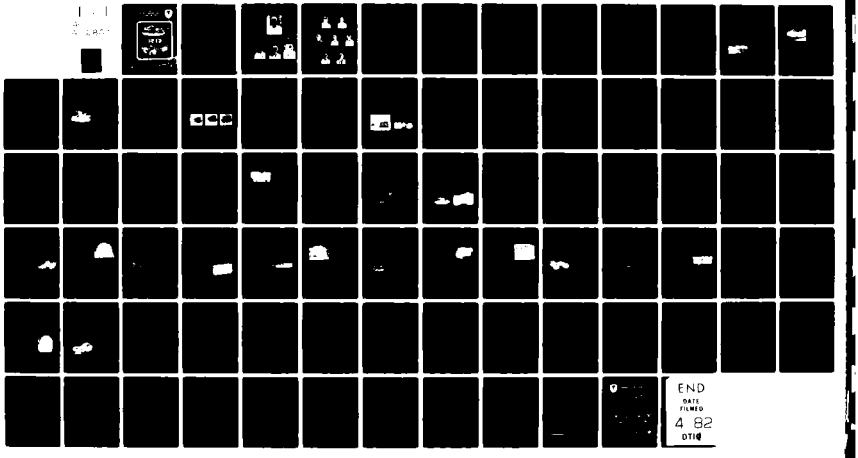
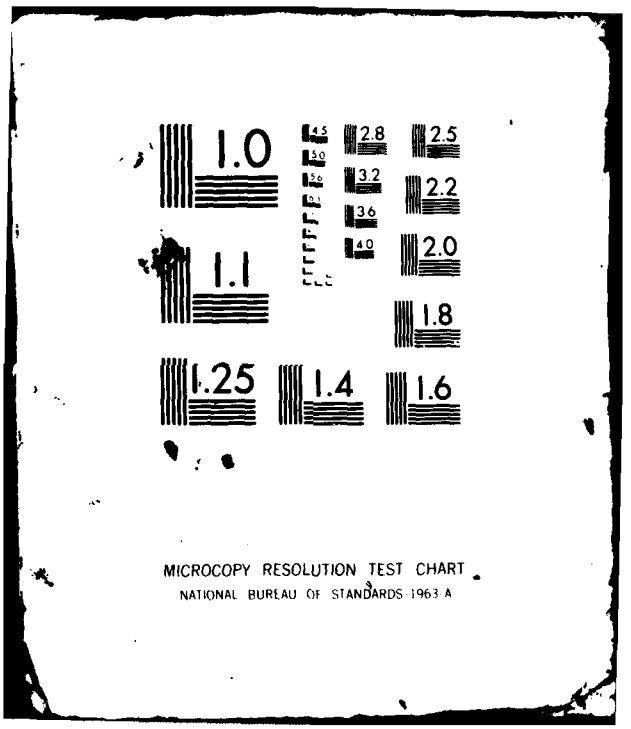
AD-A112 807 ARMY TANK-AUTOMOTIVE COMMAND WARREN MI F/G 5/1
FY 1981 ANNUAL LABORATORY POSTURE REPORT RCS DRCLD - 101.(U)
1981

UNCLASSIFIED NL

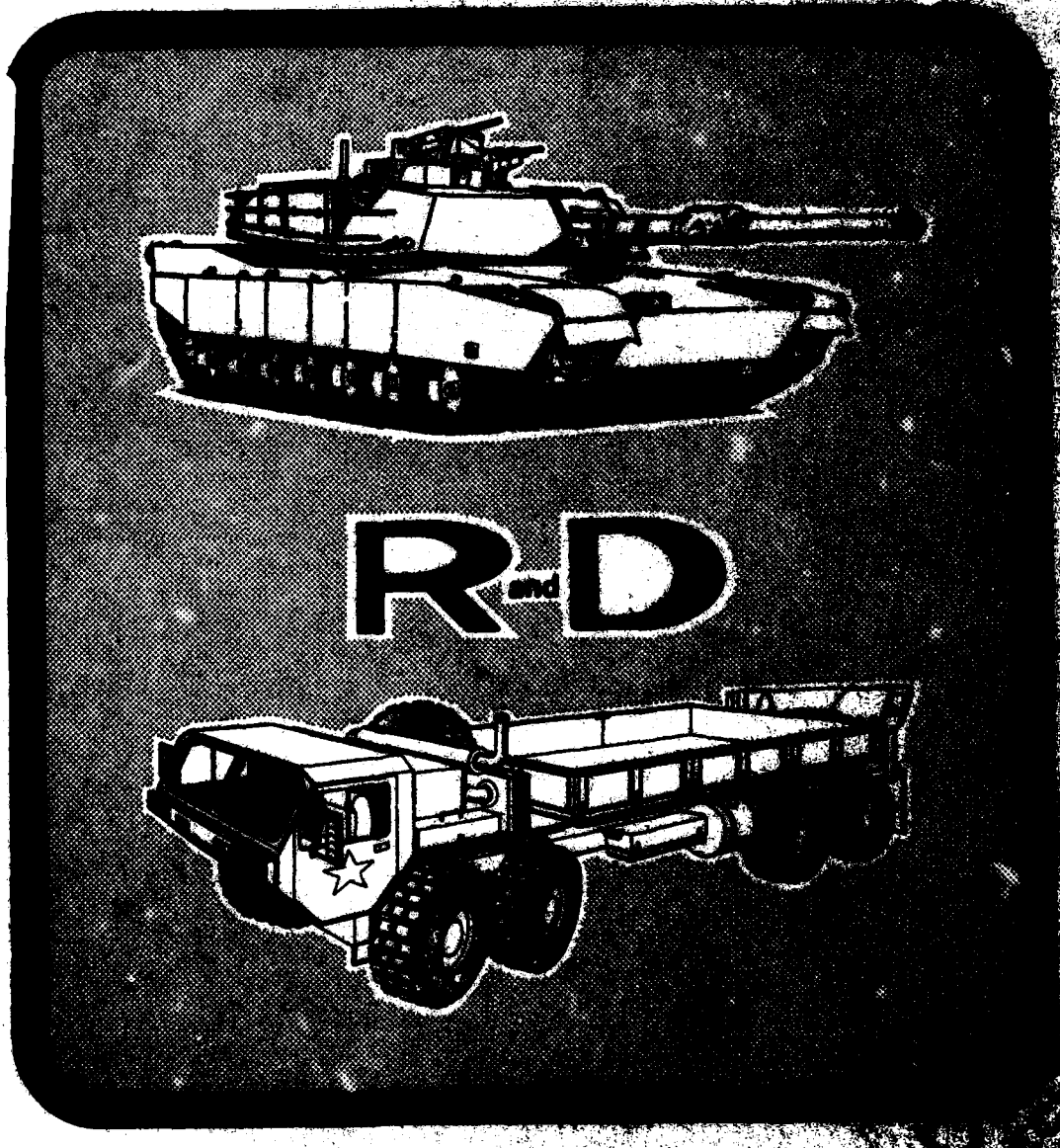


END
DATE FILMED
4 82
DTIC


1.0
1.1
1.25
1.4
1.6
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.8
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

FY 1981
ANNUAL LABORATORY POSTURE REPORT

RCS DRCLD - 101



Approved for public release;
Distribution Unlimited

U.S. ARMY TANK-AUTOMOTIVE COMMAND
RESEARCH AND DEVELOPMENT CENTER

[redacted]

command executive staff

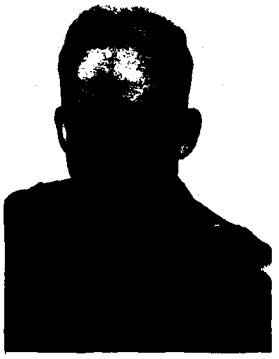
BG C.M. Matthews, Jr.
Commanding General

Col Oren Wolfe
Deputy Commander

Cpt Joseph K. Penick
Executive Officer

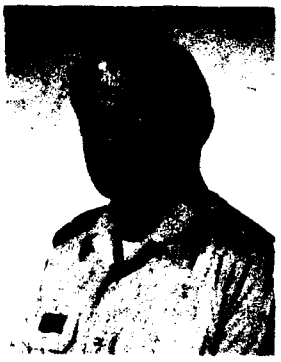
Dr. Ernest N. Petrick
Technical Director

command executive staff



Col H.H. Dobbs
Director, Tank-Automotive
Systems Laboratory

Col T.H. Huber
Director, Tank-Automotive
Concepts Laboratory



LTC Perry F. Brake
Project Officer
Vehicle NBC

LTC (P) John M. Gamino
Chief, Systems
& Technology Planning Office

George Newcomb
Director, Engineering
Support Directorate

Col J.W. Wasson
Project Officer
Tank Development

Robert E. Simak
Chief, Foreign
Intelligence Office

TABLE OF CONTENTS:

MANAGEMENT

ORGANIZATION ASSIGNMENTS/RESPONSIBILITIES

TANK-AUTOMOTIVE CONCEPTS LABORATORY

The Tank-Automotive Concepts Laboratory (TACL) was established to focus mangement attention on advanced vehicle development program, initiatives, and survivability. TACL operated during FY81 with an organization structure consisting of an Exploratory Development Division, a Survivability Research Division, and a Program Control Office.

The Exploratory Development Division is responsible for advanced military vehicle system research, concept feasibility studies, and advanced engineering design programs, including the development and maintenance of tank-automotive long-range technology/ methodology programs.

The Survivability Research Division is responsible for basic and applied research directed toward new and improved vehicle performance, operational capability, survivability including research leading to new principles for sensing and measuring vehicle signatures and electromagnetic interference, counter-surveillance, signature reduction, electronic warfare countermeasures for military vehicle systems, and for exploratory development programs in ground mobility.

VEHICLE NBC PROTECTION

This project office was chartered in 1979 by DARCOM to plan, manage and direct the expedited development of Hybrid Collective Protective Equipment (HCPE) for application to selected combat vehicles as initially stipulated in the Army Plan for Incorporation of NBC Protection for Armored Vehicles and Crews, dated February 1978. This plan was requested by and subsequently submitted to Congress by virtue of Public Law 95-79. An implementation plan was presented and approved by DCSRDA in March 1978. A more expansive list of combat vehicles calling for HCPE has been provided by TRADOC and currently includes: M1, M3, ROLAND, MLRS, DIVAD, AFARV, FAAR, CSWS, JEDS (XM16) and the NBC Reconnaissance Vehicle. This office also furnishes a resident POC for nuclear hardening and monitors the resolution of crew performance degradation imposed by NBC protection measures.

SYSTEMS AND TECHNOLOGY PLANNING OFFICE

The Systems and Technology Planning Office (STPO) evolved from the Systems/Technology Integration Division. The office serves as the R&D Center mid- and long-range planning element to establish future development goals and objectives in coordination with TRADOC and DARCOM subcommands. The office develops and coordinates technical planning documents in support of the Army materiel acquisition, research and development systems and provides staff management of the R&D Center program through the provision of a review and decision process.

The STPO provides management and coordination of the combat Vehicle Science and Technology Program. Additionally, the office serves the lead in developing a fuel engergy efficiency plan and manages the NATO Rationalization, Standardization and Interoperability program.

TANK-AUTOMOTIVE SYSTEMS LABORATORY

The Tank-Automotive Systems Laboratory (TASL) was organized to consolidate research, development, engineering efforts, and conduct of performance-related product-improvement programs and consists of three divisions (Combat Systems, Tactical Wheeled Vehicle Systems-with two divisions, and Propulsion Systems) and one supporting office (Program Control).

MANAGEMENT

ORGANIZATION ASSIGNMENTS/RESPONSIBILITIES

The Combat Systems Division conducts advanced development and engineering development for combat vehicles through first production and initial fielding. This division provides technical support, world-wide, to planners, producers and users of combat vehicles, including product improvement programs. In the area of vehicle subsystems and components, the Combat Systems Division directs research on potential track materials, and executes exploratory and advanced development of armor, track and suspension, combustion fire detection and suppression, and composite materials for combat vehicle applications. Also, it executes an integration role for both fire control and fire survivability programs for ground combat vehicles. It also directs and coordinates the manufacturing methods and technology, and Military Adapted Commercial Item Programs for ground vehicles. The Weapons System Managers for the Field Artillery Ammunition Supply Vehicle and the Small Unit Support are assigned here.

During FY81, organizational changes were implemented to form a Tactical Wheeled Vehicle Systems Division which is the parent organization of two subdivisions. The sudden increase in tactical wheeled vehicle workload, and accelerated schedules on the M939 5-ton, CUCV, HMMWV and 10-Ton M.A.N. truck programs resulted in the establishment, on 1 July 81, of the Tactical Wheeled Vehicle Division. It is structured to provide intensive management of the aforementioned truck programs, as well as mission responsibilities and resources of the Tactical Wheeled Vehicle Management Office. This office provides improved control and cost effective management of the Army's tactical fleet throughtout the life cycle. This division is responsible for vehicle development, engineering development, and production engineering and management of performance-related product-improvement programs for tactical wheeled vehicles.

The Tactical Systems Support Division manages advanced military tactical wheeled vehicle systems, engineering design and development programs, including improved methods of assessing the effectiveness of future transport, and tactical and special vehicle designs. It is involved in managing the tactical vehicle systems design, development and engineering programs through first production and initial fielding of a number of tactical support wheeled vehicles (e.g., Semi-trailers for GLCM, PATRIOT and MLRS) by providing the necessary technical direction and resources essential to the accomplishment of the maintenance, supply, procurement, production and the industrial mobilization requirements for support vehicles. In addition, it is responsible for planning, directing and conducting research, development and engineering of components such as materials, wheels, mechanical and electrical devices, tires, special automotive kits and environmental systems for tactical, automotive vehicles.

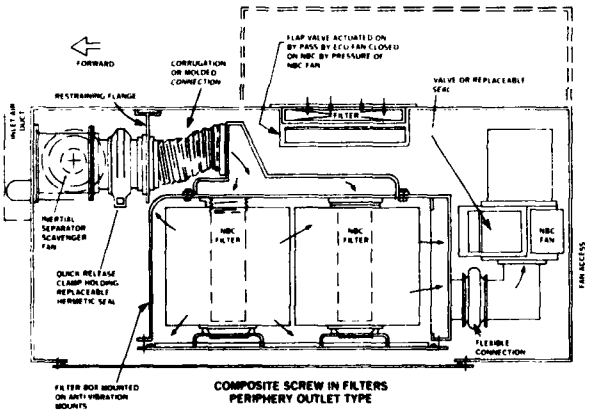
Propulsion Systems Division responsibilities include research, development, qualification, and integration of combat and tactical vehicle engines, transmissions, air cleaners, cooling systems, diagnostic and prognostic equipment, and electrical power distribution and management systems. Due to the increasing application of electronics in military ground vehicles and resulting electrical system sophistication, an added responsibility has been included called VETRONICS. This program will account for the integration of all electrical/electronic/sensing systems into military vehicles. It also performs the compilation and exchange of data with foreign and U.S.-based industries for the above activities.

Program Control Office provides budget and program support services to the Systems Laboratory, and administers the TACOM cost reduction, military adaptation of commercial items, and manufacturing methods and technology program accounts.

An ancillary office, the Computer Management and Application Research Office, consolidates TACOM's computer assets for control and function priorities.

HYBRID COLLECTIVE PROTECTION EQUIPMENT (HCPE)

Hybrid Collective Protective Equipment (HCPE), now in the prototype phase, represents an advancement in the Army philosophy and state-of-the-art in nuclear, biological and chemical (NBC) protection for US armored vehicles. It provides the combined benefits of contaminant-free overpressure with the flexibility of ventilated facepiece protection for emergency use in an NBC environment. HCPE is intended for those vehicles performing missions in which personnel are required either to remain inside for long periods or gain rapid entry or exit from the vehicle.



TOP VIEW OF ROLAND HCPE PROTOTYPE

Both a 75-CFM and a 300-CFM prototype unit were designed during the year, and a ROLAND-specific (100-CFM) unit was built. There are no readily available locations on existing combat vehicles to ideally install HCPE. So a reduction in HCPE volume is being investigated to determine the best packaging size, considering crew compartment air leakage rate and tank spatial constraints.

Installation of HCPE in combat vehicles requires a coordinated effort between FORSCOM, TRADOC, DARCOM agencies and vehicle manufacturers. Interface control definition was achieved with the first group of vehicle PMs to conform to vehicle system constraints and insure effective, system compatible NBC protection. NBC interface modifications for the U.S. ROLAND Weapon System is being phased-in during low-rate production. Similar efforts have been initiated for the M2/M3, DIVAD Gun and Armored Forward Area Rearm Vehicles.

SENET

TACOM began the implementation of its Scientific and Engineering Computer Network (SENET) during FY81.

SENET is a mini-computer based Computer Aided Design (CAD) system, supporting various engineering applications including, Computer Aided Armor Design, Drafting, Electrical Engineering, Electronic Engineering, Graphics, Mathematics, Mechanical Engineering, Physics, Project Management, Simulation/Modeling, Statistics, Structural Analysis, Thermal Analysis and Track Design.

SENET was established as a Command resource to satisfy the ever increasing demand for CAD services within the Research and Development community.

The SENET CAD services support major Army mission objectives including the M1 tank, Alternate Engine Programs, Armor Programs, Track Reliability Program. Furthermore, DARCOM resident PMs enjoy the benefit of the CAD capability provided by TACOM engineering staff. Finally, the establishment of this in-house SENET has resulted in a substantial cost savings by providing better

service at a lower cost than was previously attainable through out-of-house services. Several projects that were unable to afford expensive commercial CAD services are now able to use this advanced technology to design better vehicle systems, through use of SENET's cost effective CAD services.

INDEPENDENT EXTERNAL SUSPENSION

The Independent External Suspension program was to design and develop a high-mobility tracked vehicle springing and damping system exterior to the hull. The complete springing and damping mechanism is contained within the roadwheel arm, and the overall suspension weight is expected to be reduced. The roadwheel arm housing will support the roadwheel load and house the springs and damping components.

During FY81, the 6,000-mile durability engineering tests were completed. Future plans for the 20-25 ton test vehicles are to continue testing different seal designs and compare their results with the present seal design.

ADVANCED FILTERING SYSTEM

The Advanced Filtering Systems Project has been initiated in FY81. The project is to conduct parametric studies leading to the development of a full scale prototype of an alternative to the time honored charcoal type filtering system. Efforts are directed towards reducing existing drawbacks to present combat vehicle air purification systems by:

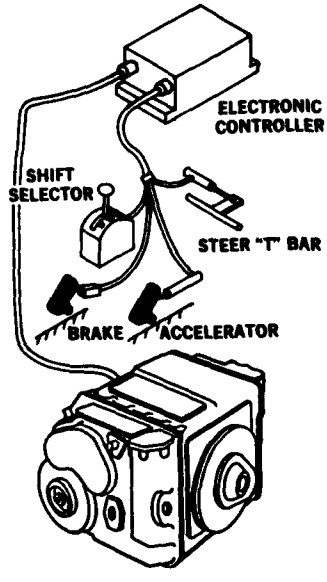
- o Increasing filter life
- o Avoiding gas filter poisoning
- o Providing for regeneration of gas filter
- o Eliminating toxic by-products

Five categories of air purification methods have been considered:

- o Catalytic air
- o Corona discharge
- o Regenerative absorption
- o Regeneration recycle life support (NASA type)
- o Combination of two or more of the above

The regenerative absorption air purification method has been selected as the lowest risk method for application in the 100 to 200 CFM air flow range. Design, fabrication and testing of the prototype will be conducted during FY82.

CVX-650 HYDROMECHANICAL TRANSMISSION



The CVX-650 Transmission Development Program represents a significant advancement in hydromechanical technology. Designed for tracked vehicles up to 25-tons and 650-HP, it

incorporates several features that makes this transmission an improvement over current hydromechanicals: (1) The propulsion and steering power paths are separate, improving transmission controllability; (2) Hydromechanical drive is effective in all ranges resulting in increased efficiency, electronic control along with the additional benefit of an inherent diagnostic system. Design features will enable the continuously variable speed ratio characteristics of this transmission to control more effectively engine operation for fuel efficiency and performance.

Two CVX-650 transmission prototypes were fabricated and assembled in FY81. One transmission has completed shakedown and functional testing in the laboratory.

Prototype electronic controls have been fabricated and incorporated into the transmission system. The test vehicle has been prepared for installation of the power train for testing during FY82. The transmissions will undergo extensive testing in both the laboratory and a vehicle in FY82.

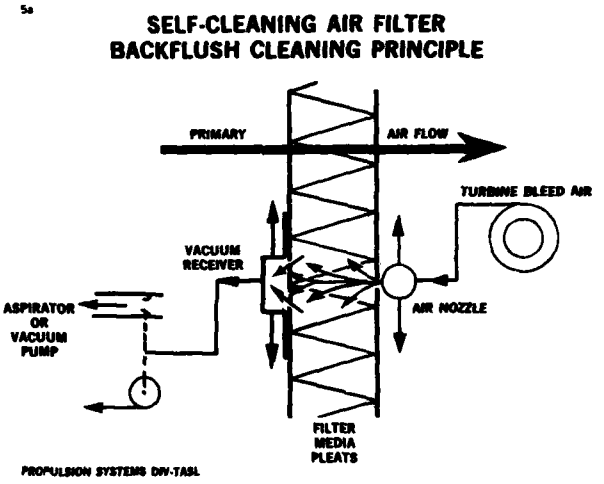
BEADLESS TIRES WITH "RUN-FLAT" CAPABILITY

An 8,000-mile endurance feasibility test is underway for a version of a "Run-flat" tire in a military scenario of mixed terrain of 30% primary roads, 30% secondary roads and trails, and 40% cross-country roads. After 3,000 miles both front tires were deflated, and the vehicle was operated for 30 miles at 30-MPH. No bead slippage or damage to the tires was noted. The tests are continuing.

SELF-CLEANING AIR FILTER

High concentration of dust under field conditions and the desire of user units to eliminate frequent and lengthy maintenance procedures provided the program impetus to develop a self-cleaning air filter (SCAF) system to clean engine induction air for the M1 tank and other combat vehicles.

Current military air filter specifications require 99.5 percent efficiency and 20 hours of dust capacity (service life) under laboratory conditions. Under severe field conditions, however, the service life can be reduced to less than two hours.



Goals of the SCAF program are to provide air filtration within the same space and at the same level of efficiency as in existing configurations, while extending service life by a factor of five.

During FY81, developmental testing of the SCAF Phase I prototype has demonstrated a ten fold increase in filter system life. Under a given dust condition, the standard filter was limited to 20 hours of operation; however, under the identical conditions the SCAF exceeded 200 hours of satisfactory performance. Phase II prototype design is complete and fabrication has been initiated.

In FY82 one Phase II prototype will be installed and tested in an M1 tank operating in a severe dust environment.

PATRIOT SEMITRAILER

TACOM is providing design, development and production support for semitrailers to be used with the Army's new PATRIOT Missile System.

PATRIOT-peculiar XM860A1 semitrailer is a rigid, mobile platform used to transport a radar or a launcher system. The XM860A1 is an XM860, reconfigured in the gooseneck section to make the vehicle compatible with a 10-ton HEMTT tractor, prime mover. First-year production of a multiyear contract was awarded to Southwest Truck Body Co., St. Louis, MO.

ARMY GROUND TURBINE 1500 FUEL ECONOMY PROGRAM

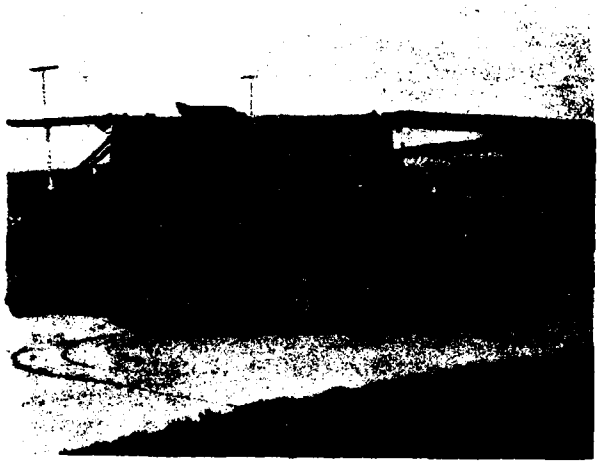
The object of the Army Ground Turbine 1500 Fuel Economy Program (FEP) primarily has been to reduce the mission fuel consumption. Fuel economy improvement was obtained by improving engine efficiency in the idle regime, achieving the greatest percentage of fuel reduction in the 40-50 percent power range, and obtaining a mission-weighted 10 percent average reduction is specific fuel consumption throughout the engine operating range. The program benefits include extended range for the M1 vehicle and reduced fuel supply logistics and associated costs, improved RAM-D factors and lowered engine acquisition cost.

During FY81, the initial program was completed with the fabrication and rig testing of all redesigned component hardware and the assembly and testing of one complete FEP engine. Initial results indicate that design objectives have been achieved. Fuel scheduling adjustments were conducted for performance optimization. A programmed contract extension into FY82 will permit performance evaluations of FEP engine module interchangeability with current production engine modules. Additional durability testing is scheduled for FY82 on a second FEP engine.

FIELD ARTILLERY AMMUNITION SUPPORT VEHICLE (FAASV)

On 31 Dec 1980, the Field Artillery Ammunition Support vehicle (FAASV) was transferred from the Concepts Laboratory to the Systems Laboratory. A Full Scale Engineering Development (FSED) contract to design and fabricate five prototype vehicles was awarded to Bowen-McLaughlin-York Company on 25 March 1981. This contract includes upgrading M108 chassis to the M109A2 Self-Propelled Howitzer configuration and the integration of an armored cargo compartment equipped with onboard ammunition handling equipment, an Auxillary Power Unit, and a crane for self-loading ammunition projectile racks into the vehicle.

The FAASV will be a total artillery ammunition carrier/handling system for transferring complete rounds to either the supported M109 or M108 self-propelled howitzer.



The FAASV demonstrates and exploits such advantages as maximizing ammunition payload and selectivity, increasing capability for rapid handling of large munition quantities during reloading and fire support, increasing the capability to provide sustained conventional artillery fire support rates, and increasing crew, cargo, and vehicle survivability.

M109A2 self-propelled howitzer will result in an estimated cost savings of $590,000 (FY80) for the FSED phase of this program. The carrier will make the labor intensive ammunition loading and transfer functions less fatiguing to the supported 155mm or 8-inch self-propelled howitzer crew.

XT-152 45-65-TON VEHICLE TRACK

The XT152 track testing during FY81 showed that the new center guide configuration is effective in improving wheel/guide/pin interfaces, thereby reducing track alinement and guide failures. Concepts for a new, lighter weight track will be developed using this and other information obtained from FY81 testing. This lighter weight track is for the M1 tank.

FLUIDIC DAMPER

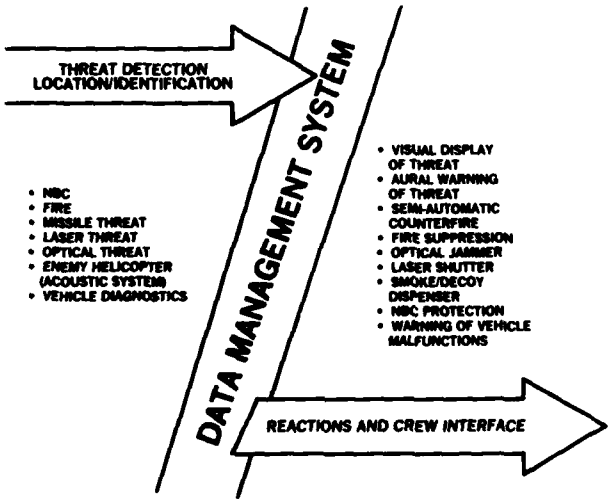
The Fluidic Damper program was to develop a fluidically controlled, adaptive damper suitable for the M113 class vehicles that would increase meantime between failure and reduce shock loads to the vehicle in rough terrain, thereby increasing mobility, ride quality, gun platform stability, RAM-D and reduce costs. Fabrication and testing of two self-contained dampers, with improved accelerometers, began and the fluidic jounce valve (laminate stack) and bonding techniques were developed and successfully tested.

VEHICLE INTEGRATED DEFENSE SYSTEM (VIDS)

The Tank-Automotive Concepts Laboratory is developing combat vehicle self-protection systems to increase battlefield survivability for future ground-borne combat vehicles. Specifically, VIDS, which incorporates a suite of threat detection devices, countermeasure responses or reactions, display and communications interactions, and threat warning hardware from which the best combination may be selected for specific vehicle application and anticipated battlefield scenario.

The technology basis for this integrated self-protection system is a microprocessor-based processor, identified, as the Data Management System (DMS). The DMS is structured to

interrogate sensor engagement algorithms based on a prior and/or real time threat information as derived from a suite of early warning sensors. Threat classification and prioritization are accomplished based upon discrimination analysis of identified threat parameters and multidisciplined threat characterization. High-priority threat data are subsequently displayed or communicated directly with the vehicle Commander through artificial intelligence and heuristic simulations. The vehicle Commander has the option of implementing various survivability responses against the high-priority threat, including main armament counterfire in conjunction with either electro-optical or electronic warfare countermeasures.



Significant program achievements include successful hardware demonstrations of systems and subsystems including helicopter threat detection by a non-imaging sensor coupled with a main armament counterfire response directed against the threat and by development and integration of artificial intelligence symbology into the M1 tank and thermal night sight display.

Current program developments include the expansion and direction of the DMS toward the perception of VETRONICS; a computer design with artificial intelligence software, very large memory, very high speed, integrated circuitry and an interactive display system. It also uses military computer family hardware and ADA higher order language. It has threat detection devices such as the laser early warning receiver for multi-threat discrimination, integration of NBC and radiological sensors for internal vehicular protection, implementation of voice synthesis/artificial intelligence for selective communications within the man/machine domain, built in system self test, graceful degradation, and power management during quiet vehicle operation.

ADVANCED COUNTERMEASURES

Current areas of combat vehicle signature concern include the infrared, visible, millimeter wave/radar, and acoustic spectrums. Reduced detection ranges are accomplished through implementation of both vehicle signature suppression and ground clutter enhancement techniques.

Significant program achievements to reduce detection ranges include the fabrication and test of acoustic signature reduction components for the track and suspension system of a lightweight combat vehicle. Prototype components including idlers and sprockets have affected an acoustic signature suppression equivalent to a 40% reduction in the vehicle detection range.

In the millimeter wave and radar disciplines new equipment has been obtained and methodology developed for the acquisition and analysis of data and the evaluation of the effectiveness of various millimeter wave/radar absorbent materials was also

supported. Significant accomplishments in the infrared area included research on high technology coatings, investigation of suppression techniques for turbine powered vehicles, and progress toward the quantification of survivability improvement obtained by infrared signature reduction. This quantification was accomplished through the development computer-based methodology for assessment of the effects of various infrared countermeasurers against established and projected enemy threats.

SECURE LIGHTING PROGRAM

TACOM's investigation into detection during night operations, by threat forces, using low-light-level (LLL) imaging devices revealed that current blackout security lighting is ineffective. Analysis showed that the near infrared portion of incandescent lamp emission "leaking" from openings in the hull and turret, made the vehicle easily visible at ranges exceeding 2 km with LLL imaging devices. By restricting emission of a lamp to energy only in the visible portion of the EM spectrum, the signature of that lamp to a typical LLL device could be reduced by 28 dB with no loss of visibility inside the vehicle.

TACOM and TRADOC compared the signature of a blue-green infrared-absorbing filter over a blackout dome lamp to that of a vehicle using the red filtered dome light. The red blackout light was clearly visible through LLL sensors while the blue-green light virtually disappeared.

All new production combat vehicles will be equipped with the new filter. Fielded vehicles will require only a minor field modification to be upgraded.

The decision to use red light to provide illumination to the crew for secure night operations was based on the fact that red has less detrimental effect on dark adaptation of the human eye. Tests showed that, under tank lighting conditions, the human eye could become dark-adapted in 4.7 seconds after exposure to the red light whereas 7.0 seconds would be required after exposure to the blue-green light. The decision was made to trade the increase in dark adaptation time for the added security.

A typical combat vehicle has as many as 100 incandescent lamps, which are illuminated during night operations. Through an ongoing secure lighting program, each lamp will be examined and redesigned to emit only energy visible to the human eye and to optimize its intensity using light-emitting diodes, as well as spectral and spatial distribution. This program to provide the best vision in and around the vehicle with minimum light signature.

FULL SCALE SIMULATION AND THE MECHANICS OF VEHICLE SYSTEMS

The current interest in the development of lightweight combat vehicle carrying high impulse weapons has generated several technical problems. Foremost of these are the cross-country dynamics and firing platform stability trade-offs which must be made to obtain a balanced chassis and turret design resulting in optimum dynamic response of the total system. These trade-offs are necessary because lightweight vehicle systems are more sensitive to terrain and recoil induced vibrations and, consequently, selection of the optimum set of design parameters is of greater importance than that for the heavier combat vehicles.

A new approach has been initiated to combine analytical simulation and laboratory testing. The laboratory research objectives are to:

(1) Establish fundamental sources of gun positioning error;

(2) Quantify base line performance levels;

(3) Determine man/machine interaction and limitations;

(4) Establish performance criteria based on total system response and performance;

(5) Develop evaluation techniques based on standard control and real terrain inputs;

(6) Develop microprocessor-based systems to demonstrate the design feasibility and system performance; and

(7) Develop an analytical methodology to evaluate conceptual systems via simulation.

The theoretical basis and analytical framework for these experiments are provided by two basic research tasks: "Mechanics of Vehicle Systems" and "The Application of Control Theory to the Dynamics of Vehicle Systems".

The Dynamic Analysis and Design System (DADS) methodology is being developed under the former task. It represents the most advanced vehicle ride dynamics and firing platform stability simulation available today. It will be used in conjunction with the laboratory test to explore design variations and sensitivity analyses which cannot be conducted economically in the laboratory.

The control theory research will provide the control schemes and methodology to be implemented and evaluated experimentally.

Recent DADS development advances include automatic equation formulation for the kinematic, static and dynamic analysis of conceptual combat vehicles. Specific accomplishments are the coupling of rigid body and servo system dynamics, rigid body-flexible member interaction analysis and the initiation of parameter trade-off investigations which consider the effect of design variations on platform stability, cross-country speed and weapon stabilization percision. An important element of ACVT support, the combat vehicle platform stability analysis for moving and stationary firing, could not have been conducted without the methodology developed as part of this program.

VEHICLE IMAGE PROCESSOR

A microprocessor controlled image processor is used to store and analyze images of military vehicles. A number of image-processing algorithms have been used to determine a measure of detectability for US and threat vehicle targets. Convolution filters are employed to determine which features of ground vehicle images make them recognizable as potential targets. Several computer algorithms have been developed for both two-dimesnional and one-dimensional representations of vehicle images which enhance contrast, detect edges, and perform various other filtering operations. Histogram modification algorithms are also utilized to set threshold and priority levels for edge and region enhancement of vehicle images.

Several types of IR, low-light level, and photometric sensor data are being analyzed for vehicle target classification and recognition. The main area of emphais is the examination of IR imagery of US tanks in a variety of background scenarios. The imagery is processed to determine how much improvement in resolution and contrast is possible for potential target recognition and classification applications.

GRADIENT AND LAPLACIAN FILTERING

ORIGINAL GRADIENT LAPLACIAN

PHOTOGRAPH

The gradient and laplacian convolution filters have been applied to a thermal image of a tank. A decisive improvement in the resolution of the original is apparent particularly in the Laplacian filtered image. The appearance of the gun barrel and detail on the turret and track have been recovered using these standard image processing techniques.

TECHNICAL ACHIEVEMENTS

MANAGEMENT OF RESOURCES

IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

Fifteen research tasks were conducted under this program in FY81. The technology areas represent research in several scientific fields including optics, ultrasonics, radar, control theory, infrared, and material properties. These tasks, initiated in FY81, and two other proposals were combined with existing tasks. A joint laboratory task continued with the Engineer Topographic Laboratory, Ft Belvoir, VA. Several noteworthy technical achievements resulted from this program including several publications and presentations at scientific and engineering symposia. The program has been a valuable tool for recruiting and retaining qualified scientists and engineers. Three tasks were selected for individual mention.

Ultrasonic surface acoustic wave (SAW) technology has several important applications in the non-destructive evaluation (NDE) of material properties. A specific application of this SAW technology concerns the testing of ceramic engine components for the TACOM/Cummins Adiabatic Diesel engine development program. The design and construction of an ultrasonic SAW strain sensitive transducer was undertaken primarily for the NDE of small surface cracks and other imperfections which are critical to the performance of these ceramic engine components. The SAW strain sensitive devices promise a unique potential for accurate strain measurement at ultrasonic frequencies under high stress conditions.

Analysis of structural acoustic and vibration phenomena is an important task in the evaluation of prototype military vehicle components and systems. The holographic analysis of these vehicle systems is an important tool for determining their global structural behavior at a single instant in time. The holographic fringe data provide an experimental mechanism for validating the model or finite element models of these prototype structures. The application of pulse holography has provided several important clues to the coupling of track-induced forces to the hull in the M113 Armored Personnel Carrier.

The design and evaluation of countermeasure techniques is an important task to increase the survivability of military vehicles against anti-tank missiles which use millimeter wave seekers. The millimeter wave reflectivities of key materials play an important role in reducing the overall millimeter wave signature of a vehicle. An improved apparatus to measure the millimeter reflectance of materials has been designed and assembled using the RF substitution reflectometer technique. This apparatus has been used to measure millimeter reflectivities of camouflage paints, track and road wheel rubber and wood.

6.1 BASIC RESEARCH

Work under the "Research in Vehicular Mobility" was divided into four major thrust areas: Structural Phenomenon Research, Component Technology Research, Applied Mobility Research, and Countermeasure Research. The general program plan was reviewed and supported by the Army Research Office.

Previous ILIR basic research in real time optical and digital correlation techniques provided the technical basis for the Structural Image Analysis Program, began in FY81. This new research effort relates the structural

image characteristics of military vehicle signatures to improve their survivability on the modern battlefield.

Finite element analysis and mathematical models have been developed for the thermal and structural aspects of tank pads. Boundary conditions and actual field tests have shown the validity of these programs. These programs will be used for failure analysis and design studies. Basic studies on fracture analysis of visco elastic materials have been initiated.

The mechanics of vehicle systems research task was a new start in FY81. It is based upon the newly developed Dynamic Analysis and Design System modeling method which is the culmination of previous and current TACOM and ARO sponsored research in the areas of large scale mechanical systems dynamics and modern control theory techniques. Models of wheeled and tracked combat vehicles to predict cross-country ride and platform firing stability dynamics as a function of terrain, vehicle speed, weapon recoil mechanism and impulse have been formulated. Articulated tracked vehicle models coupling rigid body, flexible track and servo control system degrees of freedom have also been formulated to predict obstacle crossing performance, vehicle geometry/obstacle interference and vehicle system response/stability. These models will significantly enhance TACOM's concept vehicle design and evaluation process.

The development of the mathematical simulation of a wheeled military vehicle traveling along a curved path in soft soil has continued. Based on theory and on an extenstive set of experimental data obtained in FY80, equations have been written for the lateral force acting in the tire/soil interface. This is the key component of the overall vehicle handling model. Full scale field validation tests will be conducted in early FY82.

The development of fundamental vehicle/soil interaction equations which account for moving loads and, therefore, are dependent of velocity and slip has progressed in FY81. Two basic models are being explored: a finite element analysis approach for cohesive soils and a discrete particle model for frictional soils.

Laboratory and field test methods were also established to measure soil parameters needed for the mathematical simulation. In the near future, the fundamental theory will be applied to particular practical situations, such as a 4x4 vehicle operating in soft soil. These specific models will greatly enhance TACOM's vehicle design and performance evaluations capability.

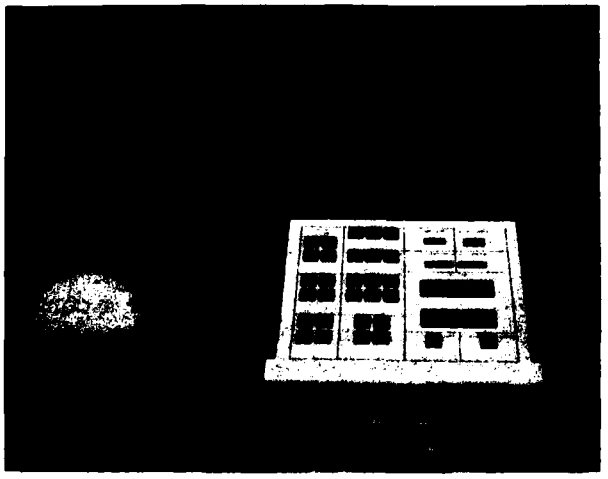
The methodology development for analyzing and determining target and background interrelations and their effects on the infrared/thermal signatures of static vehicles has been completed and validated. The model is based on facetizing the vehicle into a number of isothermal regions for static and dynamic operating conditions. This research effort will yield results which will contribute to our ability of designing vehicles with reduced signatures.

6.2 EXPLORATORY DEVELOPMENT

We completed the fabrication of five ATEPS core elements, i.e., the crew's terminal, three remote terminals and the bus controller/remote terminal, and a data bus/power

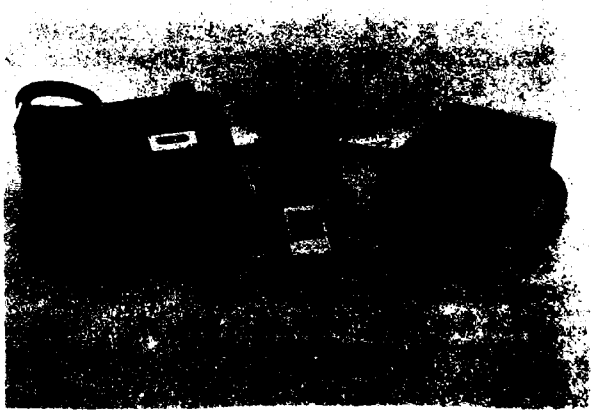
cable assembly during FY81. Chrysler Defense performed a checkout of the system which was installed in a baseline M1 tank hull. The driver's/crew's terminal also contains the helmet/intercom connections. All core elements are interconnected by the data bus/power cable assembly.

Work continued for the size reduction effort with completion of the design and breadboard construction of the 5, 15, and 40 switches. These solid-state switches were designed using advanced technology which reduces the heat sink requirements and permits modular construction techniques because of their ease of paralleling.



Work was initiated to develop a fiber optics data bus for application in the ATEPS hardware system and future combat vehicle designs.

Advanced Prognostics Program objectives are to improve vehicle availability and readiness by predictive maintenance; reduce maintenance costs by reducing secondary failures parts and labor requirements; provide the unit commander knowledge of his vehicles condition by predicting vehicle component failure and time or mileage to failure using modified Vehicle Monitoring System hardware and software. The technical effort involves development and expansion of prognostic technology (hardware, software, sensors, transducers, test methods and data analysis). Successful prognostic tests will be incorporated into ATEPS. FY81 progress includes APG vehicle test and data analysis and VMS prototype redesign prior to building three additional sets of equipment which will be available for testing in FY82.



In the prognostic equipment, the VMS Electronics Assembly (VMSEA), is vehicle

mounted and receives the transducer/sensor input through the two upper connectors not mated. The VMSEA has a memory which controls data manipulation, storage, decisions, calculations, trend analysis and uses an integral battery to preserve the memory and data if the vehicle battery is disconnected. The Set Communicator (SET COM) permits communication between the operator and the VMSEA or vice versa (automatic display of trend data or alarms). The Maintenance Action Input device, is used by maintenance personnel to enter maintenance activity and man-hours into the VMSEA memory. The Data Retreival Equipment can perform the following functions: Transfer data from the VMSEA to a cassette tape, load a new program into the VMSEA, initiate VMSEA self-test and perform all required VMSEA initialization tasks necessary prior to start of testing.

6.3 ADVANCED DEVELOPMENT

An Advanced Development contract for Simplified Test Equipment-Expandable (STE-X), a test set which will have field reprogramming capability and expansion capabilities to test all combat systems, was awarded in Mar 81. System and hardware/software interface specifications, system level 1 drawing package, microprocessor software development, and a breadboard STE-X core will be some of the items resulting from this contract. Full scale engineering development is scheduled to start in FY82.

During FY81, the ATEPS prototype system was installed in an M1 hull for demonstration and evaluation. An early facility vehicle hull was refurbished and used for the installation. The installation included the basic ATEPS core elements and eleven new harnesses which interconnect the Line-Replaceable-Units to the remote terminals.

A turret study was completed which provides a detailed technical evaluation for merging the ATEPS technology into the turret of a combat vehicle using the M1 tank fire control system as a design reference. Hardware configurations included both optimum and minimum system applications. Plans for FY82 include the development of the minimal system for installation and evaluation in an M1 turret.

STANDARDIZED FIRE SUPPRESSION COMPONENTS

Validation testing of components and systems against purchase descriptions ATPD-2070, Sensor, Fire, Optical: System with Amplifier, Standard Control, Electronic and ATPD-2071, Extinguisher, Fire, Bromotrifluromethane (Halon-1301): Fixed, Automatic, System are in progress. These ATPDs fully described the functional, performance and environmental requirements and test methods for a complete standardized, automatic optical fire detection and suppression system. The ATPDs follows MIL-STD-961, Outline of Forms and Instructions for the Preparation of Stand Fire Specifications and Associated Documents and will be converted to Military Specifications in late FY82. This time frame coincides with completion of validation testing of components. At the present time and up to the time of conversion, the purchase descriptions will be used by several Project and Weapon System Manager offices for procurement purposes.

NOTEWORTHY TECHNICAL MANAGEMENT ACTIONS

REDIRECTION OF EFFORT

BI-DIRECTIONAL SUSPENSION SYSTEM

This study effort investigated the feasibility of a bi-directional suspension system on a track-laying vehicle to improve ride quality. Bi-directional suspension implies that some degree of longitudinal compliance is added to the vehicle to reduce the longitudinal component of absorbed power experienced by the crew. Results which compared longitudinal compliance with an unaltered M1 tank ride performance over a given course, show modest improvement in driver-absorbed power but an apparent degradation in commander-absorbed power.

Examination of other ride parameters, namely acceleration and pitch angle, show no advantage for the longitudinal compliance. Test runs over discrete ramps show a relative insensitivity to damping over a wide range of damping values. Analysis indicates that the compliant roadwheel arm would be suitable only at the first station. Then a single compression spring could be used with possible limited snubbing.

The limited longitudinal compliance implementation investigation reinforces the negative desireability of the device, therefore, the task was terminated during FY81.

MAJOR PERSONNEL AND MANPOWER DATA

	Auth.	On Board	Doctors	Masters	Bachelors	Other Tech.	Av. Age	Av. Grade
Military	30	26	1	15	6	4	37.1	Major
Civilian	523	526	14	58	212	242	43.5	10.7
Total	553	552	15	73	218	246	-	-

Man Years/Funds	DARCOM			Non-DARCOM		
	RDTE	PROC[1]	OMA	RDTE	PROC[1]	OMA
Classified Act	358/123M	-	165.3/5,289.2	26/.9M	-	-
Administration	-	-	-	-	-	-
Prof. (S&E)	-	-	-	-	-	-
Prof. (Other)	-	-	-	-	-	-
Technicians	-	-	-	-	-	-
Support	-	-	-	-	-	-
Wageboard	33/.9M	-	41.1/1,214.5	2/.1M	-	-

[1]PROC + REIMBURSABLE FUNDING

MAJOR MANAGEMENT IMPROVEMENTS

INDUSTRIAL TECHNOLOGY EXCHANGE

One hundred seven industrial firms submitted 131 volumes of IR&D technical plans in FY81; a 26% increase over FY80.

The TACOM APBI, usually scheduled every three years, was held on 13 Nov 80 at the Michigan State University Management Education Center, Troy, MI. Our programs and needs for the 1980's were presented to 380 attendees representing 164 industrial firms and 15 international guests representing seven foreign Governments.

Meetings are continuing on a one-for-one basis to correlate the industry IR&D with the TACOM R&D. In April, the Command hosted a meeting with representatives from 13 firms to describe our R&D programs and outline our unfunded needs.

We provide assistance to the Staff Small Business Advisor and TACOM technical representative contacts to small businesses regarding Government programs. The periodic review of procurement documents regarding Small Business participation is an on-going task.

We received 113 unsolicited proposals, eleven of which were approved by the Review Committee. Three contracts valued at $1,359,000 went to small businesses.

Many of the registrants, over 500 in number, are re-registered this year in the Qualitative Requirements Information program. A revised draft of AR 70-35 proposes to change the name of the program to the Army Potential Contractor program.

The major thrust at the Spring Meeting of the Federal Laboratory Consortium was the impact of the Stevenson-Wydler Technology Innovation Act of 1980 (PL 96-480), which requires Federal laboratories to provide a responsive channel for coupling outside users to Federal technology. Since the full implementation of the Stevenson-Wydler Technology Act is still under study, further comments are planned for the Fall Meeting scheduled for 2-5 Nov 1981.

INTERNATIONAL TECHNOLOGY EXCHANGE

The principal mechanism for technology exchange within the NATO community is the Combat and Support Vehicle AC 225 Panel II. TACOM monitors activities with its International Technology Office (ITO) providing support to NATO and similar activities under the Quadripartite Agreement, International Memoranda of Understanding & Data Exchange Agreements (DEA).

TACOM has 16 technical project officers (TPOs) and 27 assistant technical project officers (ATPOs) to maintain communication with foreign counterparts concerning TACOM activities. The Annual DEA Report was prepared by TACOM TPOs, and forwarded to DARCOM. The report, ending in Jul of each year, presents the consolidated activity and status for each DEA during the year.

There were six visits by TPOs and ATPOs during FY81 to France, Germany, Sweden and Egypt to exchange information under the auspices of DEA and a visit to England under the ABCA Agreement.

ITO was involved in 34 visits with 110 visitors to TACOM & TACOM contractors. Foreign visitors included notables from Korea, Japan, Israel, Australia, United Kingdom, and other European countries. Briefings were held on laboratory facilities, advanced concepts, research and engineering, ITV, HSTV, M60, M1, STE/ICE, future concepts, survivability, suspensions, propulsion systems, and quality assurance programs. Foreign contractors for whom visits were arranged, represented

companies of Sweden, Israel, Switzerland, and Germany.

ITO participated in equipment loans to and from foreign countries. An Italian 1/2-ton, 4x4 amphibious vehicle, loaned to the U.S. for examination and extensive testing, was returned. STE/ICE equipment, loaned to the UK for a year of extensive evaluation with British vehicles, is being returned.

The Foreign Engineer Exchange Program was responsible for the employment of a group of German engineers and a Korean engineer for technical interchange training.

ITO prepared and provided requested copies of U.S./Foreign vehicles comparisons dealing with Armored Cars and Light Tactical Trucks. Two guidebooks, "Design Guidelines for Prevention of Corrosion in Tactical Vehicles" and "Rationalization, Stadardization & Interoperability Guidebook", were prepared and published to provide basic information to TACOM engineers.

FIRE CONTROL/WEAPON SYSTEMS INTEGRATION

TACOM's Fire Control/Weapon Systems activity coordinates and integrates the fire control developments by various DARCOM Commands and other organizations to assure that new technologies progress in an orderly manner, time-phased with the fielding of related combat vehicle systems.

During FY81, TACOM continued an in-house effort that included managing a contractural, analytical effort, coordinating support for the fire control/target acquisition portion of a future vehicle concept program, and planning the FY82 Fire Control/Weapon Systems Integration Program.

The study, entitled "Fire Control Concepts for Maneuvering Targets", was completed. Using the model validation procedure developed under the initial effort, the paths generated by the AMSAA Maneuvering Target Model have been validated with test data from ATMT and STAGS field tests. Using fire control system models previously developed, the AMSAA maneuvering path generator and optimal control models of the human gunner, simulation studies are being conducted for selected fire control configurations in order to furnish specific guidance for future fire control system development.

TACOM assisted ARRADCOM in updating the Army Fire Control Science and Technology Base Planning Guide.

TACTICAL WHEELED VEHICLE MANAGEMENT OFFICE

The Tactical Wheeled Vehicle Management Office (TWVMO) has been operational during FY81. TWVMO's Mission is to create and maintain overall fleet development, product improvement, acquisition, maintenance and replacement planning to provide a balanced, economical and effective fleet. TWVMO also coordinates interchange requirements from other commands and develops interdepartment requests from other services. TWVMO was involved in coordinating the procurement planning for the budget increase granted by the new administration. Program planning also is on going for a new vehicle between the 5/4- to 5-ton class, the Medium Multipurpose Wheeled Vehicle (MMWV), which will replace 2-1/2-ton truck.

COST/COMBAT EFFECTIVENESS METHODOLOGY FOR PROPULSION SYSTEMS

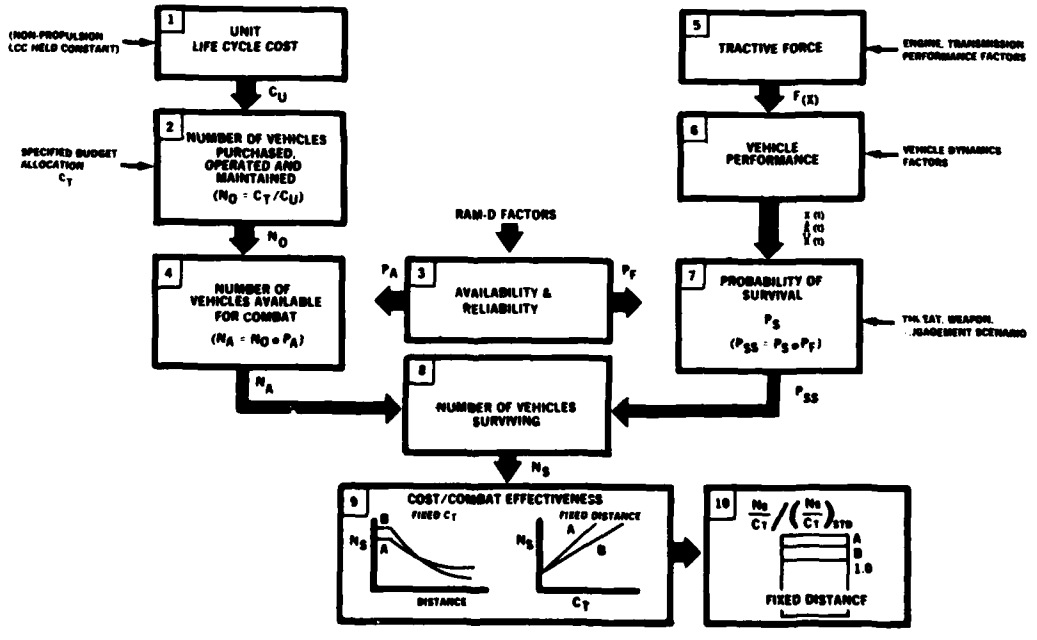
TACOM, working jointly with ARRADCOM, developed a standardized method for evaluating engines.

One propulsion system candidate is judged to be more effective than another if it can be shown that its performance and dependability are such that it can make combat vehicles less vulnerable to enemy fire. Thus, the approach to evaluating the cost/combat effectiveness of two or more engine candidates is to fix the total budget allocated to the vehicle fleet (for each engine candidate) and then compare the availability, survivability and reliability of the candidates. This is done by first determining the number of vehicles, with each type of engine, that can be purchased, operated and maintained for a fixed total dollar investment, then calculating and comparing the number of combat vehicles that will survive with these engines, giving consideration to the propulsion system performance, availability and reliability.

The following chart summarizes the principal steps involved in computing the cost/combat effectiveness of combat vehicle engines. The branch on the left computes the number of vehicles, with each type of engine, available for combat (for a fixed budget allocation) and the branch on the right computes the probability of successfully completing the mission(s), P_{SS}, for the combat vehicle employing each type of engine. These two parameters, number of engines available, N_A and probability of success, P_{SS}, are multiplied in block 8 to yield the number of vehicles (with each type of engine) successfully completing the combat mission, N_S. The last step (block 9) shows how the results can be presented comparing two different engine candidates, A and B.

A final method of presenting the results is to calculate the ratio of N_S/C_T (for a fixed distance) for candidate A and B divided by the value of N_S/C_T for the baseline vehicle with the baseline engine. This is shown in block 10, and has the advantage of indicating the relative improvement in cost/combat effectiveness of each candidate in comparison to the base vehicle and engines.

COST/COMBAT EFFECTIVENESS METHODOLOGY
PROPULSION SYSTEM



PLANNING FISCAL PROGRAM

TANK AND AUTOMOTIVE TECHNOLOGY FUNDING

The following chart constitutes the funding breakouts for TACOM's R&D Center Single Program Element Funding for the various efforts constituting AH91 as subject to change based on higher level guidance and the Commander's flexibility to redirect funds into areas which present higher potential payoff.

TANK AND AUTOMOTIVE TECHNOLOGY FUNDING

MOBILITY	FY81	FY82	FY83
ADVANCED PROPULSION			
Adv Adiabatic Tech	510	550	1,400
Eng Concepts - Alt Fuel	265	600	1,100
Adv Pwr Train Comp	0	0	600
Adv Air Filtration	200	600	600
Adv Turbine	146	400	1,000
Hi Energy Gen & Store Unit	0	0	375
Advanced Concept Team	675	0	0
WASP CEP	215	550	0
ADVANCED TRACT & SUSPENSION			
Track Development	320	1,785	1,030
Suspension Development	40	365	370
ADVANCED ARMOR COMPONENTS			
Adv Comp Matl & Struct	200	0	0
Hi Strength Matl & Comp	42	200	0
SYSTEM INTEGRATION			
TECHNOLOGY EXPLOITATION			
Comb Veh Sys Integ	200	400	650
Comb Veh Support	101	430	350
TACL Concept Support	39	200	350
TASL System Support	127	400	600
NATO Cooperative Act	156	120	200
Veh Effectiveness Tech	380	600	780
TGSM/Mine Sub-Model	175	0	0
Vetronics			545
Land Navigation Integ	41	0	0
Fvt Close Combat Veh Sys Study	1,561	0	0
Cbt Veh Analysis	335	350	645

PLANNING FISCAL PROGRAM

TANK AND AUTOMOTIVE TECHNOLOGY FUNDING (Continued)

	FY81	FY82	FY83
Data Acq & Veh Simulation	0	0	900
Chassis Weapon Interaction	30	235	200
CONFIGURATION CONCEPTS			
Future Veh Systems	500	800	1,600
Land Navigation Integ	41		
Weapon Station Integ	350	140	1,000
SURVIVABILITY			
REDUCTION OF DETECTION			
Secure Lighting	0	100	300
Veh Image Control	0	0	170
AVOIDANCE			
Adv Countermeasures	910	1,100	1,100
REDUCED VULNERABILITY			
FIS-COV System Integ	561	1,000	900
Fire Det/Supp System	415	0	0
Compartmenting (Ammo)	65	65	225
NBC Technology	180	400	500
Adv Armor Matl App	657	600	900
Pass Fireport HVO/Fuel	75	0	0
Direct Energy Beam Reduction	0	65	92
Neutron Shield	27	0	0
SUPPORT			
KRC Maint Support	135	200	250
Wheeled Veh Exploration	177	0	0
ATEPS Technology	150	250	335
Adv Diagnostics/Prognostics	530	600	500
Run Flat Tire	5	0	0
Catalytic Batt Heater	0		12
Noise Control	55	60	120
Forward Area Repairability	0	0	645
TOTAL	11,441	13,330	20,844

INSIDE/OUTSIDE EXPENDITURES

The following chart addresses the inside/outside program ratio for the RDT&E PAA, and OMA appropriations.

Outside support accounts for 43% of the total RDT&E Program. This represents a 12% decrease from the prior fiscal year and reflects an acceptable balance between government workforce and contractor effort for RDT&E functions. This external support is indicative of a healthy interest by industry and others in TACOM's R&D programs. This interest is encourage to retain a base of knowledgeable, expert sources to augment the Army's R&D in-house resources.

Materiel and service contracts account for 82% of the PAA appropriations.

The OMA appropriation is basically an in-house support function for the day-to-day workload of the Command. Contractual requirements to support this program are minimal.

FY81 INSIDE/OUTSIDE PROGRAM
(in thousands)

Effort RDT&E FUNDS	Industry and Academia Contract/Total Expend		Other DARCOM Labs Contract/Total Expend		Other Government Agencies Contract Total Expend		Estimated Cost To Administer	
	$K/$K	%	$K/$K	%	$K/$K	%	$K	%
	491		59		20			
6.1	1,533	32%	1,533	4%	1,533	1%	24	2%
	6,681		878		667			
6.2	13,950	48%	13,950	6%	13,950	5%	413	3%
	10,050		4,779		26			
6.3	26,403	49%	20,403	23%	20,403	0%	745	4%
	6,289		4,463		7			
6.4	12,692	50%	6,953	0%	6,953	0%	68	1%
	370		19		25			
6.5	6,953	5%	6,953	0%	6,953	0%	36	1%
6.7	-		-		-		-	
	23,881		10,198		745			
RDT&E Total	55,531	43%	55,531	18%	55,531	1%	1,286	2%
PROCUREMENT FUNDS								
	207,301		210		3,889			
DARCOM	252,890	82%	151,890	0%	252,890	0%	2,529	1%
NON-DARCOM								
(Other Army)	-		-		-		0	0%
	91,321		-		-	-		
NON-ARMY	113,305	81%	113,305	0%	113,305	0%	1,167	1%
	298,622		210		3,889			
PAA TOTAL	366,195		366,195	0%	366,195	1%	3,696,	1%
OMA FUNDS								
	0		84		0			
DARCOM	8,084	0%	8,084	1%	8,084	0%	0	0%
NON-DARCOM	0		0		0			
(Other Army)	6	0%	6	0%	6	0%	0	0%
	0		0		0			
NON-ARMY	114	0%	114	0%	114	0%	0	0%
	0		84		0			
OMA TOTAL	8,204	0%	8,204	1%	8,024	0%	0	0%
	322,503		10,492		4,634			
GRAND TOTAL	429,930	75%	429,930	2%	429,930	1%		

OUTSTANDING ACCOMPLISHMENTS BY IN-HOUSE PERSONNEL

RESOURCE SAVINGS/VALUE ENGINEERING

M2/M3 FIGHTING VEHICLE SYSTEM (FVS) COMPOSITE TRIM VANES

Our program to manufacture trim vanes from molded composite materials reduces fabrication costs approximately 50%. Currently, production of M2/M3 FVS trim vanes entails a great deal of plate cutting, edge preparation, and the welding of over 50 aluminum plates. Fabrication of resin transfer molded trim vanes eliminates labor and reduces component weight. The composite trim vanes will be functionally equivalent to the current metal vanes and will provide greater corrosion protection.

LASER WELDING TECHNIQUES FOR MILITARY VEHICLES

The Illinois Technology Research Institute developed for TACOM techniques and process parameters for laser welding of armor plate. An effort, coordinated with TACOM M1 tank personnel at the Lima Tank Plant, OH, was made to validate the laser welding process by using mock-up vehicle joint configuration. The process can reduce welding costs by as much as 75%, due to reduced labor costs, increased welding speed and automation. Test plates were fabricated for ballistic testing.

Information regarding the laser welding process was given to prime contractors and subcontractors for the M1, M2, and M3 vehicles, thus helping reduce their acquisition costs and helping to increase production rates.

TORSION BAR COATING

The new coating system for the combat vehicle torsion bars will improve service life of tracked vehicle suspension torsion bars, reduce bar failures due to corrosion, and will increase costs less than 2%. Commercial coating systems with improved corrosion resistence are being investigated and laboratory testing performed for adaption to military use. Tests have demonstrated that Platisol per MIL-P-20689, when applied by the vertical dip method, will increase bar life by 146%. The current practice is to apply a primer coating and vinyl tape wrapping.

INTEGRALLY CAST LOW-COST COMPRESSOR

The integrally cast low-cost compressor program has produced the first and second stage low-pressure compressor wheels for the AGT-1500 turbine engine. Tooling and casting parameter evaluations, thermo-mechanical processing and mechanical evaluations, and preliminary testing have been completed. This program has potential of reducing engine costs by approximately $2,000 per engine.

CAST ALUMINUM TURRET - M2 AND M3 FIGHTING VEHICLE SYSTEMS

Efforts were initiated to establish production procedures to manufacture a one-piece cast-aluminum-alloy-A206 turret to replace the currently fabricated M2/M3 turret. The advantages of a cast turret versus a fabricated turret are numerous; a cast turret would eliminate much labor, thus reducing manufacturing costs by approximately $1,000 per turret. Another benefit would be improved integrity of the turret for M2/M3 application. Phase I of the program will be completed in Oct 1981. Progress toward the manufacturing of a one-piece aluminum turret, by planned stages, is on schedule.

OUTSTANDING ACCOMPLISHMENTS BY IN-HOUSE PERSONNEL

MANUFACTURING TECHNIQUES FOR TURBINE ENGINE RECUPERATOR

The manufacturing techniques for the AGT 1500 turbine engine recuperator program were initiated to improve the welding process used in the turbine engine recuperator, which contains almost two miles of welding, and to reduce manufacturing costs. New laser welding techniques have the potential to weld five times faster than the current resistance welding process, and are less expensive. The program verified the laser as a viable method to produce an acceptable weld for joining Inconel 625 to the recuperator. The laser welding technique will be implemented by AVCO Lycoming.

VEHICLE COMPONENTS FOR FLEXIBLE MACHINING SYSTEMS

The Flexible Machine Systems (FMS) Vehicle Component Program is to support and advance the use of the Computer-Aided Manufacturing (CAM) concept by producers of tank-automotive components. The FMS approach is one of the most viable of the CAM concepts for handling intermediate quantities (1,000 to 100,000) of machined parts normally handled in batch operations.

The FMS maintains the high level of flexibility associated with stand-alone numeric control and gains the high productive capacity associated with transfer-line production. It is achieved by grouping a medium number of parts having similar work content and size into a family which can be economically handled in an automated manner. The system, containing specialized work modules and fully automated working and material handling systems, is computer controlled. A Buyer's/User's Handbook has been completed to enable Government Contractors to evaluate and acquire FMS.

BATTERY SYSTEMS IMPROVEMENT PROGRAM

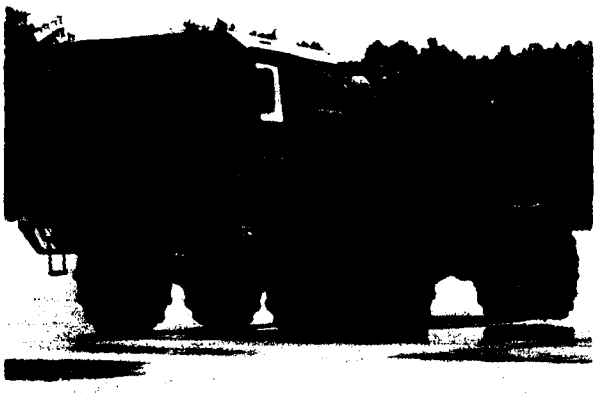
A revised storage battery performance and procurement specification has been completed. NATO-type batteries will be procured for combat vehicles per the new specification document. A program to develop a tactical vehicle battery has been initiated, incorporating the plastic container and low-maintenance features of the combat vehicle battery design. A procurement request for contractor prototype development was released, and contract award is scheduled for early FY82. Both the combat and tactical vehicle batteries are designed in high impact-resistant plastic containers, and incorporate the maintenance-free concept for inherent long-term "wet" storage life and reduction in servicing and maintenance.

IMPROVED INSPECTION OF TRACK PIN SHOT PEENING

This project investigates the practicality of implementing automated X-ray diffraction (XRD) equipment for quality control of the shot peening operation in the manufacture of T142 track pins used on M60 tanks. Automated XRD, if successful, would be used to supplement or replace the current antiquated quality control method outlined in MIL-S-13165B. Automated XRD equipment configured for go/no-go operation would signal the occurrence of poor shot peening quality on track pins and designate the need for adjustment to shot-peening equipment to correct this condition. This will reduce the possibility of using improperly shot-peened track pins in M60 Tanks and increase track pin service life. Preliminary investigations will be made at TACOM using the automated XRD go/no-go equipment. Results of these investigations will be used in implementing this work at the contractor's facility.

OUTSTANDING ACCOMPLISHMENTS BY IN-HOUSE PERSONNEL

10-TON M.A.N.



Acquisition of the 10-Ton M.A.N. truck was set apart from the Heavy Expanded Mobility Tactical Truck (HEMTT) program to fulfill the requirements of the Air Force Ground Launched Cruise Missile (GLCM) and the Army Pershing II Missile system, which are being deployed in Europe. By using the M.A.N. Truck, the existing M.A.N. supply and maintenance network can be used advantageously. The M.A.N. will have two basic chassis configurations, a tractor, with either medium- or heavy-duty crane and a wrecker/recovery vehicle. A contract for 15 vehicles was awarded on 31 Oct 80, and the first three vehicles were delivered for testing on 31 Jul 81. This contract contains an option for purchasing an additional 453 vehicles. On 10 Jul 80, HQ DA approved type classification for the M1001 Pershing II tractor, M1002 wrecker, M1013 GLCM tractor with crane and M1014 GLCM tractor without crane. A meeting is scheduled for Dec 81 to review test results and consider the contract option for additional GLCM and Pershing II carrier requirements.

PROGRAM BALANCE SHEET

FY81 FUNDING
FROM ALL SOURCES INCLUDING CUSTOMERS
(IN THOUSANDS)

				FY80 SUBTOTAL	TOTAL
RDT&E FUNDS					
6.1	Research			$ 1,533	
6.2	Exploratory Development			13,590	
6.3	Advanced Development	6.3A	$ 12,157		
		6.3B	8,246	20,403	
6.4	Engineering Development			12,692	
6.5	Management and Support			6,953	
	RDT&E TOTAL				$ 55,531
PAA FUNDS					
HQ					
DARCOM			$250,990		
OTHER			1,900	$252,890	
NON-DARCOM (Other Army)					
NON-ARMY				113,305	
	PAA TOTAL				$366,195
OMA FUNDS					
HQ					
DARCOM			$ 2,745		
OTHER			5,339	$8,084	
NON-DARCOM (Other Army)				6	
NON-ARMY				114	
	OMA TOTAL				$ 8,204
	GRAND TOTAL				$429,930

The chart shows the funding posture for FY 81. A total of 429.9 million was authorized. Of this amount, $55.5 million or 13% was RDT&E funded; $366.2 million or 85% was funded by the Arm Procurement appropriation; and $8.2 million or 2% was provided bv OMA.

TECHNICAL ACHIEVEMENT BY PROGRAM BREAKOUT

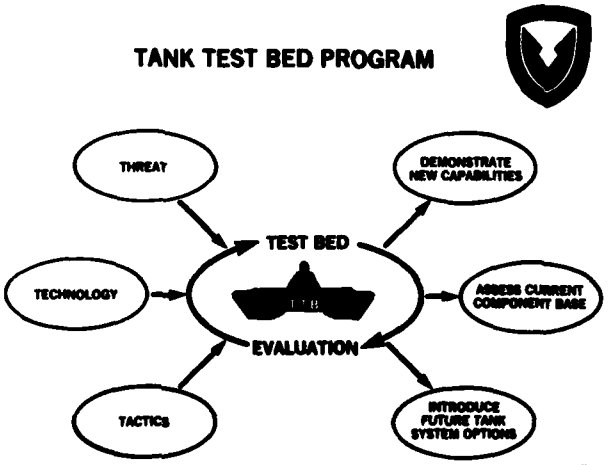
TANK-AUTOMOTIVE CONCEPTS LABORATORY

FUTURE VEHICLE SYSTEM

We initiated an integrated combat vehicle program to address the successors to the M1, M2, and M3.

MID TERM

For the tank, an approach was conceived which stressed innovation through new configuration, but using the maximum portion of the existing component base. Feasibility of this approach was proven by in-house design studies and the construction of a full-scale wooden mock-up. Other DARCOM commands, TRADOC, and HQ DA, were brought into the program in its formulative stages and the personal support of Generals Vessey, Starry, Guthrie, Keith, and Otis obtained. Design and fabrication of multiple test beds will begin in early FY82.



For the infantry, we began design studies for alternatives based on both the M1 and M2 component bases. Coordination with the Infantry Center has been initiated and should lead to detailed test bed planning in FY82.

LONG TERM

For our long-term program, we initiated an innovative 6.2 program to address combat vehicles in the 1995+ time frame. This effort is marked by several unique features -- a family approach for close combat vehicles in the maneuver battalions, early involvement of other DARCOM commands and TRADOC agencies in a principal way, and a series of one government and four contractor teams working in parallel. The output of these efforts will be a series of concept designs for a family of close combat vehicles to perform the functions now assigned to the M1, M2, and M3. The conduct of this effort is also innovative, using a combined team of TACOM, other DARCOM, TRADOC and HQ DA participants to write the solicitation, evaluate proposals and conduct the management reviews. Contractor teams have been exposed to the most accurate and sensitive threat and technology projections as well as the emerging results of the ARMVAL and ACVT programs. This effort has enjoyed such success that its method and procedures are being applied to other topics, both within TACOM and at other DARCOM agencies.

DIVISION SUPPORT WEAPON SYSTEM

We have provided continued support to ARRADCOM for the initial development of the Division Support Weapon System (DSWS). Activities included technical coordination and evaluation of the automotive chassis and companion vehicle support for three contractual design approaches. In addition,

specific attention was given to a fourth solution involving a MAXI-PIP M109 self-propelled howitzer version, for which we provided significant inputs. Throughout FY81, TACOM personnel actively participated in meetings, presentations, industry design reviews and evaluations.

ELEVATED KINETIC ENERGY TEST BED PROGRAM

The Elevated Kinetic Energy (ELKE) weapon program objective is to design and fabricate a demonstrator cannon for a combat vehicle to fire from defilade positions.

During FY81, the component design and fabrication was completed. A 75-mm automatic cannon was successfully proof-fired in Apr 1981.

The ELKE optical sight, tested in Dec 1980, will allow weapon firing from any elevation.

ELEVATED KINETIC ENERGY WEAPON SYSTEM

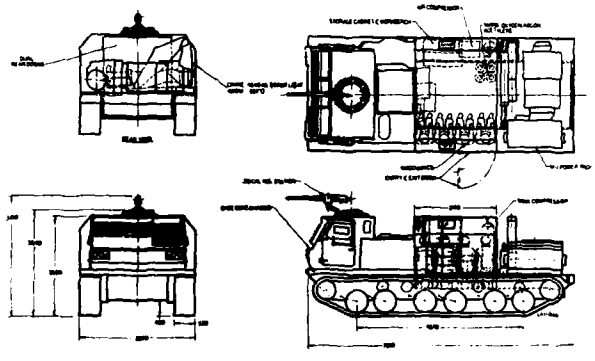
The assembly and integration of components and major subsystems began in 4Q FY81 and will be completed in 2Q FY82. Following the integration, contractor testing will begin at the contractor's facility and will conclude at Yuma Proving Ground, AZ, with preliminary test firing safety certification. Upon completion of contractor testing, a Government evaluation will be conducted at YPG during the 2nd half of FY82.

The ELKE Test Bed will allow the development and evaluaiton of new tactics utilizing defilade positioning and provide a technology base for the assessment of weapon dynamics, auto-loaders, and fire control requirements of future weapons systems.

ARMORED FORWARD AREA REARM VEHICLE (AFARV) ARMORED MAINTENANCE VEHICLE (AMV) AND MEDICAL EVACUATION VEHICLE (MEV)

The AFARV serves as a force multiplier by rearming combat vehicles (M1, M2, M3, ITV) at their battle positions with the necessary

mix of ammunition (105/120mm, TOW, DRAGON, 25mm, small arms) while both crews remain under armor. The AFARV, with on-/off-loading handling equipment for single rounds and pallets of ammunition, will protect the crew and payload from direct artillery fire and smallarms/NBC attacks.



PRELIMINARY CONCEPT DRAWING OF ARMORED MAINTENANCE VEHICLE

Preliminary Concept Drawing of Armored Maintenance Vehicle.

The design and fabrication of the AFARV Test Bed initiated in FY 80 was completed in January 1981. The concept evaluation, conducted at Ft. Knox, KY, during Jan-Apr 1981, was successfully completed, and the AFARV program is prepared to enter full-scale engineering development.

In keeping with the Fix-It-Forward Doctrine, the AMV will provide maintenance teams with the mobility, survivability, necessary tools, equipment and repair parts to repair nonoperational combat vehicles as close to the line of contact as possible. The AMV, with its own lift capability, can repair disabled weapon systems and free current recovery vehicles to perform their intended task, thus improving combat system operational availability. The initial vehicle concept design studies have begun and will be completed in FY 82.

The Medical Evacuation Vehicle (MEV) concept is to provide ground medical evacuation from company/battery/troop locations to the battalion aid station. Operating with mobility comparable to the M1, M2, and M3 vehicles, the MEV will provide a secure space and the equipment necessary for life-saving techniques to be applied as far forward as possible. The armored and fully tracked MEV will have indirect and small-arms-fire protection as well as NBC protection.

INTEGRATED COUNTERMEASURE (ICM) VEHICLE TEST BED

We initiated the ICM Vehicle Test Bed Program to exploit nonconventional solutions for providing vehicle survivability and improved mission effectiveness against future threats.

The proliferation of threats to armored vehicles indicates that passive armor alone will not be adequate to defend against the full range of threats. Traditionally, the mechanism to gain increased armor protection for a combat vehicle is to put on passive armor directionally and reduce vehicle volume. To adequately armor the modern combat vehicle, though, would severely limit its strategic and operational mobility.

To exploit the ICM advantages, the system needs to be a strategically mobile, anti-armor system that will provide a heavy anti-armor capability in a vehicle concept that can be easily deployed by air. Passive Counter-

measure (CM) design guidelines were developed, while active CM brassboard configurations available were established. Active CM threat assessments were conducted to indicate the major techniques to be employed by the test bed. An ICM concept development test bed for both a wheeled and tracked combat vehicle was initiated, with driving factors based on acquisition reduction, hit avoidance and damage reduction techniques.

This test bed will play a broad-based role in increasing system survivability that will influence combat vehicle designs across a wide spectrum, from wheeled combat vehicles mounting relatively small weaponry up through a main battle tank in the 50-60-ton range.

INDIVIDUAL LIFT DEVICE (ILD)

The Williams Aerial Systems Platform (WASP II) is a kinesthetically-controlled (the operator leans in the direction he wishes to travel) ILD powered by a modified cruise missile engine. Technical feasibility was successfully demonstrated in FY80, but funds did not become immediately available for any follow-on WASP II effort. Due to constant perserverance from TRADOC, TACOM, and strong user community support, funds were finally made available in Jun 1981 to initiate a user evaluation program. This program is to evaluate the military potential of the WASP II vehicle as an ILD and validate the TRADOC-approved ILD concept. The program is divided into three tasks: Task I provides for the establishment of the vehicle safe operational envelop, onboard instrumentation design, refurbishment of vehicles, safety and preliminary hazard analyses report, and subsystems and components development investigation report; Task II involves test pilot training, WASP II testing and AVRADCOM airworthiness release; and Task III involves the training of three (nonaviation) military personnel, user tests and evaluation. User testing is scheduled for Apr 1982 at Ft. Benning, GA.

Individual Lift Device (WASP II)

NATO REFERENCE MOBILITY MODEL

TACOM is using the NATO Reference Mobility Model (NRMM) whenever mobility performance is given in initial vehicle acquisition specifications. It is necessary, therefore, to familiarize interested segments of private industry with the model developed by TACOM and the Corps of Engineers' Waterways Experiment Station. To this end, TACOM contracted with Stevens Institute of Technology to organize seminars, with instructors provided by both organizations. A seminar was held for managers in May 1981 and, subsequently, two more seminars were given to working level engineers and programmers.

Meanwhile, bidders and the Source Selection Boards for the DIVAD, HEMTT, LAV, HMMWV and CUCV used the model intensively. The use of the NRMM in the development of the bids and competitive evaluation forced bidders to use the same quantitative basis for the description of mobility performance and, in some instances, revealed design concepts which would have lead to unacceptable performance. It also allowed Source Selection Boards to rank the mobility performance of the submitted bids by means of objective quantitative engineering terms.

Additionally, the NRMM has been intensively used for several in-house studies by exploratory development personnel whose mission, in part, is to conduct advanced concept feasibility studies.

SIGNATURE SUPPRESSION MODELING

We are developing a computer program to model the effectiveness of infrared and thermal countermeasure hardware. The program is based on the use of temperature data files which can be used to generate a two-dimensional representation of a vehicle viewed in azimuth and elevation. The hot exhaust outlet of the vehicle can be modified and the signature reduction assessed. Terrain background characteristics and atmospheric transmission can also be varied to simulate many types of background and weather conditions.

VEHICLE EFFECTIVENESS TECHNOLOGY SYSTEM

TACOM's Vehicle Effectiveness Technology (VET) System program began in FY81. The basic design for the overall system was begun and the "mini" system, which will include analysis of vulnerability and survivability, will be operational by Mar 82.

The VET will be a unified computer-based system for analysis of the engineering problems of combat formulation. It will augment the capabilities of the vehicle designer, giving him quick, usable answers about the vehicle concept capabilities.

Existing analysis software developed by and for TACOM will be the VET system base. It will be supplemented with two user-oriented interactive facilities which will let the engineer deal with the computer in terms dictated by the problem under study, not by the computer. A "front end" will relieve the engineer of the burden of dealing with separate simulations that require inputs in different formats. A comprehensive data management system will make it possible to shift data from one model to another, and to tailor output without being concerned with details irrelevant to the analysis. The VET will eventually include models treating all aspects of combat vehicle performance, such as mobility, armor protection, vehicle dynamics, firing stability, and survivability.

VEHICLE ANALYSES AND EVALUATION

TACOM used the NRMM to conduct a number of mobility analyses during FY81.

a. Several wheeled combat vehicles' mobility performances were evaluated over terrain segments and in West Germany and the Mid East compared to a similar weight tracked vehicle. The wheeled vehicles evaluated were the Cadillac Gage V150 4x4, the Cadillac Gage V300 6x6, the Canadian COUGAR 6x6, and a US Army advanced concept 6x6 (one of the ACVT concepts). The tracked vehicle evaluated along with these wheeled vehicles was the M113A1 Armored Personnel Carrier.

b. Several candidates for the Heavy Expanded Ammunition Trailer (HEMAT) were evaluated for mobility when being towed by the 10-ton Heavy Expanded Mobility Tactical Truck (HEMTT). The mobility performance of three truck-trailer combinations was evaluated for on- and off-road mobility.

c. The off-road performance of the FISTV was evaluated with several options currently available on the M113 Chassis. The FISTV performance was evaluated at 28,000 pounds using power train and suspension variations that are available on the M113A1, M113A2, and the M113A1E1.

d. The High Mobility Multipurpose Wheeled Vehicle (HMMWV) was evaluated to determine the performance degradation due to increased vehicle weights. A generic HMMWV was developed and used to predict the performance of the vehicle at 7,200 pounds, 8,000 pounds and 8,500 pounds.

e. To improve survivability, a ballistic shelter was proposed for the M110A2 self-propelled howitzer. This shelter and its supporting structure added an estimated 6,000-pounds. We determined that the mobility of the M110A2 should not degrade significantly with this additional weight.

The capability to evaluate vehicle variations and alternatives for survivability has been developed in the Survivability Optimization Model (SOM). In the combat vehicle analysis program, a number of vehicle concepts are being evaluated using SOM. These vehicles include variations in vehicle size, silhouette and armor. The effect of these vehicle variations against a range of threats on the vulnerability and survivability of each vehicle will be quantified and used in the development of future combat vehicle systems.

COMPUTER AIDED DESIGN/ENGINEERING

In FY81 we acquired a Computer-Aided Design/Engineering (CAD/E) System. CAD/E will be used by several functional areas during the initial development and analyses of conceptual combat vehicle designs. This system will enable many design, analysis and drafting operations to be automated, thereby improving productivity and shortening product development cycles.

COMBAT VEHICLE AMMUNITION COMPARTMENT INTEGRATION

The year saw significant progress in a TACOM program to develop combat vehicle ammunition compartments that can withstand catastrophic detonations caused by enemy threats. The ultimate aim of this effort is to design a compartment that will vent the hot propellant gases to the atmosphere while protecting both the crew and vehicle from consequent damage following a hostile penetration of the ammunition compartment.

The FY81 ammunition compartment research project investigated fratricide prevention measures, the design of a full-scale ammunition compartment and an investigation of large-caliber threats.

Ammunition compartment fratricide tests were conducted which validated water jackets as, perhaps, the most effective device for fratricide prevention.

A full-scale ammunition compartment design has been constructed for validation at Jefferson Proving Ground, MD early FY82.

An investigation into the effects of larger

threats has extended the mathematical design model.

Future investigations will include the resolution of autoloader integration restrictions, the stowage of high-energy propellants and further large-caliber threat demonstrations.

ARMORED COMBAT VEHICLE TECHNICAL PROGRAM SUPPORT

The Armored Combat Vehicle Technology (ACVT) program support was conducted and is complete. Several refinements selected by the Armor Engineer Board (AEB) were made to the original 25 ACVT conceptual lightweight vehicles. These design changes included a variety of cannon and missile weapon stations, crew sizes, which ranged from two to four, turreted externally and internally mounted weapon systems and wheeled and tracked vehicles with weight level varying from 14.5- to 40-tons.

To arrive at specific recommended subsystem performance levels, we continued to develop and refine vehicle performance simulations established in support of the ACVT program prior to FY81. These include two models for assessing vehicle agility: a tracked vehicle turning model and the optimimum evasive missile avoidance maneuver model. In addition, a version of the Dynamic Analysis and Design System version was used to investigate the platform stability of vehicles as a function of suspension and weapon system recoil characteristics. Other existing models, such as the NATO Reference Mobility Model, have been used to examine mobility/agility performance and various power train alternatives. Vehicle motion-time histories were produced for several vehicle concepts and those data were used to study fire-on-the-move capability.

The ACVT program has established a new documented technology base and methodology for use in future weapon system evaluations, and provided extensive information on the capability of lightweight, highly mobile/agile, medium-caliber weapon systems in a variety of scenarios and terrain conditions.

TECHNICAL ACHIEVEMENT BY PROGRAM BREAKOUT

TANK-AUTOMOTIVE SYSTEMS LABORATORY

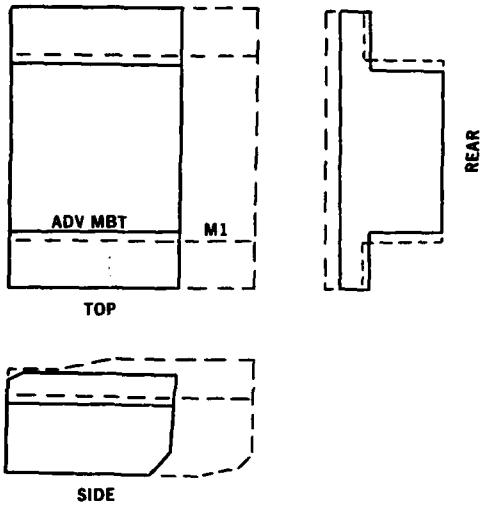
AMX-1000 MULTI-SPEED TRANSMISSION

A concept anaylsis and feasibility study was performed to determine the optimum configuration of a 1,000-HP transmission which could be used in tracked vehicles of the 35- to 45-ton GVW range. We concluded that a six-speed arrangement employing a lock-up type torque converter, bias path hydrostatic steering system and hydraulic brake retarders was the optimum hydrokinetic configuration. Computer simulation of vehicle operation over the APG Churchville and Munson test courses showed a 20% reduction in transmission cooling requirements and a 4% improvement in vehicle fuel economy. The resulting AMX-1000 transmission volume would be 32-cu ft and its weight would be in the 2,700-pound range. This compares favorably to the 56-cu ft and 4,600 pounds of the 1,500-HP X-1100 transmission used in the M-1 Abrams Tank.

ADVANCED MBT POWER PACKAGE

A program to identify, design, build, and test a complete power package for the next generation Main Battle Tank (MBT), to be fielded in the 1990's, will optimize the integration of the salient components of the power package. These components include the engine, transmission, auxiliary power unit, air filtration, diagnostics, cooling system, induction, exhaust and fuel systems. The primary propulsion goals are small volume and weight, reduced fuel consumption, improved reliability, ma ntenance and wide fuel tolerance. The figure shows the volumetric design goal of the program, representing a one-third improvement in the power density over the M1 tank.

This is a two phase program. The first is a one-year competitive design analysis which will result in the presentation of recommended concepts by the several contractors. The second will consist of hardware development, fabrication, and demonstration of the two most promising design concepts.



MBT PROPULSION SYSTEM COMPARTMENTS

12/24-VOLT CONVERTER

A 12/24-volt conversion unit to provide 24-volt power on commercial vehicles procured for the military was successfully tested and a Technical Data Package is being prepared.

The proposed converter will supplant the current procedure of adding a complete new 24-volt system to each vehicle, with two batteries, a 24-volt regulator and 24-volt alternator. The converter will be used for operating radio sets, gun firing solenoids, rotating warning beacons and other lights and devices currently powered by the 24-volt military vehicle electrical system.

HIGH PERFORMANCE CONE BRAKES

The high-performance cone brake (HPCB) project objective is to modify commercially available cone brakes to fit an M939 5-ton truck. These brakes will be evaluated for performance, heat rejection and the ability to expel contaminants. If they prove to be superior to drum brakes, the result will be prolonged pad and drum life. A set of HPCB, with spare parts, is to be used in the Phase I evaluation.

LOOPWHEEL SUSPENSION

The Loopwheel Suspension program is to further develop and evaluate the feasibility of the loopwheel concept for military automotive vehicles. Through this concept, the elimination of components such as roadwheel arms, roadwheels and torsion bars has the potential for providing a lighter weight, simpler suspension system. During FY81, we completed the design, testing, and vehicle evaluation of the third generation loops.

TRACK RETENTION AND CONTROL

The design was completed and fabrication started to mount resilient teeth partially encased in rubber on the drive sprocket body to permit slight yielding as driving loads are applied. The objective is to improve track engagement, reduce loading, noise and vibration and improve track and sprocket life.

Track tension adjustment system will permit the driver to monitor and adjust track tension while the vehicle is moving. The objective here is to maintain optimum track tension to eliminate track loss and assure satifactory vehicle performance. The fabrication contract was awarded in FY81 for a replaceable tire roadwheel. It will include a stamped steel roadwheel, non-bonded rubber tire and a steel wear ring and tire retainer. Some benefits include the capability to replace tires in the field which eliminates depot rebuilding.

M939-SERIES 5-TON TRUCK

The M939-Series 5-Ton Truck achieves increased mobility durability, and serviceability, while retaining maximum possible parts interchageability with the M809.

A contract for M939 production was awarded to AM General on 8 April 1981 with delivery of Initial Production Test (IPT) vehicles to begin in January 1982. Six IPT vehicles will undergo 20,000 miles of durability tests and two necessary performance tests. The five year contract entails production of 11,394 vehicles in support of Army, Air Force, and Marine requirements with 100% increase option provision. The award of a System Technical Support Contract on 24 April 1981

made available the increased manpower necessary to apply current industry expertise and production technology to the Technical Data Package. A fielding In-Process review is scheduled for July 1982, with an initial operation capability date of September 1982.

ADIABATIC DIESEL ENGINE

The adiabatic diesel engine program is to apply high-temperature, insulating materials within the combustion system of a diesel engine to allow a drastic reduction in lost heat to the cooling and exhaust systems. The use of turbocompounding permits thermal energy normally lost to the cooling water and exhaust gas to be converted to useful work.

Advantages of the adiabatic engine include virtual elimination of the conventional cooling system, a 30% improvement in fuel economy over current highly efficient diesel engines, and a 40% reduction in engine system size and weight. Elimination of the engine cooling system, including cooling fans, radiators, hoses, shrouds, water pump, would produce a *quantum jump in reliability* and maintainability as over 50% of engine failures in heavy duty vehicles are attributed to cooling system related items. Because of high-temperature engine operation, smoother combustion, less noise and improved multifuel characteristics result. By using this engine concept, combat vehicle design becomes far less restrictive with regard to space claim and location of cooling system components.

During FY81, over 800 hours of single-cylinder engine and 300 hours of multicylinder engine operation were successfully accomplished. Fabrication of an adiabatic engine for installation in a military 5-ton truck has been completed. Design of the second generation adiabatic engine has begun, emphasizing performance, compactness, and ease of manufacturing.

HEAVY EXPANDED MOBILITY TACTICAL TRUCK (HEMTT)

On May 22 1981, a five-year contract was awarded to the Oshkosh Truck Corporation, Oshkosh, WI, for base production of 2,140 HEMTT series of 10-ton trucks. A 250 percent option clause allows a total production potential of 7,490 vehicles.

The HEMTTs will be 8x8, diesel engine driven trucks comprised essentially of commercially proven components using a fully automatic 4-speed transmission and super-single radial-ply tires.

The HEMTT family will include:

a. The M977 Cargo Vehicle to be used for ammunition resupply.

b. The M978 Tanker Vehicle to be used both as the prime refueling vehicle for the PATRIOT Missile System and other refueling mission requirements.

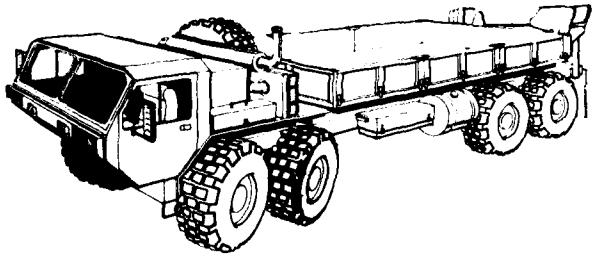
c. The M983 Tractor Vehicle to serve as the prime mover for PERSHING II (PII).

d. The M983 tractor Vehicle to be used a the prime mover for PATRIOT.

e. The M984 Wrecker Vehicle to be used both as the prime recovery vehicle for the PII and PATRIOT Missile Systems and other recovery mission requirements.

f. The M985 Cargo Vehicles to serve as the prime ammunition resupplier for the Multiple Launch Rocket System.

HEAVY EXPANDED MOBILITY TACTICAL TRUCK



Initial Production Evaluation/First Article Testing of the series at Aberdeen Proving Ground, MD, is planned for May-November 1982.

SINGLE-LEVER LIGHT SWITCH

The recently completed single-lever light switch project will provide a new, easily operated military light switch that is interchangeable with the current three-lever military switch. The current switch is unnecessarily complex and difficult to operate. Our new single-lever switch will provide infinite pilot lamp dimming, a National Highway Safety Standard requirement. A new specification has been prepared, but release of the new switch into the military system is pending.

MOLDED PLASTIC ORDNANCE ELECTRICAL CONNECTOR (MPOEC)

MPOEC program replaces the current metal electrical connector with connectors made of material such as GE VALOX-420, Rilsan nylon or polycarbonate. The plastic molded connectors eliminate corrosion problems, reduce weight and cost, are flame retardant and non-toxic, and are interchageable, intermateable, intermountable with the existing metal connectors.

Follow-on testing will use other plastic materials, such as Torlon, Delron and Zytel. MPOEC revised drawings and specifications will permit solictation of competitive procurement of MPOEC's of all sizes.

HIGH MOBILITY MULTIPURPOSE WHEELED VEHICLE (HMMWV)

The HMMWV will perform the mission of 1/4- to 1-1/4-ton vehicles currently operating in the forward area. The HMMWV will be capable of operating over roads, trails, and off road with speeds up to 60-MPH. It will have a 300-mile cruise range and be equipped with run-flat tires which will run 30 miles at speeds up to 30 MPH.

Contracts were awarded to three contractors on 1 Jul 81 to design and build 11 prototype

vehicles each. The completion of prototypes is scheduled for Apr 82 and the competitive runoff DT/OTII will be conducted through Sep 82.

M819A1 5-TON TRACTOR WRECKER

The M819A1 Tractor Wrecker Program was initiated to provide a prime mover and on/off loading capability for the XM974 and XM976 semitrailers supporting the PATRIOT Missile System. The M819A1 will consist of a commercially produced telescoping boom crane and a military 5th wheel mounted on an M809-series 5-ton truck chassis. This C-141 aircraft air transportable vehicle can also be used in other material handling operations.

FMS TECHNICAL SUPPORT ACTIVITIES

TACOM lead a survey team with Foreign Military Sales representatives from TACOM and ARRADCOM to Egypt where the team planned and prepared offers of technical assistance projects to upgrade T62 Tanks and keep the tanks in operation in future years.

Nine terms of reference have been written, with validated cost estimates, and sent to Egypt for approval.

11-TON HEAVY EXPANDED MOBILITY AMMUNITION TRAILER (HEMAT)

During FY81 HQ DA approved the HEMAT ROC and performance specification. The trailer was type classified generic, a competitive procurement package was finalized, and a five-year contract was awarded in Sep 81.

The HEMAT will be a heavy-duty tandem-axle trailer designed to accomodate four Multiple Launch Rocket System pods and various ammunition pallet configurations. The HEMAT's prime mover is to be the 10-Ton HEMTT.

SIMPLIFIED TEST EQUIPMENT-EXPANDABLE (STE-X)

Advanced STE-X development began in early FY81 and will be followed by engineering development in FY82. The Required Operational Capability, including a basic cost estimate currently is being staffed, with approval anticipated in FY82.

STE-X is intended to provide the forward support combat vehicle mechanic with a simple, rapid means of diagnosing and assessing the condition of the total vehicle in its "as is" condition. The application includes automated tests of vehicle power packs, hull

systems, turret systems, and on-vehicle missile support systems.

STE-X will become the single standard test set for on-line diagnostics of all current combat vehicles, and it will be readily expandable for application to future vehicle development. It also will have the capability to be reconfigured and reprogrammed in the field through software modifications.

MINE CLEARING VEHICLE-ROBOTIC

We initiated a project to build a remote-control mine clearing vehicle using an M60A2 tank chassis. Major milestones through R&D into initial production were scheduled and cost estimates made to request funding. Project planning involved coordination with Marine Corps, TRADOC and several DARCOM subcommands.

ANTI-CORROSIVE MATERIAL

To improve corrosion resistance of tactical wheeled vehicles, an anticorrosive materials and techniques program was established to adopt the application of pre-coated sheet steel, such as two-sided galvanized, aluminized, and Zincro. The goal is to develop vehicles capable of operating for a total service-life of 15-years in a corrosion prone military environment, involving high humidity, salt spray, road de-icing chemicals or atmoshpheric contamination.

GROUND LAUNCHED CRUISE MISSILE TRANSPORTERS

The Ground Launched Cruise Missile (GLCM) Program is an Air Force Program chartered by DOD under the Joint Cruise Missile Project Office, Washington D.C.

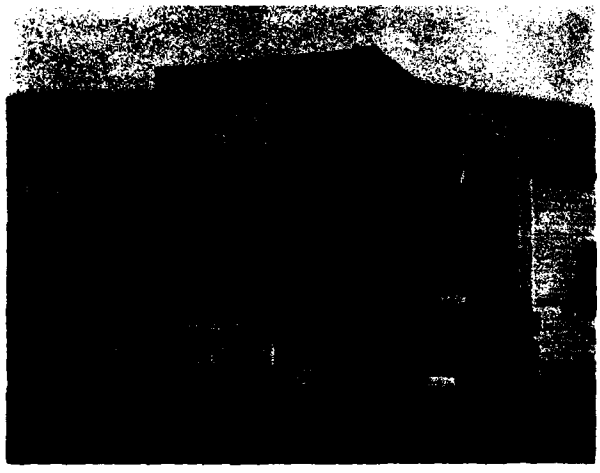
TACOM is an associate GLCM contractor for design and development of two transporters: The XM986 Transporter Erector Launcher and XM999 Launch Control Center. One pilot and seven prototype transporters have been fabricated by TACOM. The pilot and six prototypes were delivered. One prototype transporter successfully completed durability, shock and vibration, and rail-hump testing at Aberdeen Proving Grounds, MD. This prototype test vehicle was returned and will remain at TACOM to be used as a "Shop Queen" vehicle.

A production contract will be awarded in late FY81 for 220 units, with initial deliveries scheduled for mid FY82.

M871 TACTICAL 22-1/2-TON DUAL PURPOSE BREAKBULK/CONTAINER TRANSPORTER

The M871 is a 30-foot tandem axle flatbed semitrailer capable of carrying containers or breakbulk cargo weighing up to 22-1/2-tons. A new requirement for the capability of carrying missile loads has been incorporated by adding

twenty additional tiedowns. To date, 900 vehicles have been built.



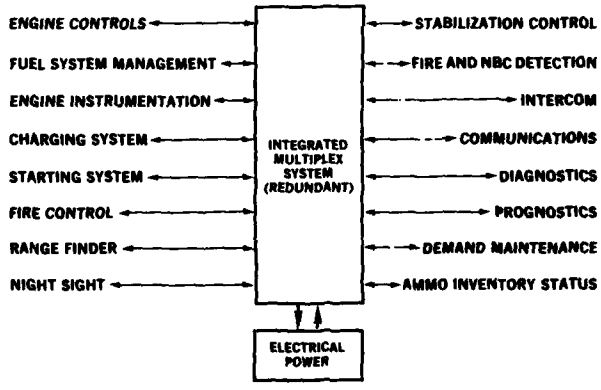
ADVANCED TECHNIQUES FOR ELECTRICAL POWER MANAGEMENT, CONTROL AND DISTRIBUTION (ATEPS)

During FY81, fabrication of a hull prototype ATEPS hardware system was completed and is in the process of check-out prior to shipment for installation at Chrysler Defense.

ATEPS is an advanced technology systems which integrates all vehicle electrical/electronic functions and information transfer with built-in capabilities for diagnostics and prognostics. The system integration is achieved by using digital multiplexing with microcomputer control, integrated controls and displays and solid-state power control switching. Communication among vehicle subsystems is accomplished by the Multiplex Data Bus.

ATEPS hull prototype hardware system was developed, fabricated and installated in a baseline M1 tank in FY80. The hull project with follow-on turret prototype hardware development, will establish the feasibility of the ATEPS system and allow IT to be considered as M1 tank Product Improvement Program and for other Army vehicle development programs. The ATEPS hull prototype hardware consists of a bus assembly (data and power), driver's/crew terminal, microcomputer/remote terminal, and three other remote terminals.

TOTAL TANK SUBSYSTEM INTEGRATION POTENTIAL



RIDE SIMULATOR

The Computer Management and Application Research Office ran the Tank Gunner's NBC Gear test for TACOM's Development Project Office for NBC Protection in the late summer of 1981. The test was to determine the influence of NBC gear on gunner performance while engaging moving targets from moving and stationary vehicles, and to establish the amount of training for proficient gunnery in NBC gear. The simulation was run by a hybrid computer. Scenario sequences were stored in the computer which instructed a Fire Control

Combat Simulator which engagement scenario should be run. The ride sequences were also stored in the computer and were automatically fed into the ride simulator on cue from the computer operator.

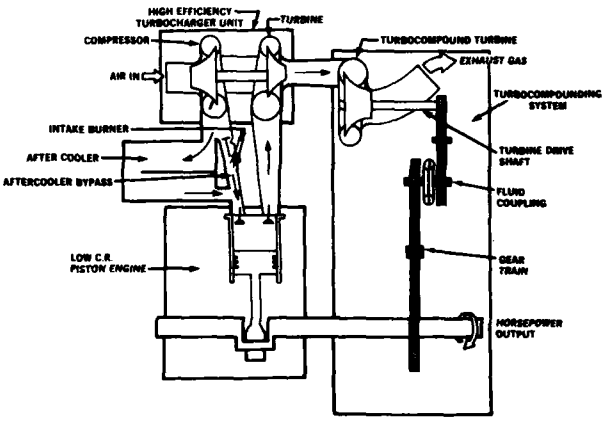
The test lasted about one month and resulted in over 30,000 simulated firings. The results of the test are computer generated graphs and charts showing gunner performance vs time (learning curve). An analysis of variance is being made to determine the effects of NBC gear (whole and component) with different handles, scenarios, rides and their combinations on gunner performance.

1,000 HP ADVANCED DIESEL ENGINE

The 1,000-HP Advanced Diesel Engine Program objective is to demonstrate the feasibility of dramatically improving the diesel engines' horsepower-to-weight ratio and fuel economy by applying diesel technology to existing commercial-based engines, with the goal of achieving 1,000 horsepower. The advanced technology being applied includes a high-pressure, high-efficiency turbocharger, a turbocompound system, low-compression ratio and an intake manifold burner to aid in cold-starting and light-load operation.

TACOM currently is evaluating a diesel engine test rig designated the LCR-903, which is a modified version of the Cummins VTA-903, 8-cylinder, 500-HP diesel engine used in the M2/M3 Infantry Fighting and Cavalry Fighting Vehicles. The engine has been structurally tested for brief periods successfully to 1,005-HP without the turbocompound system. The brake specific fuel consumption at this power level was 0.373 LB/HP-HR. Through Sep 1981 the test rig has accumulated 275 hours of total test time.

1000 HP ADVANCED DIESEL ENGINE



Testing will continue in FY82, with emphasis on new advanced turbomachinery and turbocompound system tests culminating with a 1,000-HP demonstration on the LCR-903 with the turbocompound system installed. Future work will focus on further engine mechanical and performance development, turbomachinery development, cold-start and light-load optimization, and engine system integration.

1,500-HP DIESEL ENGINE DEVELOPMENT

The objective is to continue development of a diesel engine (AVCR 1360) option until the Army Ground Turbine (AGT) 1500 has fully demonstrated satifactory operation in the M1 tank.

During 1981 a variable-area turbocharger and variable-speed fans were performance tested for the AVCR 1360 engine.

Two AVCR 1360 engines were extensively modified to improve durability and fit the M1 tank. A 1,000-hour durability test of the modified engine equipped with variable-area turbochargers and variable-speed fans and controls has been started.

Procurement for two new engines is about 95% complete. Two M1 pilot vehicles were delivered to Teledyne Continental Motors for power pack installation. Hull modifications are about 95% complete on one vehicle and 50% on the other. All modified transmissions, cooling system, turret hydraulic oil supply system, vehicle fuel system, ammo storage system, ballistic grill, electrical system and driver interface modifications are being procured and many of the parts have been delivered. Vehicle testing is scheduled to begin in Jul 82.

EVALUATION OF GT-601 COMMERCIAL GAS TURBINE TRUCK ENGINES

The feasibility of using a Garrett Corporation GT-601 commercial gas turbine engine in armored vehicle applications was investigated by testing the engine in a test bed mechanized infantry combat vehicle. An Allison X-300 transmission was used with the engine, but with the torque converter removed because it was considered unnecessary for this particular engine.

Systems operational characteristics such as driveability, rolling resistance, tractive effort, acceleration, gradeability, fuel consumption, infrared and acoustic signatures and vibration were evaluated.

The data also have been used to validate a computer simulation program so a performance comparison with alternate engines can be made. The data obtained in this program will allow the Army to better evaluate and select engines for future medium weight combat vehicles.

ENGINE CONCEPTS FOR ALTERNATE FUELS

In FY81 the primary effort for alternate fuel was devoted to establishing a technology base for development of fuel insensitive and efficient combustion systems for new engines, modification kits for multifuel operation of present engines, and data for alternative fuel specification.

The activity on engine concepts for alternate fuels consisted of an in-house test of a NA3208 Caterpillar engine with shale fuel; the evaluation of alternative fuels in diesel injection systems at Wayne State University; the evaluation of alternative fuels in a turbine combustor at Purdue University; the determination of alternative fuel operation in the AGT-1500 Turbine engine at AVCO Lycoming; and the evaluation of alternative fuels in an adiabatic single-cylinder engine at Cummins Engine Co. All of the above alternative fuel testing has been conducted with fuels manufacturered to existing specifications.

The engine/fuel compatibility results obtained to date have been excellent. For FY82, initial testing is planned on "off" specification fuels which will be more representative of future alternative fuels. We expect these fuels to create problems with engine/fuel compatibility.

The analysis of nonconventional combustion systems for alternative fuel operation has been in progress both in-house and at Cummins Engine Co. The experimental evaluation of nonconventional combustion systems is scheduled to start in FY82. Additional programs have been initiated in the areas of Hypergolic combustion, alternative fuel cold starting, and electronic fuel injection.

HYDRAULIC BRAKE RETARDER

Design and development work was initiated for a single-torus ultra-high capacity output braking retarder for use in high-speed tracked military vehicles which employ cross-drive transmission. A hydraulic brake retarder will improve vehicle deceleration characteristics while improving brake durability. The need for hydraulic retarders is accentuated by the constantly increasing weight, acceleration, and top speed of tracked military vehicles.

AUXILIARY POWER UNIT (APU)

Continuing APU development will result in a gas-turbine-engine-driven 10-KW generator set capable of supplying 28-VDC to the M1 tank's winterization, cold-weather starting, battery charging and silent watch systems. The APU will decrease main engine demand, thereby reducing fuel consumption.

Five prototype APU's were delivered for laboratory and vehicle tests. One unit, installed in an M1 tank, was tested in the low-temperature chamber at Eglin Air Force Base and Ft. Greely, AK. Excellent results were achieved with APU operation and main engine starts. APU-assisted main engine starts at temperatures down to -70°F were obtained in less than one minute with a minimum of battery preheating and precharging.

Noise reduction and repackaging efforts were initiated to reduce high sound levels and installed volume. Prior experience with the Gemini engine indicates that "F" silencing level (60-65 dB) is obtainable. Test results showed that the removal of the Nicad battery system will reduce APU installed volume by approximately 30%. Reconfiguration of the barrier air cleaner is being considered to aid in the installed volume reduction.

ADVANCED DIAGNOSTICS

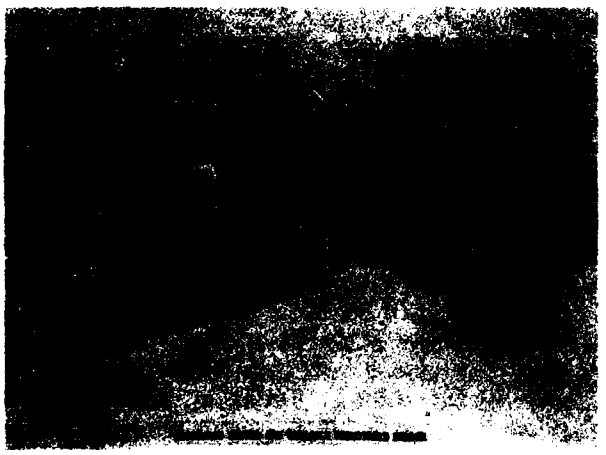
Advanced development of vehicle diagnostic techniques suitable for transition to the Simplified Test Equipment family to provide the forward support mechanic with simple and effective means of rapidly diagnosing vehicle malfuncitons will be realized by the Advanced Diagnostics Program.

The FY81 program defined techniques feasible for field use to determine engine revolutions

per minute, piston top dead center reference, cylinder identification and turbocharged engine power using non-contact/minimal contact sensors such as variable reluctance and microwave sensors. The program will continue to investigate advanced diagnostic techniques concerned with fuel injection system fault diagnosis, turbine fault diagnosis, high resolution engine data.

The payoff attainable with Advanced Diagnostic techniques are:

a. Increased diagnostic capability;
b. Increased fleet readiness posture;
c. Enhanced STE-system capabilities;
d. Simplified training (reduced).



SIMPLIFIED TEST EQUIPMENT TRACK VEHICLE (STE-T)

The STE-T program expanded the Simplified Test Equipment for Internal Combustion Engines (STE/ICE) concept to support the M1 and M2/M3 vehicles including the turrets. To accomplish the interface, two additional modules were developed. The Controllable Interface Box (CIB) enables the basic STE/ICE to address several hundred reference points required to test the turret while the Set Communication (SET COM) provides an expanded communication link between the test set and the mechanic. In operation, the CIB provides the interface between the turret and the STE/ICE set and the SET COM displays automated step-by-step instructions for the mechanic to perform test procedures for fault isolation.

STE-T, sometimes referred to as STE-M1/FVS to identify with the Abrams tank and the Fighting Vehicle Systems, has the following features: dynamic measurement control of the gun stabilization system, dynamic measurement of the AGT 1500 turbine engine system, automatic cable test, maintenance diagnostics with functional subsystem test strategy, standard STE/ICE test capability, compreshensive self-test/self-diagnosis capability and the ability to operate in a combat vehicle environment. By applying STE-T to the M1 tank, we were able to replace five M1-peculiar test sets. This accelerated the Army's program for standardization of multipurpose test sets by at least 10 years. STE-T prototypes were developed with the capability to support both the turret and hull, including the AGT 1500 turbine engine. These STE-T sets were tested as part of the M1 tank DT/OT III. Initial production test sets have been issued to units to support the M1 tank.

COMMERCIAL UTILITY AND CARGO VEHICLE

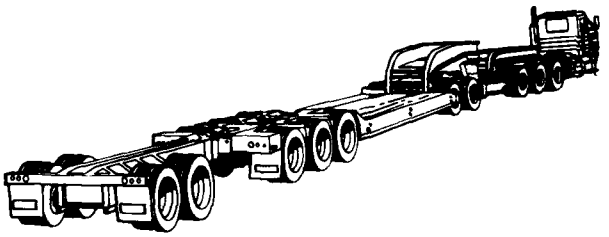
The Commercial Utility and Cargo Vehicle is intended to fulfill the Army light-load requirements; cargo, utility, and ambulance for those missions and roles that are basically rear area oriented. These vehicles will replace part of the M151A2 1/4-ton truck and all of the M880/890 series trucks. We plan to procure the various derivative vehicles, utilizing commercial designs and production base of a diesel engine driven 4x4 vehicle that represents a family approach of trucks for configuration and logistic benefits.

Specific Army changes will include blackout lights, STE/ICE, NBC, driver weapon security,

and military towing provisions. Applicable kits include winterization, machine gun, 24-volt electrical system with 100-amp capacity, troop seats, cargo box cover, and communication shelters.

A survey is in progress to determine available trucks in the 3/4- to 1-1/4-ton range payload in the commercial market which will meet our performance requirements. Technical Feasibility Tests are currently being conducted at Aberdeen Proving Grounds, MD. A multi-year procurement is planned for these vehicles starting with contract award scheduled in Dec 81.

HEAVY EQUIPMENT TRANSPORTER (HET) 70-TON SEMITRAILER-XM1000



The XM1000 HET will provide the means to legally transport the M1 Tank over highways within CONUS. Due to its weight, the M1 overloads both highway road surfaces and existing military equipment transporters.

The XM1000 HET is a tri-axle low-bed semitrailer that uses a tandem axle dolly and a tandem axle booster during highway operation. Off-road capability in a tactical environment will be achieved by using the low-bed without the dolly and booster axle.

Two MACI contracts were awarded in FY81 for the procurement of commercial test vehicles that are to be evaluated for military adaptability.

Depending on the results of the test scheduled in FY82, procurement specifications will be drafted for quantity procurement.

ADVANCED COMPOSITE MATERIALS AND STRUCTURES

To achieve lighter weight components, TACOM is investigating the use of Advanced Composite Materials to replace metals in selected components. Advanced composites are plastic-based resin systems with high-strength fibers embedded in the plastic matrix. Fibers being considered are "S"-Glass, "E"-Glass, and high-strength graphite fibers. We selected components for the M939 5-Ton Series Truck and they are the leaf springs, propeller shafts, the frame and the wheels. During FY81, the Materials Division of EXXON Enterprises, Inc. manufactured the front and rear leaf springs and two different drive shafts.

The front-spring weight reduction was 52.5% and the rear spring weight was reduced 49.4%. The drive shafts weight savings is in only the drive shaft tube; the end-fittings weight remains the same. The short shaft shows a weight reduction of 26% while the long shaft weight was reduced by 58%.

Ewald Assoc. manufactured a frame using a hybrid graphite/fiberglass composition for the frame rails. High-strength fiberglass was used for the crossmembers. This frame shows a weight saving of approximately 50%.

The wheels were compression molded, and, a weight savings of 50% was achieved. The wheel design successfully passed the SAEJ 267A requirement for dynamic radial fatigue.

TECHNICAL ACHIEVEMENTS BY PROGRAM BREAKOUT

NOISE CONTROL

During FY81, we investegated the dynamic properties of an experimentally welded M113 hull using the narrow band analysis approach. Constant input drive forces were produced and sine swept from 20 Hz to 15,000 Hz. The velocity amplitudes and loss factors were recorded. Our results follow:

a. The microphone radiation scan located only one acoustic hot-spot, i.e., in the neighborhood near the driving source.

b. The hull exhibited three closely coupled modes around 200 Hz with small mode density away from this frequency region.

c. The hull was not acoustically soft enough to generate sufficient modes for velocity scans away from the driving point.

Climate exposure tests on the 5-ton truck engine hood show the FM-100 and UF-100 hood liner adhered well to the surface when attached with mechanical fasteners. The 151-1/2-pounds dry weight of the hood and liner increased to 157-1/2-pounds when fully soaked. Consequently, the liner material does not present a water retention problem. Acoustical tests of the FM-100 and UF-100 hood liners have been completed and the results are being analyzed.

Absorption coefficients were measured for special composite urethane foam and urethane barrier material. These combinations of material may be used in future Army wheeled vehicles.

SMALL UNIT SUPPORT VEHICLE (SUSV)

The SUSV is helicopter transportable and has the mobility to traverse all kinds of terrain, either on-road or cross-country, under year-round conditions. The SUSV is to support mobile units by transporting equipment, ammunition and supplies in northern and mountainous regions.

A revision to the original letter requirement (Oct 78) to procure a non-developmental item is being finalized and approval is expected in Oct 81.

As a result of the market survey conducted in FY81, two candidate vehicles will be considered. One is the Swedish-built BV206 and the other is a model from the Bombardier Co.

FIRE SURVIVABILITY TECHNOLOGY

Three related efforts, Fire Survivability System Integration, Passive Fire Protection for Hydraulic and Fuel Lines, and Gas-Liquid Dynamics, are combined into one program, Fire Survivability Technology. All three were exploratory development programs to develop improved fire survivability hardware, systems design/integration techniques, or unique instrumentation (such as Halon distribution analyzer) required for optimum vehicle installation of fire survivability components.

Work performed during FY81 to improve componentry includes preparation for a test

program to measure the electromagnetic signature of armor penetrating munitions as a function of wavelength and time. Also, work was begun on a nitrogen gas generator assisted Halon expulsion system. We continued work on experimental hardware to determine the feasibility of protecting hydraulic and fuel lines with fire suppressant jacketing. A mid-infrared band sensing system and a leak free solenoid valve were fabricated for testing in FY82. Funding was provided to the Jet Propulsion Laboratory to begin development of dispersion nozzles.

Computer models for free and restricted flow of fire suppressant are being written and verified. These models will be important elements of the design handbook. A multichannel Halon concentration analyzer will be procured to be used as an aid in the placement of extinguisher bottles for improved Halon dispersion.

COMPOSITE ARMOR

Several composite armor configurations were designed for ballistic tests and evaluation in FY81. Composite armor designs were of spaced, parallel and louver type applique concepts using steel and aluminum armor plates with some ceramic inserts. These composite armor systems afford lightweight armor design for ballistic protection against small arms up to 30mm high velocity kinetic energy projectiles (HVAP). Two composite armor applique systems, parallel and louver type, weighing approximately 50 to 60 lb/ft^2 in densities have been designed, fabricated and ballistically tested against 20mm HVAP projectiles. Ballistic evaluations and design of attachments of applique armor for vehicle use are in progress.

LASER HEAT TREAT OF TRACK COMPONENTS

Laser heat treat operations produced track components that exhibit excellent potential. Currently, the program is establishing a production system for the heat treat of parts. The process is being designed to be placed directly into a contractor's facility.

ELECTRODES FOR WELDING STEEL ARMOR

Several electrodes, based on mechanical properties, were selected for welding steel armor. Ballistic test plates are being fabricated. They will be subjected to firing tests to determine weld integrity and the acceptability of the electrodes.

MILITARY ELASTOMERS

In the fundamentals of elastomers (track pads), finite element analyses were accomplished and mathematical models derived, one dealing with the thermal aspects and the other with the structural aspects. During FY81, these models were validated by varying boundary conditions and actual field measurements. The codes are now being modified for compatibility with and transfer to the TACOM scientific computer systems.

Two areas of the track pad manufacturing process cause problems: differential curing occurs in thick slabs of rubber, and poor heat conduction and diffusion cause the rubber exterior to be overcured while the center is undercured. To overcome this, a program to cure pads by microwave was initiated.

Another problem area is adequate dispersion of materials in the rubber matrix. Plans have been made to resolve this problem, but action is limited to a program in photoacoustic microscopy which may be applicable for detection of dispersion anomalies.

Field results show that cutting and chunking are the primary causes of failure during cross-country travel. Continuing programs

determine the energy and stresses involved in breaking the integrity of the surface to initiate cracking and the parameters for crack propagation. A program was initiated in FY81 to study viscoelastic fracture mechanics. Programs dealing with self healing crack and interpenetrating network of polymers are being processed.

DISRUPTION OF ANTI-TANK PROJECTILES

The continually increasing threat exposure to combat vehicles reduces potential survivability in a combat environment. The lethality of current weapons has forced armor designers to abandon monolithic armor forms and accept alternatives of spacing and complex armor arrangements. An alternate approach is to detect and identify a threat, determine its flight path and defeat the projectile while in flight. A contract was awarded to the Defense and Space Systems Group of TRW, Inc., Redondo Beach, CA, to investigate mechanisms to physically disrupt the normal flight or function of large anti-tank projectiles to the extent that the projectiles are effectively defeated in flight. The disrupt mechanisms may include, but are not limited to methods of disorient, destabilize, deflect, or destroy all the various anti-tank missiles and tank fire projectiles.

TURRET AND WEAPON STATION INTEGRATION

The turret and weapon station integration program will result in advanced systems and techniques for TACOM to use in its role as total combat vehicle systems integrator. TACOM will coordinate development efforts leading to the integration of technology within the turret under the constraints of cost, weight, space, human-factors, complexity, and performance. During FY81 several activities were undertaken concurrently.

Fluidic Tank Turret Stabilization:

Breadboard development of a pneumatic gyro rate sensor, to replace the current M1 tank gyro, was completed and has undergone preliminary laboratory testing satisfactorily. Development of a brassboard designed for direct plug-in replacement of the gyro was started and will be integrated into a test bed vehicle during FY83. This hybrid pneumatic/electronic system is expected to provide vital data to prove the concept of a direct gyro replacement and document the improvement in maintaining accuracy on target from a moving vehicle.

Position Control System (PCS):

The PCS is a displacement sensitive trackball control system developed to evaluate position-vs-rate inputs to the turret/weapon drive system. The conclusion of the test and evaluation phase, scheduled for FY82, will be an evaluation on the dynamic ride simulator.

Video Automatic Target Tracker (VATT):

During FY81, TACOM provided funding support to ARRADCOM's Fire Control System Integration Technology Program. At the conclusion of the prototype's development phase in mid- FY82, the VATT hardware will be integrated and evaluated in the ARRADCOM M60A1/A3 Tank Test Bed.

OVERHEAD ARMOR PROTECTION

Combined conventional munitions and nuclear radiation protection overhead armor is being developed by Ballistic Reserach Laboratory. Target configuration tests will be completed by Dec 1981. Fifty percent of the computer analysis has been completed. Based on these results, methods will be established for predictive analysis of ground vehicle top armor requirements. Designs can then be made to protect against any kind of overhead threat.

CREW PROTECTIVE SEAT

A contract was awarded to TriTec, Inc. of Columbia, MD, in Jul 81 to develop methods of attenuating the forces and motions to the seat, and in turn, the driver of a combat vehicle when subjected to mine-blast. Currently, although rupture of the floor plate is not contemplated, the velocities and accelerations from the blast would cause severe injuries to the crew members. It is desired to isolate the seat further and, thus attenuate the energy transfer. TriTec will be working with its subcontractor, Wayne State Univ, on mathematically modeling the occupied seat when subject to mine-blast.

Based on the computer generated results, the best mix of isolation techniques such as using hydraulic or thixotropic fluids for damping, honeycomb type crushable materials, and friction devices, will be determined.

TRACK FOR 15- TO 18-TON VEHICLES-XT150

This track is double pin, extended end connector design with quick disconnect/replaceable chevron pads. Second generation track has been tested at Aberdeen Proving Ground, MD, and tests are continuing at Ft. Lewis, WA. Experimental track tests using various fabrication methods and configurations are scheduled to begin at Nevada Automotive Test Center (NATC).

LIGHTWEIGHT SADDLE FUEL TANK

Feasibility testing of our 5-ton truck lightweight fuel tanks was completed at Yuma Proving Ground, AZ, in a cold-weather region and a tropical test site. Fuel tanks distorted at all test sites and some leakage occurred around the fittings. The bonded seams did not leak.

These tests showed that the fabrication technology and the selection of material were achieved. A contract, awarded on 30 Jun 81, for the fabrication of fuel tanks for engineering evaluation tests, is to correct the deficiencies assessed during feasibility testing, e.g., the incorporation of necessary ribs (fillets) and corner radii for desired durability, structural integrity, and dimensional stability.

Durability testing (20,000 miles) will be conducted at various TECOM test sites and, based on the engineering test results, the Technical Data Package and specification will be modified.

TURBINE ENGINE CERAMIC COMPONENTS

Phase I of the Ceramic Coatings Program was successfully completed. This included initial testing, heat transfer/stress anlayses and a detail design configuration incorporating a turbine inlet temperature af 2650°F which was selected as the optimum temperature. The ceramic coatings applied over metal components provide heat barriers, allowing

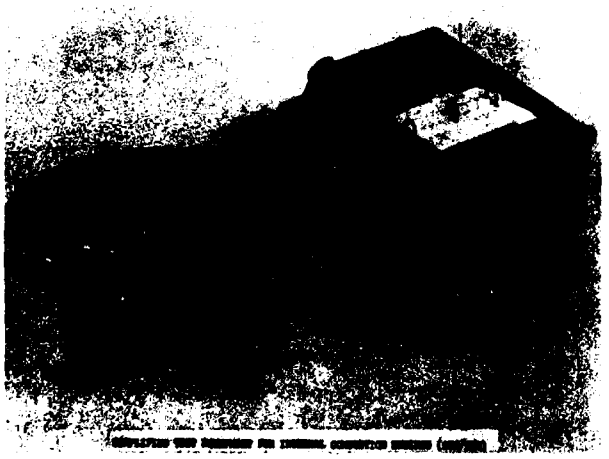
higher cycle temperature with resultant combustion efficiency increases. This translates into improved fuel economy.

Phase II of the program is under way with fabrication of a coated turbine rotor. This will be followed by testing and evaluation of the rotor in a test rig engine.

HYDROMECHANICAL TRANSMISSION CLUTCH

The project to develop improved hydraulic clutches of the type used in hydromechanical transmissions is aimed at improving the efficiency and operational characteristics of existing transmissions, as well as meeting the demands of higher horsepower transmissions now being considered.

SIMPLIFIED TEST EQUIPMENT FOR INTERNAL COMBUSTION ENGINES (STE/ICE)



STE/ICE replaces five separate pieces of test equipment at organizational maintenance level and additional testers at direct support level. STE/ICE diagnostic connectors are being installed in vehicles under development, including the 5-ton PIP truck (M939), M915 truck series, M1001/2 (M.A.N.) 10-ton truck, HEMTT 10-ton truck, M109 Self Propelled Howitzer PIP, M2 IFV, M3 CFV, M993 MRLS, UET, and Marine Corps LVT7A1.

Design to Unit Production Cost goals ($4,350 in FY75 dollars) were exceeded in the Jul 80 procurement which was awarded with a 3,700 (FY80) unit cost. The latest production run, starting in Sep 81, will complete delivery of the STE/ICE in Europe and Korea and initiate the fill in CONUS. The successful development and fielding of STE/ICE resulted in the expansion of the STE/ICE concept to test the entire combat vehicle system, which resulted in the initiation of the Simplified Test Equipment-Tracked vehicle (STE-T) program.

MACI SUPPORT FOR STE/ICE

A contract has been awarded to adopt commercially available transducers for use with the Simplified Test System Family of diagnostic testers (STE/ICE, STE-T, and STE-X). This action was prompted by the military system's present lack of modern transducers for application to the vehicular diagnostic and prognostic areas. Transducers to be adapted include mechanisms that measure current by the Hall effect in lieu of shunts, differential pressure, temperature, and battery electrolyte level.

End products for the project include manufacturing data, drawings, specifications, and interfacing data to comprise a complete Technical Data Package for end item procurement.

XM975 ROLAND CARRIER

TACOM is responsible for the development and fielding of the US Roland air defense missile system carrier.

During FY81, a new cost estimate was prepared for the required "ventilated face piece" (VFP) only with interface to the Hybrid NBC system of the Fire Unit Module (FUM). The first 18 Low Rate Production (LRP) Carriers will not have the NBC VFP collective protection system and the interface carrier/FUM. These LRP carrier's will have to be modified later to include carrier chassis modifications to accept the FUM with the Hybrid NBC System Unit installed. The LRP carrier's domed driver's hatch cover with the passive driver's nightviewer AN/VVS-2 installation will be retrofitted after delivery. Number one LPR Carrier was delivered at Boeing Aerospace Corporation, Seattle, WA in Aug 81.

HIGH STRENGTH MATERIALS AND COMPONENTS

The objective of this R&D program is to investigate the substitution of newly developed materials for current steel components. Metal matrix composites, organic composites, and oxide dispersion strengthened super-alloys will be evaluated.

A graphite/epoxy tow bar with a Kevlar overwrap was designed and fabricated as a potential substitute for the current heavy vehicle tow bar. The current steel tow bar weighs approximately 340 pounds in contrast to the weight of 125 pounds for the composite tow bar. A lightweight steel tow bar also was fabricated with a similar weight to the composite design. The tow bars are being evaluated at Aberdeen Proving Ground, MD to obtain a safety release for subsequent testing at Ft. Knox, KY.

MA 754, an oxide dispersion strengthened alloy potentially useful for high temperature applications such as turbine engine components, currently is being evaluated. Specific testing involves stress rupture and creep testing at elevated temperatures (1,600 to 2,200°F). The test data will supply information required to rationalize fundamental mechanisms of deformation and rupture which occur during elevated temperature testing. The program currently is concentrating on recrystallization response of 70% cold rolled MA 754 alloy.

Alumina/Aluminum metal matrix composite materials are being evaluated for use on lightweight military vehicles. The two composite systems being evaluated consist of SiC whisker/aluminum and alumina/aluminum. These systems have an attractive combination of cost and material properties. If R&D proves favorable, some existing vehicle components can be significantly reduced in weight with negligible configuration change.

UPSCALING POWDER METALLURGY PROCESSES

The forging of powder metallurgy (P/M) preforms into net and near-net shapes is a viable manufacturing process for making high performance components. In this program, cold, warm and hot forgings of sintered preforms are being conducted on families of gear shapes. A computer program is used to design the preform and perform die shape; this is generic technology applicable to wrought forging also. A die with interchangeable inserts will be used to minimize tooling costs. This design will allow the production of a family of gears from one die. Number 3 and 6 accessory gears for the AGT 1500 turbine engine will be produced and tested to verify the computer program, die design and process parameters.

DISSIMILAR METALS JOINING

The joining of dissimilar metals program is to develop, without using metallic fasteners, optimum production welding techniques for weld-joint geometries for the application of dissimilar metals to combat vehicles. The technique will assure incorporation of dissimilar metals in a vehicle to provide the

required ballistic and structural integrity. Here, aluminum and steel are used. Ballistic capability will be improved and weight reduced to increase combat vehicle mobility and reliability. The protection capability of aluminum armored vehicles could be enhanced with the use of steel in certain areas.

GEAR DIE DESIGN

Gear manufacturing processes are highly specialized due to the complex geometry and high accuracy requirements of the teeth. Bevel gears are different from other types of gears because they cannot be completely illustrated and analyzed in just one or two planes. Traditionally, bevel gears are manufactured using highly specialized cutting and grinding machines. Precision forging of bevel gears offers considerable advantages because this process reduces the machining losses and increases the fatigue life of the gears. This project applies advance computer aided design and manufacturing technology to gear forging, die design and manufacturing. The computer's immense capability in computing and information storage reduces trial and error and represents a general method applicable to the family of bevel gears (straight, spiral, zerol, and hypoid).

IMPROVED LARGE ARMOR STEEL CASTINGS

Research has proven the ballistic performance of cast steel armor can be improved through advanced processing procedures/techniques. This project is to demonstrate production feasibility and establish methods and procedures for general use in the manufacture of improved cast armor. Two contractors provided both thick cast armor plates and castings which simulated turret sections for ballistic test and evaluation. Test results show that production cast plates can be manufactured to provide material capability exceeding the minimum ballistic requirements of rolled armor specification MIL-A-12560. Ballistic capability of improved cast armor approaches the perforamnce of rolled steel armor.

BALLISTIC SHOCK DESIGN TECHNIQUES

A contract was negotiated for development of predictive design procedures to provide protection and shielding of the critical vehicle components against ballistic shocks. The effort will provide a quantitative approach for evaluation of shock damage potentials and needed protective measures to protect components, such as fire control, optics, electronics, computers and radios from typical shocks in combat environment (large caliber armor piercing impacts, high explosives blasts and mine detonations). Development of shock prevention analytical design methodology has been completed. Simulated validation shock tests will be conducted to finalized formulation and design.

LOCKING ADHESIVES AND SEALANTS

The utilization of anaerobic adhesives provides a simple and economical method of applying locking torque to all threaded fasteners. Sealants provide improved reliability and performance and eliminate the need for precut gaskets. Both of these products are being evaluated through laboratory and field testing. All are subject to deterioration, but no information is available reflecting the deterioration, or its effect on locking performance. Field testing was performed on 10 modified M551 vehicles, air screw brackets and power packages using anaerobic adhesives. No failure was recorded. The project has application for all present and future military vehicles. Phase II is essential to determine the ultimate useful shelf-life, to revise the military specification, establish quality control procedures, and fielding of the products to achieve the potential benefits.

TORSION BAR DEVELOPMENT

Manufacturing methods are being established to fabricate torsion bars from aircraft quality, vacuum-degassed high-strength steel. This will provide steels with higher strength and toughness to increase the capacity of single torsion bars, which will extend the life-cycle of individual torsion bars while increasing cross-country mobility through greater roadwheel travel.

CAST ARMOR REPAIR

Large armor castings fabricated to MIL-A-11356E are acceptable based only on calculations. The cast armor repair program consists of preparing simulated repairs on various casting thickness, heat treatments and defect sizes. The repaired cast plates were shipped to and ballistically tested at Aberdeen Proving Ground, MD. After the firing record has been received, the results will be evaluated and, if necessary, modifications will be made to MIL-A-11356.

HYDRAULICALLY DAMPED TOWING LUNETTE

This program will investigate the adaptability of a hydraulically damped towing lunette for two-wheeled trailers. The hydraulically damped towing lunette, unlike the fixed lunette system, will cushion the impact felt by the driver while increasing the durability of the towing eyelet. Both lunette systems have been converted to interchangeable assemblies. Aberdeen Proving Ground, MD, testing is scheduled for completion by Oct 81.

RADIAL vs BIAS PLY TIRES

A study of technical reports on projects completed between 1969 and 1979 determined radial-ply tires were superior to bias-ply tires. The study established that radial-ply tires have increased traction, better lateral stability, increased tread life, improved puncture resistance and decreased rolling resistance. Efforts began to introduce radial tires into the Army system with low-rate initial production of approximately 1,000 tires for use on 5-ton trucks. These tires were to be issued to select troops to establish field performance. Service test results would then determine if military tread radial-ply tires could be used on all new-production and developmental tactical vehicles. The project, however, was terminated for lack of funds, which were transferred to higher priority programs.

12-VOLT VEHICLE LIGHTING

The 12-volt lighting project will provide a system for adapting commonly available 12-volt lamps for use in 24-volt military vehicles. This system will eliminate the requirements for shock-mounting lights with 24-volt lamps, as these lamps are prone to failure due to the extra fragile filaments. Two M151 1/4-ton trucks equipped with 12-volt lamps are now undergoing tests at both TACOM and the Keweenaw Research Center, Houghton, MI. Test results will determine the desirability of continuing this project.

TACTICAL VEHICLE DEVELOPMENT PLAN (TVDP)

A contract with Battelle Columbus Laboratories to prepare a TVDP for the Army was awarded in Oct 80 and publication of the TVDP was planned for 30 May 83. However, FY82 funding restrictions will require program revisions which have not been finalized. It is expected that a TVDP will not be feasible with current funding and that Battelle will summarize its results in the spring of 1982. Battelle has completed, for the wheeled vehicle exploration project, a report on

current and future tactical and commercial truck engines, and a similar report on transmissions and drivelines.

ELECTRIC VEHICLE PROGRAM

Five electric vehicles in the 650- to 1,000-pound payload class were delivered to the Red River Army Depot under an interagency agreement between the Department of Energy (DOE) and DA. This agreement provided that DOE fund TACOM for the acquisition and testing of these vehicles. Data on performance, maintainability and reliability are being collected and, when testing is complete, the results will be forwarded to DOE through TACOM. The tests, begun in Nov 80, will continue for approximately three years.

SUPPLEMENTAL ARMOR ENGINEERING SUPPORT

Continued technical support was provided to the M1 tank Project Manager in the development, direction, and analysis of ballistic test programs. These programs include evaluation of ballistic protection capabilities for the M1 engine grille, and a recommended course of action for the thin-gauge steel armor plate program.

COMMERCIAL MILITARY MOTORCYCLE

The military adaptation of commercial items motorcycle project currently is studying existing commercial motorcycles through a market survey. The motorcycle will be an on-road and off-road type with a gross vehicle weight rating between 465 and 520 pounds. The engine size will be at least 165 cubic centimeters. The U.S. Army Training and Doctrine Command has completed the letter requirement and is preparing to submit it to HQDA for approval.

NATO ARMOR PROTECTION VULNERABILITY MODEL STANDARDIZATION

This effort supports the NATO Armor Protection/Vulnerability Standardization Program to obtain a standard armor protection/vulnerability model. TACOM representatives participated in a special meeting with technical representatives of NATO Working Group 2, AC/225 Panel II, to define and agree on a common reference target to permit comparison of various national vulnerability models. Common reference drawings were released by Ballistic Research Laboratory to all group members. Each member will perform a vulnerability analysis of the common target using their own national model. Comparsion and discussion of vulnerability assessments will be the purpose of the next scheduled meetings, Nov 81. TACOM will evaluate the TACOME-3 model.

NBC DEVELOPMENT PROJECT OFFICE

MATERIALS COMPATIBILITY WITH CHEMICAL AGENT

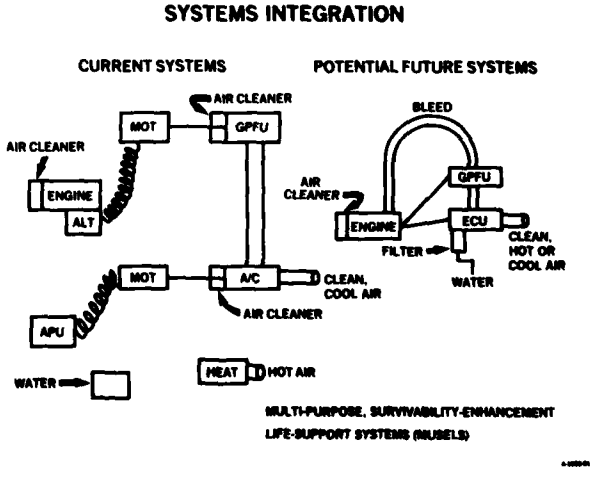
The US Army Materials and Mechanics Research Center has been funded to initiate a program on the interaction of chemical agents with non-metallic materials to guide the selection of agent resistant materials for Army weapons systems. Solubility and diffusivity of chemical agents in selected materials will be calculated and correlations drawn as to the materials' chemical agent resistance. The effort will initially concentrate on assembling, interpreting and organizing information from the literature and known or modified methods of calculating the solubility parameter. The end result will be a handbook allowing engineers to choose chemical-agent resistant materials structurally acceptable and affordable for weapons systems application.

SOVIET VENTILATION BLOWER

Because many foreign countries, including the Soviets, have placed considerably greater emphasis over the last ten years than the US on the development related to NBC protection, opportunity exists to exploit the acquired state-of-the-art to our own advantage. In that regard, an opportunity was presented to evaluate two special crew compartment ventilation blower systems of Soviet origin. These blowers are employed on Soviet combat vehicles as dual-purpose NBC filter blowers and crew compartment ventilators. The unique features of these blowers are that they combine into the impeller design, an inherent inertial dust separating capability. In so doing, the Soviets are able to provide an initial dust removal stage inherent to the blower design, whereas the US approach currently requires an add-on inertial dust separating tube assembly to a blower unit for accomplishing the same capability.

Air flow and dust removal efficiency tests were conducted on the first Soviet blower during FY 80 with the report completed in FY81. A second Soviet blower of slightly different design commenced in testing in FY81 with report availability scheduled for FY82.

NBC SYSTEMS INTEGRATION



A major thrust of the NBC Development

Project Office is the application of systems integration to provide collective protection for vehicular crew compartments. To provide NBC protection, crew survival and effectiveness, and rapid decontamination, the combining and integration of NBC functions with existing vehicle system componentry can provide the most efficient performance and space claims attainable.

FY81 efforts at combining functions included: A contract with Donaldson Co. for the design and development of a combination ventilation-blower/dust separator for tank application. An in-house study to define power requirements for various levels of NBC protection, net power available on representative vehicles, and alternate power augmentation approaches. A contract with Williams International for investigating waste heat as the primary energy source for a vapor cycle collective protection system, to provide clean conditioned air, compartment heating-cooling, and potential for net electrical power. A collective system is essential to protect personnel from heat stress caused by environmental conditions and NBC protective clothing. Other work included investigating filtered main engine bleed air as a source for the NBC system air, also hot air decontamination, and potential for water reclamation.

Future activities will include studying full systems integration utilizing a turbine engine power source, hardware demonstrations of FY81 development and investigative projects, and initiating an advanced technology ventilation blower-separator (centrifugal) development program.

ENGINEERING SUPPORT DIRECTORATE

REMOTE CONTROLLED UNMANNED TARGET VEHICLES (RCTV)

We provided the equipment, installation and operation of the RCTV. M47 medium tanks and M114 reconnaisance vehicles were used for DT/OT of various DOD weapons systems. Operation of the RCTV's was improved by using a new RF grid system. A new line-of-sight system was developed to replace obsolete equipment in the field.

TRACK PAD TEST MACHINE

In early Nov 1980, we began to design and build a track pad testing machine. The machine is intended to make comparative tests on track pads; the results will be used to evaluate the relative merits of different pad materials. Track pads will be tested in a manner simulating pad wear characteristics actually encountered on a vehicle, thus eliminating costly and time-consuming evaluation by actual vehicle application. The machine will test one pad (with track shoe) from the T142 shoe used on the M60 tanks, the T130 shoe used on the M113 personnel carriers and the T156 shoe used on M1 tanks. Additional fixtures will enable the machine to handle other size pads.

SNOW, SAND, AND MINE REMOVAL EQUIPMENT STUDY FOR 5-TON TACTICAL TRUCKS

During NATO exercises, a heavy snowfall usually means construction equipment is diverted from normal duties to clear snow, resulting in diminished combat effectiveness. The use of tactical vehicles to clear snow would remedy this situation.

A study, requested by the Marine Corps, investigated the adaption of commercially available snow removal devices for the M39-series 5-ton trucks that could be used to clear snow, sand, rubble, and antipersonnel mines from roadways. The study report summarizes equipment descriptions and contains recommendations relating equipment to tasks.

ACTIVITY INDICATORS

TECHNICAL ARTICLES PUBLISHED

GAS TURBINE ENGINES
TACOM News (15 Apr 81)
Taylor, George

ADIABATIC ENGINES
TACOM News (13 May 81)
Taylor, George

ARMY OIL ANALYSIS PROGRAM (AOAP) SAVES ARMY MISSIONS
TACOM News (10 Jun 81)
Taylor, George

ARMY CONVERTS TO SILICONE BRAKE FLUID
TACOM News (24 Jun 81) and
DARCOM News (Aug 81)
Taylor, George

VEHICLE PROGNOSTICS
TACOM News (24 Jun 81) and
DARCOM News (4 Aug 81)
Taylor, George

10-TON HEAVY EXPANDED MOBILITY TACTICAL TRUCK (HEMTT)
TACOM News (8 Jul 81)
Taylor, George

COMBAT VEHICLE BLACKOUT SECURITY LIGHTS
TACOM, News (22 Jul 81)
Young, Harry

COMPOSITE TOW BAR
TACOM News (22 Jul 81)
Boblenz, James N.

ARMY AWARDS HIGH-MOBILITY MULTIPURPOSE WHEELED VEHICLES (HMMWV) CONTRACT
TACOM News (19 Aug 81)
Taylor, George

COMBAT VEHICLE CONCEPTS
Army R,D,&A Magazine (May/Jun 81)
Bradley, Clifford D.

END OF AN ERA; ARMY TRUCK FLEET
Army R,D,&A Magazine (Jul/Aug 81)
Michitsch, John F., LTC

EVALUATION OF ENGINE DESIGNS
Army R,D,&A Magazine (Jul/Aug 81)
Glance, Dr. Paul C. and Cohen Herbert N. (ARRADCOM)

NEW BLACKOUT SECURITY LIGHTS
Army R,D,&A Magazine (Sep/Oct 81)
Young, Harry

VISION BLOCKS FOR COMBAT VEHICLES
Army R,D,&A Magazine (Sep/Oct 81)
Houston, C. Douglas, Jr.

NEW CONCEPTS IN PROGNOSTICS
Army R,D,&A Magazine (Sep/Oct 81)
Sraj, Joseph

FIELD ARTILLERY AMMUNITION SUPPORT VEHICLE
Field Artillery Journal (Jul/Aug 81)
Taylor, George

ARMY's FIFTH-WHEEL WRECKER UNIT
Army Logistician (Sep/Oct 81)
Boblenz, James N.

NBC PROTECTIVE PAINT (POLYURETHANE)
TACOM News (2 Sep 81)
Taylor, George

LIGHTWEIGHT STEEL TOW BAR
TACOM News (16 Sep 81)
Boblenz, James N.

FIELD ARTILLERY AMMUNITION SUPPORT VEHICLE
TACOM News (16 Sep 81)
Taylor, George

BRAKE FLUID CHANGES BRING IMPROVEMENT
Army Logistician (Sep/Oct 81)
Taylor, George

ACTIVITY INDICATORS

ARMY BUYS NEW HEAVY TRUCK
Army Logistician (Sep/Oct 81)
Taylor, George

HIGH-MOBILITY MULTIPURPOSE WHEELED VEHICLE
Field Artillery Journal
(Sep/Oct 81) Taylor, George

ARMY BUYS NEW 10-TON TRUCK
Field Artillery Journal (Sep/Oct 81)
Taylor, George

REGAIN THE TECHNOLOGICAL ADVANTAGE
National Defense (Oct 80)
Bradley, Clifford D.

FUTURE CLOSE COMBAT VEHICLES
Armor (Jan-Feb 81)
Bradley, Clifford D.

WHEELS VERSUS TRACKS
Armor (May-Jun 81)
Bradley, Clifford D.

FIGHTING VEHICLES: THE NEXT GENERATION
Army RD&A (May-Jun 81)
Bradley, Clifford D.

THE FUTURE IFV
Infantry (Jul-Aug 81)
Bradley, Clifford D.

WHAT'S NEXT FOR THE TANK
Armor (Jul/Aug 81)
Bradley, Clifford D.

TECHNICAL PAPERS AND PRESENTATIONS

"Future Developments in U.S. Military Vehicles," by COL Herbert H. Dobbs and Mr. Clifford D. Bradley, 9 Apr 81, to Michigan Society of Professional Engineers, Selfridge ANGB, MI

"Tracks for Combat Vehicles," by Dr. E. Petrick to Mr. David Hardison, USofD, 9 Apr 81, at DA, Washington D.C.

"Signature Considerations in the Design of Future Close Combat Vehicles," by COL Herbert H. Dobbs, 17 Aug 81, at the 3rd Annual Vehicle Signature Conference, Michigan Technological University, Houghton, MI

"TACOM Track Development Program," by COL H. Dobbs, 17 Sep 81, to MG Maloney, ODCSRDA, and MG Menetrey, ODCSOPS, at DA, Washington, D.C.

"Combat Vehicle Mobility Projections," by COL Herbert H. Dobbs, 23-24 Sep 81, to the ADPA Combat Vehicle Systems Conference at the Armor Center, Ft. Knox, KY

"Industrial Research and Development," by COL Herbert H. Dobbs, 28 Aug 81, at Detroit Diesel Allison, Detroit, MI

"Engine Research & Development," by George E. Cheklich, 10 Oct 80, to advanced engine engineers at Chrysler Corp., Highland Park, MI

"Propulsion Overview Briefing," by Dr. Paul C. Glance, 16 Oct 80, to the Congressional Staff, Washington D.C.

"Engine R&D and Acquisition Strategy for U.S. Army Ground Vehicles," by Dr. Paul C. Glance, 13 Nov 80, at the Advanced Planning Briefing to Industry, Troy, MI

"Engine Research and Development Program," by George E. Cheklich, 18 Nov 80, to the French Command Group, at TACOM, Warren, MI

Engine R&D Strategy," by COL Herbert H. Dobbs and Dr. Paul C. Glance, 5 Jan 81, to HQ, TRADOC, Ft. Monroe, VA

ACTIVITY INDICATORS

"Adiabatic Diesel Engine Program," by George E. Cheklich 12 Feb 81, to US Congressman E. Weber (R-OH) and Mr. Ford Weber, Staff Assistant, at TACOM, Warren, MI

"Tactical MACI Engine Program," by George E. Cheklich, 17 Mar 81, to Mr. John Baer of DARCOM at TACOM Warren, MI

"Diesel Engine R&D Program," by George E. Cheklich, 14 Apr 81, at the DARCOM Propulsion Review, Ft. Belvoir, VA

"Rotary Engine Options for Army Vehicular Use," by Dr. Richard Munt, 14 Apr 81, at the DARCOM Propulsion Review, Ft. Belvoir, VA

"Gas Turbine Engine Research and Development for Vehicular Use", by Dr. Richard Munt, 15 Apr 81, at the DARCOM Propulsion Review, Ft. Belvoir, VA

"Army Vehicular Gas Turbine Program," by Dr. Richard Munt, 20 May 81, to the French Army Engineers at TACOM, Warren, MI

"TACOM's Engine R&D Program," by George E. Cheklich, 28 May 81, to BG Wheatcroft and Mr. Ainley, MVEE, at TACOM, Warren, MI

"TACOM Propulsion Research and Development Program," by Dr. Walter Bryzik, 7-9 Oct 80, at the Internal Combustion Engines Symposium, Imperial College, London, England

"Adiabatic Engine Program," by Dr. Walter Bryzik, 11-13 Nov 80, at the DOE National Automotive Technology Development Meeting, Dearborn, MI

"Cummins-TACOM Adiabatic Turbocompound Engine Program," by Dr. Walter Bryzik, 23-27 Feb 81, Published in the International ASE Congress and Exposition as Paper No. 810070

"Army Ground Mobility Requirements and Activities," by Dr. Walter Bryzik, 25-25 Jun 81, at the American Defense Preparedness Association Meeting (ADPA), London, Ontario, Canada

"Army Propulsion Systems Overview," by Dr. Walter Bryzik, 25-25 Jun 81, at the American Defense Preparedness Association Meeting (ADPA), London, Ontario, Canada

"Adiabatic Turbocompound Engine Development," by Dr. Walter Bryzik 15-20 Aug 81, at the 7th International Society of Terrain-Vehicle Systems, Calgary, Alberta, Canada

"Integrated On-board Detection, Diagnosis, and Prognosis System for Military Application," co-authored by Marquis Woody and Wsewolod Hnatczuk (Presented by Hnatczuk), 7-9 Oct 80, at the Mechanical Failures Preventions Group Symposium on Detection, Diagnosis and Prognosis contribution to the Engery Challenge, Santa Monica, CA

"System Integration of Electrical Power Distribution and Information Transfer in Tactical Vehicles," by Marquis Woody, 27-31 Oct 80, at the 8th Quadripartite Work Group/Electrical Power Sources, Melbourne, Austrailia.

"ATEPS and APU for M1/M60 Applications," by Anthony Comito, 14 Nov 80, to MG D.D. Ball, PM for M1 Tank Systems at TACOM, Warren, MI

"ATEPS M1 Tank Interface," by Anthony Comito, 9 Feb 81, to MG D.D. Ball, PM for M1 Tank Systems, at TACOM, Warren, MI

"Gemini T-20G-8 M1 Tank APU," Co-authored by John Zeno and Al Karchon (TACOM) and C. Rodgers and E.A. Drury (Turbomach Division of ASME), Mar 81, at the Gas Turbine Conference and Products Show, Houston, TX

"Advanced Electronics Applied to U.S. Army Ground Vehicles," Co-authored by Anthony Comito and Marquis Woody (TACOM) and Jerry Perry and Walter Ziegler (Systems Consultant, Inc.), 6-8 Apr 81, at the IEEE Vehicular Technology Conference Washington D.C.

"Analysis of STE-M1/FVS Testability Issues," by Donald S. Sarna, 4 May 81, to DA, Washington, D.C.

"APU Program and Status," by Anthony Comito, 1 Sep 81, to the Ft. Knox Armor Planning Board at TACOM, Warren, MI

"Track and Suspension Components," by Mr. Edward Gow, 13 Nov 80, at the Advanced Planning Briefing of Industry, Troy, MI

"Track for Combat Vehicles," by BG Church Matthews, Dr. E. Petrick and Mr. Geza Szakacs (Presented by Dr. Petrick), 9 Apr 81, to Mr. David Hardison, USofD, at DA, Washington, D.C.

"Fire suppression Procedures for M1, M2 and M3 Vehicles," by Mr. Karl Brobeil, 16 Sep 81, to the Annual Army Fire Chief's Training Session, St. Louis, MO

"Plan for Combat Vehicle Track Improvement Program Execution, by COL Herbert H. Dobbs, Dr. James Chevalier, Mr. Edward Gow and Mr. Geza Szakacs (Presented by COL Dobbs), 17 Sep 81, to MG Menetrey, ODSCOPS, and MG Maloney, ODCSRDA, HQDA, Washington, D.C.

"Overview of Track and Suspension," by Mr. Edward Gow, 24-25 Jun 81, at the American Defense Preparedness Association Meeting, London, Ontario, Canada

"Rust Free Vehicle Conference," by CPT Joel Grover, Mr. Kazys Navasaites, and Mr. Dan Palmer, 14 Apr 81, TACOM, Warren, MI

"Military Vehicle Manufacturing Technology Conference II," by Mr. George Bugarin, 28 Jun -1 Jul 81, at the Tactical Vehicles Overview, Hyatt Regency, Dearborn, MI

"Tactical Wheeled Vehicle Fleet Status," by Mr. Melvin Burcz, 20 Sep 80, to J. David Willson, HAC, at TACOM, Warren, MI

"U.S. Tactical Wheeled Vehicle Fleet Status," by Roger Gay, 2 Jun 81, at the 10th Annual Saudi Arabian Land Forces Program Review, Washington, D.C.

"Alternative Concepts for Transporting Firefinder (AN/TPQ-37)," by Philip Meengs, 21 Jun 81, at Ft. Monmouth, NJ

"Tactical Vehicles for Jam Resistant Secure Communications," by Eugene Balla 12 May 81, to SATCOMA at TACOM, Warren, MI

"High Mobility Multipurpose Wheeled Vehicle," by Melvin E. Burcz, 20 May 81, as witness at the House Appropriations Committee Hearings, Washington, D.C.

"High Mobility Multipurpose Wheeled Vehicle," by Melvin E. Burcz and Ronald Wummel, 2-3 Dec 80, as witness at the House Appropriations Committee Surveys and Investigations Staff Presentation, Washington, D.C.

"High Mobility Multipurpose Wheeled Vehicle," by Ronald Wummel, 4 Dec 80, to LTG Hardin, at DARCOM, Alexandria, VA

"High Mobility Multipurpose Wheeled Vehicle," by Ronald Wummel, 4 Mar 81, to the Study Advisory Group, TACOM, Warren, MI

"Gunner Station Evaluation," by Richard Lee, 10-11 Dec 80, at Modern Control Theory Symposium, Aberdeen Proving Ground, MD

"Dynamic Gun Tube Bending Analysis," by Richard Lee, 10-11 Dec 80, at the Modern Control Theory Sysmposium, Aberdeen Proving Ground, MD

"Dynamic Gun Tube Bending Analysis," co-authored by Richard Lee, John Kring, and Dana Charles (Presented by Kring), 26-27 Feb 81, 1981 Army Numberical Analysis and Computers Conference sponsored by the Army Mathematics Steering Committee, Huntsville, AL

ACTIVITY INDICATORS

"Effects of Vibration on Vision," by Richard Lee, 16-18 Sep 81, at the International Workship on Research Methods on Human Motion and Vibration Studies, New Orleans, LA

"Tank-Automotive Emerging Trends for the Future," by Dr. E. Petrick, 13 Nov 80, at the Advanced Planning, Briefing for Industry (APBI), Troy, MI

"Tank-Automotive Energy Programs, by Theodore J. Stahara, 13 Nov 80, at the APBI, Troy, MI

"Tactical Vehicle Fleet - Present and Future," Roger R. Gay, 13 Nov 80, at the APBI, Troy, MI

"Light Division/RDF Material Concepts" by MAJ Jack M. Paul, 13 Nov 80, at the APBI, Troy, MI

"Heavy Close Combat Vehicle Program," by Harry Hayter, 13 Nov 80, at the APBI, Troy, MI

"Integrated Countermeasurers Test Bed," by Roland A. Asoklis, at the APBI, Troy, MI

"Engine R&D and Acquisition Strategy for Ground Vehicles," by Dr. Paul C. Glance, 13 Nov 80, at the APBI, Troy, MI

"Material R&D and Manufacturing Technology" by Dr. James Chevalier, 13 Nov 80, at the APBI, Troy, MI

"Track and Suspension Components," by Edward Gow, 13 Nov 80, at the APBI, Troy, MI

"Non-Contact Diagnostics," by Donald S. Sarna, 13 Nov 80, at the APBI, Troy, MI

"Signature Considerations in the Design of Future Close Combat Vehicles," by COL Herbert H. Dobbs, 18 Aug 81, at the 3rd Annual Keweenaw Research Center (KRC) Symposium, on Ground Vehicle Signatures, Houghton, MI

"Perspective of TACOM-KRC Signature Research Program," by O. Renius, 18 Aug 81, at the 3rd Annual KRC Symposium on Ground Vehicle Signatures, Houghton, MI

"Track Skirts as Thermal Suppression Devices for Armored Vehicles," by D. K. Wilburn, 19 Aug 81, at the 3rd Annual KRC Symposium on Ground Vehicle Signatures, Houghton, MI

"Infared Exhaust Suppression Test Bed," by W.R. Mick, Jr., 19 Aug 81, at the 3rd Annual KRC Symposium on Ground Vehicle Signatures, Houghton, MI

"IR/Thermal Digital Image Enhancement," by Dr. Grant Gerhardt and Jack Graziano, 19 Aug 81, at the 3rd Annual KRC Symposium on Ground Vehicle Signatures, Houghton, MI

"The TACOM Vehicle Effectiveness Technology System," by James L. Thompson, 1 Jun 81, at the 1981 Midwest Simulation Council Meeting, Oakland University, Rochester, MI

"R&D Management," by James L. Thompson, 6 Apr 81, to a US Army Reserve Class on Defense Research Management, Detroit, MI

"Color Encoding of Halographic Fringe Patterns with White Light Holography," by Dr. Grant Gerhardt, published in applied Optics, page 3085 (1 Sep 81)

"Algorithms and Hardware Technology for Real Time Classification and Target Detection of Military Vehicles," by Dr. Grant Gerhardt, Apr 81, at the Society of Photooptic Instrumentation Engineers Conference, Washington D.C.

"Holographic Analysis of Large Military Vehicle Structures," by Dr. Grant Gerhardt, May 81, at the BEACON Conference, Chicago, IL

"Pulse Holography and Stress Analysis," by Dr. Grant Gerhardt, Feb 81, at the Oakland University Graduate Seminar, Rochester, MI

ACTIVITY INDICATORS

"Holographic Study of the M151 and M113 Army Vehicles, The," by Dr. Grant Gerhardt, Oct 81, at the Shock and Vibration Information Center Symposium, San Diego, CA

"Tank Test Bed Program," by Clifford Bradley, 28 Jan 81, to GEN Starry HQ, TRADOC, Ft Monroe, VA

"Future Close Combat Vehicle Program," by Clifford Bradley, 24 Sep 81, to the American Defense Preparedness Association, Ft. Knox, KY

"Heavy Close Combat Vehicle Program," by Harry L. Hayter, Sep 81, at the Advanced Planning Briefing to Industry, Dearborn, MI

"Future Close Combat Vehicle Program," by Harry L. Hayter, Feb 81, to the Firepower Action Team, TACOM, Warren, MI

"Wheels Versus Tracks Study," by Roland A. Asolkis, 5 Nov 80, to the U.S. Army Combined Arms Combat Development Agency, Ft. Levenworth, KS

"Integrated Countermeasure Vehicle Test Bed Vehicle Program," by Roland A. Asoklis, 13 Nov 80, at the APBI, Troy, MI

"Armored Forward Area Rearm Vehicle Protection Level Versus Ammunition Payload Concept Study, by Roger Halle, 10 Apr 81, at Ft. Knox, KY

"Armored Forward Area Rearm Vehicle Concept Study," by Roger Halle, 14 Nov 80, at Ft. Knox, KY

"Elevated Kinetic Energy Weapon Program," Roger Halle, 11 Jun 81, at Ft. Benning, GA

"Armored Forward Area Rearm Vehicle Program," by Roger Halle, 31 Jul 81, at TACOM, Warren, MI

"Armored Forward Area Rearm Vehicle Cost," by Roger Halle, 24 Aug 81, at TACOM, Warren, MI

"Future U.S. Main Battle Tank Studies," by J.B. Gilvydis, 6-10 Oct 80, to German Ministry of Defense, Bonn, Fed Ofc of Tech, Koblenz, Government Test Facility, Lichtenav, Pietzch Corp., Ettlingen, FGR and to the U.S. Army Ballistic Research Laboratories, Aberdeen, Proving Ground, MD on 2 Dec 80

"Reconfigured M1 Tank Studies," by J. B. Gilvydis, 29 Oct 80, to BG D. D. Ball, 29 Oct 80, to the Armor Group at Ft. Knox, KY, and 5 Nov 80, to MG Maloney, DCSRDA, HQDA, Washington, D.C.

Innovative Mobility Designs Utilized on Foreign Wheeled and Tracked Vehicles," by R.W. Kaczmarek, 16-20 Aug 81, at the 7th International Society of Terrain-Vehicle Systems, Calagray, Alberta, Canada

"Improved Technique of Field Ring Shear Testing for Soil Strength Determination," Co-authored by Zoltan J. Janosi and L.L Karafiath, 16-20 Aug 81, at the 7th International Society of Terrain-Vehicle Systems, Calgary, Alberta, Canada

"Investigation of Advanced Spectral Analysis Techniques," by R.A. Daigle, 16-20 Aug 81, at the 7th International Society of Terrain-Vehicle Systems, Calgary, Alberta, Canada

"Initial Validation of a Mathematical Model of Steering Techniques," by David A. Sloss and Dennis L. Calbeck, 16-20 Aug 81, at the 7th International Society of Terrain-Vehicle Systems, Calgary, Alberta, Canada

"Tire Turning Forces under On- and Off-road Conditions," Co-authored by Zoltan J. Janosi, J. Kamm and Gil Uray, 16-20 Aug 81, at the 7th International Society of Terrain-Vehicle Systems, Calgary, Alberta, Canada

ACTIVITY INDICATORS

"Use of NATO Reference Mobility Model in Military Vehicle Procurement, The," by Zoltan J. Janosi, SAE Paper No. 810373, International SAE Congress (Feb 81) Detroit, MI

"NATO Reference Mobility Model, Background and Implementation," by Zoltan J. Janosi, 27-28 May 81, at the NRMM Managerial Seminar offered to Industry, Troy, MI

"NATO Reference Mobility Model, Program Structure and Algorithims," by Peter W. Haley, at the MRMM Managerial Seminar, Troy, MI

"NATO Reference Mobility Model, Program Structure and Algorithims," by Peter W. Haley, 11-13 Jul 81, at the NRMM Technical Seminar at Stevens Institute of Technology, Hoboken, NJ

"NATO Reference Mobility Model, Program Structure and Algorithims," by Peter W. Haley, 11-14 Jul 81, at the NRMM Technical Seminar, Calgary, Alberta, Canada

"Tank Test Bed Program," Clifford D. Bradley, 9-10 Jan 81, for LTG Keith, ODCSRDA, GEN Guthrie, CDR, DARCOM, and GEN Vessy, VCSA, Pentagon, Washington, D.C.

"Combat Vehicle Survivability," by Otto Renius to visiting French Officers (COL Mounier, MAJ Cordaro, CPT Guilmain), 8-9 Oct 80, at TACOM

"Vehicle Countermeasures," by Otto Renius to USODR&D, 16 Dec 80 at TACOM

"Signature Reduction Techniques," by Otto Renius to Dr. Pierre, ASDARD, 16 Dec 80 at TACOM

"Survivability of Combat Vehicles," by Otto Renius to MG Ball, M1 PM, 14 Feb 81 at TACOM

"Combat Vehicle Survivability," by Otto Renius, to GEN Guthrie, CDR DARCOM, 25 Feb 81 at DARCOM

"Non-traditional Survivability," by Otto Renius to BG Screaton, Canadian Defense HQ, 5-7 Mar 81, Ottawa, Canada

"Survivability Enhancement Techniques," by Otto Renius to Dr. O'Neill, Pres, Army Science Board, 31 Jul 81, Warren, MI

"Signature Reduction Techniques, by Otto Renius to Mrs. Holber, Dep ASDAR&D, 8 Jul 81, TACOM

"Survivability Enhancement," by Otto Renius ADPA, 23-24 Sep 81 at Ft. Knox, KY

SEMINAR/COMMITTEE CHAIRMANSHIPS

Session Chairman, 3rd Annal Keweenaw Research Center (KRC) Symposium on Ground Vehicle Signatures, 18-19 Aug 81, D. K. Wilburn

Session Chairman, 3rd Annual KRC Symposium on Ground Vehicle Signatures, 18-19 Aug 81, O. Renius

Session Co-Chairman, 1980 Shock and Vibration Information Center Symposium on "Experimental Stress Analysis," Dr. Grant Gerhardt

Session Co-chairman, Armored Forward Area Rearm Vehicle Joint Working Group, Ft. Knox, KY, 15-16 Jul 81, Roger K. Halle

Session Co-chairman, Armored Maintenance Vehicle Mission Element Need Statement Joint Working Group, Aberdeen Proving Ground, MD, 16-17 Sep 81, Roger K. Halle

Chairman, Mobile Force Countermeasure Workshop, Naval Postgraduate School, Monterey, CA, Dec 80, Otto Renius

Chairman, 27th Army Mathematicians Conference, West Point, NY, 10-12 Jun 81, James L. Thompson

Session Chairman, Technical Management Committee of the NATO Reference Mobility Model, 21 Aug 81, Calgary, Alberta, Canada, Zoltan J. Janosi

Panelist, Field and Terrain Evaluation Session at the 7th International Society for Terrain-Vehicle Systems, 16-20 Aug 81, Calgary, Alberta, Canada, Zoltan J. Janosi

Chairman, Joint Service Guidance & Control Committee, Countermeasure Working Group, Dec 80, Monterey, CA, Otto Renius

Chairman, Mobile Force Countermeasure Workshop, Naval Postgraduate School, 9-12 Dec 80, Monterey, C. Otto Renius

Member, program committee, 3rd Ground Target Signature Symposium, Michigan Technological University, 18-19 Aug 81, Houghton, MI, Otto Renius

PATENTS ISSUED 1 Oct 80 -30 Sep 81

METHOD OF REMOVING A TRACK PIN FROM A TRACK SHOE
US Patent 4,266,016 issue 7 Oct 80
to Nathaniel Carr

MINIATURE TARGET VEHICLE
US Patent 4,226,292 issued 7 Oct 80
to Anthony J. Monte and Ernest C. Wahoski

CARGO TIE DOWN ANCHOR MEANS
US Patent 4,229,132 issued 21 Oct 80
to Chester J. Taylor

MANUAL OVER-RIDE FOR SHORT STROKE VALVE
US Patent 4,245,660 issued 20 Jan 81
to Edward J. Roznieckl

CLUTCH EMPLOYING CONSTANT FORCE SPRINGS
US Patent 4,252,224 issued 24 Feb 81
to Erwin F'Geppert

VEHICLE SUSPENSION USING PRESSURIZED BOURDON TUBES
US Patent 4,254,970 issue 10 Mar 81
to Dr. Ernest N. Petrick

CARTRIDGE EJECTOR
US Patent 4,262, 578 issued 21 Apr 81
to William R. Bains

FIRE SUPPRESSION BLADDER SYSTEM FOR FUEL TANKS
US Patent 4,262,749 issued 21 Apr 81
to Anthony J. Monte

MECHANISM FOR REMOVING DUST PARTICLES FROM AN ENGINE AIR CLEANER
US Patent 4,266,953 issued 12 May 81
to Bernard A. Matthys, Donald W. Scheon, and Carl E. Anderson

LOCKING CONNECTOR
US Patent 4,266,591 issued 12 May 81
to Erwin F'Geppert

DRIVE MECHANISM
US Patent 4,272,998 issued 16 Jun 81
to Erwin F'Geppert

BLACK-OUT LIGHTING FOR VEHICLES
US Patent 4,277,819 issued 7 Jul 81
to Valentine M. Sobota and Marshall Vinson

CLOG-PROOF CHECK VALVE
US Patent 4,289,166 issued 15 Sep 81
to Harold R. Haines

BOOM LIFT LOAD RELIEF
US Patent 4,289,442 issued 15 Sep 81
to James L. Stevens

PATENT APPLICATIONS FILED 1 Oct 80 - 30 Sep 81

ANNULAR SEAL
Ser No. 251,610 filed 6 Apr 81
by Roger R. Smith

FULL SPECTRUM SELECTIVE COLOR PRODUCING AND SPRAYING DEVICE
Ser No. 270,329 filed 4 Jun 81
by Marion V. Gwyn

TAPERED ROLLER BEARING
Ser No. 277,477 filed 26 Jun 81
by Erwin F'Geppert

CONTINUOUS SHAFT SEAL
Ser No. 277,457 filed 26 Jun 81
by Erwin F'Geppert

MILITARY VEHICLE IDENTIFICATION SYSTEM
Ser No. 278,808 filed 29 Jun 81
by Harry R. Young

SPEED REDUCER
Ser No. 282,895 filed 13 Jul 81
by Erwin F'Geppert

TOWBAR ASSEMBLY
Ser No. 266,223 filed 22 May 81
by Roger R. Smith

COMPASS
Ser No. 289,938 filed 4 Aug 81
by John G. Bennett

SEGMEMTED CLUTCH PLATES
Ser No. 292,308 filed 12 Aug 81
by Erwin F'Geppert

BLAST ACCELEROMETER
Ser No. 297,294 filed 28 Aug 81
by Anthony SanMiquel

COMPOSITE FLOOR ARMOR FOR MILITARY TANKS FOR THE LIKE
Ser No. 297,295 filed 28 Aug 81
by Anthony SanMiquel

COVER HOLD DOWN MECHANISM
Ser No. 193,255 filed 2 Oct 80
by Erwin F'Geppert

RESILIENT BAND STRUCTURE
Ser No. 245,481 filed 19 Mar 81
by Algis L. Lapsys

LIGHTWEIGHT ONE PIECE SIDE RACK WITH STAKES FOR FLATBED SEMITRAILER
Ser No. 194,646 filed 6 Oct 80
by Earl M. Ash

TRAILER FRAME BEAM
Ser No. 200,297 filed 24 Oct 80
By Andrew J. Scully

STOPS FOR BAR STOCK IN A LATHE
Ser No. 215,950 filed 1 Dec 80
by William Arnold

TURBINE WHEEL FOR HOT GAS TURBINE ENGINE
Ser No. 220,947 filed 29 Dec 80
by Andrew J. Scully

DISCONNECTABLE COUPLING
Ser No. 230,922 filed 2 Feb 81
by Erwin F'Geppert

FUEL TRUCK FIRE ESCAPE MECHANISM
Ser No. 236,100 filed 20 Feb 81
by Anthony J. Monte

AMMUNITION STORAGE AND TRANSFER MECHANISM
Ser No. 238,313 filed 26 Feb 81
by Joseph M. Dabrowski, Valentine P. Daubar, Richard H. Fryer, John Geraltowski, James R. Underwood, Roger K. Waid and Jaunutis B. Gilvydis

REVERSIBLE KINGPIN FOR TRAILERS
Ser No. 241,292 filed 6 Mar 81
by Erwin F'Geppert

LOGISTIC VEHICLE ARMOR
Ser No. 243,287 filed 13 Mar 81
by Victor H. Pagano

DRIVING GUIDANCE SYSTEM AND RESILIENT VEHICLE PROPULSION BAND
Ser No. 244,548 filed 16 Mar 81
by Algis L. Lapsys

ACTIVITY INDICATORS

TECHNICAL REPORTS

TITLE	NUMBER	CONTRACT NO.	PRINT DATE
Field Expedient Infrared Countermeasurers and Tactics for Armored Vehicles	12505	IN-HOUSE	01/81
Electrically Heated Windshield Defrost System Performance Evaluation	12510	DAAK30-79-G-0002	11/80
Research on Fire Control Concepts for Maneuvering Targets	12511	DAAK30-79-C-0104	12/80
Advanced Heater Components	12514	DAAK30-79-C-0091	09/81
Bonded Brake Lining on Fabricated Welded Brake Shoes: Test of	12516	IN-HOUSE	10/80
Forging of Powder Metallurgy Gears	12517	DAAK30-78-C-0029	02/81
Some Thermal Suppression Considerations for the XM-1 Tank	12518	IN-HOUSE	12/80
Feasibility Study and Conceptual Design of XM1E1 Automatic Loader	12519	IN-HOUSE	10/80
Evaluation of Gunner Station Configurations for Firing-on-the-Move	12520	IN-HOUSE	11/80
Isothermal Forging of Large Gears by P/M Techniques	12521	DAAK30-78-C-0099	02/81
Analytical Model for the Turning of Tracked Vehicles in Soft Soils	12522	DAAK30-78-C-0080	12/80
M60 Crew Compartment Air Leakage Reduction	12524	IN-HOUSE	11/80

ACTIVITY INDICATORS

M113A1 Armored Personnel Carrier (APC) Air Leakage Reduction Study	12527	IN-HOUSE	11/80
Battery Heater Feasibility	12528	IN-HOUSE	10/80
Rotational Molding of Large Capacity Fuel Tanks for Combat Vehicles	12529	IN-HOUSE	10/80
Manufacture of Flat Light Gage Alloy Steel Armor Plate, Egar-Thompson-Irvin Works	12532	DAAK30-78-C-0128	10/80
Analysis of Vibration Data Demonstrated with a T-142 Track Test	12533	IN-HOUSE	11/80
Prototype Banded Radial Tire	12534	DAAK30-78-C-0096	01/81
Propulsion Systems Division In-house Laboratory Independent Research (ILIR) FY80 Reports	12535	IN-HOUSE	10/80
Joining Dissimilar Metals	12536	IN-HOUSE	09/81
Feasibility Concepts Analysis The AMX-1000 Hydrokinetic Transmission	12537	DAAK30-79-C-0063	04/81
Generic Components Qualification For Diagnostic Connector Assemblies--Phase II	12541	DAAK30-79-C-0109	03/81
Performance Evaluation of An 0-350 CFM FLow Capacity Soviet Ventilator Blower/ Dust Separator and NBC Filter	12542	IN-HOUSE	07/81
Revision of Acoustic Detection Range Prediction Model Based on Psychoacoustic Study of Low Frequency Masking	12543	DAAK30-80-C-0090	01/81

Modified Acoustic Detection Range Prediction Model (ADRPM-V) Volume 1	12544	DAAK30-80-C-0006	04/81
Results of a Demonstration of Detection of Helicopters from an Operating Tank	12545	DAAK30-79-C-0088	04/81
Prototype RCTV's for Copperhead OT II	12546	DAAK30-78-C-0025	02/81
Operational Effectiveness Evaluation of Conceptual Wheeled Armored Combat Vehicle	12547	DAAK30-79-C-0137	02/81
High Speed Inspection of Flux-Core Wire	12549	DAAK30-79-C-0054	05/81
TACOM Advance Engine Studies Ceramic Coatings, Phase 6	12550	DAAK30-79-C-0092	01/81
Development of Ammunition *Compartment Design Criteria*	12551	DAAK30-79-C-0061	04/81
WASP II Concept Feasibility Program	12553	DAAK30-78-C-0111	03/81
Side Load Deflection Test of Track/Roadwheels, Conventional and Experimental of M60A1 Tanks	12555	IN-HOUSE	09/81
Spall Suppressive Armor System for M113A1/AL APC	12559	DAAK30-80-C-0023	07/81
The Development of an Advanced Electronic Fuel Injection System for High Output Diesel Engines	12560	DAAK30-77-C-0086	04/81
Airborne Platform System Study for Battlefield Surveillance Applications	12562	DAAK30-80-M-0045	08/81
Semiautomatic Counterfire System Development	12564	DAAK30-80-C-0028	08/81

ACTIVITY INDICATORS

Parametric Analysis of the Off-Road Performance of the HIMAG Vehicle	12568	IN-HOUSE	09/81
Development of Adaptive Fluidic Vibration Damper, Phase 2	12569	DAAK30-80-C-0045	09/81
Failure Analysis Studies of T-142 Track Pads	12570	IN-HOUSE	06/81
Mechanical Alloying of Metal Powders; A Study of	12571	IN-HOUSE	06/81
Electrostatic Dust Remission	12572	DAAE07-80-C-9033	09/81
Formation and Failure of Elastomer Networks via Thermal, Mechanical and Surface Characterization-Phase II	12573	DAAK30-78-C-0098	07/81
Manufacture of Improved Large Armor Steel Castings	12578	DAAK30-79-C-0129	09/81
TACOM Advanced Turbine Engine Studies	12582	DAAE07-80-C-9127	06/81
Investigation Into Failure of Tank Track Pads	12583	IN-HOUSE	09/81
Voltage Regulation of 12-volt Trailers to 24-volt Tractors	12594	IN-HOUSE	09/81
Data Management System Concept Design Study	12598	DAAE07-80-C-9100	08/81
Conformance of Storage Battery to Tensile Strength and Elongation	12605	IN-HOUSE	08/81

FACILITIES

OVERVIEW

The U.S. Army Tank-Automotive Command's R&D Center Laboratories and shops are equipped to develop and support the military vehicle fleet. Research and study are performed here on propulsion systems, surface mobility systems, vehicular components, and materials, from concept through prototype. Replacement cost of these facilities in today's dollar is $173,800,000.

We turned in aging equipment valued at approximately $1,541,814 as excess/unserviceable property. The test-vehicle fleet was reduced to 63 vehicles.

We acquired, at no cost to the Government, excess LTV Corporation property conservatively valued at over $150,000. This property is operable and will be used in the fabrication facility here or at the Keweenaw Field Station, Houghton, MI.

The increasing need for the modernization of test facilities and experimental fabrication machine tools has resulted in the decision to prepare an updated master plan for a 5- to 10-year modernization effort. This plan, which includes funding alternatives, will require expenditures of more than $5 million per year.

PHYSICAL SCIENCE LAB

The laboratory has facilities for extensive investigations into vehicle signatures and signature reduction methods. Non-destructive test capabilities include holographic analysis. Mini-computers and remote terminals provide a ready capability for engineering analysis, modeling, and simulation studies. Automated word processing equipment provides the capability to readily retrieve stored technical source and technical report data.

PROPULSION SYSTEMS LAB

Present facilities include nine test cells: two are transmission cells, one is a vehicle cell, and six are for engines. One cell is equipped with a semianechoic chamber. Cell 9 is equipped to test tracked and wheeled vehicles at temperatures up to 160°F, for solar radiation simulation and wind speeds up to 20-MPH.

TRACK AND SUSPENSION LAB

One of the outstanding features of this laboratory is its dynamic simulation capability. Vibration and shock inputs from terrain tapes are fed through hydraulic actuators to the tires, wheel spindles or roadwheel arms. The simulation approaches permit accelerated testing of vehicles and components so that designs can be optimized without time-consuming field testing. Smaller actuators accommodate fatigue tests on components and subsystems.

EXPERIMENTAL FABRICATION

This facility includes sheet metal, welding and machining equipment capable of fabricating steel or aluminum hulls and turrets. The assembly area has high bays and heavy-duty cranes to handle vehicles up to 60-tons. The experimental foundry model and pattern shop, heat treating, plating and painting equipment complete the fabrication complex.

ELECTRO-MECHANICAL SYSTEMS

Additional facilities permit testing of engine accessories such as tank air cleaners, electrical equipment components, and [redacted]

KEWEENAW FIELD STATION:

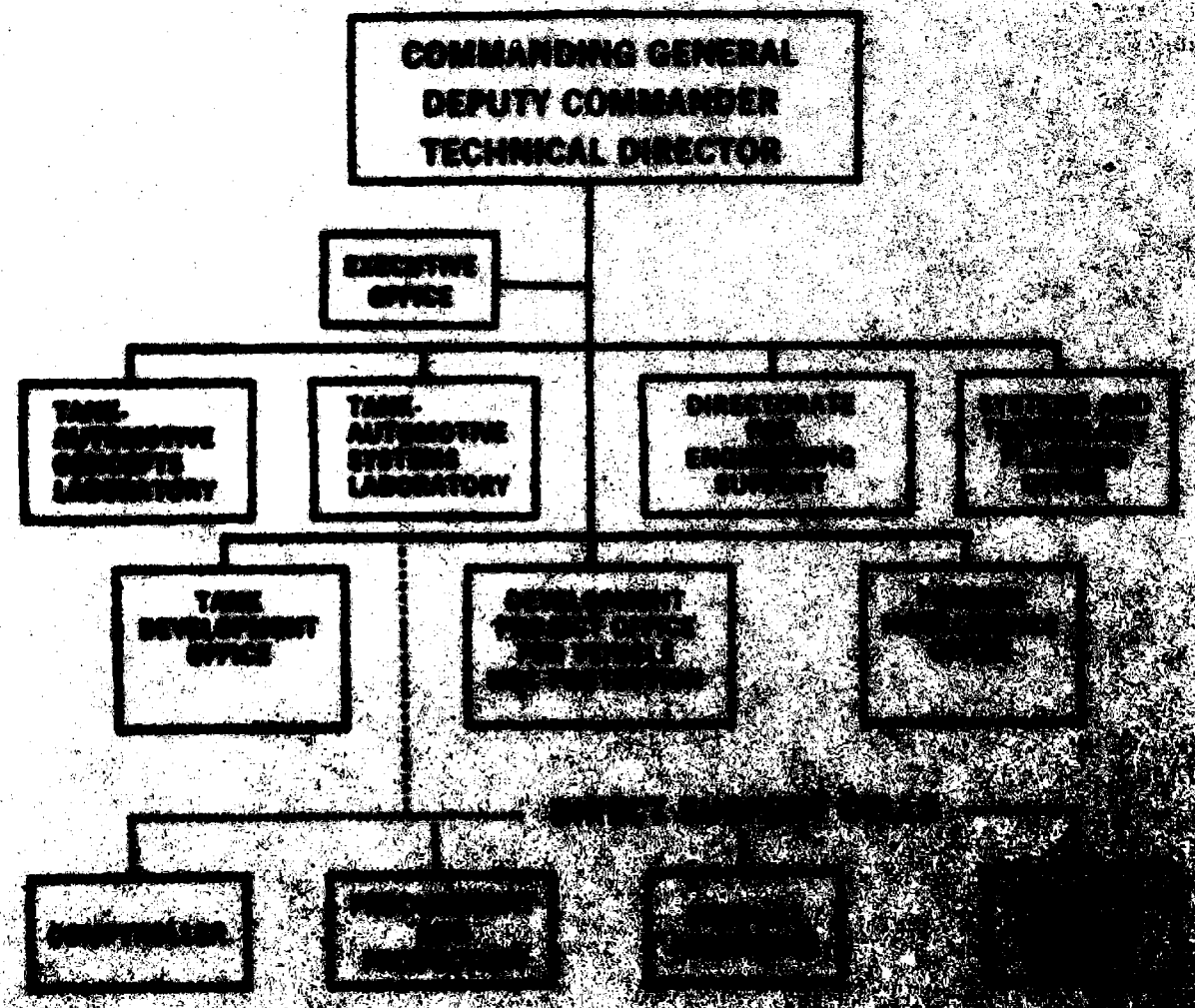
The Keweenaw Field Station located at Houghton, MI, is managed by the Keweenaw Research Center at the Michigan Technological University. It consists of vehicle maintenance shops, small machine shop storage and office buildings. It houses many types of support vehicles and equipment. A wide variety of R&D work, along with related field testing in support of TACOM's mission, is performed there.

Edited and coordinated by:
JAMES N. BOBLENZ, Technical Editor and
Project Officer for the Posture Report

Suggestions to improve this report are welcome.
[redacted]
U.S. Army Tank-Automotive Command,
ATTN: DRSTA-TS, Warren, MI 48090

ORGANIZATION CHART

U.S. ARMY TANK-AUTOMOTIVE COMMAND RESEARCH AND DEVELOPMENT CENTER




DAT
FILM