense Logistics Studies Information Exchange ATTN: DRXMC-D Fort Lee, VA 23801	2
Commander US Army Tank-Automotive Command ATTN: AMSTA-CV, Col Burke, Deputy Commander R & D Center Warren, MI 48397-5000	1