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S-TANK AGILITY/SURVIVABILITY (STAGS) TEST

TEST PLAN
BY
LTC JAMES A. BOEHME

US ARMY
ARMOR & ENGINEER BOARD
FORT KNOX, KENTUCKY

FOREWORD

This test was designed and coauthored by the following personnel:

TRASANA	-	Mr A. Freeberg Mr Ron Cooper
HEL	-	Mr A. Eckles
USAARENBD	-	Mr J. Kelton MAJ T. Covington MAJ J. Maharrey MAJ C. Macchiaroli Mr W. Mayhew CPT M. Selvitelle

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SECTION 1. INTRODUCTION

1.1 BACKGROUND

The Defense Advanced Research Projects Agency with the concurrence of Department of Defense for Research and Evaluation (DDR&E), and the cooperative participation of the Army and Marine Corps, has been involved for the past 2 years in an exploratory development effort to advance the state-of-the-art in armored combat vehicle technology. An important part of the program is an assessment of foreign tank technology. Accordingly, DDR&E has requested that ARPA conduct an evaluation of the Swedish S-Tank with participation and support by the Services. MG Donn A. Starry, Commanding General, US Army Armor Center and Fort Knox, accepted responsibility for conduct of the S-Tank test and evaluation. MG Starry designated the US Army Armor and Engineer Board as his agent for the management of the test program.

1.2 DESCRIPTION OF MATERIEL

1.2.1

The Swedish S-Tank (Strv 103) incorporates design features unique to the current fleet of main battle tanks found in armies throughout the world. The main difference between the S-Tank and conventional turreted tanks is that the Strv 103 is turretless with the main weapon (105MM) in a fixed mounting in the hull. In consequence, its gun is elevated or depressed by altering the pitch of the hull by means of an adjustable hydropneumatic suspension and traversed by turning the whole vehicle. Traversing is accomplished by a clutch-and-brake mechanism for rapid turns and a hydrostatic drive for fine steering movements.

1.2.2

The fixed-gun design produces three desirable results. The first is the reduced silhouette afforded by the elimination of the turret. In theory, this presents a more difficult target to enemy weapons, and consequently reduces the probability of being hit by anti-tank fire. Secondly, the fixed gun eliminates the space within the armor envelope for movement of the breech, and allows for the provision of an automatic loader. The automatic loader has eliminated the need for a loader, thereby further reducing the required interior space. Information from Sweden indicates that the S-Tank has a reduced frontal vulnerability to various rounds. Thirdly, since control of the main gun is by movement of the hull, the S-Tank has integrated driving and gun controls. In an emergency, one man can operate the tank.

1.2.3

The S-Tank is powered by two engines. The primary engine for normal operations is a 6-cylinder multifuel (diesel) piston engine. For "combat drive" a nonregenerative turbine provides greater output. The hydropneumatic suspension system and automatic loader are powered by the piston engine (with a manual backup system).

1.2.4

The main armament of the S-Tank is a 105MM gun (62 calibers long). Two 25-round ammunition magazines load the weapon. Two 7.62MM machineguns are located in fixed mountings in the hull, and one 7.62MM machinegun is located in the flexible mounting on the commander's observation dome.

1.2.5

The S-Tank has a permanently attached collapsible screen for swimming. The S-Tank can be fitted with a bulldozer blade for simple grading work.

1.3 TEST OBJECTIVES

1.3.1

Evaluate the combat effectiveness of the features of the S-Tank which might be considered in the design of future armored vehicles.

1.3.2

Compare the performance of the S-Tank with existing tank systems.

1.3.3

To evaluate the effects of mobility, agility and silhouette on tank survivability.

1.4 SCOPE

1.4.1

The test of the Swedish S-Tank will be performed by the Armor Test Branch, US Army Armor and Engineer Board at Fort Knox, Kentucky. Limited testing is to be conducted at Fort Bliss, Texas. The duration of testing will be 6 months from the time the S-Tank is received at Fort Knox. Two Swedish S-Tanks will be available for test purposes, and two M60A1 (with add-on stabilizer (AOS)) will be operated and fired concurrently with the test vehicles for direct comparison of capabilities during selected mobility, survivability, and functional field testing exercises. Two M60A1E3 will be evaluated during selected areas of the test. Test personnel will be instructed in and will follow all safety precautions in the equipment publications, or other pertinent documents during the conduct of the test.

1.4.2

Testing to be performed includes: vehicle characteristics; Fort Knox and Fort Bliss Mobility Courses; live fire exercises; gun camera

exercises; human factors evaluation; and survivability and silhouette experiments.

1.4.3

Training of the S-Tank crews will be conducted at Fort Knox by two Swedish Army officers. A total of 7 weeks training with seven three-man crews will be performed. Driving, crew maintenance, battle drill, and live firing will be stressed in the course. Each crewmember will be tested at the end of training to evaluate his performance as an S-Tank crewmember.

1.4.4

Operator maintenance will be performed by the trained crews under supervision of Swedish Technical Advisors. Higher level maintenance will be performed under the direction of Swedish maintenance experts.

1.4.5

The limited time available for testing has necessitated the reliance on a large amount of data previously recorded on the S-Tank, i.e., its performance, capabilities, etc. The Fort Knox testing will be structured to partially validate and verify selected portions of data obtained from earlier Swedish and British reports on the S-Tank.

1.4.6

Data recorded during Fort Knox testing, and data collected from Swedish sources will provide a basis for comparative analysis with existing Army tank systems, and inputs for the AMC Mobility Model and Tank Exchange Model (TXM). In addition, data will be collected to provide future inputs to the Dynamic Tactical Simulation (DYNTACS). The AMC Mobility Model will be used to rank the S-Tank's maximum cross-country speed along given paths

against performance of other tanks and scout vehicles. The TXM and ultimately DYNTACS simulation will be used to compare the S-Tank's performance against other tanks and antitank weapons in a force-on-force environment.

1.4.7

The scope of the test and the S-Tank areas of interest has required that the USAARENBD obtain support from a number of additional agencies. Support roles defined to date include:

1.4.7.1 TRADOC System Analysis Activity (TRASANA). Assistance in the areas of test design, test planning, test conduct, and evaluation of results (with emphasis on the interface of testing and the computer simulations).

1.4.7.2 United States Army Human Engineering Laboratories. Assistance in the collection and reduction of data pertinent to HFE. Participate in survivability and intervisibility/silhouette experiments.

1.4.7.3 BDM Corporation. Assistance in the collection and analysis of existing S-Tank data.

1.4.7.4 United States Army Waterways Experimentation Station. Record data for input to AMC 71 model.

1.4.7.5 White Sands Missile Range. Data reduction of gun camera film.

1.4.7.6 ARSV Task Force. Assistance in planning and conduct of Fort Knox and Fort Bliss mobility/agility courses.

1.4.7.7 AMC Agencies (TACOM, AMSAA, USABRL). Provide necessary data requirements for computer analysis and simulation, e.g., vulnerability, mobility, survivability, and hit probability.

SECTION 2. DETAILS OF TEST

2.1 ABBREVIATED TEST OF VEHICLE CHARACTERISTICS

2.1.1 Preoperational Inspection; Physical Characteristics, and Break-In Operations (TOP 1-3-504 and 1-3-505)

2.1.1.1 Objectives

a. To ensure that the S-tank and control vehicles and their weapon and communication systems are in proper condition for test operations.

b. To record the physical characteristics of the S-tank.

c. To ensure adequate break-in of all vehicular components.

d. To verify proper functioning of vision devices, armament, and fire control subsystems, and to conduct necessary functional firing checks of both test and control vehicles.

e. To verify that all items of the maintenance test package have been received.

f. To record the nomenclature, serial number, and other identifying information for each S-tank (vehicle) and its components.

2.1.1.2 Method

a. The S-tank and control vehicles will be given a technical inspection on receipt. Repairs and adjustments will be made as necessary to place the vehicles in the best possible operating condition. The inspection will be accomplished by contractor (BOFORS) maintenance personnel (with assistance of assigned project personnel where required) and will include:

(1) A complete check of automotive components and equipment.

(2) Functional and serviceability checks of vision devices, armament, fire control systems to include dry firing, verification of superelevation values, and other ballistic corrections provided in the sighting system.

(3) Checking the operational readiness of the communication system.

(4) Checking the operational readiness of the fixed fire extinguisher system on the test items by removing and weighing the cylinders. With engine operating, actuation of the control handles to verify time delay and fuel shutoff.

(5) Checking and updating entries in the equipment logbooks (if appropriate).

(6) Recording of bore gauging measurement reflecting condition of weapon bores at the start of the test for reference in assessing wear characteristics.

b. The test vehicles will be weighed (both curb and gross vehicle weight), measured dimensionally, and checked for other characteristics related to configuration. Photographs will be taken. The ground clearance of each test vehicle will be measured before and after the vehicle is combat loaded.

c. The main armament and secondary weapons systems of all test and control vehicles will be fired remotely and any malfunctions will be recorded. (This will be accomplished as part of the training exercises.)

d. The maintenance test package will be inventoried and any discrepancies noted. The basic issue items of all test vehicles will be inventoried and checked for completeness and evidence of damage. The basic issue items, if available, for one vehicle will be displayed and photographed. Broken or missing items will be replaced.

e. The test vehicle will be inspected to ensure that required data plates, nameplates, caution plates, and other identification plates are provided. Caution plates will be posted in English for the US crews.

f. The complete nomenclature and serial number of all components (to include kits, if furnished) will be recorded.

g. The mileage on the odometer and any contractor installed counters and timers of each test and control vehicle will be recorded.

2.1.1.3 Data Required

a. Record of all results of the technical inspection to include a listing of all equipment faults noted and repair actions performed to correct the faults

b. Tabulation of vehicle dimensions, weights, ground clearance, and other pertinent vehicle physical characteristics

c. Photographs of the vehicle and basic issue items display

d. Inventory of the maintenance test package and basic issue items

e. Record of mileage indicated on vehicle odometers and any contractor installed counters and timers as they were received

f. Record of all servicing and adjustments performed

g. Record of all test firing to include lot number of ammunition fired, number of rounds fired from each weapons, and any faults noted

h. Record of identification and data plates

i. Record of notes on the adequacy of interpreted caution plates

j. Record of nomenclature and service number of all components.

b. Tabulation of vehicle dimensions, weights, ground clearance, and other pertinent vehicle physical characteristics

c. Photographs of the vehicle and basic issue items display

d. Inventory of the maintenance test package and basic issue items

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h. Record of identification and data plates

i. Record of notes on the adequacy of interpreted caution plates

j. Record of nomenclature and service number of all components.

2.1.1.4 Analytical Plan. Data will be evaluated to determine if the test and control vehicles are ready for testing.

2.1.2 Weapon System Calibration

2.1.2.1 Objectives

a. To determine the limits of adjustment provided in the sight or sight mount for boresighting and zeroing the sighting systems.

b. To determine the adequacy of the sighting system as mounted in the vehicle with respect to boresight and zeroing procedures and retention of adjusted alignment.

2.1.2.2 Method

a. Boresight

(1) Vertical and horizontal limits of adjustment provided in the driver/gunner's sighting system for boresighting the introduction of zeroing correction will be measured and recorded. Similarly, limits of adjustment provided in the

commander's sighting system will be measured and recorded. All measurements will be performed with vehicles on a concrete firing pad.

(2) A gridded target permitting measurements corresponding to angular accuracy of plus or minus 0.10 mil and comparable to that shown in figure 1 will be used. The tank under test and related sighting devices in turn will be positioned at the exact distance from the gridded target corresponding to the established mil values of the basic grid.

(3) Using appropriate gun controls, each sighting device in turn will be oriented to the center of the grid (or to some other point which is clearly defined) and the limits of movement, both vertically and horizontally, provided in various adjustments will be read from the scale of the target grid. All readings will be recorded.

(4) All armament and related sighting devices will be boresighted against suitable targets at 1,200-meter range (or the range required by Swedish procedures) using procedures prescribed in the operator's manual. The coax will be boresighted utilizing procedures specified in the operator's manual. 1,500 m

b. Zeroing

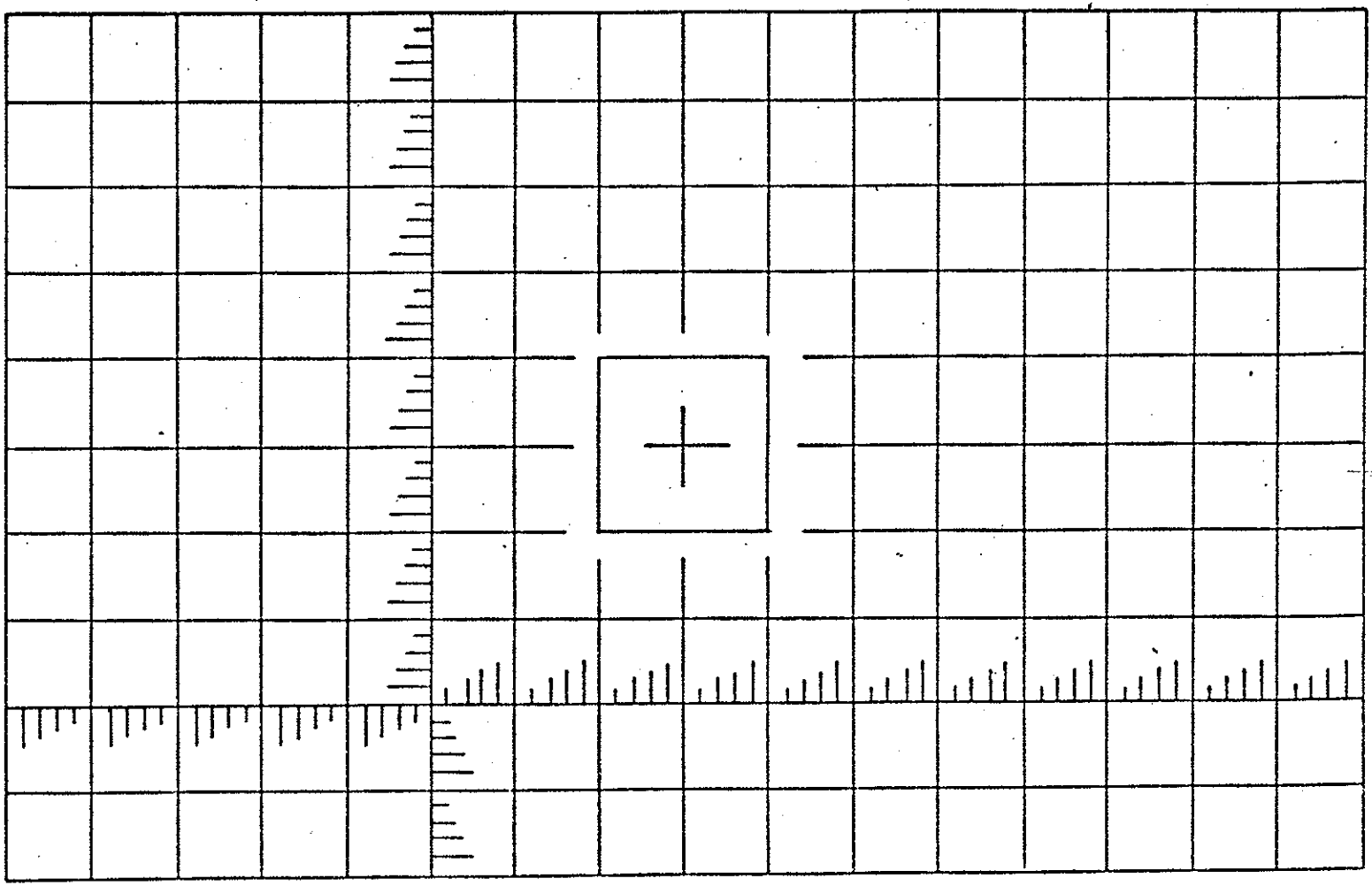
(1) Starting with the prescribed boresight alignment, the system will be zeroed in accordance with the operator's manual or other appropriate publication. Zeroing will be accomplished with the various types of ammunition provided for the main gun. The zeroing target will be 6.1M x 6.1M with appropriate aiming pattern (See figure 2.). (This exercise will be conducted as part of the live firing subtest.)

(2) Final zero settings of the telescope boresight marks will be recorded.

(3) Main gun throwoff produced by single-round firings will be observed and measured concurrently with zeroing of APDS-TP ammunition (i.e., three-round bursts). (NOTE: Throwoff is defined as the angular change in alignment of the gun and turret, vertically or horizontally, or both, which results from the firing of a round of main armament ammunition. It is a measure of gun and turret control system stability. It is also in part a measure of the recovery characteristics of the vehicular suspension system. The overall effect is reflected in the return of the sight to or near its original lay with respect to the point-of-aim.)

(a) Firing will be conducted against a vertical target at 1,200-meter range.

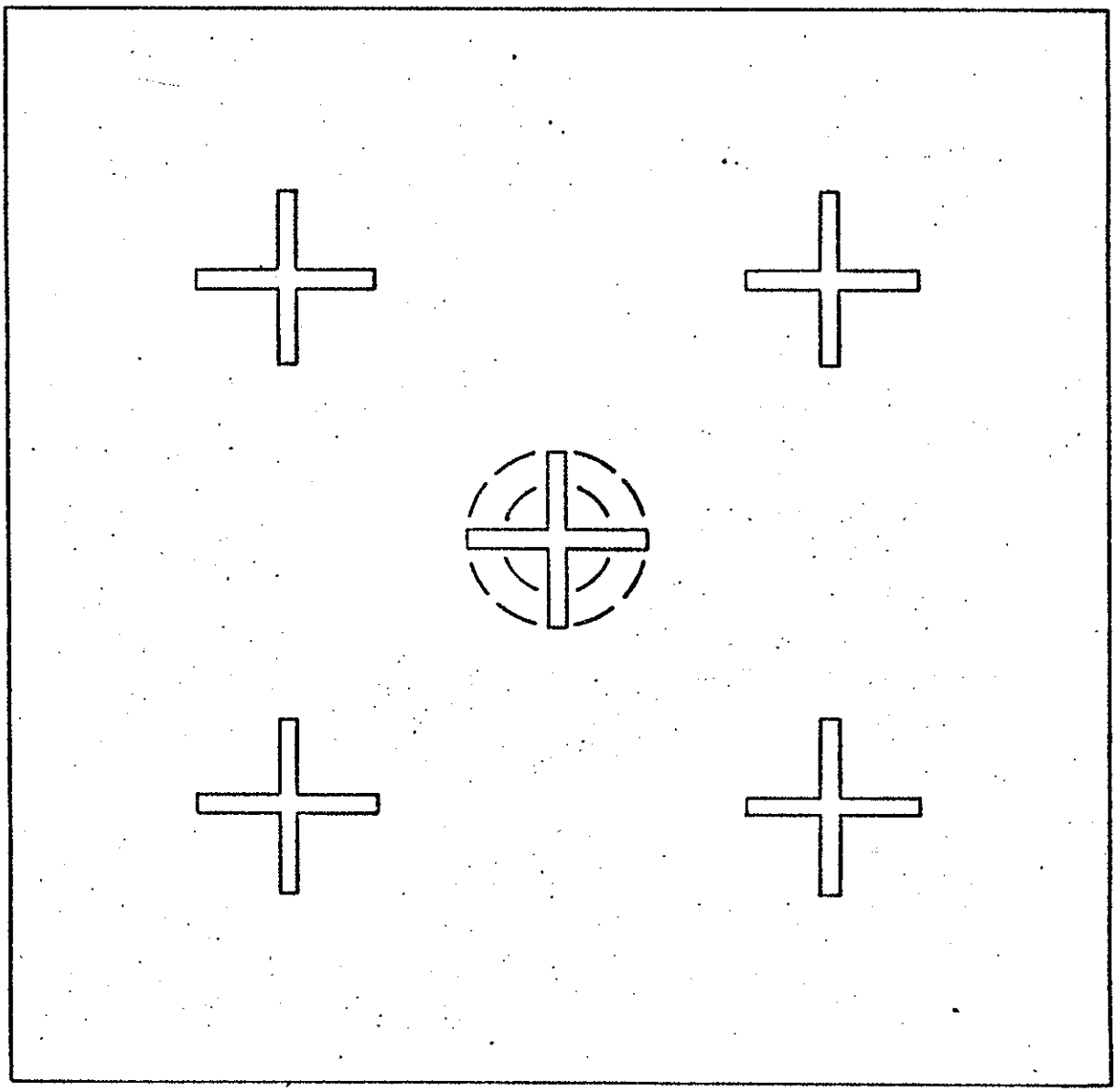
SAMPLE GRIDDED TARGET



Grid Pattern: 0.50-mil squares
Scale: 0.10-mil graduations

FIGURE 1. SAMPLE GRIDDED TARGET

SAMPLE BORESIGHT AND ZERO TARGET



Overall dimensions, 6.1m x 6.1m. Center cross and circle pattern is used for zeroing. All crosses have 1 meter members. Outlying patterns are used for confirming zero or round-to-round dispersion.

FIGURE 2. SAMPLE BORESIGHT AND ZERO TARGET

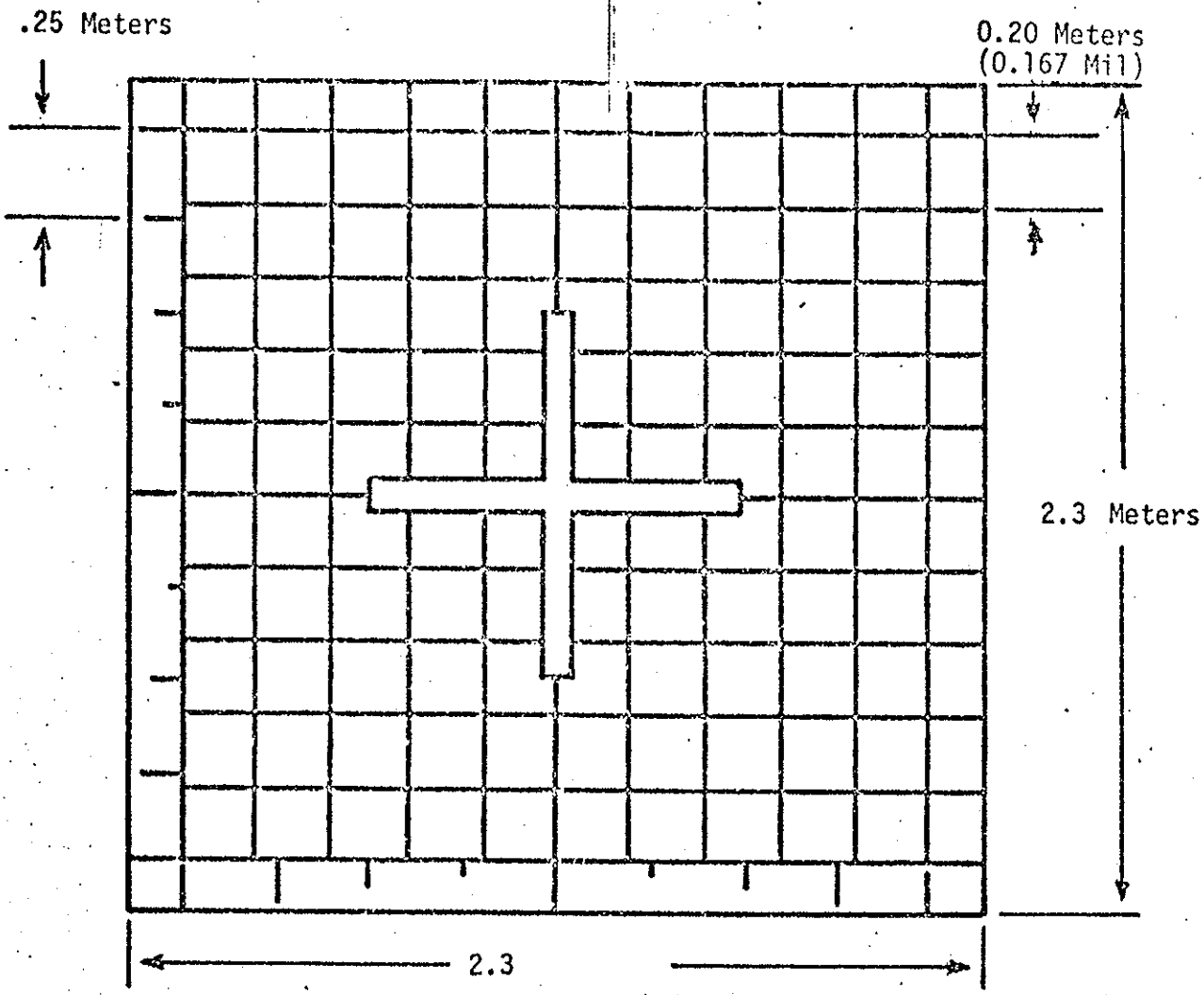
(b) A specially prepared 2.3M x 2.3M target cloth with a grid pattern as described below will be mounted (centered) on a larger (6.1M x 6.1M) target used for zeroing and dispersion. The pattern will include a clearly defined center cross for aiming, and a grid designed to permit reading the sight picture change as a result of firing with a precision of at least 0.25 mils from a range of 1,200 meters. (See figure 3.)

(c) A round will be loaded. Then, using the mode selected for the exercise for control of the gun and turret, the gunner will lay on the center cross. Before firing, he will note for later reference the exact relationship of the 1,200-meter aiming point on his primary sight and the center cross on the target. The round will then be fired. Camera on sight

(d) Without disturbing the lay of the gun after firing, the gunner will note the change in location of the sight reticle on the target and report the deviation from the center aiming cross.

(e) Projectile impact coordinates will be noted and recorded.

(f) Three APDS-TP rounds each will be fired from



NOTE: FOR USE AT 1,200 METERS

Explanatory Notes:

Pattern for preparation of a target cloth panel of dimensions shown; to be centered on 6.1-m X 6.1-m cloth or wire mesh backing. Aiming cross has 1-meter members.

FIGURE 3. SPECIAL 2.3-METER SQUARE GRIDDED TARGET

different test items. In each instance, the procedures prescribed above will be followed. (This will be conducted as part of the live fire exercises).

(g) The commander's sight will be used as a means for detecting any internal shift in alignment of the driver/gunner's sight apart from the throwoff effect.

(4) Coaxial Machinegun. Zeroing will be accomplished at a range of 800 meters using procedures presented in the operator's manual.

(5) Alignment of all sights will be checked periodically, and cumulative (running) records in the form of graphical plots backed by narrative explanation when necessary for clarity will be maintained for each sight and weapon showing the magnitude and direction of alignment deviation in terms of that established at initial zeroing adjustment. Entries accompanying daily operational log submitted by the test crews will include any change made in scale settings in conjunction with rezeroing, correction to restore alignment after noting deviation, realignment after removal or repair of the sight or an element of the system, etc.

(6) Prescribed boresight and zeroing procedures will be analyzed at the conclusion of all testing to determine whether

Note: barrel bend

or not any steps can be consolidated or should be restated for clarification.

2.1.2.3 Data Required

a. Record of vertical and horizontal limits of adjustment of all sights representing travel available for boresighting and zeroing

b. Record of zeroing exercises to include changes in settings of sight adjustment controls, impact data, CI locations and deviation of confirming rounds or groups

c. Record of zero settings, by ammunition type(s), as appropriate

d. Record of vertical and horizontal limits of adjustment available after zeroing

e. Continuing record of results from all checks pertaining to a sighting system stability and retention of adjusted alignment

f. Record of suggested changes in prescribed boresight and zeroing procedures, if applicable

g. Complete tabulation of gun throwoff values categorized by mode of control and type of ammunition

h. Record of projectile impact data by three-round groups for each ammunition type and each mode of control

i. Record of any irregularity in alignment of sights on the target after firing which would indicate an internal shift of the gunner's primary sight. Similarly, record of the tank commander's observations of throwoff and related aspects of sighting system reaction to firing

j. Record of each type of ammunition fired and its lot number

k. Record of weather conditions.

2.1.2.4 Analytical Plan

a. The limits of adjustment of weapon sights and mounts will be evaluated to determine if they are adequate for initial and subsequent boresighting and zeroing and for ease and simplicity of operation.

b. The gun throwoff data will be evaluated for its degree of deviation from the original line of sight. The resultant CI and dispersion for each three-round stability series will be compared to the results achieved in deliberate, repeat-lay firings in zeroing and dispersion. Minimal throwoff, combined with positive damping of vehicular motion, is critical to successful use of burst-on-target fire adjustment technique.

2.1.3 Functional Suitability - Weapon System and Fire Control Components

2.1.3.1 Objectives

a. To evaluate the performance characteristics of the S-tank main gun control system with respect to controlled response rates and operation and accuracy of the superelevation feature.

b. To evaluate the adequacy of provision for emergency control of the S-tank main armament.

c. To compare the functional suitability of the weapon and fire control systems of the S-tank with comparison items.

2.1.3.2 Method

a. The main gun and traverse control system will be functionally checked to determine whether or not response to control rates graduate continuously from a low to a high rate of tank/turret traverse and gun elevation-depression. Evidence of distinct change in rates of response, if any, will be noted. This will be accomplished at both the gunner's and commander's controls.

b. The capability of 6,400 mils (360°) continuous traverse will be verified.

c. Measurement of the maximum rate (slew) of traverse will be accomplished with both the S-tank and M60AOS tank. A stopwatch will be used to time the interval required to traverse the tank/turret 10°, 20°, 30°, 50°, 70°, and 90°. Timing is to start with the tank/turret at a standstill. In addition, maximum rate of response will be measured by timing a 90° interval with timing started with the tank/turret moving at a maximum rate. Rate of response in traverse will be computed in seconds per revolution. This will be accomplished at both the gunner's and commander's controls. The soil in which the exercise will be conducted will be characterized by USAWES personnel.

d. The primary and secondary armament will be observed during all firings on various targets at different ranges utilizing each of the items of ancillary equipment and subsystems provided

with the armament for performing its design function. This will be done in a sufficient number of trials to establish the functional suitability of the weapons, sighting and fire control components, and stabilization components.

e. During all firing exercises of both the S-tank and comparison tanks, the functional suitability of the components in the fire control system will be evaluated. Operations will be conducted under various weather conditions.

f. During all firing exercises conducted with primary armament ammunition, the functional suitability of the commander's and gunner's sighting system components will be subjectively evaluated. Operations will be conducted under conditions by daylight, haze, fog, darkness, and under various weather conditions.

g. The tank/turret control system of both the S-tank and comparison items will be operated in various modes to evaluate the performance and operational characteristics of the components of the systems with respect to traverse rates, main gun elevation and depression limits, will be recorded.

h. Throughout all firing exercises conducted during the test, crewmembers of both the S-tank and comparison items and project personnel will be instructed to evaluate critically the performance

of each component in the primary and secondary weapons systems, sighting systems, and fire control systems.

i. Operating characteristics of the emergency manual controls for traverse and elevation will be evaluated. After simulating failure of the K60 (piston) engine, the hand hydraulic pump will be used to elevate the gun. Degree of laying accuracy and time-to-lay at various ranges will be recorded. This procedure will be repeated using the clutch and brake system of the gas turbine to traverse the S-tank. (With both engines off, there is no system of traverse.)

2.1.3.3 Data Required

a. Record of results of checks of response rates

b. Record of confirmation of 6,400-mil (360°) continuous traverse

c. Record of time required to traverse the S-tank and comparison turrets 6,400-mil (360°) both from the commander's and gunner's station in clockwise and counterclockwise directions. Record of times to traverse 10°, 20°, 30°, 50°, 70°, and 90° from the standstill, and the maximum rate of response for 90°

evenness of tracking

d. Record of maximum elevation and depression of the primary weapon

e. Record of results of periodic recheck of all areas of performance

f. Record of evaluation for emergency manual controls

g. Record of weather conditions.

2.1.3.4 Analytical Plan

a. The response rates of the S-tank gun controls will be compared with the results of the comparison vehicles.

b. The provisions for emergency manual control will be evaluated for their adequacy to lay the gun quickly and accurately in an emergency situation.

2.1.4 Weapons Functioning

2.1.4.1 Objective. To determine whether the weapons function satisfactorily.

2.1.4.2 Method

a. Test personnel shall inspect each weapon system (weapon mount, recoil system, feed system, etc.) prior to each test operation that requires weapons to be fired.

b. Ammunition will be inspected and a record made of dents, bulges, long or short rounds, condition of links, and any other indications of deterioration.

c. During all firing tests, weapons will be observed for proper functioning with respect to loading, extraction, and ejection. Any improper functioning will be recorded together with pertinent details and firing conditions.

d. Each weapon will be fired under varied conditions of weather, exposure, tube life, gun elevation and azimuth, using appropriate ammunition.

e. Periodically during testing, the tube wear will be measured. Gauging of the main gun will be accomplished at frequent intervals by trained personnel.

f. The 45-round automatic loader will be operated in all available possible situations to assess any limitations of this system. Since the automatic loader is electrically controlled and hydraulically

operated, the system will be operated under simulated failures of these two modes. The ability to load and fire the main gun without benefit of the electrical and/or the hydraulic system will be evaluated. The five-round magazine will be evaluated similarly, with emphasis on the hand loading of these rounds by the backwards driver and backup systems if the hydraulic system fails. Manual operation of the breech will be evaluated and compared with that of the control vehicles.

2.1.4.3 Data Required

a. Record of test inspections

b. Record of each malfunction or stoppage to include:

(1) Model and serial number of weapon

(2) Total number of rounds (by type) fired prior to malfunction

(3) Ammunition type and lot number

(4) Type of malfunction (e.g., failure to fire, failure to extract or eject, partial ejection, etc.)

(5) Elevation of weapon if applicable

(6) Cant of weapon if applicable

(7) Orientation of the weapon with respect to the vehicle, if applicable

(8) Identification of part(s) or subassembly(s) which malfunctioned

(9) Measures taken and time required to place the weapon back into operation

c. Record of tube wear measurements and total rounds fired by type at the time of measurement

d. Record of testing with automatic loader

e. Record of weather conditions.

2.1.4.4 Analytical Plan. Test data will be consolidated and presented in graph or chart form for easy comparison with results of tests of similar type weapons.

2.1.5 Obscuration

2.1.5.1 Objective. To determine the effects of obscuration produced by muzzle smoke, flash, and dust in the firing of the main gun, coax, and commander's machinegun.

2.1.5.2 Method

a. During all firing tests, including the firing of first rounds, tracking and hitting performance, and machinegun firings, operating crews and other designated test personnel stationed at points of vantage will observe and report effects of obscuration to include the ability to sense rounds, track, and related implications in adjustment to fire. (Still photographs or motion pictures will be used during dry conditions to demonstrate any difference in weapon degradation caused by the differing silhouette of the S-tank and comparison items.)

b. The flash shutter on the S-tank sighting system (designed to prevent gunner blindness from muzzle flash) will be evaluated. The degree to which it prevents loss of vision, or any degradation in gunner's sighting performance, will be subjectively assessed. Difficulties resulting from mechanical failure will be noted.

2.1.5.3 Data Required

a. Record of detailed observations by the crew and adjacent observers, and film with respect to muzzle smoke, flash, and blast produced obscuration (dust, grass, etc.)

b. Record of ammunition type, lot number, and any other identification available for that ammunition producing noticeable obscuration

c. Record of meteorological data for all observed firings

d. Record of observations pertinent to flash shutter operations

e. Photographs and motion pictures.

2.1.5.4 Analytical Plan

a. A subjective analysis of the observations will be made to determine the extent, if any, to which the crew is affected by obscuration in the firing of the tank's weapons.

b. Training and/or operational techniques, if applicable, required to overcome obscuration effects will be analyzed.

2.1.6 Compatibility with Related Equipment (TOP 2-3-512)

2.1.6.1 Objective. To compare the compatibility of the test vehicles with related vehicles and equipment.

2.1.6.2 Method

a. This test will be conducted only as required by field situations. Towing, loading, and removing powerpacks will be accomplished only as part of normal field operations.

b. If the situation arises, the S-tanks will be used to tow each other; they will be recovered from terrain immobilized positions, and be towed by appropriate recovery vehicles. Pertinent equipment publications will be checked for instructions and restrictions for towing the test vehicle.

c. The S-tank shall be "on-loaded" and "off-loaded" appropriate heavy equipment transporters. The vehicles will be driven on and off and winched on and off the transporters to determine equipment compatibility. An S-tank (nondisassembled) will

be transported a minimal distance on highways and any unsafe features will be noted.

d. The S-tank's engine will be started using all prescribed auxiliary starting means.

e. The S-tank's auxiliary power receptacles will be used to slave start stalled vehicles, and charge batteries external to the vehicle.

f. As required, the S-tank's back deck and powerpack will be removed by use of the M88 VTR, and M543 5-ton wrecker.

2.1.6.3 Data Required. Record of:

a. Comparison and determination of adequacy and compatibility of towing lugs, tiedown brackets, tow pintles, snatch blocks, tow bars, tow cables, and associated components of the S-tank and comparison vehicles

b. Comparison and determination of ease of coupling, uncoupling, and adequacy of coupling provisions in all types of environments (mud, water, snow) of the S-tank and comparison vehicles

c. Comparison of average cross-country speeds obtained by the S-tank and comparison vehicles while towing each other

d. Comparison of compatibility of the S-tank and comparison vehicles with transporters to include any unsafe features revealed during transport

e. Comparison of any difficulties encountered in using auxiliary starting means to start the S-tank's engines

f. Results of furnishing electrical power for application external to the vehicle via the auxiliary power receptacle

g. Any difficulties experienced in removing the power-pack with any recovery vehicle or wrecker.

2.1.6.4 Analytical Plan. Data will be subjectively analyzed and compared with results from previous tests on US Vehicles.

2.1.7 Personnel Training (TOP 3-3-501)

2.1.7.1 Objective. To identify and analyze problem areas in training of S-tank crews.

2.1.7.2 Method

a. Throughout training, all personnel will be encouraged to submit comments, and responses will be solicited to determine the adequacy of the safety design of the S-tank. (See para 2.7.)

b. Throughout all testing, operation, and maintenance procedures carried out by test personnel on the test tanks, the information gained will be evaluated against the knowledges and skills required by MOS numbers assigned to organizations that would be expected to operate and maintain the S-tank. Knowledge and skills not normally required of the crew and maintenance personnel will be recorded and reported.

c. New equipment training, available from the Swedish Army, will be accomplished for the test crew personnel upon receipt of the test tank(s). Based on this training and OJT acquired through normal use of the tank, a determination will be made as to the ability of personnel in established TOE positions to use, maintain, and service the S-tank.

(1) Driving. The vehicle will be driven over various road and cross-country courses in conjunction with the survivability subtest, para 2.9, and FDTE Mobility subtest, para 2.8.

(2) Gunnery. Crew procedures as prescribed in appropriate publications or as taught during new equipment training will be followed during all firing and nonfiring tests. Difficulties experienced or recommendations for redesignation of crew duties will be noted and reported. Immediate action for secondary weapon malfunctions incurred will be observed and evaluated. During SMF and hit performance, times to load, lay, and fire the main gun will be recorded. This, coupled with achieved results and training time on the equipment, will be used to determine estimated skill acquisition curves.

2.1.7.3 Data Required

a. Record of comments and responses from test personnel as to the safety of the design of the S-tank will be reported in the safety subtest, para 2.7

b. List of specific areas which have been identified as training problems for each MOS

c. List of additional skill and knowledge requirements beyond current job descriptions for each MOS

d. Record of difficulties or recommendations or redesignation of crew duties and system employment techniques. Times

for separate tasks in firing and nonfiring exercises will be reported in the subtest which contains that exercise

e. Record of summary of training provided test personnel to include scope and training schedule utilized. Areas of NET requiring additional emphasis

f. Record of any additional difficulties encountered.

2.1.7.4 Analytical Plan

a. Analysis of test data will be made to determine adequacy of current MOS training or need for special training to develop US crews that are capable of operating and maintining the S-tank item.

b. Recommendations for changes in current employment techniques and crew duties will be made.

c. NET will be analyzed to determine its adequacy for initial transfer of knowledge to the field and recommendations will be made.

2.1.8 Inland Waters Operation (TOP 2-3-510)

2.1.8.1 Objectives

a. To assess the relative performance of the S-tank and a comparison vehicle negotiating inland waterways.

b. To assist USAWES in obtaining waterway entrance and egress data for mobility evaluation of candidate and comparison vehicles.

2.1.8.2 Method

a. One S-tank and one comparison vehicle (M113A1) will enter, swim, and exit Tobacco Leaf Lake under controlled conditions.

b. The S-tank and M113A1 will enter, swim, and exit under direction of USAWES personnel to ascertain specific data on entrance and exit.

c. Both vehicles will be stopped (engine off) and re-started while floating.

d. Both vehicles will make 180° turns in both directions while swimming.

e. Preparation of vehicles for flotation, entrance, swimming, and egress will be recorded on motion picture film.

f. This subtest will be conducted on a time available basis.

2.1.8.3 Data Required

a. Record of times of entrance and egress, measured between a point 2 meters from the water point where flotation is achieved, from both a moving and stationary start

b. Record of time to traverse a water course of given length and to make a 180° turn in each direction

c. Data, as required by USAWES personnel

d. Comments on vehicle performance while floating

e. Film documentation.

2.1.8.4 Analytical Plan. Waterways performance will be subjectively analyzed to assess the swimming capabilities of the S-tank.

2.1.9 Road Mobility Tests (TOP 2-3-505)

2.1.9.1 Objective. To evaluate selected aspects of the S-tank and comparison vehicles' road mobility.

2.1.9.2 Method

a. The S-tank and all comparison vehicles, fully equipped and manned as in a tactical operation, will be timed for acceleration in 10-mile-per-hour elements (i.e., 0-10 mph, 0-20 mph) over a one-fourth mile measured hard-surface road. The test will be started from a halt and time measured with a stopwatch held by personnel riding in the vehicle. This will be conducted once using a qualified driver.

b. The S-tank and comparison vehicles will be operated on a level 1/2 to 1 mile measured hard-surface road at the maximum achievable safe speed (open-hatch mode only). This operation will be conducted once using a qualified driver.

c. The S-tank and comparison vehicles will be operated on a 50-meter backing course to ascertain maximum safe reverse speed. This will be conducted once using a qualified driver.

d. Fuel consumption will be calculated over varying types

of terrain. No specific test is designed for measuring fuel consumption. These data will be gathered concurretly with other subtests.

2.1.9.3 Data Required. Record of:

a. Elapsed time and final speed for one-fourth mile course

b. Elapsed time from acceleration trials, e.g., 0-10 mph, 0-20 mph, etc.

c. Maximum achievable safe forward speed

d. Maximum achievable safe backward speed

e. Fuel consumption, and types of terrain and exercises conducted.

2.1.9.4 Analytical Plan. Data will be evaluated to compare the road mobility of the various comparison items.

2.2 SPEED AND PRECISION OF LAY

2.2.1 Objective

2.2.1.1 To determine the difference in time required to lay accurately the S-Tank and comparison tanks on stationary and moving targets.

2.2.1.2 To compare the provisions for emergency control (laying) of the main gun of the S-Tank and comparison tanks.

2.2.2 Method

2.2.2.1 The S-tank and comparison vehicles (M60A1AOS and M60A1E3) will be inspected prior to the beginning of the test. Necessary repairs will be performed to bring the tank up to the best possible operating condition.

2.2.2.2 Selected well-trained personnel will be used for these tests.

2.2.2.3 The stationary tank, stationary target testing will be conducted on field targets, with well defined aiming points, that can be seen at various distances up to 3,000 meters from the gun position, and where the vehicle under test can be placed in a fairly

level position or be canted to a maximum of 15 degrees to the left and right.

2.2.2.4 Targets will be placed at varying surveyed ranges and numbered for easy identification. A plot of the target area showing the range to and the number of each target will be made for use as a reference in recording test results.

2.2.2.5 The S-Tank and comparison tanks will be positioned on level ground and all appropriate fire control optics will be boresighted at 1,200 meters. Clearly defined starting points will be established approximately 540 and 1,600 mils right and left of the center sector of the targets. Each test engagement will begin from one of these points, and the resulting direction of movement to the target will be recorded.

2.2.2.6 With the weapon system set at the desired starting point the test will be conducted as follows:

a. Test controller personnel will randomly designate to the tank commander the target (and range) to be engaged

b. The tank commander will (M60 tanks index the range into the computer) then employ what ever means are necessary to engage the target. Time will be recorded and measured from the moment the tank commander announced "gunner" and end:

(1) When the tank commander releases control to the gunner (gunner announces "identified")

(2) When the gunner signifies completion of his lay by announcing "on the way"

NOTE: A gun camera will record the sight picture and the target on which the gunner made his final lay.

c. Each tank/crew will engage in random sequence at least five targets at least three times from each starting point for a total of 15 engagements for each crew (a total of five crews will be utilized for each firing vehicle).

d. Test controller personnel will record total time, starting point, direction of movement, range, target used and the time from the initial fire command until the gunner announces "identified" and the time until the gunner announces "on the way".

2.2.2.7 Repeat the exercises outlined in paragraph 2.2.2.6 with the vehicle canted left and right at various angles up to 15 degrees.

2.2.2.8 A moving target test course will be selected where the S-Tank and comparison vehicles (M60A1AOS and M60A1E3) moving at various attack angles of attack and retreat can engage the target utilizing the proper engagement techniques for that weapon system.

2.2.2.9 The moving target, moving tank test will be conducted as follows:

a. Targets (live vehicle) will move over a given course at a given range and prescribed speed. The S-tank and comparison vehicles moving at the angle of attack or retreat selected will begin the engagement at the direction of the test controller.

b. The test controller will announce the range to the tank commander (for the S-tank)

c. The tank commander will (M60 tanks index the range into the computer) then issue his fire command and employ what ever means are necessary to engage the target. Time will be recorded and measured from the time the tank commander announces "gunner" and end:

(1) When the tank commander releases control to the gunner (gunner announces "identified")

(2) When the gunner signifies completion of his lay by announcing "on the way".

NOTE: Gun cameras will record the sight picture and lead utilized by the gunner in making his final lay.

c. Each tank/crew will engage three attack angle and three retreat angle targets at three ranges for a total of 27 engagements. Each tank (S-tank, M60A1AOS, M60A1E3) will utilize five crews for this exercise. During moving exercises gunners should simulate firing a second round.

d. Test controller will record total time, (range and lead to be used) and the time from the initial fire command until the gunner announces "identified" and the time until the gunner announces "on the way".

2.2.2.10 Repeat the exercises outlined in paragraph 2.2.2.6 one time utilizing the emergency control (laying) of the main gun for both test and comparison vehicles (M60 series vehicles utilize manual mode and telescope).

2.2.3 Data Required

2.2.3.1 For each target:

a. Size of target, in meters

b. Type of target (panel, live)

c. Type of aiming point (aiming cross, center mass)

d. Range plot from vehicle to targets, in meters

2.2.3.2 For each test iteration

a. Vehicle used

b. Cant in degrees and direction

c. Tank commander and gunners name

d. Starting point, in mils and direction from the target

e. Range to the target and lead applied (where applicable)

f. Target speed and test vehicle speed (where applicable) and method of engagement. (Halt to fire, stabilized, etc.)

g. Time in seconds, for commander's control, gunner's final lay, and total time

h. Results of each lay (photographic coverage)

i. Record of problems encountered

j. Record of test crew comments

k. Weather and light conditions (clear, overcast, rain, snow).

2.2.4 Analytical Plan

2.2.4.1 For all specialized tests complete the following:

a. Add the times required for each individual to accomplish each separate task and compute the average

b. Compute the average time for all test personnel for each operation

c. Compare the average time for each individual against the overall average

d. Compare the results obtained for the S-tank with those obtained for the comparison tanks

e. Compare results obtained from the emergency or manually operated system with those of the power operated system.

2.2.4.2 Film data will be analyzed (by WSMR) to evaluate aiming errors, time-to-lay from various positions and attack attitudes, and time to fire. These data will be compared with data collected on M60A1, and will be used for input to the force-on-force models.

2.3 HITTING PERFORMANCE

2.3.1 Stationary Tank - Stationary Target

2.3.1.1 Objective

a. To determine the first round hitting performance of crews employing the weapon system against stationary targets from a stationary gun mount. Data will be used to validate/verify Swedish hitting performance data.

b. To compare the system capabilities of the LRF S-tank to those of the LRF M60A1 (AOS) tank.

2.3.1.2 Method

a. Selected crews (S-tank and M60A1 tank) will engage panel targets at various ranges and fire a limited amount of ammunition at each range. Cloth targets with a 2.3 x 2.3 meter square superimposed on a 6.1 x 6.1 meter target will be placed at the following ranges: 1,000M, 1,500M, and 2,000M.

b. Each crew will conduct 10 repetitions of each condition listed below. Crews will engage each target at the specified range

utilizing the ammunition indicated. The vehicle location will be changed between each exercise and the exercise repeated. The gunner/driver's periscope will be used for all exercises.

c. The M60A1 (AOS) tank will be used for comparative purposes.

Range (Meters)	Ammunition	Vehicle	Target
1,000*	HE	S*	S
1,500	HE	S	S
2,000	KE	S	S

*Stationary

d. The test vehicles will be stationary, with the brakes set, and the main weapon zeroed at 1,200 meters with HEAT-TP-T (for M60 AOS tank) and AP-TP (S-tank) ammunition.

e. The gun tube will be rotated away from the target by 540 mils prior to engaging each target.

f. The project officer will randomly designate to each tank commander the target to be engaged and will announce the tank-to-target range. The tank commander will give the appropriate fire command. Time will be measured beginning from the time the tank commander announces "Gunner", and end when the round is fired.

g. The time required to engage the target will be recorded. Each round will be sensed and a record made of target strike information. A record will be made of firing conditions, rounds fired, and settings used on the fire control equipment.

2.3.1.3 Data Required. Record of:

a. Vehicle identification and total test miles accumulated

b. Target plot with ranges

c. Name and position of person firing

d. Time to acquire target and fire

e. Time of engagement to include range used, and total time to complete the exercise

f. Number of target hits obtained

g. Total rounds fired

h. Ammunition identification and lot numbers

i. Date, weather, wind speed and direction, temperature, light and soil conditions.

2.3.1.4 Analytical Plan

a. Data will be consolidated and presented in tabular or graph form. Data will be used to verify/validate Swedish data for input to selected Force-on-Force models.

b. The total number of hits obtained by each gunner against targets of the specified dimension at each of the critical ranges established will be divided by the total number of trials (rounds fired per test condition) made at that range for that time to compute hitting rate or hitting percentage; i.e., a point estimate of hit probability.

c. In order to translate the point estimate hitting rate into a statistical expression of hit probability, the values for number of failures (misses) and the number of trails will be entered into the formula shown below to provide a 90-percent confidence interval about the point estimate.

d. Formula for computing the confidence interval is as follows:

$$\frac{1}{1+\frac{(r+1)}{(n-r)}F_{\frac{\alpha}{2},\,2r+2,\,2n-2r}} \leq P \leq \frac{1}{1+\left(\frac{r}{n-r+1}\right)F_{1-\frac{\alpha}{2},\,2r,\,2n-2r+2}}$$

Where: r = number of failure (misses)

n = number of trials

$F_{\frac{\alpha}{2}\,2r+2,\,2n-2r}$ = degrees of freedom which will be used to determine the appropriate F value from distribution tables

$F_{1-\frac{\alpha}{2},\,2r,\,2n-2r=2}$

2.3.2 Stationary Tank - Moving Target

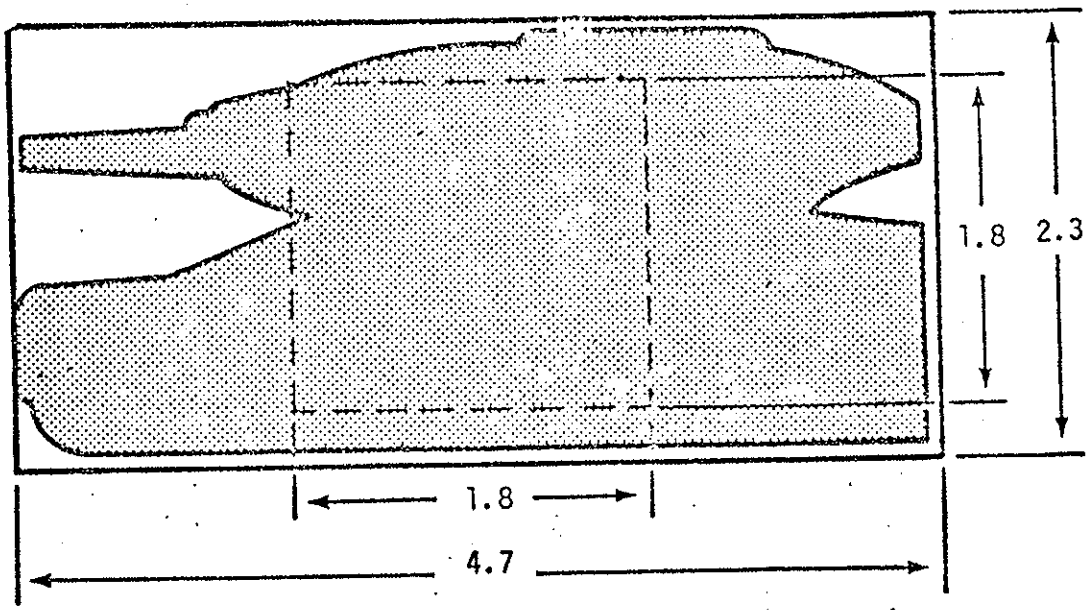
2.3.2.1 Objective

a. To determine tracking and hitting performance of crews employing the weapon system against moving targets from a stationary gun mount. Data will be used to validate/verify Swedish hitting data.

b. To compare the system capabilities of the S-tank to those of the M60A1 (AOS) tank.

2.3.2.3 Method

a. Cloth or plywood targets, 2.3M x 4.7M (figure 4), will move perpendicular to the line of fire at speeds of 11 miles per hour and ranges of 1,000M and 1,500M.



(all dimensions in meters)

Explanatory Notes:

Target concept assumes the basic 6-ft x 6-ft (1.8m x 1.8m) superstructure of existing facility can be extended to provide target of larger overall dimensions shown.

Brace and frame structure for the extension to be lightest possible suitable for support of screen wire mesh cover and attached tactical silhouette cut from OD target cloth.

Gunner may note outline of the target frame but aims at the tank silhouette centered on the target face.

If the larger target cannot be used then the entire 1.8m x 1.8m target area will be covered with OD target cloth and the gunner's aim modified accordingly.

FIGURE 4

SAMPLE MOVING TANK TARGET

b. Each "run" will be conducted as a tactical exercise with the vehicle commander designating the target and either acquiring it or assisting the gunner, when appropriate. Each crew will conduct 10 repetitions of each condition listed below. Crews will engage each target at the specified range utilizing the ammunition indicated. The gunner's periscope will be used for all exercises.

Range (Meters)	Ammunition	Vehicle	Target
1,000	HE	S*	M*
1,500	HE	S	M
1,500	KE	S	M

*S - Stationary, M - Moving (target Speed 11 mph)

c. The test vehicles will be stationed on level ground with the main weapon zeroed in accordance with instructions contained in the vehicle operator's manual.

d. Starting with the gun tube oriented on the limiting range marker opposite the side the moving target will approach from, each "run" will begin as the target passes the opposite limiting marker with the trained crew attempting to obtain a hit in the shortest possible time. The project officer will designate to each tank commander the target to be engaged and will announce the tank-to-target range. Time will be measured beginning from the time the tank commander announces "Gunner," and end with the round is fired.

e. The time required to engage the target will be recorded. Each round will be sensed and a record made of target strike information. A record will be made of firing conditions, rounds fired, and settings used on the fire control equipment.

2.3.2.3 Data Required. Record of:

a. Vehicle identification and total test miles accumulated and rounds fired

b. Date, time, location, wind speed, and direction, weather, temperature, and light conditions

c. Attitude of vehicle and mode of operation

d. Type target and range

e. Course description

f. Name of person tracking and firing

g. Method used to acquire target within gunner's field of view

h. Speed of target and range

i. Settings on fire control equipment

j. Time to acquire target and fire

k. How lead was determined

m. Gunner's sensing

n. Target hit or miss

o. Nomenclature and lot numbers of rounds fired

p. Total time target was in view

q. Any incompatibility between components in the weapon system.

2.3.2.4 Analytical Plan. Analysis will be performed as indicated in para 2.3.1.4, above.

2.3.3 Short Pause - Stationary Target

2.3.3.1 Objective

a. To determine the hitting performance of crews employing the weapon system to acquire a stationary target from a moving tank and thereafter to engage the target during a short halt. Data will be used to validate/verify Swedish hitting performance data.

b. To compare the system capabilities of the S-tank to those of the M60A1 (AOS).

2.3.3.2 Method

a. Stationary targets 2.3 x 2.3 meters will be superimposed on a 6.1 x 6.1 meter target and will be spaced at 1,000M and 1,500M. Target ranges will be surveyed and plotted. The project officer will designate to each tank commander the target to be engaged.

b. With the weapon system properly zeroed, the tank crews will acquire the target while moving, bring the vehicle to a halt, and fire at a stationary target. Driving surfaces will be gently rolling and graded to the extent necessary to permit all-weather use.

c. To the extent practical, each firing run will be treated as a tactical exercise with the vehicle commander designating

the target, issuing the appropriate fire command, and acquiring the target for the gunner. The tank will be driven at 11 mph. The targets to be fired at will not be revealed to the TC until the vehicle approaches the firing point. While approaching the firing point, the gun tube will be oriented parallel to the direction of movement. When the tank reaches the firing point, the project officer will direct the tank commander to begin the engagement and will announce the tank-to-target range. The tank will be required to halt prior to firing at the target.

d. Time will be measured beginning with the time project officer designates the target and end when the round is fired.

e. Each crew will conduct 10 repetitions of each condition listed below. Crews will engage each target at the specified range utilizing the ammunition indicated. The gunner's periscope will be used for all exercises.

Range Meters	Ammunition	Vehicle	Target
1,000	KE	M*	S*
1,500	KE	M	S

*M - Moving (Vehicle Speed 11 mph), S - Stationary

f. The time required to engage the target will be recorded.

g. Each round will be sensed and a record made of target strike information. A record will be made of firing conditions, rounds fired, and settings used on the fire control equipment.

2.3.3.4 Data Required

a. Vehicle identification and total test miles accumulated

b. Plot of target positions and range

c. Name of person firing

d. Methods used to acquire target within the gunner's field of view

e. Time required to engage the target

f. Vehicle speed

g. Nomenclature and lot number of rounds fired

h. Total rounds fired by type

i. Settings on fire control

j. Date, weather, wind speed and direction, temperature, and light conditions

k. Number of target hits.

2.3.3.5 Analytical Plan. Analysis will be performed as indicated in para 2.3.1.4, above.

2.3.4 Short Pause - Moving Target

2.3.4.1 Objective. To determine tracking and hitting performance of crew employing the weapon system to acquire a moving target from a moving tank and thereafter to engage the target during a short halt.

2.3.4.2 Method

a. Cloth or phywood targets, 2.3M x 4.7M (figure 4), will move perpendicular to the line of fire at speeds of 11 mph at a range of 1,500M. The speed of the tank will also be 11 mph.

b. With the weapon system properly zeroed, the tank crews will acquire the target while moving, bring the vehicle to the halt, and fire at a moving target. Driving surfaces will be gently rolling and graded to the extent necessary to permit all weather use.

c. To the extent practical, each firing run will be conducted as a tactical exercise with the vehicle commander designating the target, issuing the appropriate fire command, and acquiring the target for the gunner. The targets to be fired at will not be revealed to the tank commander until the vehicle approaches the firing point. While approaching the firing point, the gun tube will be oriented parallel to the direction of movement. When the tank reaches the firing point, the project officer will direct the tank commander to begin the engagement and will announce the tank-to-target range. The tank will be required to halt prior to the firing at the target.

d. Each exercise will begin as the target passes the opposite limiting marker with the trained crew attempting to obtain a hit in the shortest possible time. The project officer will designate to each tank commander the target to be engaged. The time will be measured from the time the project officer designates the target, and end when the round is fired.

e. Each crew will conduct 10 repetitions of each condition listed below. Crews will engage each target at the specified range utilizing the ammunition indicated. One round will be fired for each target "run". The gunner's periscope will be used for all exercises.

Range Meters	Ammunition	Vehicle	Target
1,500	KE	M*	M*
1,000	HE	M	M

*M - Moving (Vehicle and Target Speeds 11 mph)

f. The time required to engage the target will be recorded.

g. Each round will be sensed and a record made of target strike information. A record will be made of firing conditions, rounds fired, and settings used on the fire control equipment.

2.3.4.3 Data Required. Record of:

a. Vehicle identification and total test miles accumulated

b. Type and size of target used and range

c. Course description

d. Name of person tracking and firing

e. Speed of target and direction of travel in relation to the course of the firing vehicle

f. Speed of vehicle

g. Type of driving surface

h. Time to acquire target and fire

i. Total time to complete each exercise

j. Number of target hits

k. Settings on fire control equipment

m. Nomenclature of lot number of rounds fired

n. Type and total number of rounds fired

o. Date, weather, temperature, and light conditions.

2.3.3.5 Analytical Plan. Analysis will be performed as indicated in para 2.3.1.4, above.

2.4 SIMULATED MISSION FIRING

2.4.1 Objectives

2.4.1.1 To compare the overall system capabilities of the LRF equipped S-tank to those of the LRF equipped M60A1 (AOS) tank.

2.4.1.2 To determine whether test vehicle crews can satisfactorily perform crew functions during extensive range firings.

2.4.2 Method

2.4.2.1 S-tanks and M60A1 (AOS) tanks will traverse a predesignated course which consists of an array of targets (main gun, and coax targets). Crews will be required to engage "popup" targets, stationary hard targets, and moving targets in both an attack and defense scenario. When the S-tank is required to fire an HE-TP round, the M60A1 (AOS) tank will fire the HEP-TP-T round.

a. Five S-tanks and five M60A1 (AOS) comparison tank crews will perform attack and defense SMF exercises in daylight. The crews will not rotate between test and comparison tanks. Sufficient exercises will be conducted to ascertain if there is a performance difference between the two tanks due to the fire control systems.

b. Detailed instructions and range overlays are at parts 1 and 2, app I.

c. An analysis of crew skills and a system capabilities comparison will be made.

d. Targets (during attack exercises) will be remotely controlled from a vehicle following the attacking tank. The attacking tank will have targets designated by a controller riding on the tank who will also indicate the type ammunition to be used to engage the target, and will announce the tank-to-target range.

e. Targets (during defense exercises) will be remotely controlled from the firing point. The defensive tanks will have targets and ammunition designed for each engagement specified by control personnel, who will also announce the tank-to-target range.

f. If during the performance of an exercise, a target or tank malfunctions, the exercise will be aborted and rerun.

2.4.3 Data Required

2.4.3.1 SMF (Attack). Record of:

a. Environmental conditions at time of each execution

b. Miission accomplishment by test item, tank crew, and crew set

c. Engagement results for all targets for each attack execution by type item, tank crew, and crew set

d. Number of rounds expended for each main gun engagement by type item, tank crew and crew set.

2.4.3.2 SMF (Defense). Record of:

a. Environmental conditions for each execution

b. Mission accomplishment by crew and item

c. Maximum penetration of enemy attack by crew, item, and set

d. Engagement results for each enemy target by crew, crew set, type item, and rounds expended.

2.4.4 Analytical Plan. Data from the SMF (attack and defense) will be analyzed and presented in two manners. The first will be as outlined in para 2.4.3.1 and 2.4.3.2 above (results reflecting crews having the exact tank-to-target range). In addition, the same data will be presented utilizing degradation factors that represent the type of error associated with the rangefinder currently employed on the comparison tanks. This procedure will allow for comparison of two tank systems with perfect ranging facilities, and two tank systems with degradation caused by the current ranging techniques appropriate to each tank system, i.e., TC's range estimation for the S-tank and coincidence rangefinder for the M60A1 (AOS) tank.

2.5 HUMAN FACTORS ENGINEERING EVALUATION (TOP 2-3-516)

2.5.1 Objective

a. To assess the human factors engineering aspects of the S-tank, and its compatibility with the skills, aptitudes, and limitations of personnel who use, operate, and service the items

b. To evaluate a three-man tank crew operation.

2.5.2 Method

2.5.2.1 The S-tank will be combat loaded (dummy ammo) for the human factors assessment. The tank will be assessed for standard human factors engineering requirements, systems performance measures, and visual capability of crews while stationary and moving.

2.5.2.2 Time and motion studies will be collected on crews under various conditions.

2.5.2.3 Throughout all testing, crews and project personnel will report all conditions or circumstances which affect their comfort (positively or negatively) or reduces the effectiveness of the man-machine combination.

2.5.3 Data Required. Record of:

a. Description of each problem reported

b. Description of action taken to diagnose and resolve each reported problem area

c. Anthropometric accommodations of body dimensions, motion ranges, vehicular and crewmen equipment compatibility ingress and egress, seating, safety, etc.

d. Controls and displays, to include layout placement, illumination and coding (legend, indicators, color, flash, etc.) accessibility, compatibility, adjustability, manual effort, read-out, labelling, etc.

e. Operational tasks to include individual crewman task, total crew task, as related to allocation, interfacing, overlay, interference, etc.

f. Visual capabilities as related to close-in viewing, configuration interference, etc.

g. Ammunition handling, basic load replenishment and stowage (for primary and secondary weapons), accessibility, chambering (loading) etc.

h. Stowage of vehicle equipment, life support equipment, ancillary components, etc.

i. Crew environment, to include ventilation, heating, noxious substances, noise, shock vibration, etc.

j. Maintainability of the S-tank as related to crew maintenance (before, during and after operation services) crew and organizational unscheduled and scheduled maintenance, i.e., servicing of immediate stoppages (primary and secondary weapons), replacement of components (visual devices, fire control components, etc.) boresighting, component accessibility and adjustability, etc.

2.5.4 Analytical Plan

a. Data in all areas will be assessed, evaluated, and compared against existing data recorded for US tanks.

b. Data are to be collected and analyzed by USAHEL.

2.6 RELIABILITY (TOP 2-3-507)/MAINTAINABILITY (TOP 2-3-502, 2-3-514, 2-3-527, and 2-3-528)

2.6.1 Objectives

2.6.1.1 To perform a limited evaluation of the S-tank's reliability/maintainability (R/M) characteristics by:

a. Comparing the limited operational data collected during this test with that furnished by the Swedish and United Kingdom Governments in order to establish comparability of the data.

b. Comparing the operational test data collected during this test with that on file for the US M60A1E3, M60A1 (add-on-stabilization), and M60A1 tanks.

c. Comparing Swedish and United Kingdom data with that on file for the US M60A1E3, M60A1 (AOS) and M60A1 tanks.

2.6.1.2 To compute R/M indices and perform comparative analysis to the extent that test constraints will allow.

2.6.2 Method

2.6.2.1 Reliability

a. Two S-tanks will be furnished for testing. Each vehicle will be operated over cross-country, secondary, and highway courses (as part of the survivability exercises). Test mileage will be accumulated during the approximately 6 months of training and testing. Limited firing will be accomplished for both the main and secondary weapon system.

b. Armament and related equipment reliability including weapon and ammunition functioning will be evaluated (insofar as possible) in conjunction with operational testing.

c. A record of all failures will be maintained throughout the test. Attempts will be made to classify the failures as mission system/subsystem failures and component failures.

d. A failure is defined as any malfunction which the operator/ crew cannot remedy by adjustment, repair, or replacement action using the controls, OEM tools, and OEM parts within 30 minutes and which causes or may cause:

(1) Inability to commence operations, cessation of operations, or degradation of performance capability of system/ subsystem below designated levels.

(2) Serious damage to system/subsystem by continued operation.

e. Simultaneous related malfunctions are considered as one failure.

f. Malfunctions which do not affect performance of system/subsystem functions will not be considered failures. For the purposes of testing, only system/subsystem failures (as opposed to component failures) will be used in calculating MMBF. Component failures which do not result in chargeable system failures will be identified and recorded but will not be included in determination of MMBF. A system/subsystem failure is chargeable whenever:

(1) Organizational, direct, or general support maintenance is performed between scheduled preventive maintenance service and inspections, if such maintenance affects the performance of the system/subsystem. This concept is based on the assumption that sufficient maintenance should have been performed during the previous scheduled preventive maintenance service to give reasonable assurance of trouble-free operation until the next scheduled service is performed.

(2) An incipient system/subsystem failure is detected at the organizational maintenance level during the scheduled preventive maintenance service or inspection that is referred to and corrected by direct or general support maintenance.

(3) A system/subsystem failure is not chargeable when:

(a) The failure results from not following the prescribed operational or maintenance procedures dictated by the equipment manuals or can be directly attributed to improper replacement of components or assemblies.

(b) The failure results from an accident unless such is a direct result of a component failure.

(c) The failure is detected and corrected by organizational maintenance during scheduled preventive maintenance inspections or services.

(4) In the event that an incipient system/subsystem failure is detected during the correction of a chargeable system/subsystem test item failure, two failures shall be charged provided that the failures are totally unrelated and that maintenance is performed to prevent progression of the incipient failures.

g. It is recognized that the operating profile for this test will not be identical to that used for the M60A1E3, M60A1 (AOS) and M60A1 tank test, however, some comparability will exist and every attempt will be made to make the most valid comparisons possible.

2.6.2.2 Maintainability

a. It is anticipated that all maintenance above crew level on the S-tanks will be performed by Swedish maintenance technicans; however, required data will be recorded during the performance of maintenance activities. These data will be broken down by level of maintenance to the extent possible, contingent on availability of a Maintenance Allocation Chart and/or guidance from the Swedish representative. Data will be recorded during the performance of scheduled and unscheduled maintenance operations.

b. Failed components will be identified. Time to perform each repair will be recorded insofar as possible.

2.6.3 Data Required

2.6.3.1 Reliability. Record of the following for each test item for each daily operation:

a. Equipment identification

b. Date of operation, weather, light, ambient temperature, and operating area conditions

c. System or component miles/hours of operation

d. Total number of rounds fired by weapon and type

e. Miles and hours operated over various surface conditions

f. Log and description of failures

g. Result of failure

h. Characteristic of failure

i. Total miles and time operated

j. Total failures and total number of each type failure

k. Number of rounds of ammunition fired by weapon and type to include miles transported.

2.6.3.2 Maintainability. Record of the following for each test item:

a. Each scheduled and unscheduled maintenance action to include the active maintenance time (clock-hours/man-hours) expended per maintenance task

b. Each malfunction

c. System failures

d. Failed components or assemblies and the accumulated operating time of the test item and failed component at the time of failure

e. Comments on design considerations for case of access to components and test points, use of modular constructions, use of built-in "go-no-go" systems, simple fault isolation indicators, and protective devices to prevent damage during maintenance

f. Comments on design considerations for ease of maintenance, maximum utilization of interchangeable components, minimization of maintenance and supply, compatibility of maintenance operations with common tools, and easy removal of major components and individual units

g. Any special tools or test equipment provided and/or required

h. Repair parts used

i. Difficulties in installation, adjustment, alignment, and interchangeability of repair parts

j. Comments on the adequacy of storage compartments and storage components.

2.6.4 Analytical Plan

Data accumulated will be evaluated to provide a subjective evaluation of reliability and maintainability to include a point estimate of reliability. Commensurate with the data obtained during testing and the data furnished by the Swedish and United Kingdom sources, the following values of reliability and maintainability indices will be presented for comparative analysis:

2.6.4.1 Point estimate of the mean-time-between-failure Mathematically:

$$MTBF = \frac{T}{R}$$

where:

T = Total operating time

R = Total number of failures

2.6.4.2 The maintenance ratio (MR) will be computed by dividing the total active maintenance man-hours for each level of maintenance by the total hours of operation. The overall maintenance ratio will be

computed by dividing the total active maintenance man-hours for all levels of maintenance by the total hours of operation. Mathematically:

$$MR = \frac{\text{Total preventive and corrective maintenance in man-hours}}{\text{Total operating test time}}$$

2.6.4.3 The mean-time-to-repair failures and malfunctions ($MTTR_f$ and $MTTR_m$) will be expressed as:

a. The total corrective maintenance time in clock-hours (and man-hours) to correct chargeable system failures*, divided by the total number of chargeable system failures/malfunctions recorded. Mathematically:

$$MTTR_f = \frac{\text{Corrective (Unscheduled) maintenance time}}{\text{Total number of failures/malfunctions}}$$

b. The total corrective maintenance time in clock-hours (and man-hours) to correct malfunctions, divided by the total number of malfunctions recorded. Mathematically:

*System failure definition may be found in para 2.6.2.1d above.

$$MTTR_m = \frac{\text{Corrective (unscheduled) maintenance time}}{\text{Total number of malfunctions which required corrective action}}$$

2.6.4.4 The mean-time-between-maintenance (MTBM). Mathematically:

$$MTBM = \frac{\text{Total operating time (engine hours)}}{\text{Total maintenance actions}}$$

2.6.4.5 The mean active maintenance downtime ($\overline{M}$). Mathematically:

$$\overline{M} = \frac{\text{Total active maintenance time (clock-hours)}}{\text{Total maintenance actions}}$$

2.6.4.6 The achieved availability (A_a). Mathematically:

$$A_a = \frac{\text{Total operating test time}}{\text{Total operating test time + preventive and corrective maintenance time in clock-hours}}$$

2.6.4.7 The inherent availability (A_i). Mathematically:

$$A_i = \frac{MTBF}{MTBF + MTTR}$$

where: MTTR is mean-time-to-repair failures, and MTBF is mean-time-between-failures.

2.6.4.8 The reliability and maintainability indices to be used in the comparative analysis will be for the M60A1E3, M60A1 (AOS), and M60A1 tanks extracted from previous test reports

2.6.4.9 The reliability and maintainability data furnished for the S-Tank by the Swedish and United Kingdom sources will be displayed in chart form (insofar as possible) in order to facilitate comparison of these data.

2.7 SAFETY EVALUATION (TOP 2-3-501)

2.7.1 Objective

To determine if the test item is safe to operate in its intended role.

2.7.2 Method

2.7.2.1 The project officer will coordinate with the Swedish Training Officer to establish an effective method to assure that test personnel will have full knowledge of the hazards and safety aspects of the test. Special emphasis will be made to inform test personnel on S-tank safety features and the test personnel will be instructed to report any hazards noted in operation or servicing the test vehicles. Safety and warning signs will be posted in the test vehicle in English.

2.7.2.2 Prior to starting of test operations, the test item will be inspected for actual or potential safety hazards. Special attention will be given to the fixed and portable fire extinguishers in conjunction with the operational readiness checks performed in para 2.1.1. The four carbonic acid, fixed fire extinguishers and the air flasks will be weighed and checked for proper sealing. The permanent fire extinguishing system will be activated with the carbonic acid flasks

removed to ensure proper operation. The two powder, portable fire extinguishers will be weighed and the seals checked.

2.7.2.3 Safety hazards and operation restrictions described in training or technical publications, and warning plates affixed to the test items, will be noted and brought to the attention of all test personnel. Complete reliance will not be placed on operation and maintenance procedures prescribed in the technical manuals, unless they have been critically reviewed and found to give the safest procedures for the test item's operation and maintenance.

2.7.2.4 The number of personnel exposed to actual or potential test hazards will be kept to the minimum necessary for the performance of the test.

2.7.2.5 Prior to starting test operations and upon completion of testing, all test personnel will receive thorough ophthalmological examinations to include retinal and fundus photographs. Results of these examinations will be recorded on USAARMC Form 2252.

2.7.3 Data Required

a. Record of safety inspection

b. Record of notes on the adequacy of safety precautions and warnings contained in technical publications, and warning plates affixed to the test item

c. Record of description of any safety hazard experienced in operation and servicing of the test item that was not covered by pertinent instructions

d. Completed USAARMC Form 2252 for ophthalmological examinations of test personnel both before and after testing

e. Record of all complaints reported by test personnel pertaining to peculiar odors, headache, dizziness, excessive noise, fumes, eye irritations, etc.

f. Comments pertinent to fixed and portable fire extinguishers.

2.7.4 Analytical Plan

All data will be subjectively evaluated and presented in such a manner as to indicate whether or not the test item meets safety requirements.

2.8 FORCE DEVELOPMENT TEST AND EVALUATION (FDTE) MOBILITY COURSE

2.8.1 Objectives

2.8.1.1 To obtain data that will allow for direct comparisons of the S-tank's mobility characteristics with those of existing US vehicles.

2.8.1.2 To obtain data for rank ordering the S-tank's operational mobility with existing US vehicles.

2.8.1.3 To obtain operational mobility data for input to force-on-force models.

2.8.2 Method

2.8.2.1 The S-tank and all other comparison vehicles will traverse the ARSV Field Mobility day courses at Fort Knox, KY and Fort Bliss, TX. The FDTE course at Fort Knox represents the terrain encountered in certain parts of West Germany and the Fort Bliss terrain is similar to that found in portions of the Middle East.

2.8.2.2 This subtest describes only that portion of FDTE mobility testing which will be accomplished at Fort Knox. The day course is

divided into seven events in which there are multiple segments of varying terrain. (See app J. for Fort Knox course overlay and description.)

2.8.2.3 The S-tank and each comparison vehicle will traverse the mobility course seven times. Each of the seven iterations will be run with unique drivers and vehicle commanders, i.e., each driver and commander will have no prior knowledge of the course.

2.8.2.4 Communications will be maintained with each vehicle throughout the mobility course. If the vehicle does not have an organic radio or the radio is not compatible with US Army communication equipment, then a PRC-77 or equivalent will be carried onboard. All radios and intercoms will be checked for proper operation prior to and subsequent to each day's testing. A command post will be established and utilized on the course to monitor location, status, and provide necessary instructions to all the vehicles during the conduct of the test.

2.8.2.5 The week prior to the conduct of the actual field mobility test, the necessary data collectors, and support personnel will be briefed on the course, what is expected of each participant, time frames involved, etc. In addition, a LOI will be written assigning responsibilities, drivers, commanders, and data collectors to the vehicles, days to run, etc. The LOI will be definitive enough so each

test participant can know the details of his assignment. The assistant project officer will act as the overall test conductor and will have the responsibility for the execution and conduct of the complete field test.

2.8.2.6 As a part of the briefing two each certification runs or "dry runs" will be made over the course utilizing M113A1s, the data collectors, and command post personnel. These "dry runs" will serve to alert all test personnel to any problem areas that might arise during the test. These runs will be conducted in the same manner as the actual test. Debriefing sessions will be held after each "dry run".

2.8.2.7 Field testing will be conducted as follows:

a. Two vehicles properly manned will start the course at the beginning of events 1, 5, 6, and 7, i.e., one vehicle starting event 1 followed 15 minutes later by the second vehicle from the same start point; another candidate vehicle starts event 5, followed 15 minutes later by the second vehicle, etc.

b. All vehicles will traverse the entire course as rapidly as possible (within the confines of safety) each day, and successful completion of the course will be upon return to that particular vehicle's starting point.

c. Regardless of which event a particular vehicle starts, it will traverse the course in numerical event sequence, i.e., Event 7, 1, 2, 3, ... or Event 5, 6, 7, 1, 2 . . . . . etc.

d. Vehicle start positions and order are as follows:

(1) Event 1 - First: M113A1, Second: S-Tank (+ 15 minutes)

(2) Event 5 - M113 Twin Engine, VRT (+ 15 minutes)

(3) Event 6 - Twister #1, M60A1 (+ 15 minutes)

(4) Event 7 - Twister #2

e. As each vehicle completes an event, contact will be made with the command post to verify event completion, and receive permission to enter the next segment.

2.8.2.8 On board each vehicle a data collector will record the vehicle's elapsed times for each course segment traversed. These times will be recorded with a stopwatch. The data collector will not interfere with the operation of the vehicle unless danger is imminent or the crew is grossly lost from the course. All vehicular breakdowns, unauthorized stops or other downtime will be noted and recorded. There are no penalties for necessary stops (man sick, thrown

track, etc). If another vehicle has stopped, no test vehicle should stop to render assistance unless personnel injury has occurred. Sample data sheets for each event are contained in app J. A completed sample data sheet is contained at app J. Each data collector will turn in his completed data forms at the command post at the completion of each day's testing.

2.8.2.9 Located coincident with the command post on each day of testing will be appropriate support capabilities: a recovery vehicle and crew, maintenance personnel, and repair parts, and medical personnel.

2.8.3 Data Required

2.8.3.1 Record of daily communication checks

2.8.3.2 Record of briefing "dry run" times

2.8.3.3 Record of the results of field test to include:

a. Vehicle identification number

b. Name, rank and MOS of vehicle commander and driver

c. Team number

d. Data collector's name

e. Date of testing

f. Light and weather conditions (day, night, rain, snow)

g. Ambient temperature in °F

h. Condition of course (wet, dry)

i. Start position

j. Course segment elapsed times

k. Unauthorized stops to include reason therefor

m. Location at time of stop

n. Difficulties, if any, encountered during test course traverse

o. Crew comments, complaints, or discomforts

p. Safety hazards noted.

2.8.4 Analytical Plan. Acquired data will be analyzed by experienced military and civilian personnel, and a comparison made of the S-tank's mobility characteristics with those of selected US vehicles. Rank order comparison will be performed. Additionally, results from the AMC mobility model will be compared with results from FDTE courses. (The ARSV TF will assist in the analysis of the mobility course data.)

2.9 SURVIVABILITY EXPERIMENT

2.9.1 Objectives

2.9.1.1 Phase I - Yano Range

a. To obtain data that will provide insight into the effects that constant speeds have on vehicle survivability.

b. To obtain data that will provide insight into the effects that rapid start and stop operations have on vehicle survivability.

c. To obtain data that will provide insight into the effects of evasive tactics on vehicle survivability.

d. To obtain data for comparison of selected vehicles in the areas of mobility, agility and silhouette contributions to vehicle survivability.

e. To obtin data for comparison of firing performances with the S-tank, M60AOS tank, M60A1E3 tank, and TOW tracker.

2.9.1.2 Phase II - St. Vith Range

a. . To examine the effects of brief discontinuities of intervisible segment lengths on gunner tracking and hitting performance.

b. To examine the effects of a moving partially concealed silhouette on gunner hitting performance.

c. To examine the effects of selected intervisiblity segment length sizes on gunner hitting performance.

d. To examine the effects of rapid advance tactics (minimum use of terrain) and maximum use of terrain tactics on intervisible segment lengths.

2.9.2 Method

2.9.2.1 The first phase of the survivability will be conducted in open terrain (Yano Range at Fort Knox) to isolate the independent variables of the experiment and evaluate the contributions that vehicle performance parameters and evasive tactics have on vehicle survivability. The second phase will be conducted in a more realistic terrain environment (St. Vith Range at Fort Knox) to assess the combined effects of the independent variables on vehicle survivability. The basic scenario for both phases is to have defending weapon systems tracking and firing on a variety of target vehicles under varying conditions.

2.9.2.2 Defender vehicles in both phases will be one M60A1 (AOS) tank, one M60A1E3 tank, one S-tank and one TOW tracker. Data collection will be by cameras mounted on the main gun of each defensive vehicle which will record metric film data for the determination of lay time, lay error, tracking accuracies, miss distances, and total number of rounds "fired" during each leg of the course. Target vehicles will be instrumented to record accelerations, speeds, and turning rates while traversing the course. On oblique runs the apparent speeds from the gunner's position will be calculated from time, speed, and approach angle.

2.9.2.3 Target vehicles presently scheduled for parts of the survivability test include: the S-tank, M60A1 tank, Twister Test Rig, 2-engine M113, German RVT and the FMC Track. All vehicles will be equipped with ultraviolet (UV) light, visible only on film, to establish a reference for center of mass calculations for analysis purposes.

2.9.2.4 For statistical validity of this subtest, five crews will be used on each trial (a trial consists of a vehicle run over one segment of each course) for each vehicle. While the number "five" does not constitute a "large" sample size for each trial, this number of iterations will assist in "averaging" out sources of variation in the experiment outcome caused by quality of the assigned gunners.

A sixth iteration on each trial will be repeated by one set of the gunners on each vehicle to examine the effects of "training" on the gunner's performance. This gunner will have had the benefit of seeing an evasive maneuver, stop-start technique or high constant speed, and be able to apply this knowledge to his firing technique.

2.9.2.5 A pilot test will be performed on both the Yano and St. Vith ranges with the controllers and drivers of target vehicles. This will allow the control personnel to iron out any problems in the test design. Target drivers will have the opportunity to run each course segment several times and will practice all evasive maneuvers prior to actual testing. Gunners will not be present during this pilot test.

2.9.2.6 During all "firing" exercises gunners will be required to range and apply correct lead when engaging a target. Prior to "firing" a second, third, etc., round simulated loading of the main gun must be accomplished. Gunners will be prevented from firing additional rounds prior to this being accomplished.

2.9.2.7 Phase I - Yano Range

a. This is a three-part experiment designed to evaluate the effects of undirectional constant speed, rapid start-stop

tactics, and the effects of evasive maneuvering on vehicle survivability.

b. One constant range, one oblique (approaching), and one head on (straight-on approach) courses will provide a variety of ranges and vehicle aspects to the "gunner" vehicles. Maximum engagement ranges will begin at 2,000 to 2,500 meters, and minimum engagement range will be approximately 800 meters with course "run" distance approximately 1,000 meters. (See app K.) Actual course dimensions will depend on range conditions.

c. Part One is the constant speed test. This is designed to determine if increasing increments of cross-country speeds cause a proportionate degradation in hit probability on the vehicle. The emphasis will be on relatively high apparent speeds (10, 20, 30 and 40 mph), undirectional, and without regard to target detection/acquisition/identification or silhouette effects. For this reason and because simulated cross-country speeds of 40 mph are required, only the Twister will be used as a target.

(1) The Twister, which does not represent a realistic attack vehicle, will have a well defined aimpoint (vertical mounted cylinder supporting a cross). This will eliminate errors in determining the "gunner" aimpoint during data reduction and calculation of

aiming error. It will also contribute to more accurate miss distance determinations for hit probability analysis. This same configuration will be run as a control vehicle through all three parts of Phase I. For a comparative analysis of the effects of well-defined versus not well-defined aimpoints on gunnery selected runs of the Twister will be made without the vertical mounted cylinder.

(2) The target vehicle wll run all four routes at speeds of 10, 20, 30 and 40 mph. The speed of each run will be randomized. Ten mph represents an approximate cross-country speed for present heavy Armor vehicles and will be used as a baseline hit probability for comparison analysis. To eliminate detection time as a variable, each defender commander will be told the time and place to expect the target vehicle. Gunners will be required to detect and acquire the target.

(3) This phase of the experiment is in a "sterile" terrain to allow isolation of the variables that affect vehicle survivability. Confusing variables (attack routes, varying segment lengths partially concealed silhouettes, etc.) will not be "played" during this phase of the experiment. In additon to allowing for an examination of the aforementioned variables, this test phase provides an evaluation of the times when a tank has to cross open country and is fully exposed.

(4) One vehicle (Twister with clearly defined aimpoint), six crews per vehicle (one crew for "training" effect), four speeds (10, 20, 30 and 40 mph) and three segments (lateral, oblique, and head-on) requires 72 iterations. Using the six crews against the Twister target without a clearly defined aimpoint at one speed and one segment requires an additional 12 iterations. Total iteration size is therefore 84 during this part of Phase I.

d. Part Two is the start - stop test. All six target vehicles will perform this test using maximum acceleration/deceleration performance levels for predetermined times over the course outlined in app K. Defensive "gunners" will engage the targets. This will allow for an evaluation of start-stop techniques (which will be a function of each target vehicle's performance characteristics) as a viable maneuver to increase vehicle survivability.

(1) Start-stop tactics will increase exposure time and probably the number of rounds fired per run. This will provide an evalution of a viable trade off between increased exposure time and decreased probability of hit when compared to constant speed targets.

(2) The procedure for the Twister control vehicle is the same as outlined above. The remaining target vehicles will present

a more realistic challenge to the gunner in that vehicle silhouette will play a role in the survivability experiment. Detection will not be required by the commander. Randomization will be introduced utilizing the tables outlined in app K.

(3) Each target vehicle is required to run the four routes only once for each of the six gun crews. To gain maximum utilization out of each run, two operational time sequences are planned on each pass. Sequence 1 programs the vehicle, to accelerate at full capability for 8 to 10 seconds, or until a maximum safe speed is reached, followed by a hard stop, then, remain stationary for no more than 3 seconds. This sequence would be repeated until halfway across the course followed by Sequence 2 for the second half. Sequence 2 is the same action except that the duration of acceleration time is 4-6 seconds; the stationary time is the same. These particular times are selected to provide maximum interference with "gunner" lay times. Sequence 1 and 2 will be alternated sufficiently to produce some randomization.

(4) Defensive gunners will be required to lay on the target and apply correct ranging and lead techniques.

(5) To establish continuity of target display and simplify the command and control problem of mixing realistic and non-realistic targets, the Twister control vehicle will run independent

of the other vehicles. Data requirements and collection methods will remain the same.

(5) Six vehicles (M60A1 tank, S-tank, RVT, FMC Track, M113 w/2-engines, and the Twister), six crews and three segments (lateral, oblique and head-on) requires 108 total iterations.

e. Part Three is the Evasive Tactic Test. This test is designed to evaluate the effects of evasive maneuvers on a gunner's ability to track and engage a target. Targets will present changes in apparent speed, acceleration, silhouette and direction.

(1) Several evasive tactics will be evaluated. The exact tactics utilized will be determined after a current study on current "survivability" data has been completed. Test officers will be collecting data from several sources (especially Germany and UK) on the best evasive maneuvers to employ. Likely candidates identified at this time include:

Dash-to-cover (all-out acceleration over the test course)

Sine motion ("classic" sine wave maneuver, with peaks determined by analysis of results from start-stop techniques).

Swerve (similar to sine motion except turns are made at 90° to line of motion)

Varying sine (either decreasing amplitude, varying amplitude, or varying "frequences")

Random Serpentine (random courses laid out that are either time or distance dependent)

(2) The vehicle configurations and course will be the same as the stop-start test, with the Twister control vehicle running independent of the others.

(3) Gunners will be required to apply proper lead and ranging techniques.

(4) A major consideration for selecting an evasive tactic is the "target" driver. A driver must be able to understand the tactic and be able to perform it within the vehicle's limitations. Because of this, simplicity of design and ease of execution will be governing factors in developing evasive maneuvers.

(5) Data collection techniques, target and defensive vehicle operational procedures and course traffic control will be

conducted as previously described. The full complement of vehicles will run the evasive action test.

(6) Six vehicles (M60A1 tank, S-tank, RVT, FMC Track, M113 w/2-engines and the Twister), six crews, three segments (lateral, oblique and head-on), and three evasive tactics requires a total of 324 iterations.

2.9.2.8 Phase II - St. Vith Range

a. This test is designed to look at the more complex combined effects of vehicle and terrain parameters on vehicle survivability. This experiment is structured similar to that of Phase I, but will be conducted in a more realistic terrain with vehicles operating in a cover-to-cover manner. Vehicle performance and silhouette parameters, as well as vegetation and terrain concealment, varying intervisible segment lengths, and different attack routes will be examined.

b. This experiment is designed as a follow-on to the testing conducted at Yano Range. "Lessons learned" from that testing will be applied to the maximum extent possible during this phase of the test.

c. The St. Vith Phase has two parts which are designed to look at different aspects of intensibility segment lengths. The first part will examine selected segment lengths and their effect on gunner's hit performance. The second part is designed to examine the differences in segment lengths caused by rapid advance tactics (minimum use of terrain) and a more evasive tactic which uses terrain to maximum effectiveness.

d. Part one of the St. Vith Phase will examine the effects of selected intensibility segment lengths on gunner's hitting per formance. A total of six attack routes in a realistic terrain setting will be prepared against a defensive position. Target vehicles will move through these attack routes to an objective and be engaged by the defenders with gun cameras. These attack routes will afford the "gunner" vehicles a combination of intenvisible segment lengths and partially concealed silhouettes.

(1) The target vehicles will consist of ~~the six~~ three vehicles used in the Yano Test Phase (M60A1 tank, S-tank, RVT, ~~M113 w/2 engines, FMC Track and Twister~~). The gunner vehicles will be the M60A1 tank, M60A1E3 tank, S-tank and TOW tracker. All gunner vehicles will be required to apply correct range and lead techniques when engaging targets.

(2) Two attack routes will be selected to examine the effects of brief discontinuities on gunner tracking and hit performance. These routes will be dependent on actual range selection, but will generally represent a series of short intervisibilities (less than 50 meters) followed by a longer segment of nonintervisibility. Ideally, it is hoped that each of the two routes can be designed to present the gunner with a series of these short then medium length segments for target engagement. Target vehicles will begin movement at approximately 2,000 meters (terrain dependent) and will proceed continuously towards the defensive positions.

(3) One attack route will be a series of medium to long intensibility segment lengths (100 to 300 meters). Three tactics will be employed along this route. In the first target vehicles will begin movement at approximately 2,000 meters and will proceed continuously towards the defensive positions, moving from one concealed position to another. Gunners will attempt to engage the targets throughout their movement. The second tactic will employ dash-to-cover over each of the segment lengths. Target vehicles will halt in each concealed position. Gunners will attempt to engage targets during the movement phase. During each period of nonintervisibility gunners will "lay-off: the target and be required to reacquire the target during the next run. The third tactic will be an evasive maneuver selected from Phase I testing which demonstrates the best potential for high survivability. This tactic will be conducted similar to the dash-to-cover tactic mentioned above.

(4) One attack route will be a series of medium to long (100 to 300 meter) intervisibility segment lengths with the vehicles progressing through terrain where they are partially concealed by vegetation. The same techniques as in (4) above will be employed.

(5) No initial detection will be required during this experiment. Vehicle commanders will be given the general area in which to expect the target vehicle's appearance, and will then be required to lay the tank in the area for the gunner's identification.

(6) ~~Six~~ 3 vehicles, six routes, and ~~five~~ six crews will require a total of ~~100~~ 108 iterations.

(7) Each route will be run once by a color-coded tank (M60A1) and filmed from each defensive position utilizing 16MM movie cameras. This will provide a documentation of the silhouette available over each route. From this film segment lengths, percent visibility, and height and quartering aspects will be calculated. These data will be required during the analysis of hit probabilities.

e. Part Two of the St. Vith Phase will examine the differences in segment lengths caused by rapid advance tactics (with minimum use of terrain) and attack tactics involving maximum use of terrain. During this part of the experiment project personnel will select between five and ten attack routes leading to an objective. Half of these routes will be designed to utilize terrain to the maximum when proceeding to the objective. Half of the routes will be rapid advance approaches which utilize terrain to a minimum.

(1) No simulated firing of defensive vehicles will be performed. Movie cameras will film each selected route from several (5 to 10) defensive positions. The target vehicle (M60A1 tank) will be color-coded to aid in film reduction.

(2) Half of the attack routes will utilize terrain to the maximum when approaching the objective. It is expected that this will be a more time-consuming method, but will offer the least number of exposed times to the defenders.

(3) Half of the routes will be rapid advance. Target vehicles will not completely avoid nonintervisibility terrain features, but will be primarily concerned with rapid movement to the objective. This tactic will require less time but expose the target for longer periods.

(4) These tests will allow computation of the average intervisibility segment length afforded by the two varying tactics.

(5) Time permitting, this subtest will be performed at three different locations at Fort Knox.

2.9.3 Data Required

2.9.3.1 Phase I - Yano Range. Data will be recorded using film and individual data collector sheets. Data required for support analysis of the survivability experiments at Yano Range includes a record of:

a. Defensive Vehicle Data

(1) Time-to-lay on targets

(2) Time to fire first rounds

(3) Time between rounds fired

(4) Number of rounds fired

(5) Time-to-acquire target

(6) Weapon range setting at time of fire

b. Target Vehicle Data

(1) Course run times

(2) Start/stop times

(3) Distance/times between maneuvers

(4) Accelerations

(5) Speeds

(6) Turning rates

2.9.3.2 Phase II - St. Vith Range. Data will be recorded using film and voice recorders, event recorders, and individual data collector sheets. Data required to support analysis of the survivability experiments at St. Vith Range includes the following:

a. Defensive Vehicle Data

(1) Time-to-lay on targets

(2) Time-to-fire first rounds

(3) Time between rounds fired

(4) Number of rounds fired

(5) Time-to-acquire targets

(6) Weapon range setting at time of firing

b. Target Vehicle Data

(1) Course run times

(2) Distance/times between maneuvers

(3) Accelerations

(4) Speeds

(5) Turning rates

2.9.3.3 The instrumentation available will determine how some of the data is to be collected. It is important to know the exact range at the time of each firing, and hence vehicle position (location) in each run (for both Yano and St. Vith Range) will be required. With time and distance between maneuvers, speed and acceleration can also be computed. For Phase II (St. Vith Range) a color-coded tank will be run over each attack route. This film will be analyzed to provide data on the length of all intervisibility segments and the vehicle aspect and silhouette available (concealed, partially concealed, etc) at time of round impact, or as a function of the tactic employed.

2.9.4 Analytical Plan

2.9.4.1 Phase I - Yano Range

a. All three parts of Phase I will be analyzed using a series of one, two, and three-way analysis of variance (ANOVA). In part one, an ANOVA on the impact that various speeds, ranges, and firing systems have on gunner miss-distance will be conducted. The same holds for Phase II and III except target types will replace "speeds" as one of the effects under analysis.

b. Several direct comparisons will be performed between the M60A1 tank and S-tank both as firing and target vehicles. Likewise, a comparison between the regular M60 tank crews and the special, training M60 tank crews will be conducted to determine if additional training appears to negate all (or part) or the advantage (if it exists) of high speed and evasive maneuvers.

c. A direct comparison between the different types of evasive maneuvers will provide insight as to which area appears most "fruitful" for adversely impacting the enemy's performance. These comparisons can best be performed by observing the control Twister (well-defined aimpoint) as it goes through all phases of the test.

d. Although the factor of silhouette itself cannot be isolated for analysis purposes, there will be several silhouette/performance candidates (e.g., M60 tank, S-tank, M113 APC, and Twister) that can be examined. In general, we will run from the larger silhouette low performance M60 tank to the small silhouette high performance Twister. Thus, if good correlation exists for the vehicles in between, firm conclusions can be drawn about

the various silhouette/performance capabilities and their impact on probability hit.

e. A multitude of additional comparisons will be conducted between the different data cells; however, these will, in general, fall out of the various ANOVA's already planned.

2.9.4.2 Phase II - St. Vith Range. Analysis similar to that of Phase I will be performed in Phase II. The comparisons will have more "confusing" factors because of the combined effects of the survivability variables. The areas to be examined during this phase are:

a. The effects of selected segment lengths of intervisibility on gunner's performance

b. The effects of tactics on intervisibility segment lengths

2.10 SILHOUETTE EXPOSURES IN STATIONARY POSITIONS

2.10.1 Objective. To ascertain the hit probabilities of the M60A1 tank against the exposed silhouette of the S-tank, and M60A1 tank in stationary positions.

2.10.2 Method

2.10.2.1 An M60A1 tank and a S-tank will be placed in various firing positions and required to lay on selected aiming points. Vehicles will always assume the best defilade position possible to minimize vehicle exposure and still be able to engage the described target. (The target will be one of two posts that mark out a range fan the gunners are required to cover.)

2.10.2.2 Vehicle sight picture will be verified by the project officer. The firing vehicles (M60A1 tank and S-tank) will then be photographed by cameras placed in the target location, and by cameras offset to the side of the target (approximately 15^{0} from the line of sight).

2.10.2.3 The firing vehicles will be placed in a number of locations. Primary interest is on the reverse side of a slope in a defilade position. Locations will be selected to provide a variety of reverse slope angles (i.e., 5^{0}, 10^{0}, 15^{0}, etc.) and gun elevation/depressions. Vehicles will also be placed in a forward slope position, and on level terrain and photographed as above. Fully exposed frontal, quartering, and side views of the silhouette will also be photographed.

2.10.2.4 While in each location five to ten gunners will be required to lay on each target mass presented by the available silhouette. A camera with cross lairs will be utilized to simulate the gunner's sight. A photograph of each gunner's sight picture will be taken.

2.10.2.5 All terrain will be surveyed and the measurements of slope recorded.

2.10.3 Date Required

2.10.3.1 A record of all survey measurements

2.10.3.2 A record of each camera location, distance from the vehicles, etc.

2.10.3.3 Complete photographic documentation of the target silhouette available for each location

2.10.3.4 Photographic record of the gunner's aim point

2.10.4 Analytical Plan. Each silhouette will be analyzed to calculate the vehicle dimensions and area presented to the cameras. These data will be recorded by total area and by dimensions. The data will be reduced and programmed into the USAARENBD irregular shaped Silhouette Program (Wimmer Program) to determine probability of hit. Probability of hit will be calculated utilizing the standard error budget of selected US rounds. Center of mass will be used in one analysis of P_H. Aim points selected by gunners will be used in a second analysis program.

SECTION 3. APPENDIXES

APPENDIX A. TEST DIRECTIVE

(Will be inserted at a later date)

APPENDIX B. TEST CRITERIA

Not used.

APPENDIX C. SUPPORT REQUIREMENTS

1. PERSONNEL

a. Vehicle Crews and Test Operations

TITLE	RANK/ GRADE	MOS	QUANTITY	PROPOSED SOURCE
Project Officer	LTC	1204	1	USAARENBD
Sub-Test Director	MAJ	1203	2	USAARENBD
Asst Sub-Test Director	LT/CPT	1203	2	USAARENBD
Asst Project Officer	CPT	1203	1	TRADOC
AOS Tk Plat Leader	LT	1203	1	TRADOC
Data Chief	GS-12	1670	1	USAARENBD
Scientific & Engineering Asst	E5	01C2	1	USAARENBD
Clerk Typist	GS-3	0322	1	USAARENBD
Project NCO	E7	11E40	1	USAARENBD
Asst Project NCO	E7	11E40	4	USAARENBD
Asst Project NCO	E6	11E40	2	USAARENBD
S-Tank Crewmen	E5-6	11E40	12	USAARENBD
S-Tank Crewmen	E3-5	11E20	9	TRADOC
Data Collectors	E4-5	11E20	8	TRADOC
AOS Tank Crewmen	E4-6	11E	18	TRADOC
AOS Tank Plt SGT	E7	11E40	1	TRADOC
Medical/Driver	E3-5	91B	1	TRADOC
Drivers, Light	E3-5	64A/11E	7	USAARENBD
Drivers, Heavy	E3-5	64B/11E	4	USAARENBD
Drivers, Heavy	E4-5	64B/11E	3	TRADOC
M113 Crewmen	E4-5	11B	28	TRADOC
Twister Crewmen	E4-5	64C/11B	28	TRADOC
M60A1E3 Crewmen	E4-6	11E	20	TRADOC
TOW Trackers	E3-4	11B	5	TRADOC
RVT II Crewmen	E4-5	11E20	14	TRADOC

b. Mechanics

TITLE	RANK/ GRADE	MOS	QUANTITY	PROPOSED SOURCE
Track Vehicle	E4-5	63C20	7	TRADOC
Track Vehicle	E3-5	63B20	2	TRADOC
Heavy Equip	E5-6	63K40	2	TRADOC
Recovery Mechanic	E3-5	63F20	4	TRADOC
Tank Turret Rpmn	E3-5	45K20	2	TRADOC
Field Radio Rpmn	E3-5	31E20	1	TRADOC
Track Vehicle	E3-6	63C30	6	USAARENBD

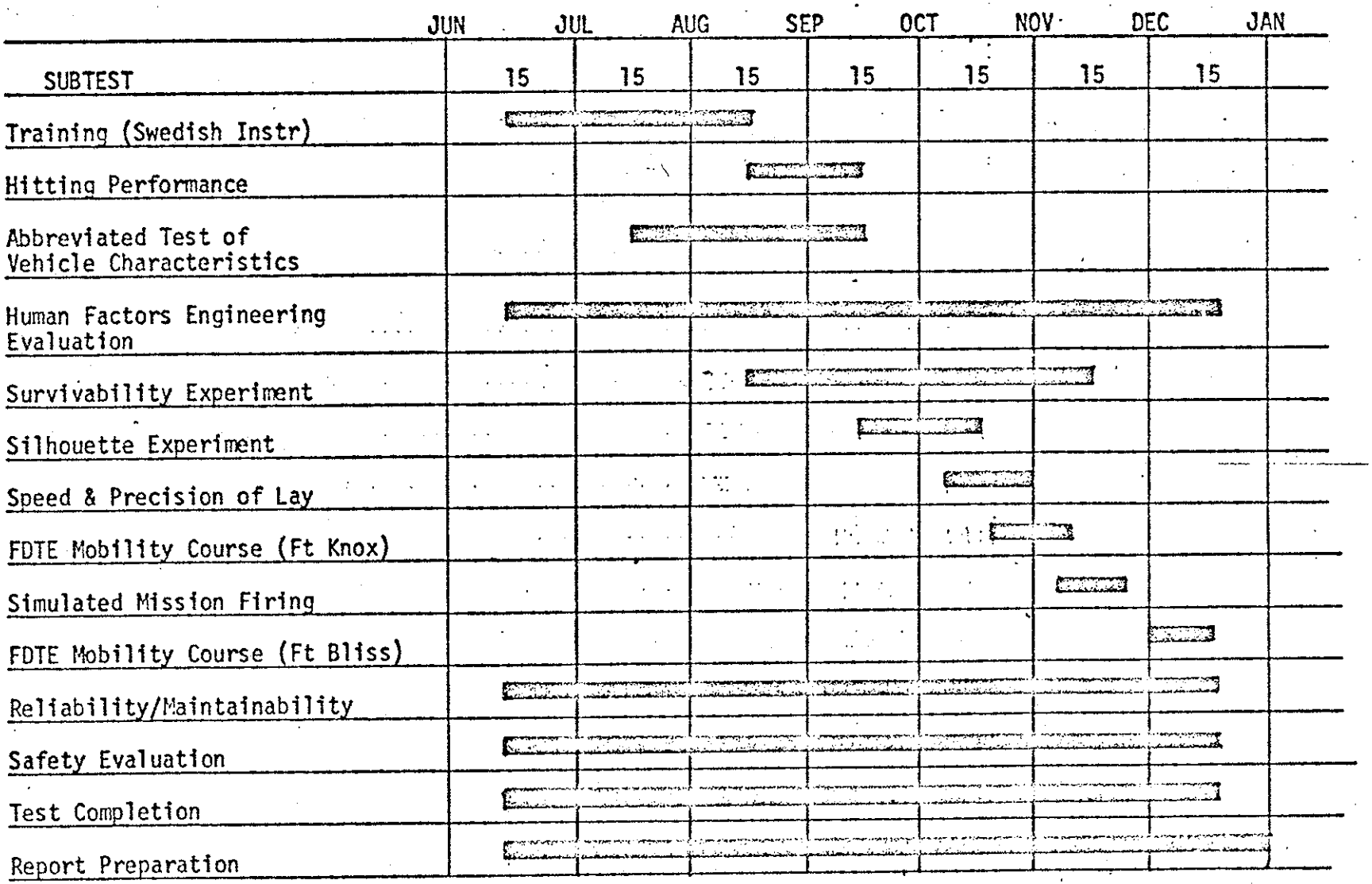
2. EQUIPMENT REQUIREMENT

ITEM	QUANTITY	SOURCE
S-Tank w/radio AN/VRC-46	2	SWEDEN
Tank, Combat, Full-Tracked, 105MM Gun M60A1(AOS) w/AN/VRC-12 Radio	2	USAARENBD
Tank, Combat, Full-Tracked, 105MM Gun M60A1E3 w/AN/VRC-12 Radio	2	TRADOC
Carrier, Personnel, Armored, M113A1 w/AN/VRC-46 Radio	1	USAARENBD
Carrier, Personnel, Armored, M113 (Modified Twin engine) w/AN/VRC-46 Radio	1	WES
Twister (Mobility Bed)	1	TACOM
Twister, XM808, w/Radio ARSV FMC XM800	1	TACOM
German RVT II	1	FRG
TOW, Heavy Antitank/Assault	2	TRADOC
Truck, 1/4-Ton, 4 x 4, w/Radio	7	USAARENBD
Bus, 37 passenger	2	USAARMC
Radio, PRC 77	8	USAARENBD
Truck, Cargo, 2-1/2-Ton	1	USAARENBD
Ambulance	1	TRADOC
Truck, Cargo, 5-Ton, w/Trailer	1	USAARENBD
Truck, Van, 2-1/2-Ton	1	USAARENBD
Heavy Equip Transporter	2	TRADOC

3. AMMUNITION REQUIREMENTS

ITEM	QUANTITY	PROPOSED SOURCE
Cartridge 105MM: HEAT-TP-T, M490	400	WECOM
Cartridge 105MM: HEP-TP-T M393A1	275	WECOM
Cartridge 105MM: DSTP-T, M724	125	WECOM
Cartridge 7.62MM: Ball and Tracer Linked for M219 Machinegun	4,000	WECOM
Cartridge 105MM: HE-TP, M61	300	SWEDEN
Cartridge 105MM: AP-TP, M67	400	SWEDEN
Cartridge 105MM: APDS-TP, M65	100	SWEDEN
Cartridge 7.62MM	9,000	SWEDEN
Grenade, Smoke, M56	12	SWEDEN

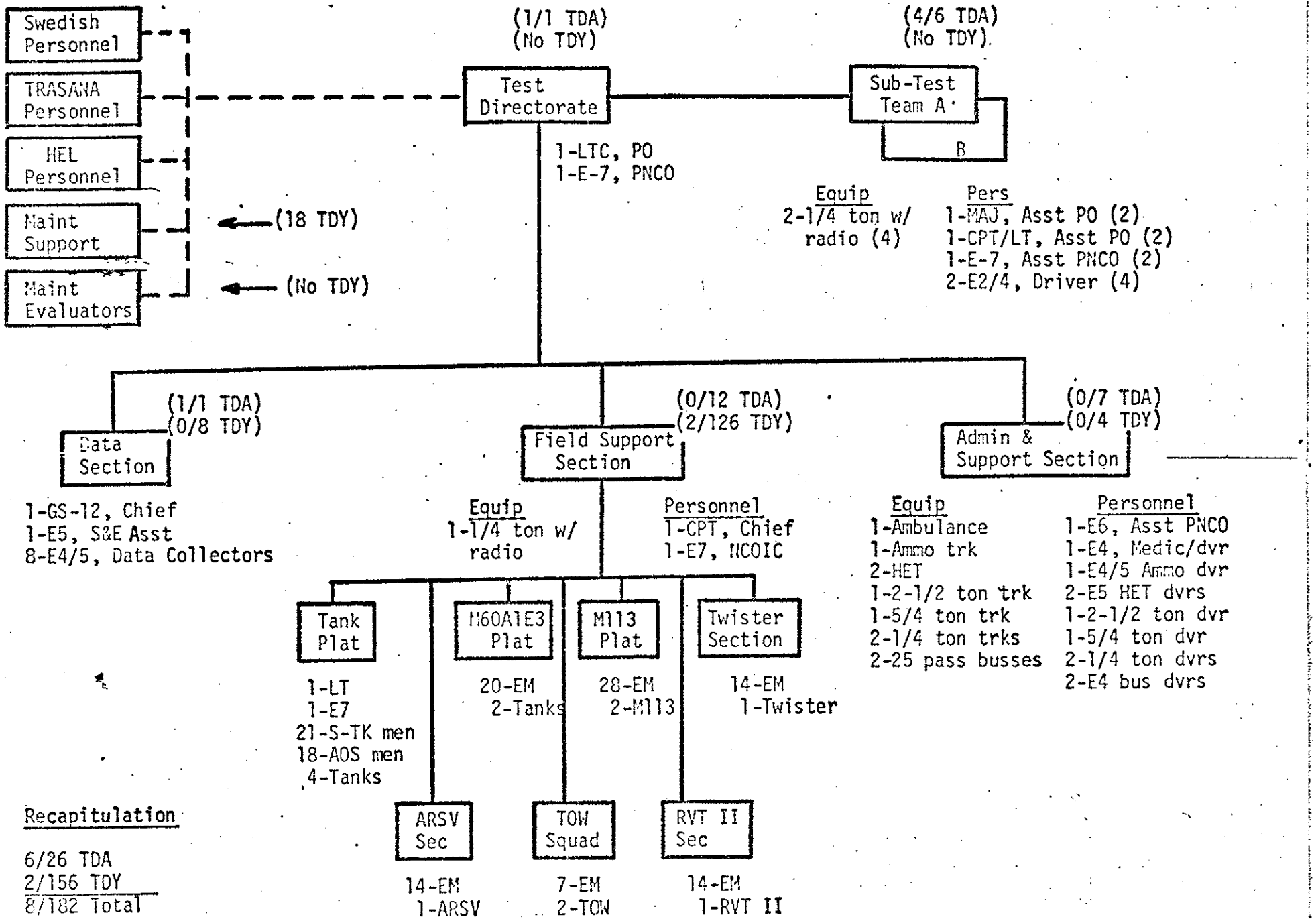
APPENDIX D. TEST SCHEDULE



APPENDIX E. INFORMAL COORDINATION

Not used.

APPE[illegible] X F. TEST PROJECT ORGANIZATIO[illegible]



Recapitulation

6/26 TDA
2/156 TDY
8/182 Total

APPENDIX G. TRAINING OF S-TANK CREWS

TABLE OF CONTENTS

PART 1. SWEDISH SELECTION CRITERIA FOR TANK CREWMEMBERS

1. Intelligence Test

Written test: Linguistic logical and technical-mechanical tests

Test group	Points	
1	- 29	
2	30 - 44	
3	45 - 59	
4	60 - 75	Reverse Driver
5	76 - 92	Gunner/Driver
6	93 - 108	Tank Commander
7	109 - 123	
8	124 - 134	
9	135 -	

2. Physical Test

Test Group	
1	
2	
3	
4	Reverse Driver
5	Gunner/Driver
6	
7	Tank Commander
8	
9	

3. Commander Talent

1	
2	
3	
4	Gunner/Driver
5	
6	Tank Commander
7	
8	
9	

4. Driver License

100% of all tank commanders, gunner/drivers and reverse drivers.

5. Height

Test Group	Meter		
9	1.91		
8	1.86 - 1.90		
7	1.81 - 1.85		
6	1.76 - 1.80	Maximum	Tank Commander
5	1.71 - 1.70		Gunner/Driver
4	1.66 - 1.70		Reverse Driver
3	1.61 - 1.65	Minimum	
2	1.56 - 1.60		
1	1.50 - 1.55		
0	- 1.49		

6. Muscle Power

Total of hand-, arm- and leg power

Test Group	Kolopond (kp)	
9	250 -	
8	240 - 249	
7	230 - 239	
6	215 - 229	
5	200 - 214	
4	175 - 199	Gunner/Driver, Reverse Driver
3	135 - 174	Tank Commander
2	100 - 134	
1	- 99	

7. PWC

Test Group	kpm/min (Kilopondmeter/minute)	
9	1651 -	
8	1551 - 1650	
7	1451 - 1550	
6	1351 - 1450	
5	1251 - 1350	
4	1151 - 1250	
3	1051 - 1150	Tank Commander, Gunner/Driver Reverse Driver
2	901 - 1050	
1	801 - 900	
0	- 800	

8. Faculty of Seeing

Test Group	With Correction		Without Correction		
	Best eye	The other	Best eye	The other	
9			1,0	1,0	TC, G/D, RD
8			1,0	0,7	
7	0,7	0,7	0,7	0,3	

9. Faculty of Seeing in Darkness

Test Group	Mikrocandela/m^2	
9	- 3	
7	4 - 9	Tank Commander, Gunner/Driver
5	10 - 18	Reverse Driver
3	19 - 22	
1	23 -	

10. Faculty of Seeing Colors

Test Group		
9	Normal	Tank Commander, Gunner/Driver, Reverse Driver
1	Any defect	

11. Auditory Faculty

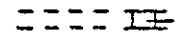
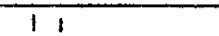
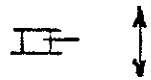
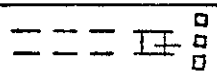
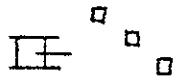
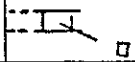
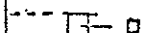
Test Group	
9	Can hear 20 db of 500, 1000, 2000, 3000, 4000, 6000Hz
7	-"- -"- " " " " Hz
5	-"- -"- " " " Hz on the better ear and a reduce of 20 - 40 db on the other. TC, G/C RD

PART 2. TRAINING PROGRAM FOR S-TANK CREWMEN

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Basic (1) Instr	Maint (1) Instr	Aiming (2)	Cupola (2)	Driving (7)	Battle (1) Drill	Battle (5) Drill
Basic Instr	Driving (2)	Machine (1) Guns	Driving (5)	Maint (8) Instr	Battle Drill	Battle Drill
Basic (2) Instr	Maint (2) Instr	Maint (5) Instr	Maint (7) Instr	Driving (8)	Battle (2) Drill	Battle (6) Drill
Basic Instr	Driving (3)	Aiming (3)	Driving (6)	Maint (9) Instr	Battle Drill	Battle Drill
Basic (3) Instr	Maint (3) Instr	Machine (2) Guns	Main (1) Gun	Driving (9)	Battle (3) Drill	Crew (1) Tests
Basic Instr	Driving (4)	Aiming (4)	Aiming (5)	Driving	Battle Drill	Crew Tests
Driving (1)	Maint (4) Instr	Maint (6) Instr	Main (2)	Spare (1) Time	Battle (4) Drill	Spare (2) Time
Radio (1) Sets	Aiming (1)	Cupola (1)	Aiming	Spare Time	Battle Drill	Spare Time
Maint (1)	Maint (2)	Maint (3)	Maint (4)	Maint (5)	Maint (6)	Maint (7)
Maint	Maint	Maint	Maint	Maint	Maint	Maint

PART 3. AMMUNITION REQUIREMENTS FOR S-TANK TRAINING

T103B ROUNDS FOR TRAINING COURSE

EX #	Target	Range (M)	Crew TC	Crew G/D	Mode	Rds Per Man	Times	Ammo M/61 HE-TP	Ammo M/67 AP-TP	Ammo 7.62 MM	Notes
1	STTK	1000	5	5	 Stop-Fire	1	2		20		
2	STTK	1000	5	5	 Turn-Stop-Fire	1	3		30		
3	MVTK	1000 1500	5 5	5 5		1 1	2 2		20 20		
4	ATMSL	1200	5	5	 Stop-Fire	3	2	60			
5	PERS	400 600 800		5		300	2			3000	
6	PERS	400	5			100	1			500	
7	PERS	400	5		 Firing on the Move	100	2			1000	
8	PERS	400	5		 Firing on the Move	100	2			1000	
							TOTAL	60	90	5500	

APPENDIX H. HITTING PERFORMANCE REQUIREMENTS

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PART 1. HITTING PERFORMANCE

S-TANK

ROUNDS

Range (M)	Ammo	Veh/Tgt	HE-TP Rds/ Crew	HE-TP M/61 Total	AP-TP Rds Crew	AP-TP M/67 Total	APDS-TP-T Rds/ Crew	APDS-TP-T M/65 Total
1,000	HE-TP	S/S	10	50				
1,000	AP-TP	S*/S			10	50		
1,000	HE-TP	S/M	10	50				
1,000	AP-TP	S**/M			10	50		
1,500	HE-TP	S/S	10	50				
1,500	AP-TP	S*/S			10	50		
1,500	HE-TP	S/M	10	50				
1,500	AP-TP	S/M			10	50		
2,000	APDS-TP	S/S					10	50
	TOTAL			200		200		50

*Stop-Fire
**Turn-Stop-Fire

PART 2. HITTING PERFORMANCE

M60A1 (AOS) TANK

ROUNDS

Range	Ammo	Veh/Tgt	HEP-TP-T M393A1		HEAT-TP-T M490		DSTP-T M724	
(M)			Rds/ Crew	Total	Rds/ Crew	Total	Rds/ Crew	Total
1000	HEP-TP-T	S/S	10	50				
1000	HEAT-TP-T	S/S			10	50		
1000	HEP-TP-T	S/M	10	50				
1000	HEAT-TP-T	S/M			10	50		
1500	HEP-TP-T	S/S	10	50				
1500	HEAT-TP-T	S/S			10	50		
1500	HEP-TP-T	S/M	10	50				
1500	HEAT-TP-T	S/M			10	50		
2000	DSTP-T	S/S					10	50
	TOTAL			200		200		50

APPENDIX I. SIMULATED MISSION FIRING

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PART 1. SIMULATED MISSION FIRING (ATTACK)

1. GENERAL

a. The attack course is designed to confront the "attacking" tank with a series of situations so sequenced in time and space as to approximate that to be expected on an actual mission to seize an objective. The configuration of the exercise stresses the performance envelope of the tank armament/fire control systems, and permits testing of the tank's fire control and fighting arrangement to the maximum extent possible.

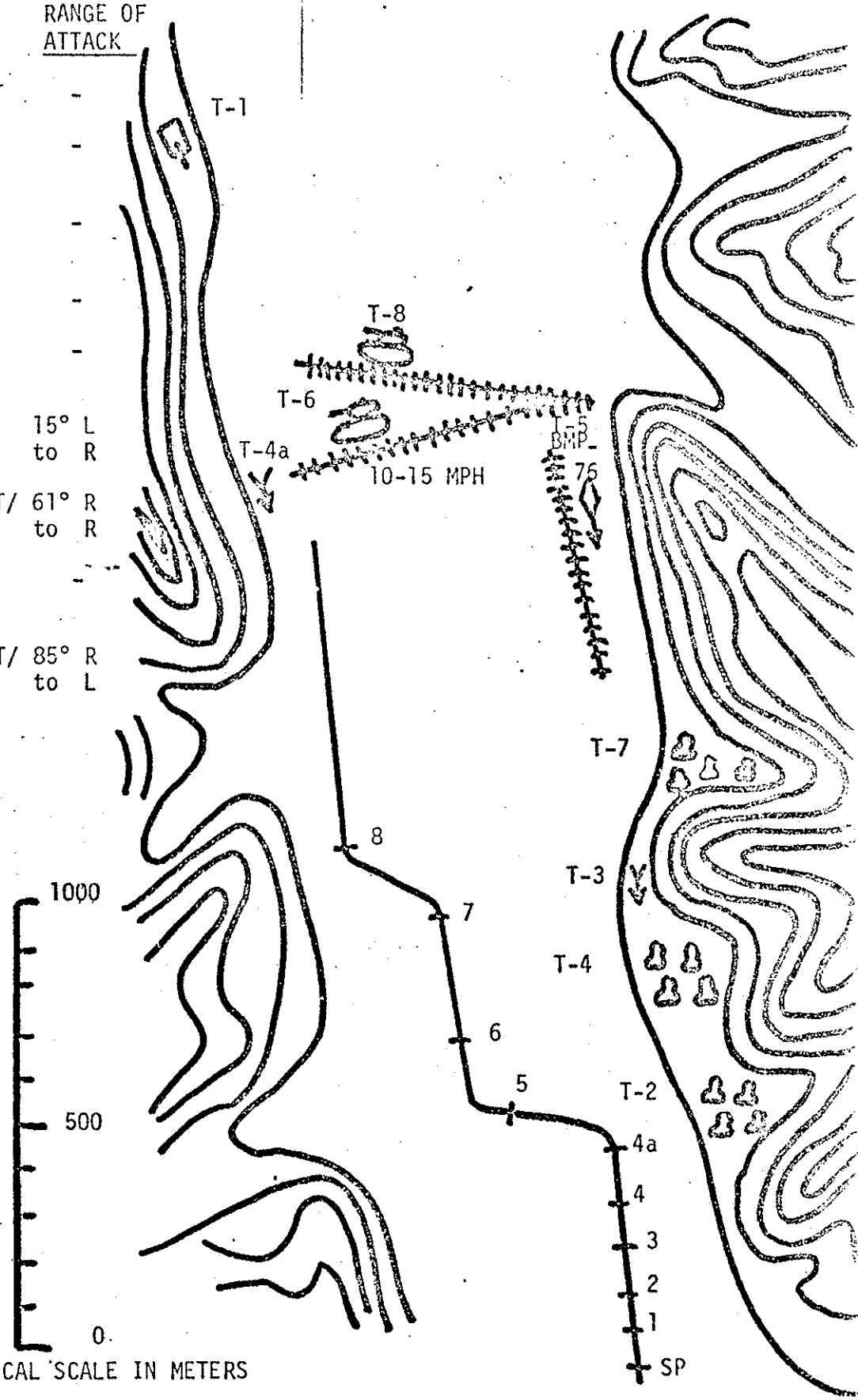
b. The enemy array confronting the tank on its mission consists of a blend of tank, antitank, missile, dismounted personnel, reconnaissance, and mechanized infantry targets, a specific number of which are preordained as CRITICAL, in that, if not neutralized, they will have catastrophic impact on mission performance. (See overlay 1.)

c. With respect to para 1b above, targets #3 (AT Gun), #4a (AT Missile), #6 (Tank), and #8 (Tank) are CRITICAL and the attacking tank's inability to destroy any one or all of these will result in mission abort, occurring when the first of these enemy targets is not destroyed.

S-TANK SMF ATTACK COURSE

OVERLAY 1

	TARGET	RANGE	AMMO	RANGE OF ATTACK
1	ST TK	2000	DSTP-T	-
2	PERS	400	COAX/ TCMG	-
3	SU-100	600	HEAT/ HE-TP	-
4	PERS	500	COAX	-
4a	ATMSL	1350	HEP/ HE-TP	-
5	MV BMP (MICV)	1350-1200	HEP/ HE-TP	15° L to R
6	MV TK	1160-1060	DSTP-T/ AP-TP	61° R to R
7	PERS	400	COAX/ TCMG	-
8	MV TK	950	DSTP-T/ AP-TP	85° R to L



APPROXIMATE VERTICAL SCALE IN METERS

NOT TO SCALE HORIZONTALLY

2. DETAILS OF EXERCISE

a. The attacking tank (with controller aboard) moves down range from the SP on command. After moving 50 meters, it is engaged by an enemy tank (T-1). Due to extreme range, the attacking tank halts to fire. Enemy tank is engaged with one round of APDS-TP. If the target is missed, a second round will be fired.

b. Since this target is not critical, tank continues on mission even though target is not destroyed.

c. Tank proceeds down range to 2 where presence of T-2 is indicated by controller. Target engaged with 100 - 125 rounds COAX/TCMG on the move.

d. At 3, attacking tank is confronted by an armed assault AT gun such as an SU-100 (T-3). The attacking tank engages the AT weapon with the main gun. The AT gun is CRITICAL. Both test and comparison tanks acquire the target while on the move. AT target will be exposed twice, for 15 and 10 seconds respectively, to both tanks. If the attacking tank fails to destroy the AT gun during the two exposures, it will be considered destroyed; however, the crew will continue the course run in order to generate required data. The target will be engaged with HEAT-TP/HE-TP. If the target is destroyed, attacker continues his mission to 4.

e. Attacking tank proceeds to 4 and engages personnel at T-4 with 100 - 150 rounds COAX, then proceeds on to 4a.

f. At 4a, attacking tank is threatened with missile engagement from T-4a. Target remains exposed for 20 seconds unless sooner destroyed. The 20-second exposure is based upon time required for the enemy to acquire the target and activiate the system and for a 15-second missile time of flight. Tanks engage with HE-TP from stationary posture. Attacker engages with one round and fires a second round if the target is not destroyed. Target is CRITICAL and attacker's failure to destroy it results in a mission abort. If target is destroyed, attacker continues to 5.

g. At 5, attacker must engage a withdrawing MICV (BMP-76) at T-5. The BMP is engaged with one round of HEP-TP/HE-TP. If the target is not destroyed, he will fire a second round.

h. At 6, attacker engages moving tank from the flank (T-6) with DSTP-T/AP-TP. If the enemy is not destroyed by the time it completes its traverse, attacker is considered destroyed and the attack aborted.

i. At 7, attacking tank engages personnel (T-7) with 100 - 150 rounds COAX/TCMG from moving tank and proceeds to 8.

j. At 8, the attacker engages the moving enemy tank (T-8) with DSTP-T/AP-TP. If the enemy is not destroyed by the time it completes its traverse, attacker is considered destroyed and the attack aborted.

PART 2. SIMULATED MISSION FIRING (DEFENSE)

1. GENERAL

a. The defense course enables testing to the maximum extent possible of the fire control and fighting arrangements of the tank while in a defensive position.

b. The same types of targets as used on the attack course will be utilized and will simulate the approach of an attacking enemy force.

2. DETAILS OF EXERCISE (See overlay 2)

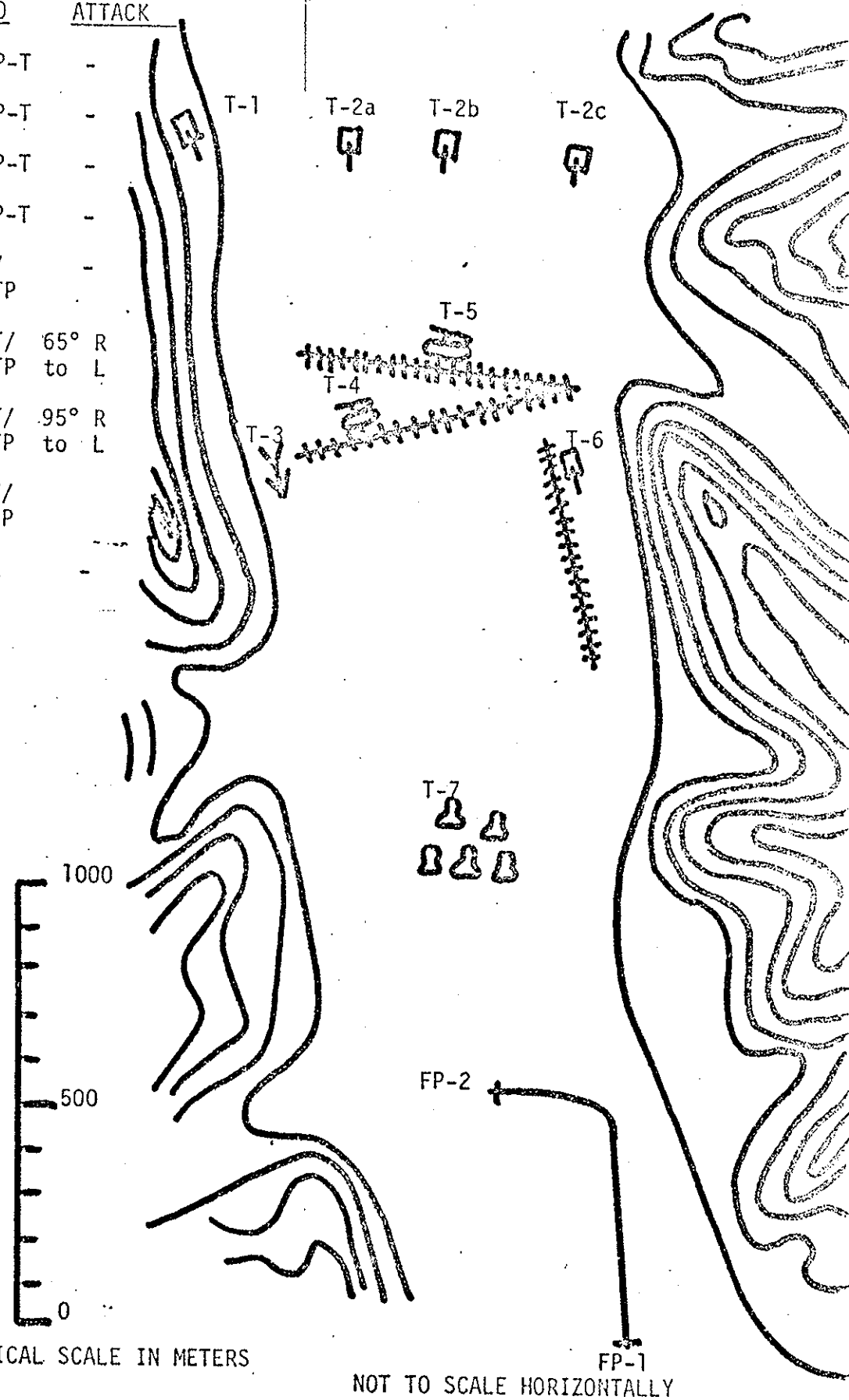
a. The exercise begins with defending tank in a defilade firing position (FP-1). Enemy force consists of six tanks, one BRDM, and one squad of dismounted personnel, initially.

b. The first indication of enemy attack is the appearance of the tank at T-1. Target is identified by defending tank which attempts to destroy enemy with APDS-TP. If the target is missed, a second round will be fired. The target will either be destroyed or will disappear from the gunner's view. Defending tank then moves to a better defensive position (FP-2).

S-TANK SMF DEFENSE COURSE

OVERLAY 2

	TARGET	RANGE	AMMO	ANGLE OF ATTACK
1	S TK	2000	DSTP-T	-
2a	S TK	1950	DSTP-T	-
2b	S TK	1950	DSTP-T	-
2c	S TK	1950	DSTP-T	-
3	BRDM	1300	HEP/ HE-TP	-
4	M TK	1410-1325	HEAT/ AP-TP	65° R to L
5	M TK	1510-1550	HEAT/ AP-TP	95° R to L
6	M TK	1320-1250	HEAT/ AP-TP	
7	PERS	650	COAX	-



APPROXIMATE VERTICAL SCALE IN METERS

NOT TO SCALE HORIZONTALLY

c. One minute after defending tank is in position at FP-2, tanks represented by T-2a, b, and c appear simultaneously for 18 seconds. This represents a forward translation of the leading edge of the enemy attack. Defending tank engages and attempts to destroy with APDS-TP as many of the enemy tanks as possible within the 18 seconds.

d. Defending tank acquires BRDM at T-3 and engages with HE-TP.

e. Thirty seconds after engagement of T-3 ceases, enemy tank (T-4) begins movement to front of defending position. Tank is trailed by another tank (T-5). Defending tank opens fire at the first tank with HEAT-TP/AP-TP, and then attempts to destroy the second tank with HEAT-TP/AP-TP as it appears in view.

f. One and one-half minutes after cessation of the engagement of T-5, an enemy tank moving forward appears at T-6. Defending tank opens fire with HEAT-TP/AP-TP round and if the target is missed, a second round is fired.

g. Defending tank acquires troops in the open (T-7) and engages with COAX.

PART 3. AMMUNITION REQUIREMENTS

S-TANK

Course	Target	Range (M)	Ammo	Rds/Crew	Firing	Rounds M/61	Rounds M/67	Rounds M/65	Rounds 7.62
DEF	1 STK	2000	APDS-TP	2	G/D			10	
	2a STK	1950	APDS-TP	2	G/D			10	
	2b STK	1950	APDS-TP	2	G/D			10	
	2c STK	1950	APDS-TP	2	G/D			10	
	3 BRDM	1300	HE-TP	2	TC	10			
	4 MTK	1400-	AP-TP	2	G/D		10		
	5 MTK	-1550	AP-TP	2	G/D		10		
	6 MTK	1400-	AP-TP	2	G/D		10		
	7 PERS	650	7.62	100	G/D				500
ATK	1 STK	2000	APDS-TP	2	G/D			10	
	2 PERS	400	7.62	150	TC				750
	3 SU-100	600	HE-TP	2	G/D	10			
	4 PERS	500	7.62	100	G/D				500
	4a ATMSL	1350	HE-TP	2	TC	10			
	5 MBHP	1350-	HE-TP	2	G/D	10			
	6 MTK	1160	AP-TP	2	G/D		10		
	7 PERS	400	7.62	150	TC				750
	8 MTK	950	AP-TP	2	G/D		10		
					TOTALS	40	50	50	2,500

M60 (AOS) TANK

Course	Target	Range (M)	Ammo	Rds/Crew	Firing	Rounds. HEP-TP-T	HEAT-TP-T	DSTP-T	7.62
DEF	1 STK	2000	DSTP-T	2	Gunner			10	
	2a STK	1950	DSTP-T	2	Gunner			10	
	2b STK	1950	DSTP-T	2	Gunner			10	
	2c STK	1950	DSTP-T	2	Gunner			10	
	3 BRDM	1300	HEP-TP-T	2	Gunner	10			
	4 MTK	1400-	HEAT-TP-T	2	Gunner		10		
	5 MTK	-1550	HEAT-TP-T	2	Gunner		10		
	6 MTK	1400-	HEAT-TP-T	2	Gunner		10		
	7 PERS	650	7.62	100	Gunner				500
ATK	1 STK	2000	DSTP-T	2	Gunner			10	
	2 PERS	400	7.62	150	Gunner				750
	3 SU-100	600	HEP-TP-T	2	Gunner	10			
	4 PERS	500	7.62	100	Gunner				500
	4a ATMSL	1350	HEP-TP-T	2	Gunner	10			
	5 MBMP	1350-	HEP-TP-T	2	Gunner	10			
	6 MTK	1160	HEAT-TP-T	2	Gunner		10		
	7 PERS	400	7.62	150	Gunner				750
	8 MTK	950	HEAT-TP-T	2	Gunner		10		
					TOTALS	40	50	50	2,500

APPENDIX J. FORCE DEVELOPMENT TEST AND EVALUATION (FDTE) MOBILITY COURSE

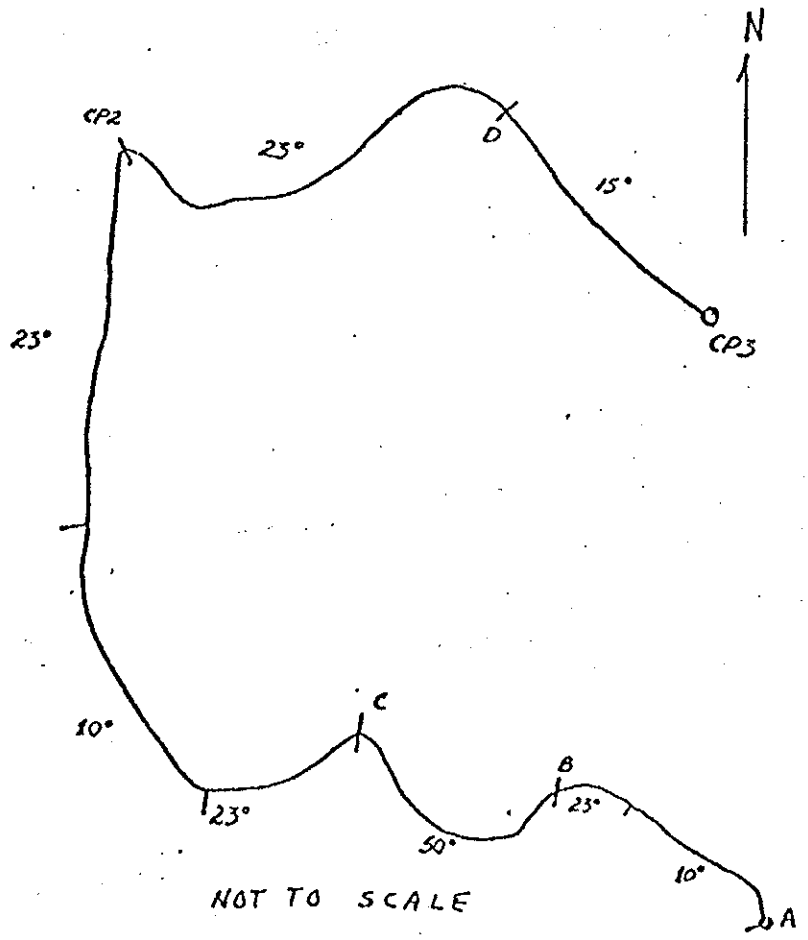
TABLE OF CONTENTS

PART 1. COURSE DESCRIPTION

DISCRIPTION OF DAY MOBILITY RUN
USING FORT KNOX SPECIAL MAP, 1: 50,000

Event #1

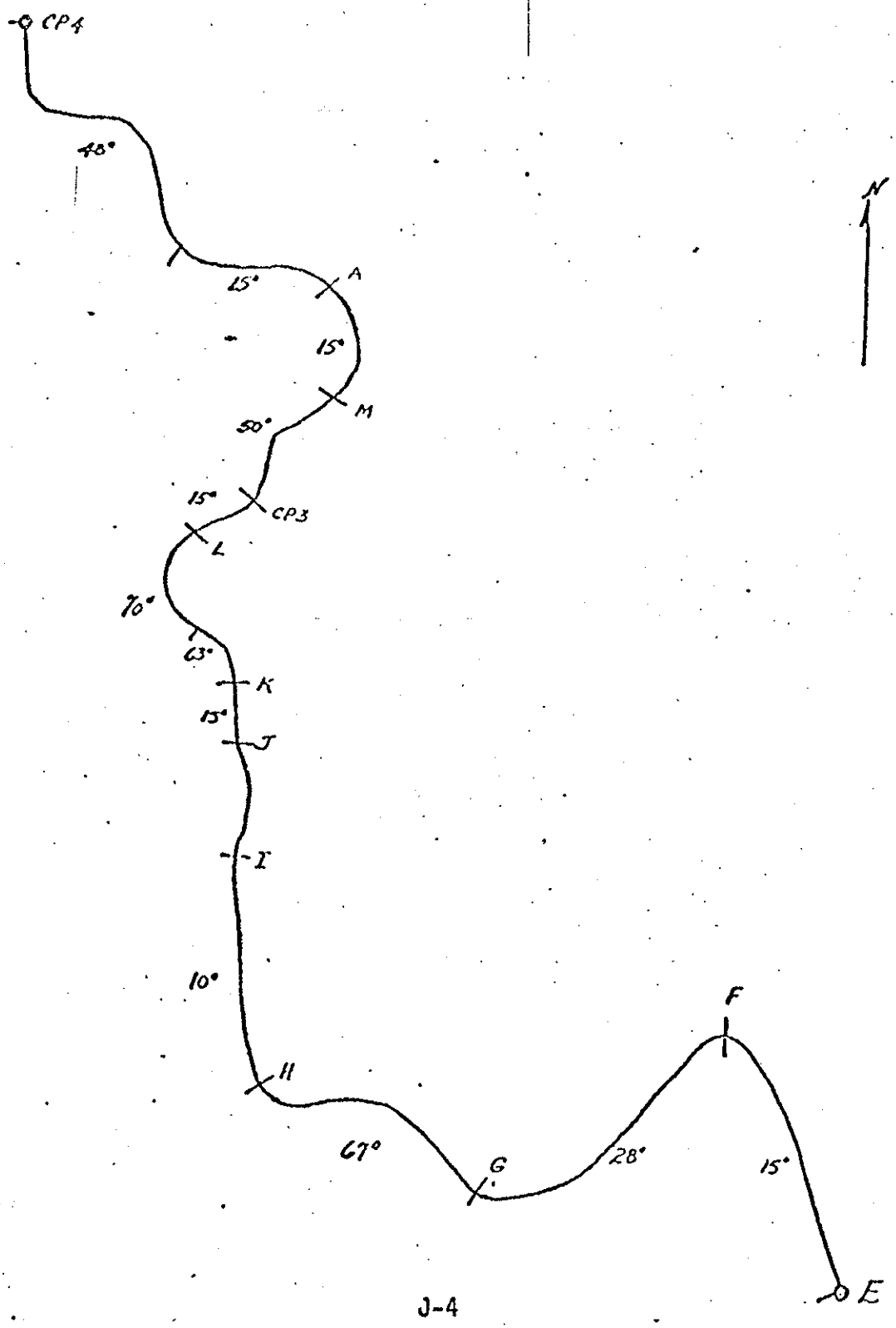
Event #1 started at coordinate 004-018, then ran on an unimproved road. The road was rocky with various ruts ranging from 4 to 6 feet in depth. A left turn was made into the woods at approximately grid coordinate 999-011. The woods portion contained dips, and a few sharp turn. The length was .3 miles long. At checkpoint C, a left turn was made back on the same road which is described above. From checkpoint C to checkpoint 2 (coordinate 991-0190) the distance was .8 mile. A right turn was made continuing up the hill to point CP D (coordinate 994-019) where a right turn was made on to a narrow dirt road. It continued for .4 mile to checkpoint 3 (coordinate 999-018), stopping for 5 minutes where a recon was made from the vehicle. The vehicle then turned around, moved approximately 75 feet forward to stop Event #1 (coordinate 999-014).



Event #2

Event #2 (starting 999-015; ending 975-045) consisted of 4 numbered checkpoints and 9 lettered checkpoints. Event #2 started by backtracking approximately .3 mile on Event #1. At this point a right turn was made into wooded terrain. A left turn was then required to cross a gully. The next portion of the course was sloped (45-60 degrees down). At the base of the slope a ditch (approximately 2 feet deep and 3 feet wide) was encountered. After crossing this ditch, another slope (45-60 degrees up) had to be climbed. After moving approximately .2 mile further a left turn was required. This portion of the course was heavily wooded. Upon entering this portion, a steep slope (50 degrees down, 35 degrees right bank) was encountered. This slope was followed by another slope (35 degrees right bank). The remainder of this portion of the course was heavily wooded and rolling terrain until reaching an unimproved road. After approximately .2 mile, a right turn was required and again wooded terrain was encountered. The unimproved road was again entered by making a right turn out of the wooded area. Following the unimproved road a steep grade (40 to 60 degrees) was encountered. The course followed this unimproved road for approximately 2 miles before ending the event at a small stream.

EVENT 2

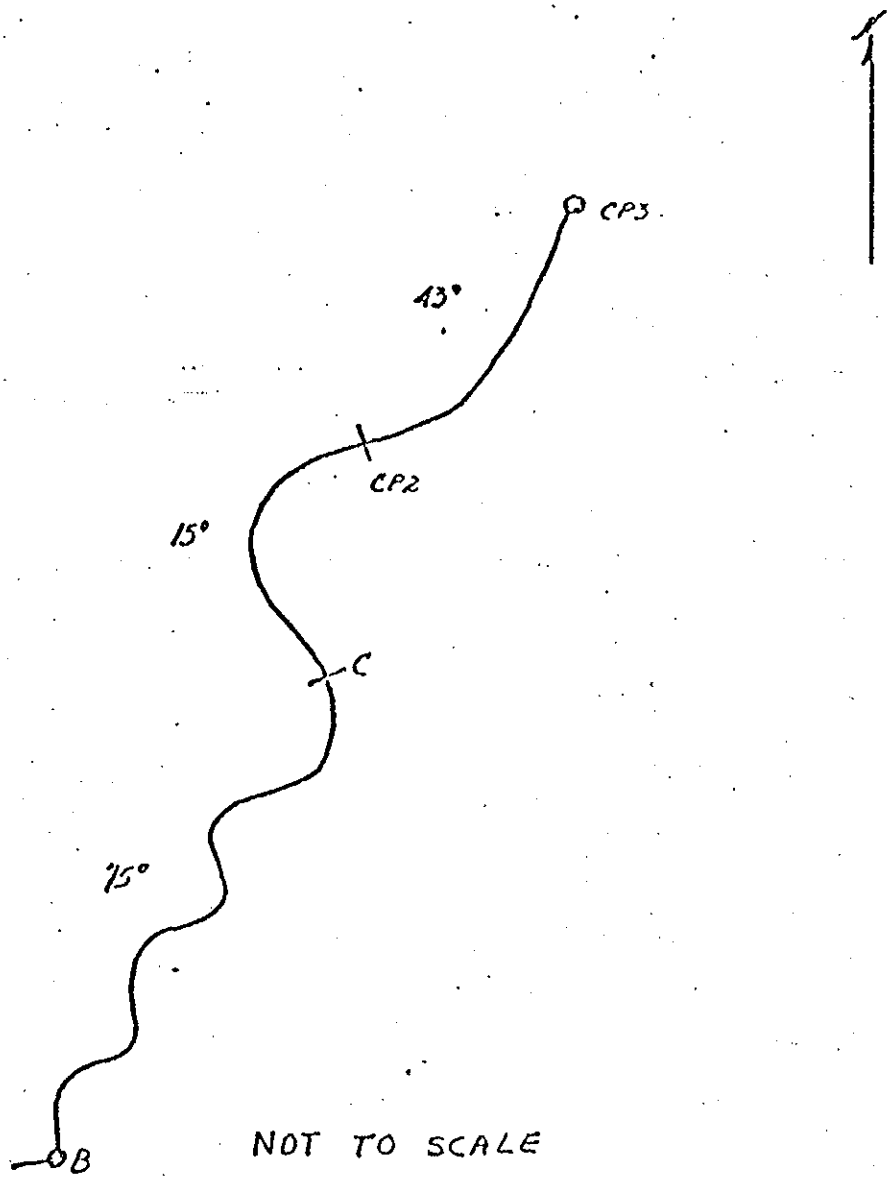


J-4

NOT TO SCALE

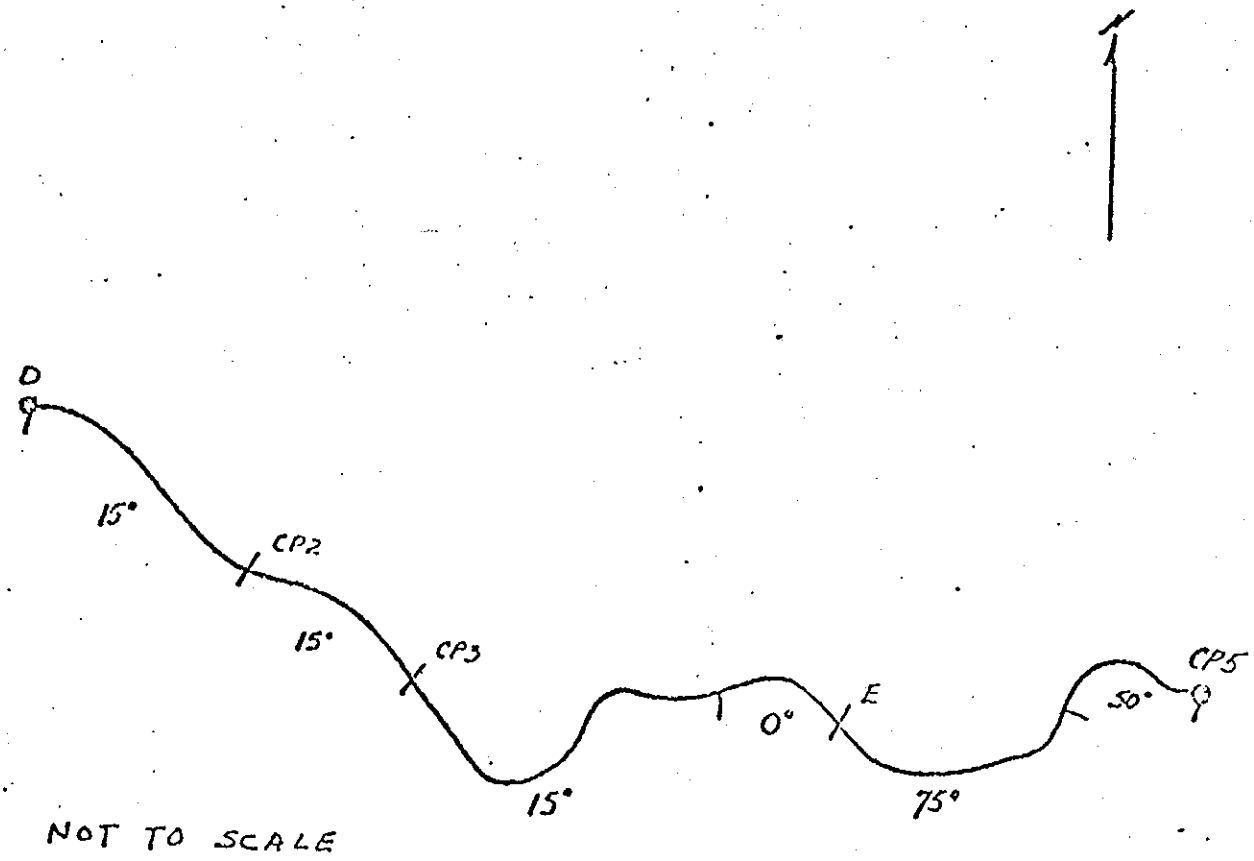
Event #3

Event #3 started at coordinate 970-045 and proceeded alongside a stream for .1 of a mile. After fording the stream, the SV continued for .3 of a mile where it stopped for CP2 for 10 minutes to deploy cratering devices. After 10 minutes, SV continued up the dirt trail to CP3. Between CP2 and CP3, the dirt trail wound up a hill with varying degrees of steepness which never exceeded 30 degrees. When the SV reached CP3, the event was terminated.



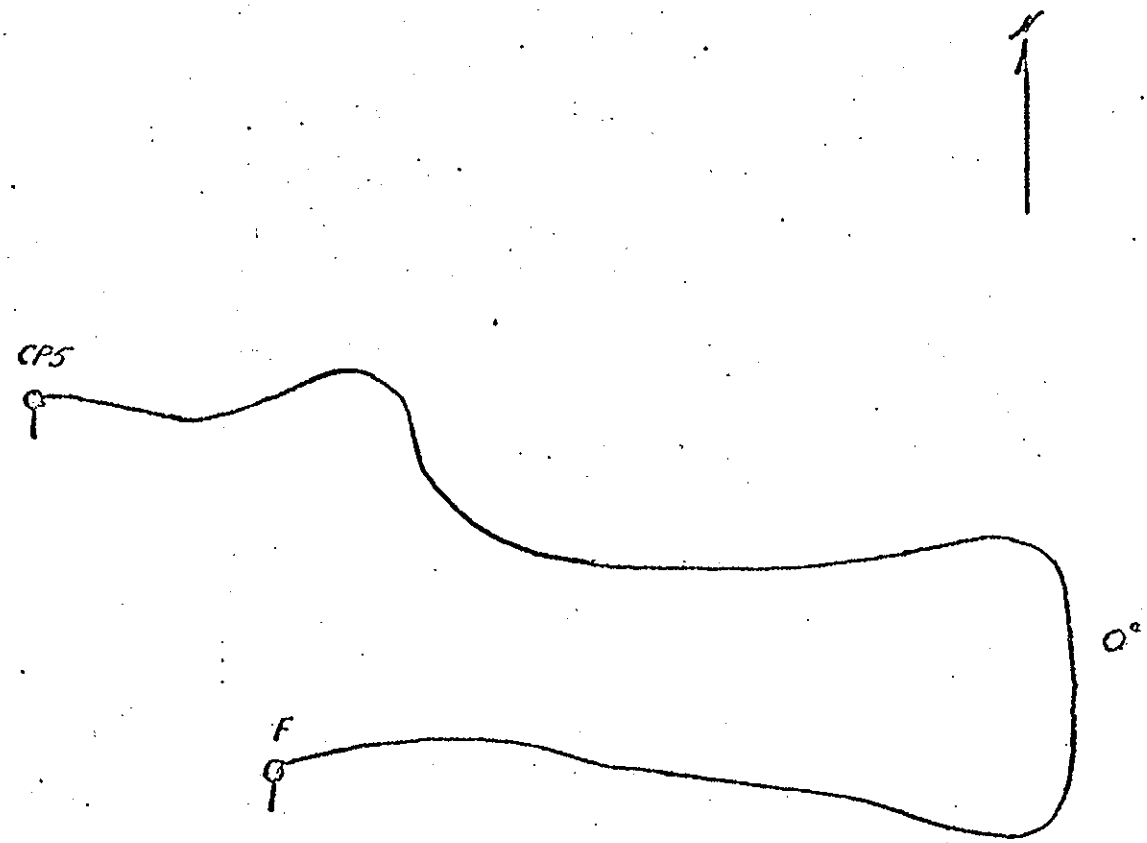
Event #4A

Event #4 started on a dirt trail (coordinate 977-056) that generally West to East. From start point to checkpoint 2, the distance is .4 mile. At checkpoint 2 (coordinate 984-051) the vehicle stopped for 5 minutes to simulate engaging the enemy. The trail continued to checkpoint 3 (coordinates 978-048) where the SV simulated engaging the enemy. The distance from CP2 to CP3 was .4 mile. From CP3 to CP4 (coordinate_077-047) the distance was .4 mile. The trail continued as a smooth dirt trail until departing CP4 where it made a right turn into the woods. The woods portion (CPE) was a rough deeply rutted narrow rocky road with trees lining both sides of the road. This segment of the event was .7 of a mile long. Event #4 stopped (Coordinate 024-048) where the road runs back on to the road described above.



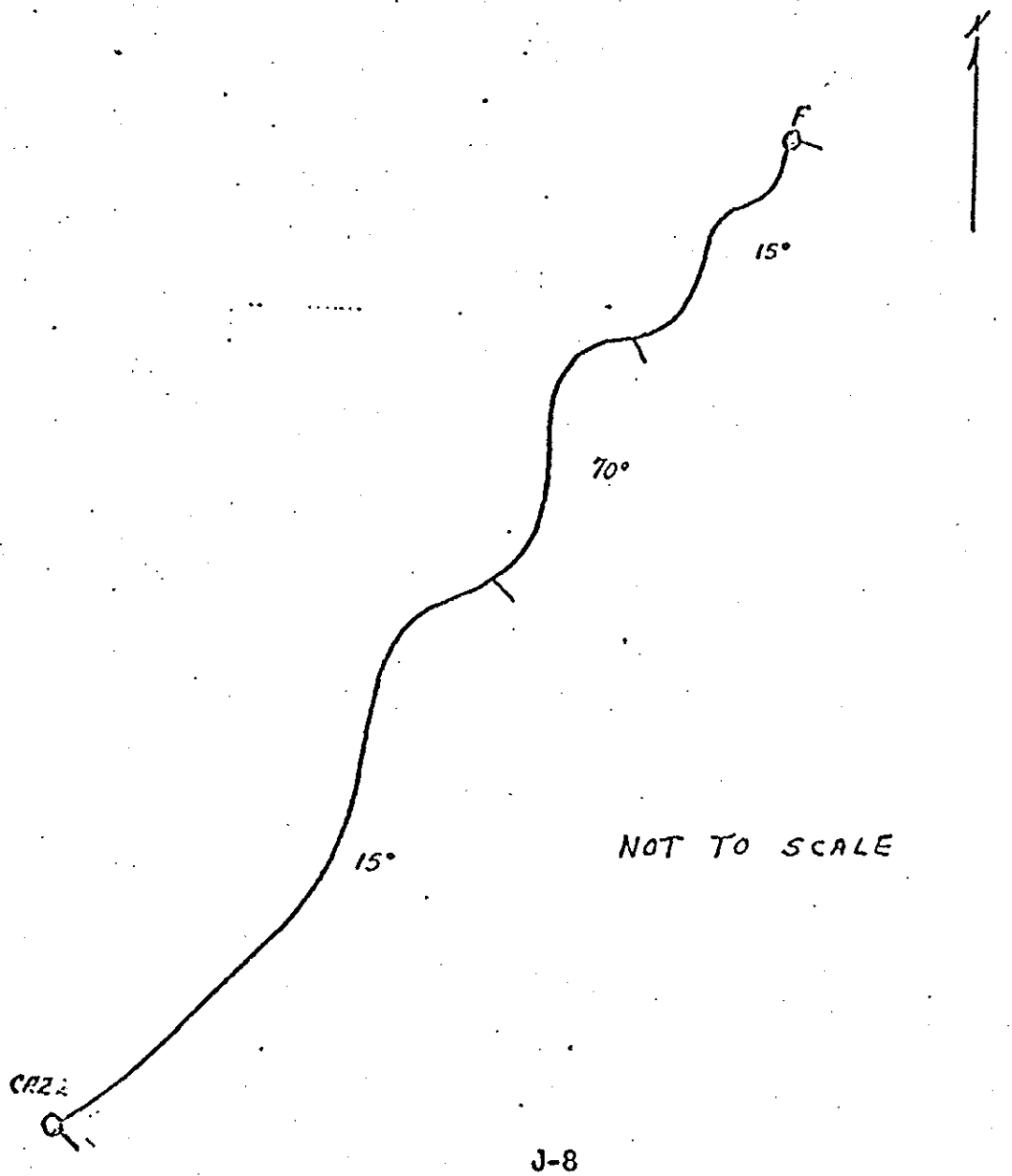
Event #4B

Event #4B started on an improved gravel road (coordinate 024-048) and ran for 2.6 miles to start Event #5 (coordinates 029-039). The purpose of the event was to assess the scout vehicle's performance while being driven buttoned-up.



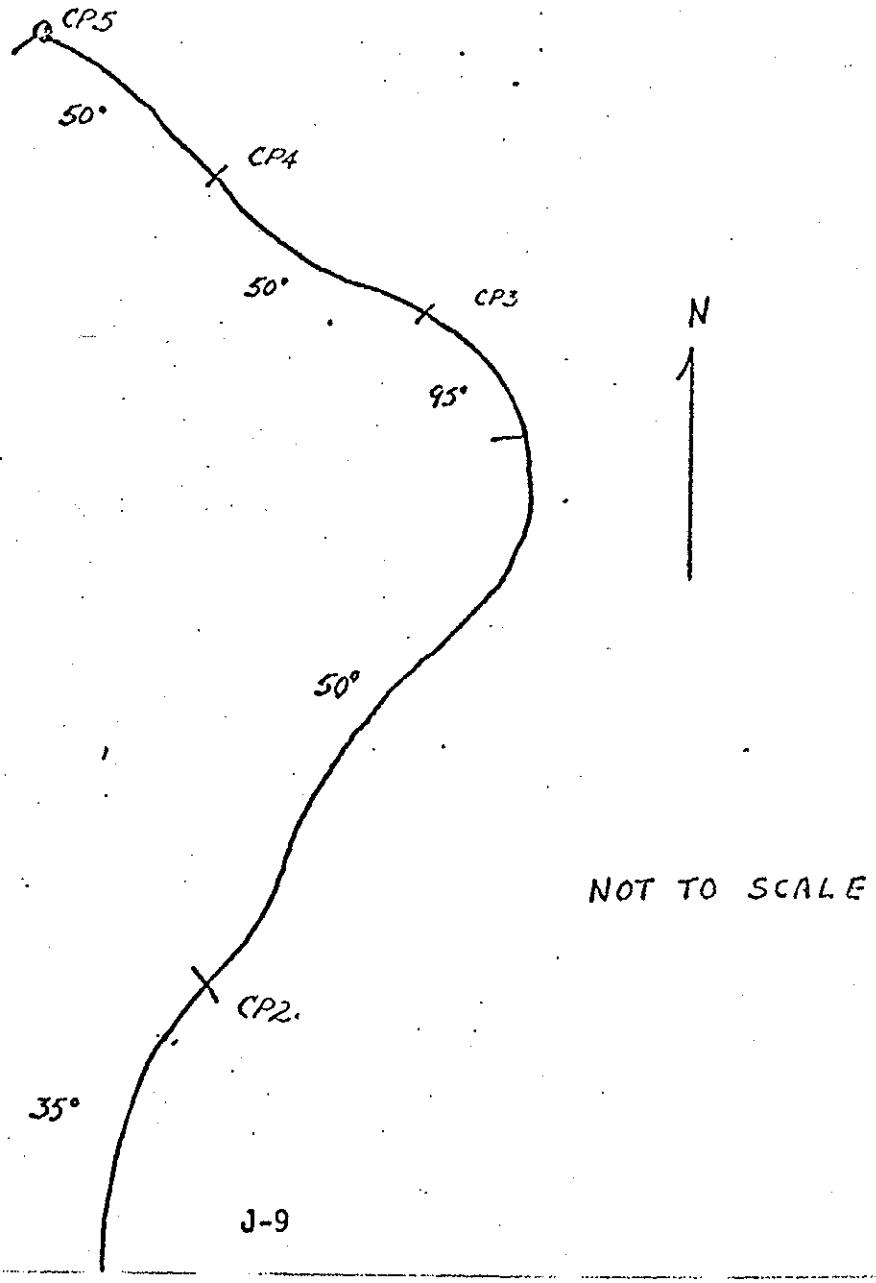
Event #5

Event #5 started at the top of a hill (coordinate 029-038) and proceeded down an unimproved road. The road was rocky and had approximately 30° decline with a slope to the right. After decending the hill, the road became a dirt trail from that point until reaching the end of the event (coordinate 014-004). The event was 2.6 miles long with no lettered or numbered checkpoints.



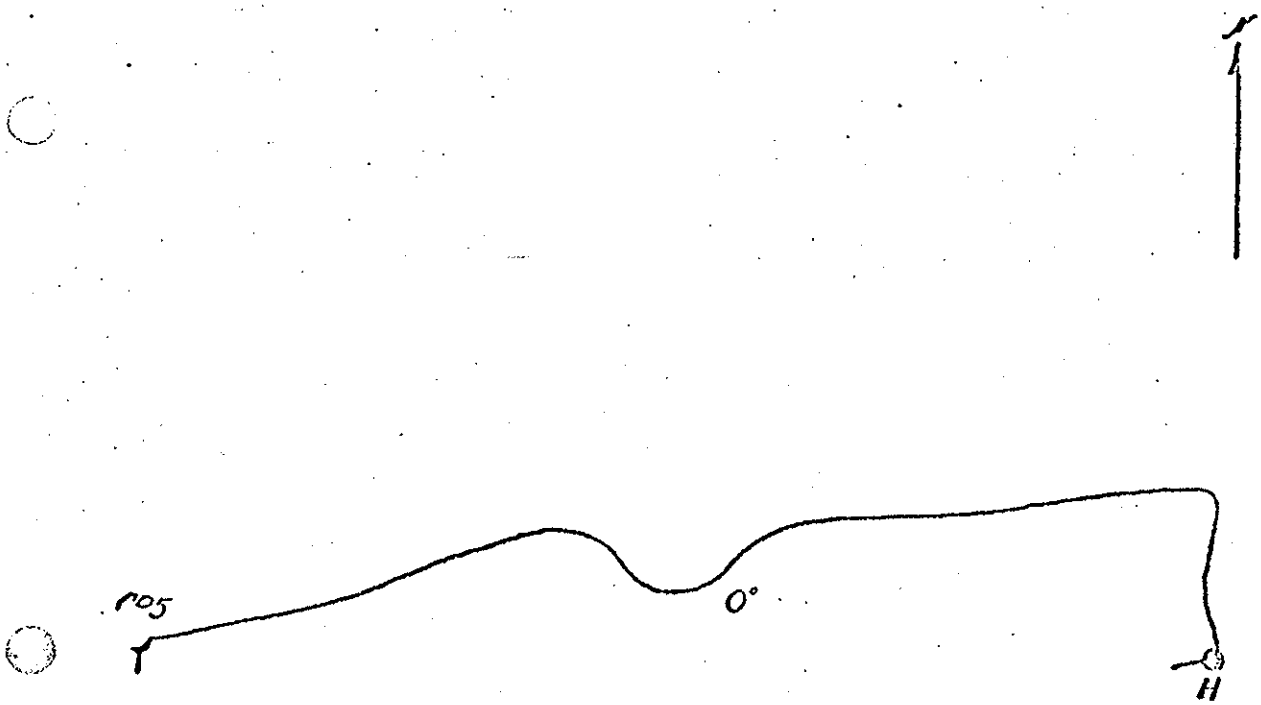
Event #6A

Event #6A (beginning 009-009 ending 002-026) was mostly dirt trail and stream crossings. After traveling .2 of a mile, the scout vehicle stopped at CP 2 for ten minutes. The scout vehicle then traveled 1.2 of a mile to reach an incline of 45 to 60 degrees. After climbing the rocky incline, the scout vehicle arrived at CP 3 where simulated enemy contact was made. The scout vehicle then continued on until it reached CP 4 where antitank mines were emplaced. When the mines were layed the scout vehicle traveled to CP 5 where Event 6A was terminated.



Event #6B

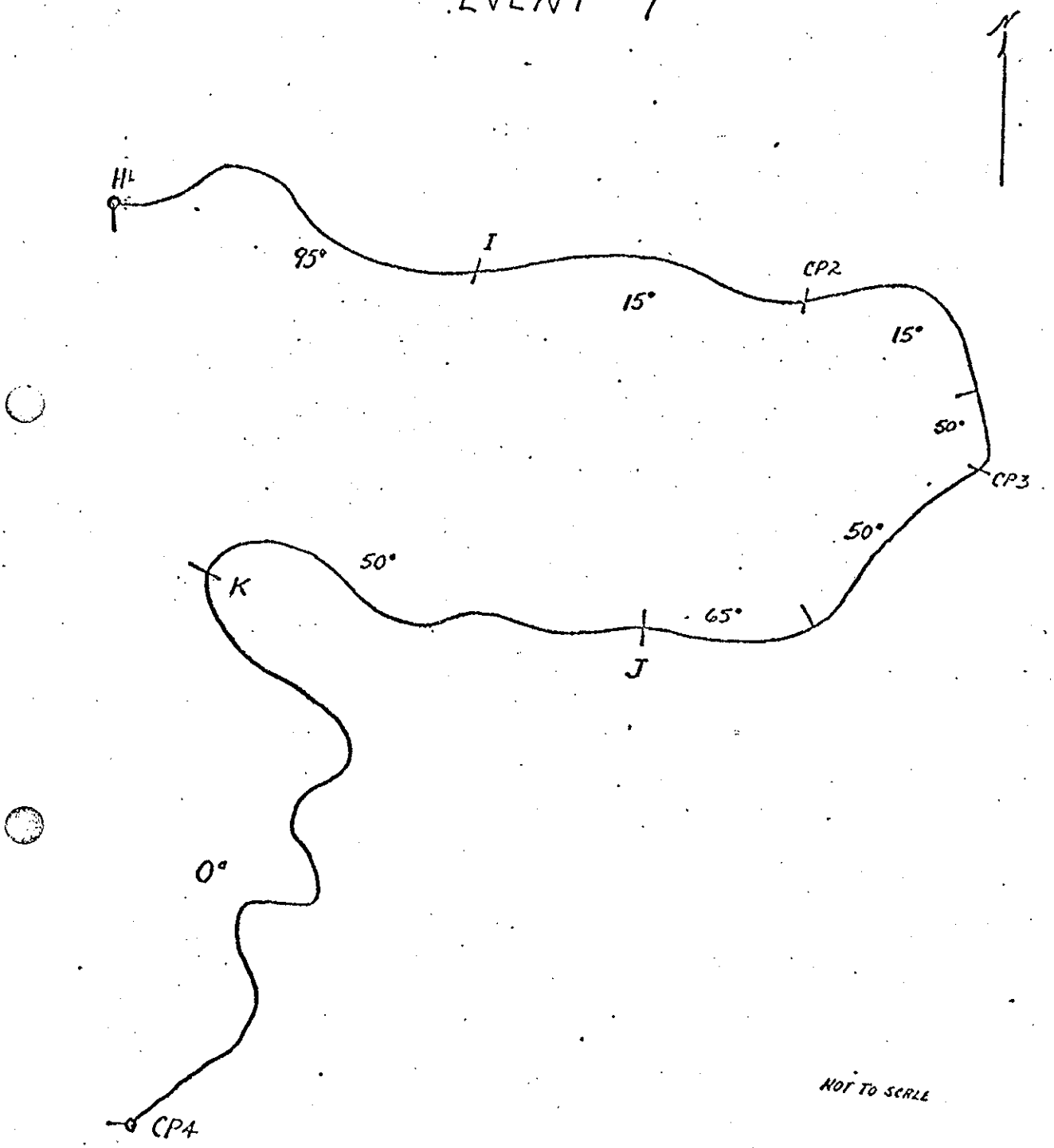
The purpose of Event #6B (beginning 002-026 ending 039-034) was to see how well the scout vehicle could be driven while buttoned-up. The vehicle was driven down a gravel road with all hatches closed for 2.5 miles. While on this event the controller took information concerning driving and vision characteristics in this configuration. Event #6B terminated at the start of Event #7.



Event #7

Event #7 (beginning 039-034 ending 023-001) was mostly on a dirt trail. At the beginning of the event, the trail was rocky with deep ruts and declined approximately 30 degrees. At the bottom of the decline there was a two and a half foot ditch. After crossing the ditch the dirt trail became smooth. Two tenths of a mile from where the ditch (CP I) the scout vehicle reached CP 2 where it stopped for 5 minutes. After the time elapsed, the scout vehicle proceeded to CP 3 where the scout vehicle stopped for 5 minutes. After the scout vehicle left CP 3, it encountered a rocky incline of 45 to 60 degrees. Reaching the top of the hill the scout vehicle wound around the trail until the scout vehicle came to a gravel road, at which time the scout vehicle made a left turn proceeding down the gravel road 1.7 miles where Event #7 terminated.

EVENT 7



EVENT #1, (PAGE 2)

VEHICLE IDENTIFICATION NO. M113A1 DATE: July 8, 1975

TEAM NO. 2

CONTROLLER NAME Brown, PA

CHECK POINT DESCRIPTOR	TIME	ODOMETER READING
LEFT CP 3 -	0850	1310.1
ARRIVED CP 4	0603 1s	1314.2

REMARKS NONE

UNSCHEDULED EVENTS: EXAMPLE

NOTE: IDENTIFY BETWEEN WHAT SEGMENT THE EVENT HAPPENED (EX CP2-CP3, CP3-CP4)

1.	EVENT SEGMENT	CP3-CP3	1309.2
	STOPPED	0823	"
	STARTED	0833	"
2.	EVENT SEGMENT		
	STOPPED		
	STARTED		

DESCRIBE WHAT HAPPENED: 1) Engine Overheated, Stopped for 10 minutes for cool down

PART 2. SAMPLE DATA SHEET

FT. KNOX

S-TANK MOBILITY RUN

EVENT DATA SHEET

EVENT #1

VEHICLE IDENTIFICATION NO. M113A1 DATE: July 8, 197

TEAM NO. 2

CONTROLLER NAME BROWN, P.A.

CHECK POINT DESCRIPTOR	TIME	ODOMETER READING
LEFT CP 1 (A) START	0810	1301.6
PASSED CP B	01M13S	1302.4
PASSED CP C	02M 40S	1305.0
STOPPED AT CP2	06M 01S	1306.4

REMARKS NONE

EXAMPLE

LEFT CP2	0820	1306.4
PASSED CP D	02M03S	1308.1
ARRIVED CP 3	06M00S	1310.1

REMARKS Between CP D and CP 3, Had High Engine Temp

PART 3. BLANK DATA SHEETS

FT. KNOX

S-TANK MOBILITY RUN

EVENT DATA SHEET

EVENT #1

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME _____

CHECK POINT DESCRIPTOR	TIME	ODOMETER READING
LEFT CP 1 (A) START	_____	_____
PASSED CP B	_____	_____
PASSED CP C	_____	_____
STOPPED AT CP2	_____	_____

REMARKS _____

_____

_____

LEFT CP2	_____	_____
PASSED CP D	_____	_____
ARRIVED CP 3	_____	_____

REMARKS _____

_____

_____

EVENT #1, PAGE 2

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME _____

CHECK POINT DESCRIPTOR	TIME	ODOMETER READING
LEFT CP 3	_____	_____
ARRIVED CP 4	_____	_____

REMARKS _____

_____

UNSCHEDULED EVENTS: _____

_____

NOTE: IDENTIFY BETWEEN WHAT SEGMENT THE EVENT HAPPENED (EX CP2-CPD, CP3-CP4)

1.	EVENT SEGMENT	_____	_____
	STOPPED	_____	_____
	STARTED	_____	_____
2.	EVENT SEGMENT	_____	_____
	STOPPED	_____	_____
	STARTED	_____	_____

DESCRIBE WHAT HAPPENED: _____

_____

_____

_____

FT. KNOX

S-TANK MOBILITY RUN

EVENT DATA SHEET

EVENT #2

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME: _____

CHECK POINT DESCRIPTOR	TIME	ODOMETER READING
LEFT CP 1 (E) START	_____	_____
PASSED CP F	_____	_____
PASSED CP G	_____	_____
PASSED CP H	_____	_____
STOPPED AT CP 2	_____	_____

REMARKS: _____

_____

_____

LEFT CP 2	_____	_____
PASSED CP I	_____	_____
PASSED CP J	_____	_____
PASSED CP K	_____	_____
PASSED CP L	_____	_____
ARRIVED CP 3	_____	_____

REMARKS: _____

_____

_____

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME: _____

CHECKPOINT DESCRIPTOR	TIME	ODOMETER READING
LEFT CP 3	_____	_____
PASSED CP M	_____	_____
PASSED CP A	_____	_____
ARRIVED CP 4	_____	_____

REMARKS: _____

_____

_____

UNSCHEDULED EVENTS: (NOTE: IDENTIFY BETWEEN WHAT SEGMENT THE EVENT HAPPENED (EX: CP2-CPD, CP3-CP4)

1.	EVENT SEGMENT	_____	_____
	STOPPED	_____	_____
	STARTED	_____	_____

DESCRIBE WHAT HAPPENED: _____

_____

_____

2.	EVENT SEGMENT	_____	_____
	STOPPED	_____	_____
	STARTED	_____	_____

DESCRIBE WHAT HAPPENED: _____

_____

_____

FT. KNOX

S-TANK MOBILITY RUN

EVENT DATA SHEET

EVENT #3

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME: _____

CHECKPOINT DESCRIPTOR	TIME	ODOMETER READING
LEFT CP 1 (B) START.	_____	_____
PASSED CP C	_____	_____
ARRIVED CP 2	_____	_____

REMARKS: _____

_____

_____

LEAVES CP 2	_____	_____
ARRIVES CP 3	_____	_____

REMARKS: _____

_____

_____

UNSCHEDULED EVENTS: (NOTE: IDENTIFY BETWEEN WHAT SEGMENT THE EVENT HAPPENED (EX: CP2-CPD, CP3-CP4)

1. EVENT SEGMENT	_____	_____
STOPPED	_____	_____
STARTED	_____	_____

DESCRIBE WHAT HAPPENED: _____

_____

_____

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME: _____

CHECKPOINT DESCRIPTOR	TIME	ODOMETER READING

UNSCHEDULED EVENTS: (CONT'D)

2. EVENT SEGMENT _____ _____

STOPPED _____ _____

STARTED _____ _____

DESCRIBE WHAT HAPPENED: _____

_____

_____

FT. KNOX

S-TANK MOBILITY RUN

EVENT DATA SHEET

EVENT #4A

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME: _____

CHECKPOINT DESCRIPTOR	TIME	ODOMETER READING
LEFT CP 1 (D) START	_____	_____
ARRIVED CP 2	_____	_____

REMARKS: _____

_____

LEFT CP 2	_____	_____
ARRIVED CP 3	_____	_____

REMARKS: _____

_____

LEFT CP 3	_____	_____
ARRIVED CP 4	_____	_____

REMARKS: _____

_____

LEFT CP 4	_____	_____
PASSED CP E	_____	_____
ARRIVED CP 5	_____	_____

REMARKS: _____

_____

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME: _____

CHECKPOINT DESCRIPTOR	TIME	ODOMETER READING

UNSCHEDULED EVENTS: (NOTE: IDENTIFY BETWEEN WHAT SEGMENT THE EVENT HAPPENED (EX: CP2-CPD, CP3-CP4)

1. EVENT SEGMENT _____ _____

   STOPPED _____ _____

   STARTED _____ _____

   DESCRIBE WHAT HAPPENED: _____

_____

_____

2. EVENT SEGMENT _____ _____

   STOPPED _____ _____

   STARTED _____ _____

   DESCRIBE WHAT HAPPENED: _____

_____

_____

FT. KNOX

S-TANK MOBILITY RUN

EVENT DATA SHEET

EVENT #4B

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME: _____

CHECKPOINT DESCRIPTOR	TIME	ODOMETER READING
LEFT CP 5	_____	_____
ARRIVED CP 1 (F)	_____	_____

REMARKS: _____

_____

_____

UNSCHEDULED EVENTS: (NOTE: IDENTIFY BETWEEN WHAT SEGMENT THE EVENT HAPPENED - EXAMPLE: CP2-CPD, CP3-CP4)

1.	EVENT SEGMENT	_____	_____
	STOPPED	_____	_____
	STARTED	_____	_____

DESCRIBE WHAT HAPPENED: _____

_____

_____

2.	EVENT SEGMENT	_____	_____
	STOPPED	_____	_____
	STARTED	_____	_____

DESCRIBE WHAT HAPPENED: _____

_____

_____

FT. KNOX

S-TANK MOBILITY RUN

EVENT DATA SHEET

EVENT #5

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME: _____

CHECKPOINT DESCRIPTOR	TIME	ODOMETER READING
LEFT CP 1 (F)	_____	_____
ARRIVED CP 2 (END OF EVENT)	_____	_____

REMARKS: _____

_____

_____

UNSCHEDULED EVENTS: (NOTE: IDENTIFY BETWEEN WHAT SEGMENT THE EVENT HAPPENED - EXAMPLE: CP2-CPD, CP3-CP4)

1.	EVENT SEGMENT	_____	_____
	STOPPED	_____	_____
	STARTED	_____	_____

DESCRIBE WHAT HAPPENED: _____

_____

_____

2.	EVENT SEGMENT	_____	_____
	STOPPED	_____	_____
	STARTED	_____	_____

DESCRIBE WHAT HAPPENED: _____

_____

_____

FT. KNOX

S-TANK MOBILITY RUN

EVENT DATA SHEET

EVENT #6A

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME: _____

CHECKPOINT DESCRIPTOR	TIME	ODOMETER READING
LEFT CP 1 (G)	_____	_____
ARRIVED CP 2	_____	_____

REMARKS: _____

_____

_____

LEFT CP 2	_____	_____
ARRIVED CP 3	_____	_____

REMARKS: _____

_____

_____

LEFT CP 3	_____	_____
ARRIVED CP 4	_____	_____

REMARKS: _____

_____

_____

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME: _____

CHECKPOINT DESCRIPTOR	TIME	ODOMETER READING
LEFT CP 4	_____	_____
ARRIVED CP 5	_____	_____

REMARKS: _____

_____

_____

UNSCHEDULED EVENTS: (NOTE: IDENTIFY BETWEEN WHAT SEGMENT THE EVENT HAPPENED (EX: CP2-CPD, CP3-CP4)

1.	EVENT SEGMENT	_____	_____
	STOPPED	_____	_____
	STARTED	_____	_____

DESCRIBE WHAT HAPPENED: _____

_____

_____

2.	EVENT SEGMENT	_____	_____
	STOPPED	_____	_____
	STARTED	_____	_____

DESCRIBE WHAT HAPPENED: _____

_____

_____

S-TANK MOBILITY RUN

EVENT DATA SHEET

EVENT #6B

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME: _____

CHECKPOINT DESCRIPTOR	TIME	ODOMETER READING
LEFT CP 5	_____	_____
ARRIVED CP 1 (H)	_____	_____

REMARKS: _____

_____

_____

UNSCHEDULED EVENTS: (NOTE: IDENTIFY BETWEEN WHAT SEGMENT THE EVENT HAPPENED - EXAMPLE: CP2-CPD, CP3-CP4)

1.	EVENT SEGMENT	_____	_____
	STOPPED	_____	_____
	STARTED	_____	_____

DESCRIBE WHAT HAPPENED: _____

_____

_____

2.	EVENT SEGMENT	_____	_____
	STOPPED	_____	_____
	STARTED	_____	_____

DESCRIBE WHAT HAPPENED: _____

_____

_____

FT. KNOX

S-TANK MOBILITY RUN

EVENT DATA SHEET

EVENT #7

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME: _____

CHECKPOINT DESCRIPTOR	TIME	ODOMETER READING
LEFT CP 1 (H)	_____	_____
PASSED CP I	_____	_____
ARRIVED CP 2	_____	_____

REMARKS: _____

_____

_____

LEFT CP 2	_____	_____
ARRIVED CP 3	_____	_____

REMARKS: _____

_____

_____

LEFT CP 3	_____	_____
PASSED CP J	_____	_____
PASSED CP K	_____	_____
ARRIVED CP 4	_____	_____

REMARKS: _____

_____

_____

VEHICLE IDENTIFICATION NO. _____ DATE: _____

TEAM NO. _____

CONTROLLER NAME: _____

CHECKPOINT DESCRIPTOR	TIME	ODOMETER READING

UNSCHEDULED EVENTS: (NOTE: IDENTIFY BETWEEN WHAT SEGMENT THE EVENT HAPPENED (EX: CP2-CPD, CP3-CP4)

1. EVENT SEGMENT _____ _____

   STOPPED _____ _____

   STARTED _____ _____

   DESCRIBE WHAT HAPPENED: _____

_____

_____

2. EVENT SEGMENT _____ _____

   STOPPED _____ _____

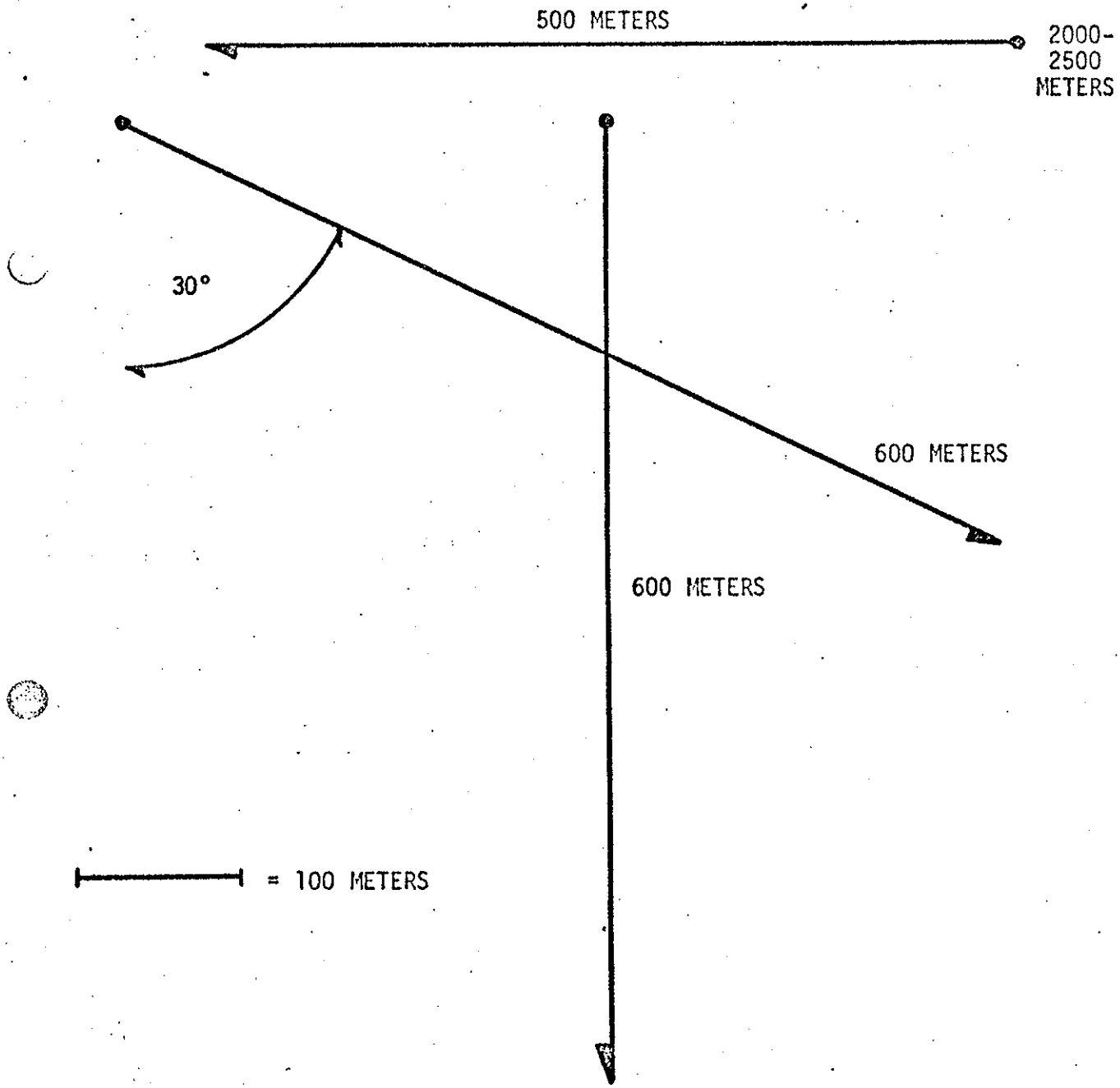
   STARTED _____ _____

   DESCRIBE WHAT HAPPENED: _____

_____

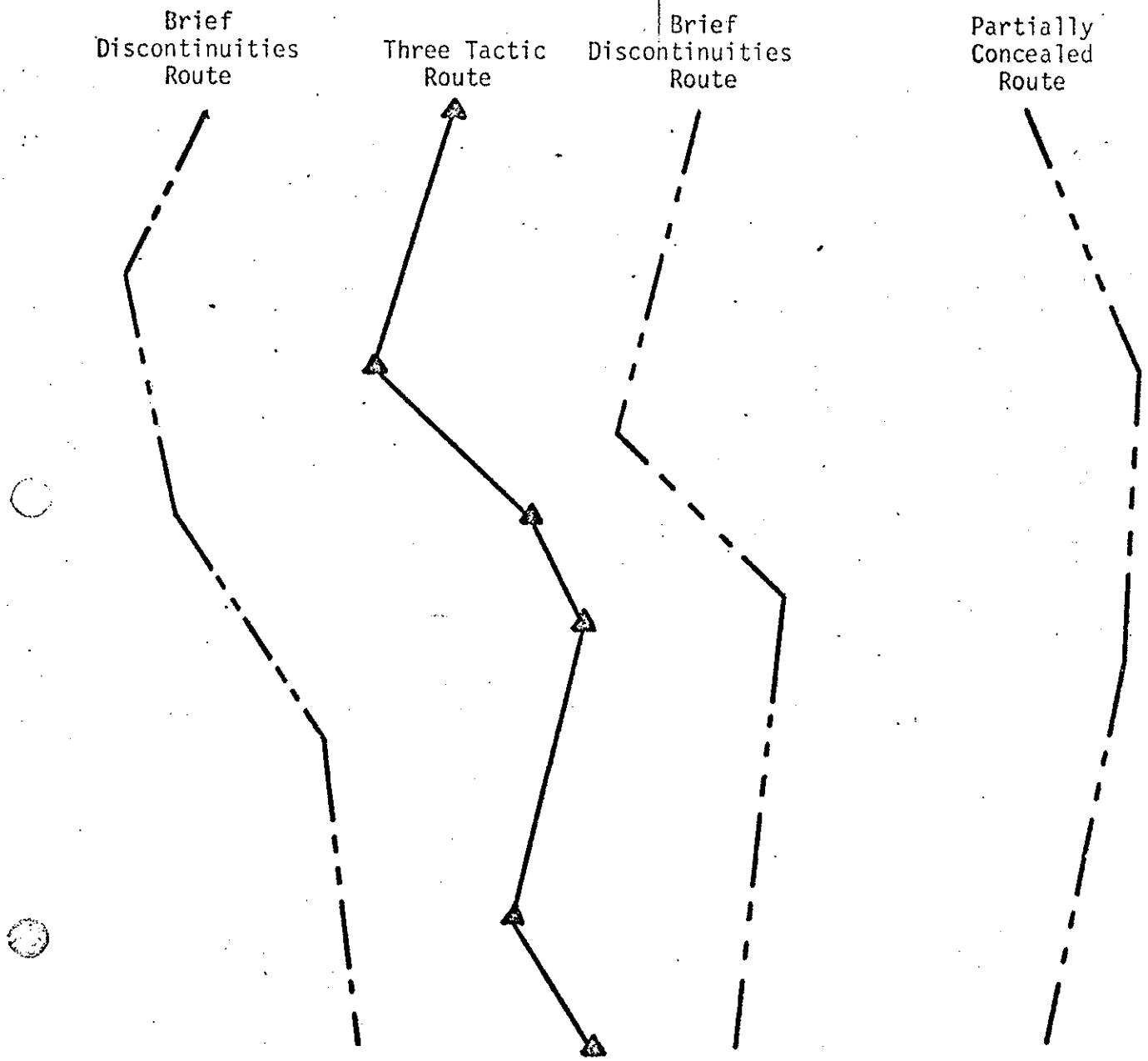
_____

APPENDIX K. SURVIVABILITY COURSES



YANO SURVIVABILITY SEGMENTS

FIGURE 5



SURVIVABILITY - ST VITH RANGE
FIGURE 6

ITERATIONS

YANO PHASE

	Constant Speed	Stop-Start	Evasive Tactics
Segments	3	3	3
Vehicles	1	6	6
Tactics	-	-	3
Speeds	4	-	-
Crews	6	6	6
w/o Aim Point	12	—	—
TOTAL	84	108	324

ST. VITH (DRY) PHASE

	Part 1			Part 2
	Discontinuities	1-Tactics	Concealed	
Routes	2	3	1	5-10
Vehicles	3	3	3	1
Tactics	1	1	1	1
Crews	6	6	6	1
Terrains	—	—	—	2-3
TOTAL	36	54	18	10-30

ITERATION TOTALS

APPENDIX L. REFERENCES

(To Be Provided Later)

APPENDIX M. ABBREVIATIONS

(To Be Provided Later)

APPENDIX N. DISTRIBUTION LIST

(To Be Provided Later)