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14. ABSTRACT
Formerly, Soldiers in the U.S. Army were not selected for their military occupational specialty (MOS) based on their physical capability to successfully perform the physical tasks necessary for that MOS. The U.S. Army Research Institute of Environmental Medicine (USARIEM) was tasked by the U.S. Army Training and Doctrine Command (TRADOC) to develop criterion-based physical requirements for entry into seven physically demanding combat arms MOSs. Researchers from USARIEM completed three studies to develop a valid, safe, and legally defensible physical performance battery to predict a Soldier's ability to serve in these MOSs. Researchers from USARIEM completed three studies to develop a valid, safe, and legally defensible physical performance battery to predict a Soldier's ability to serve in these MOSs. This report describes the process of designing and implementing the five criterion measure task simulations (CMTSs) that were common to multiple MOSs and the three MOS-specific CMTSs.

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USARIEM TECHNICAL REPORT T19-05

DEVELOPMENT OF CRITERION MEASURE TASK SIMULATIONS FOR PHYSICALLY DEMANDING TASKS

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FOREWORD

This Technical Report is part of a series documenting the development of a physical employment screening test for seven combat arms military occupational specialties (MOSs) as part of the Soldier 2020 initiative.

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LIST OF ACRONYMS

BFV	Bradley Fighting Vehicle
CASEVAC	Casualty Evacuation
CMTS	Criterion Measure Task Simulation
ESBI	Enhanced Side Ballistics Insert
ESAPI	Enhanced Small Arms Protective Insert
FAASV	Field Artillery Ammunition Supply Vehicle
HEMTT	Heavy Expanded Mobility Tactical Truck
HPDT	High Physically Demanding Task
HR	Heart Rate
IOTV	Improved Outer Tactical Vest
MPAT	Multi-Purpose Anti-Tank
MOS	Military Occupational Specialty
OPAT	Occupational Physical Assessment Test
PDS	Physical Demands Study
PPE	Personal Protective Equipment
RFID	Radio Frequency Identification
RPE	Rate of Perceived Exertion
SIAC	SPORTident Active card
SME	Subject Matter Expert
TRADOC	Training and Doctrine Command
USARIEM	U.S. Army Research Institute of Environmental Medicine
VO_2	Oxygen Uptake

BACKGROUND

The U.S. Army Research Institute of Environmental Medicine (USARIEM) was tasked by the Training and Doctrine Command (TRADOC) and their subsidiary the Center for Initial Military Training (CIMT) to develop a new criterion-based physical testing procedure for entry into the U.S. Army's seven physically demanding combat arms military occupational specialties (MOSs). The resulting test was the Occupational Physical Assessment Test (OPAT) consisting of four physical fitness tests (strength deadlift, seated power throw, standing long jump, and interval aerobic run). These tests were selected because they were predictive of Soldier occupational task performance.[1] The task performance was assessed via criterion measure task simulations of the soldiering tasks. This report describes the process of designing and implementing the criterion measure task simulations (CMTSs) used in studies that developed the Army's new OPAT.[2]

DISCLAIMERS

The opinions or assertions contained herein are the private views of the author(s) and are not to be construed as official or as reflecting the views of the Army or the Department of Defense.

The investigators have adhered to the policies for protection of human subjects as prescribed in Army Regulation 70-25, and the research was conducted in adherence with the provisions of 32 CFR Part 219. Protocol # 9300.

This research was supported in part by appointments to the Postgraduate Research Participation Program at the U.S. Army Research Institute of Environmental Medicine administered by the Oak Ridge Institute for Science and Education.

Portions of the data presented in this report have been previously reported.

EXECUTIVE SUMMARY

Formerly, Soldiers in the U.S. Army were not selected for their military occupational specialty (MOS) based on their physical capability to successfully perform the physical tasks necessary for that MOS. The U.S. Army Research Institute of Environmental Medicine (USARIEM) was tasked by the U.S. Army Training and Doctrine Command (TRADOC) to develop criterion-based physical requirements for entry into seven physically demanding combat arms MOSs.

Researchers from USARIEM completed three studies to develop a valid, safe, and legally defensible physical performance battery to predict a Soldier's ability to serve in these MOSs.[1, 3-6] This report describes the process of designing and implementing the five criterion measure task simulations (CMTSs) that were common to multiple MOSs and the three MOS-specific CMTSs.

INTRODUCTION

When evaluating the physical work demands of physically demanding tasks, testing procedures must replicate the physical demands of the task, be repeatable, reliable, safe, and not require high skill levels from naïve subjects. In some cases, the actual task performance is the most appropriate way to evaluate a subject's abilities. For others it may be too expensive or dangerous for naïve volunteers to perform an occupational task the way it would be executed in the work environment. Based on these considerations, it is essential to decide whether to use actual tasks or simulations. This paper will summarize the process of evaluating existing high physical demand tasks, and the development of criterion measure task simulations (CMTSs).

The question the practitioner must ask is: Should I use the original task or a simulation? From a test design viewpoint there are different reasons for using either the actual task or a simulation:

(1) Some tasks are safe enough and do not need specialized skills to perform. An example would be a loaded road march, which presents little objective danger and does not require specialized skills to safely execute. As such, it does not require a simulation. Although a road march does not meet the need to develop a separate simulation, there may be advantages in the test environment to changing certain parameters of the task. For example, if the goal of a road march task is to determine if the participants have the requisite fitness to perform a longer road march (e.g., 20 km), reducing the duration of the road march can maintain the predictive power of the task while reducing the likelihood of injury. Real world examples of CMTSs from the fire service arena are timed tasks like donning all of the firefighter's Personal Protective Equipment ensemble in 60 seconds or a 90-second donning test for the Self-Contained Breathing Apparatus.[7]

(2) With some of the physically demanding tasks, the activities of the task itself can cause alterations of the test environment; consequently, degrading the repeatability or standardization of the test. An example would be a dummy drag test simulating the rescue of a casualty. Depending on the surface it is dragged on, there can be a large difference in the coefficient of friction acting on the dummy; therefore, differences in the physical demands required to move it. Another way that common practices in test administration can interfere with equitable test outcomes is the practice of using test volunteers as the victim in a casualty drag. This virtually guarantees variability in the test conditions for each test-taker. By having all test volunteers drag a specified, purpose-built dummy with known mass and physical characteristics, dragging this dummy on a specific durable surface will eliminate these sources of variability across different test venues.

(3) A third approach is to simplify the test environment to preserve the physical demand and reduce the need for military equipment. An example of this would be a task simulating of loading of the main gun of a main battle tank. This approach reduces cost and the need for volunteers to have specialized skills or training to complete the test and may therefore be suitable for use as point-of-entry tests.

(4) Some tasks cannot be easily simulated due to financial, logistical or safety issues. The field artillery ammunition supply vehicle reload task is an example. This task

involves the movement of 36, 105-lb, 155mm cannon projectiles from a delivery pallet up into a large armored transport vehicle. Once the rounds have been moved into the transport vehicle, the subject secures them into storage racks on the walls of the vehicle. The construction of a simulation of this task would be financially prohibitive and the design and construction of a simulator would be massive in order to cope with the amount of weight of the rounds that each test subject would be moving during these tests. In cases like this using the original items involved in the actual occupational task make the most sense. The implementation of modified CMTSs streamlines physical employment standard testing and can make the tests more repeatable, reliable, safer, and more economically feasible.

At the start of the Physical Demand Study (PDS), the US Army Training and Doctrine Command (TRADOC) asked the different branch schools, the Centers of Excellence, as well as a set of focus groups comprised of senior enlisted and other experienced leaders[8] to generate a list of Soldier high physical demand tasks (HPDTs). This list was to encompass the most physically demanding tasks that combat arms Soldiers would routinely encounter in their combat roles. This list of 31 HPDTs included lifting and carrying tasks, heavy lifting, heavy dragging, and load carriage tasks. These tasks included movements of the upper- and lower-body and required the Soldiers to meet aerobic and anaerobic challenges as well as challenges in muscular strength and power generation. Some of the 31 tasks required Soldiers to have specialized skills to successfully meet the minimum performance standard. Other tasks were of such short duration that they presented a low physical demand. In order to create a manageable test battery for the examination of Soldier physical demands this list of 31 tasks needed to be reduced.

There are many HPDT that are multi-person / team based tasks. Figure 1 shows examples of some of these team tasks. Of the 31 HPDTs, 13 were single-person tasks, 12 were team tasks that could not be configured as a solo task and 6 of the team tasks could be configured to test an individual Soldier’s ability to complete. Tasks that were multi-person tasks were culled from the list because of the difficulty in determining the physical demands for an individual participants when they were involved in a group task (see Table 1).

If a HPDT was similar to another it would be included in the battery if it was used by more MOS and if it was the most physically demanding of those similar tasks. For example, Task 25 Establish an Observation Point is essentially the same as Task 1 Conduct a Tactical Movement. Both are long road marches with similar loads. Task 1 was chosen because many more Soldiers perform the task as part of their MOS.

A small number of HPDTs were included because they were deemed to be core critical elements of specific MOSs. In particular, two Armor HPDTs (Task 18 - Stow Ammunition on an Abrams Tank and Task 19 - Load the main Gun) and a single Artillery HPDT (Task 21 Transfer Ammunition with a Field Artillery Ammunition Supply Vehicle) were included.

Figure 1. Examples of multi-person occupational tasks

Clockwise from top left: Carrying the barrel of a 120mm mortar; carrying a M2 .50 cal machine gun; lifting the transport wheels and spade trail arms on a towed 155mm howitzer canon; carrying the rolling rocker assembly from a Bailey bridge; lifting and shifting the base assembly of a Volcano mine system.

Table 1. List of high physically demanding tasks.

Task Number and Name	MOS using this task							Task Category	Exercise domain	Multi- person	Can be modified to be a single person task	Single person	Highly skill dependent	Most demanding in category	MOS Critical
	11B	11C	12B	13B	13F	19D	19K								
1 - Conduct tactical Movement	X	X	X		X	X	X	Load Carriage	Aerobic			X		X	
2 - Employ Hand Grenades	X	X	X	X	X	X	X		Explosive			X	X		
3 - Prepare a Fighting Position (Fill and Emplace Sandbags)	X	X	X	X	X	X	X	Lift and Carry	Aerobic	X	X			X	
4a - Drag a Casualty to Immediate Safety (Dismounted)	X	X	X	X	X	X	X	Heavy Drag	Anaerobic			X		X	
4b - Remove a Casualty from a Wheeled vehicle (mounted)	X		X		X	X		Heavy Lift	Strength	X	X				
5 - Maintain 25 mm Gun on a Bradley Fighting Vehicle(BFV)-Install the Barrrel	X		X		X	X		Heavy Lift		X					
6 - Maintain 25 mm Gun on a BFV-Remove Feeder Assembly	X		X		X	X		Heavy Lift	Controlled lift			X	X		
7 - Load 25mm H-EIT Tracer Ammunition Can on BFV	X		X		X	X		Lift and Carry				X			
8 - Load TOW Missle Launcher on BFV	X					X		Heavy Lift	Controlled lift			X	X		
9 - Move Over , Through or Around Obstacles	X	X						Load Carriage	Anaerobic	X	X				
10 - Move Under Direct Fire	X	X						Load Carriage	Anaerobic			X			
11 - Prepare Dismounted TOW Firing Position	X							Heavy Lift	Controlled lift			X	X		
12 - Engage Targets with a Caliber .50 M2 Machine Gun	X							Load Carriage	Controlled lift	X					
13 - Lay a 120mm Mortar-Emplace Base Plate		X						Heavy Lift		X					
14 - Lay a 120mm Mortar-Emplace Cannon		X						Heavy Lift		X					
15 - Lay a 120mm Mortar for Deflection and Elevation		X						Heavy Lift		X					
16 - Fire a Mortar		X						Heavy Lift	Controlled lift			X			
17 - Mount M2 .50 Cal Machine Gun Receiver on an Abrams Tank							X	Heavy Lift	Controlled lift			X			
18 - Stow Ammunition on an Abrams Tank							X	Lift and Carry		X	X				X
19 - Load the 120mm Main Gun							X	Heavy Lift	Controlled lift			X			X
20 - Remove a Casualty from an Abrams Tank (Mounted)							X	Heavy Drag		X	X				
21 - Transfer Ammunition with a (Field Artillery Ammunition Support Vehivle(FAASV)				X				Heavy Lift		X	X			X	X
22 - Emplace 155mm Howitzer / Lift Wheel Assembly				X				Heavy Lift	Explosive	X					
23 - Displace 155mm Howitzer / Recover Spade Trail Arm and Blade				X				Heavy Lift	Explosive	X					
24 - Set Up Gun Laying Positioning System				X				Heavy Lift	Controlled lift			X	X		
25 - Establish an Observation Point (Carry AN/PED-1 (LLDR))					X			Load Carriage	Aerobic			X			
26 - Prepare M1200 Armored Knight Vehicle for Operation					X			Heavy Lift	Controlled lift	X					
27 - Carry / Employ Antipersonnel Obstacle Breaching System (APOBS), Perform Footmarch			X					Lift and Carry		X					
28 - Prepare Obstacle with the H6 40 pound Cratering Charge (Carry / Emplace the H6)			X					Lift and Carry	Anaerobic						
29 - Operate a Modular-Pack Mine System (MOPMS)(Carry Emplace MOPMS)			X					Lift and Carry	Anaerobic	X					
30 - Assist in the Construction of a Bailey Bridge (Lift and Carry the Rocking Roller)			X					Lift and Carry	Anaerobic	X					
31 - Load / Install a Volcano (Set Up Volcano)			X					Lift and Carry	Anaerobic	X					

The tasks that are greyed out are those that were eliminated because they were multi-person and could not be modified to be a solo task, required high skill acquisition to meet the minimal standard, or were not the most demanding task among comparable tasks.

The list of 31 HPDTs was reduced to a smaller list of tasks that included only the most physically demanding for each type of movement and energy system. These tasks were split into two groups: common tasks that were performed by more than one MOS and MOS-specific tasks that were only performed by Soldiers in one MOS.

Common tasks included:
Task 1 Conduct a Tactical Movement (Road March)
Task 3 Prepare a Fighting position (Sandbag Carry)
Task 4a Drag a casualty to immediate safety (Dummy Drag)
Task 4b Remove a casualty from a wheeled vehicle (CASEVAC)
Task 10 Move under direct fire

MOS specific tasks included:
Task 18 Stow ammunition on an Abrams tank (Stow Ammo)
Task 19 Load the main gun on an Abrams tank (Load the Main Gun)
Task 21 Transfer ammunition with an M992 Carrier Field Artillery Ammunition Supply Vehicle (FAASV)

DEVELOPMENT OF CRITERION MEASURE TASK SIMULATIONS

COMMON TASKS

Task 1 Conduct a Tactical Movement (Road March)

As defined by the proponent schools, the actual length of a training road march was 20 km and the load was 94-109 lb. Soldiers were allowed 22-24 hours to complete the march, and it was not intended to be a continuous effort. The original task was designed to simulate two separate combat patrols of roughly 10 km with a rest period in between. As a task that is representative of a combat work task, this makes sense and would be a useful training exercise. This road march task fits into the first development category in that this task presents little objective danger and does not require specialized skills to safely execute. The path that we followed in developing this CMTS was to determine the core performance and physiological aspects of the task and modify the task to maintain those aspects while reducing the logistical burden of the task in an effort to make testing more efficient and standard.

A group-based task makes it difficult to evaluate the individual performances of the various members of the group. In group-based activities, the motivational state of the test subjects can be influenced by peer pressure or other group dynamics. These influences can variously improve or degrade a volunteer’s performance. By eliminating the group aspect, in particular marching as a unit, an individual’s performance capabilities are more easily observed.

The logistical cost of administering a road march task comes from many sources including: (1) acquiring permission from the range control or the post police to use the roads and trails that comprise the route of march; (2) providing medical oversight for the route that is adequate for the number of test volunteers and is relevant to the environmental conditions (heat, cold rain, etc.); (3) monitoring the actual route of march to assure the safety of the test participants (road guards at dangerous points on the route); (4) addressing environmental/weather constraints (rain, snow, high humidity, temperature extremes) and provide water and shelter as needed; and (5) conducting the day of test activities (weighing test volunteers, adjusting carried loads to meet standards, setting up and running the timing system, retrieving any equipment or loads issued to the volunteers, collecting any survey based data). These costs are multiplied with each additional subordinate march in the day's activities.

In addition to these group and logistical issues: the use of a discontinuous task makes it almost impossible to determine an individual's ability to maximally perform on the component portions of the discontinuous task. Volunteers will pace themselves in order to finish not just the immediate task but all of those tasks that are part of the larger discontinuous task. These pacing behaviors can interfere with the determination of an individual person's physical work capacity.

As part of the development of this road march task we went to different Army posts and observed units of Soldiers performing group marches. Seeing the variability of how the different examples of these road marches were executed at different posts by different commands we realized that there were many factors that these marches had in common, but there were too many differences for these marches to be considered equivalent. These differences included climate, terrain, equipment worn, and pacing.

The next step was having Soldiers perform road march task simulations on a treadmill and measure their physical work capacity using open circuit spirometry (Parvo Medics TrueOne 2400 Cart, Sandy, UT; Figure 2). Based on the results of the road marches observed, we found that Soldiers who made it past 3 miles finished the remainder of the 12-mile course. In addition, discussions with a group of subject matter experts (SMEs) concluded that Soldiers who were capable of finishing a 4-mile course should be able to finish a 12-mile course. From this information we reduced the length of our loaded road march task to 4 miles resulting in less testing time, quicker set up and take down of the road march courses and a lower injury potential. Post hoc analysis of the 12- and 4-mile road marches showed no differences in Soldier pace ($p \geq 0.49$; Figure 3).

The load used for the PDS road march was 94-109 lb. This was a combined weight of the Basic Soldier Uniform (12 lb), personal protective equipment (PPE; 63.03 – 77.57 lb) and a 24 hour sustainment load (19 lb). This load was a reduction from the original load proposed by the Infantry School. The road march load for the Occupational Performance Assessment Test (OPAT) Study was reduced to 70 lb comprised of a Soldier Uniform (12 lb), weapon and tactical equipment (25 lb), and a loaded MOLLE rucksack (33 lb). This reduction was driven by the recommendation of the Infantry School. Because the trainees were not fully trained, the concern was that the trainees would get injured carrying the original load used in the PDS.

Figure 2. Open circuit spirometry measures on a Soldier performing simulated road march on a treadmill

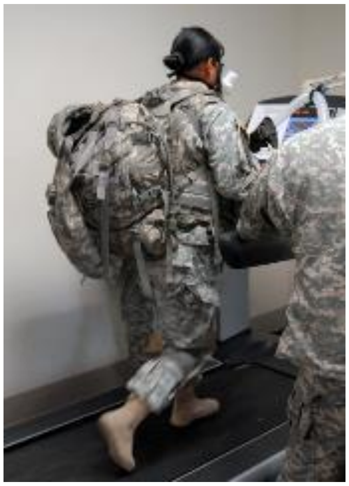
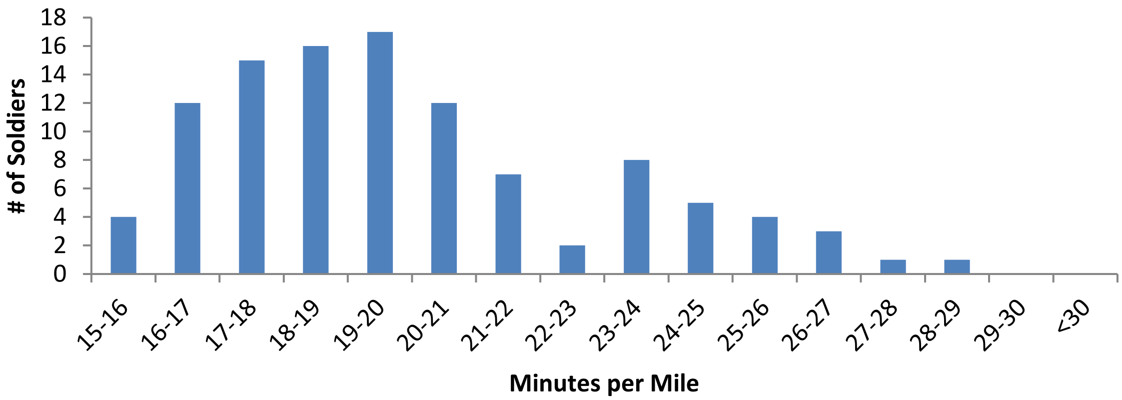


Figure 3. Pacing comparison of 12- and 4-mile road marches.

A) Pacing of a 12-mile course (N=107): Average pace 19.7 min/mile
B) Pacing of a 4-mile course (N=192): Average pace 20.0 min/mile
C) Relationship Between Soldiers 4-mile and 12-mile courses

A)



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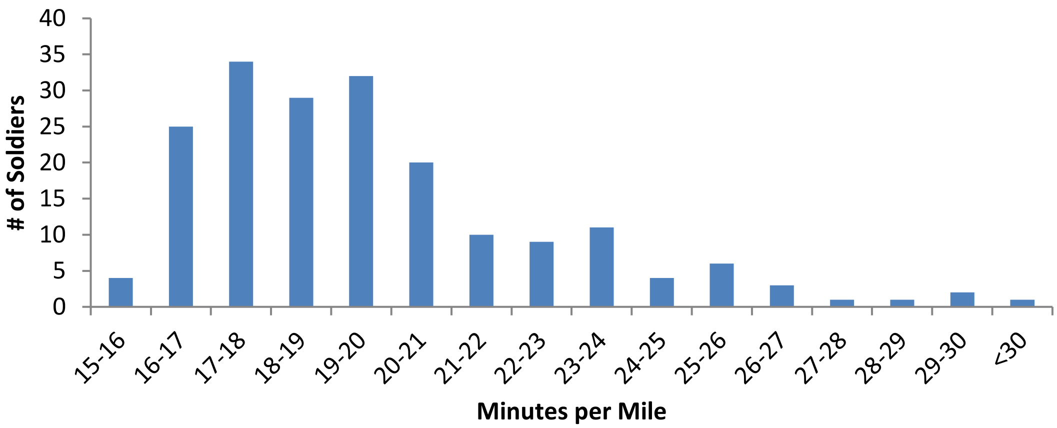

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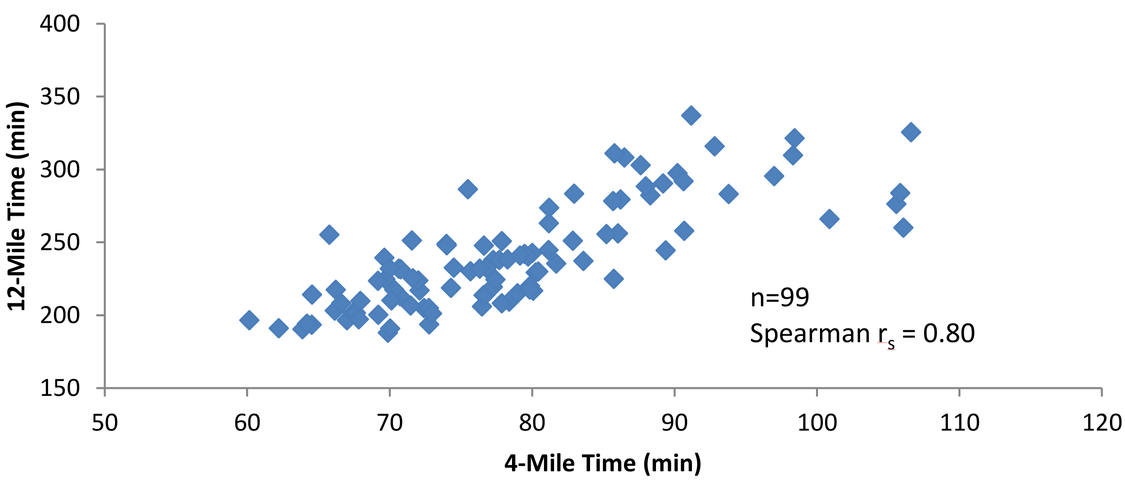


Road March Timing System

For the road march, we used a SPORTident timing system (Figure 4). This is a Radio Frequency Identification (RFID) based timing system that allowed us to capture split times along the route of march. Each of the volunteers was equipped with a RFID device manufactured by SPORTident (Arnstadt, Germany). This system, known as the SPORTident Active system, uses a RFID enabled data chip or SPORTident Active card (SIAC; Figure 5) that recorded the time of day when they passed each timing gate and when they crossed the finish line of the road march course. These SIAC cards were collected at the end of the march and the data from these devices was downloaded to a laptop computer running sporting event meet management software named "Òr" (Irish Orienteering Federation, Dublin, Ireland). This software package calculated the finish and split times for each of the volunteers.

Figure 4. SPORTident equipment components

A. SPORTident Active Card (SIAC) RFID data stick; B. Start/ finish controls; C. Soldier placing stick into control; D. SIAC timing gate; and E. Download/printer station

Figure 5. Road marching Soldiers using SPORTident Active Cards (SIACs) to record a split time as they pass SIAC timing gates.

Task 3 Prepare a Fighting Position (Sandbag Carry)

This task was in actuality a multi-person, two-phase task with two Soldiers filling 26, 30- to 40-lb sandbags (one holding the bag open and one shoveling; Figure 6). Then, the Soldiers would carry the 26 filled sandbags 10 m and place them to prepare a fighting position. There was almost no standardization in this task between sites, particularly with respect to: how much the bags should actually weigh, the range of acceptable weights, how they were to be carried, and the nature of the fighting position that was to be prepared. We also observed that the fill material was a different type, density and moisture content at each site.

After observing several iterations of this task at different locations, it was decided to eliminate the aspect of the task that required one of the participants to hold the sandbags such that they could be filled in the most consistent manner (Figure 7). The way that we tackled this issue was to have the Soldier fill a set of four 6-gallon plastic buckets to a preset line placed on outside of these buckets. This fill line was determined by filling a bucket with the locally available sand until it weighed 40 lb. The set of buckets were all marked to the same target fill level. The Soldiers would fill a bucket to the correct height and move to the next bucket in the set. As they completed filling each bucket, a test administrator would empty that bucket and place it such that the Soldier had an endless set of buckets to fill. An observer would record the split time that it took to fill each of the 26 buckets and the total time to complete the filling task. After the Soldier had completed the bucket filling task, they were timed as they shuttled 26, pre-filled 40-lb sandbags from a pre-built fighting position to a location 10 m away where they rebuilt the fighting positon. Initially this fighting positon was a U-shaped stack of 26 sandbags made of two layers of 10 bags and a top layer of six bags. Soldiers were outfitted with portable metabolic monitors (Oxycon Mobile Metabolic Unit, CareFusion, San Diego, CA) in order to measure their energy expenditure while they completed these two tasks. After making metabolic measurements of these two tasks, we found that the sandbag/bucket filling task had a lower energy cost compared to the sandbag carry task (Tables 2 and 3, respectively). Because the sandbag filling task did not have as high physical demand as the sandbag carrying task it was eliminated from the test schedule in an attempt to limit the overall testing burden.

Figure 6. Examples of the building fighting position tasks observed in the field.

From the sandbag carry split time data we were able to predict a Soldier's overall sandbag carry performance. A Soldier's performance data from the 16th bag onward through the 26th bag was predictive of a Soldier's overall sandbag carry performance time (Figure 8A). Additionally, the energy expenditure data showed that the energy expenditure did not significantly increase after the 14th carry (Figure 8B). These two factors led us to reduce the number of sandbags to be carried in this task from 26 down to 16 (including 2 extra carries as a buffer), while still giving us a robust measure of performance for this type of occupational task. With the number of carries reduced to 16, we were able to establish a faster, simplified sandbag carry and emplace task that was representative of the original military task. The final fighting position configuration, the schematics of the task and images of a Soldier performing the task are displayed in Figures 9, 10 and 11, respectively. Further detailed descriptions of this task can be found in can be found in USARIEM Technical Report #T16-10 Development of a Physical Employment Testing Battery for Infantry Soldiers: 11B Infantryman and 11C Infantryman- Indirect Fire.[6]

Figure 7. Measuring the energy cost of filling and carrying sandbags.

Table 2. Energy cost for filling 35-lb buckets of sand expressed as body mass relative VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$).

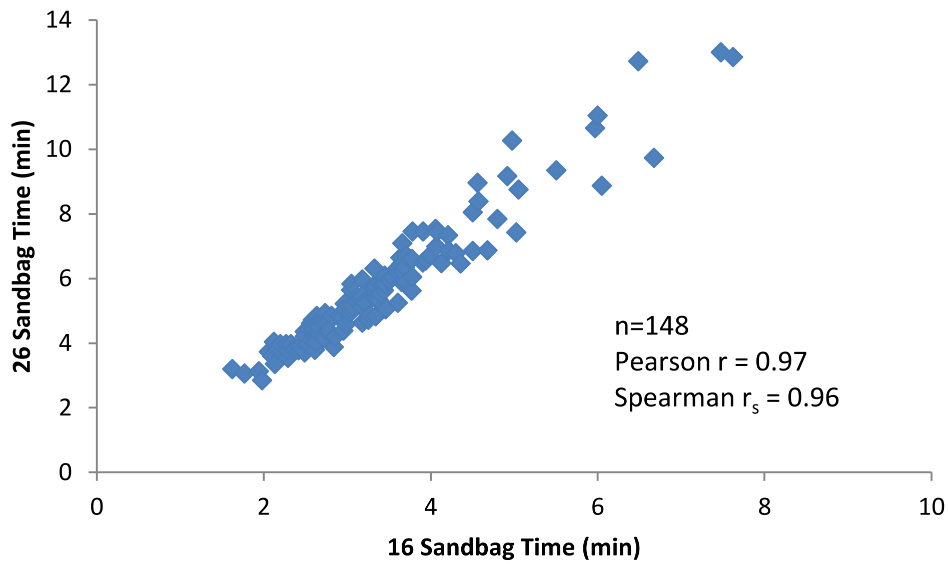
Uniform Load Carried		~83 lb				
External Load Moved		26 x 35 lb (~910 lb total)				
Physiological Demands		**N**	**Mean**	**SD**	**Minimum**	**Maximum**
Body Mass Relative VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$)	Male	127	22.30	4.10	12.22	40.51
	Female	82	19.01	3.40	10.40	27.42
	Sex Combined	209	21.01	4.16	10.40	40.51

Table 3. Energy cost for carrying 35-lb sandbags a distance of 10 m expressed as body mass relative VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$)

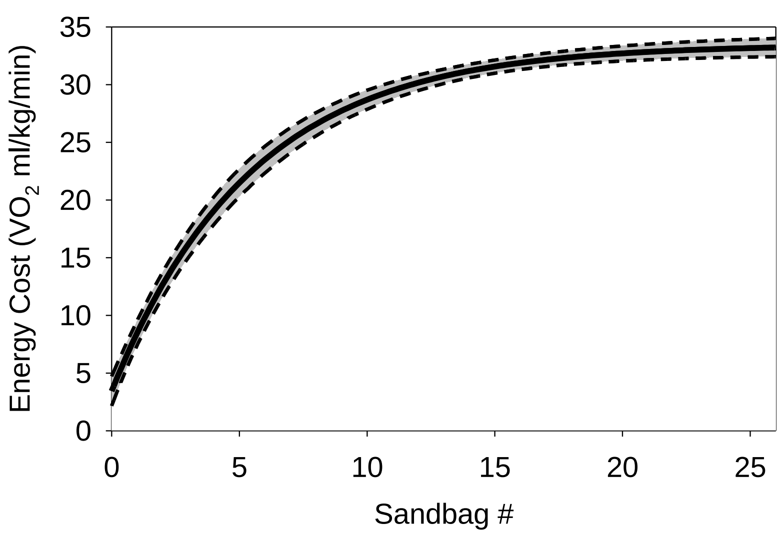
Uniform Load Carried		~83 lb				
External Load Moved		26 x 35 lb (~910 lb total)				
Physiological Demands		**N**	**Mean**	**SD**	**Minimum**	**Maximum**
Body Mass Relative VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$)	Male	128	33.11	5.29	18.61	45.26
	Female	80	27.85	4.48	17.35	42.51
	Sex Combined	208	31.09	5.60	17.35	45.26

Figure 8. Finishing order (A) and energy cost of lifting and carrying sandbags (B)

A)



B)



Mean ± 95% Confidence Interval

Figure 9. The final fighting position configuration was comprised of a stack of 16 sandbags weighing 45 lb. They were arranged in two layers of eight bags in a 2 long x 2 high x 4 wide layout.

Figure 10. Overhead view of sandbag carry test setup.

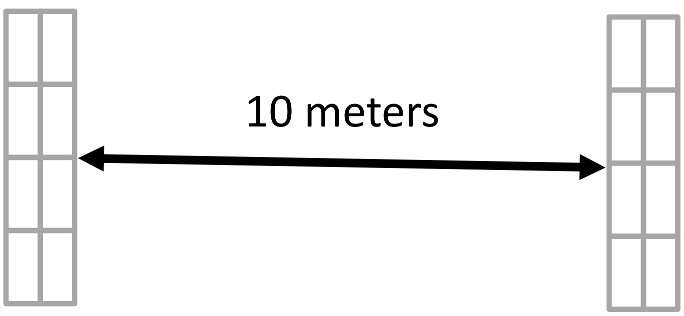


Figure 11. Volunteers carrying the sandbags from the start pile to the finishing pile and returning for the next load.

Task 4a Drag a casualty to immediate safety (Dummy drag)

The definition of this task was to drag a 271-lb incapacitated Soldier 15 m to immediate safety (Figure 12). This task was defined by TRADOC in their list of 31 HPDT as one of the tasks common to multiple MOSs and can be found in Appendix B of USARIEM Technical Report #T16-6.[8] There was no time standard stated as part of this original description. After observing this task in several different locations, we concluded there were a suite of problems that made the results from these drag tests not comparable. Here is a list of some of these issues:

1. *The item dragged*. The victims included actual Soldiers, a Rescue Randy, (Simulaids Inc., Saugerties, NY; Figure 13), and a loaded Skedco litter (Skedco, Inc., Tualatin, OR).

2. *The weight and loading of the victim*. The desired victim weight was 271 lb. If the victim was not this heavy, weight was added. This was done by strapping weightlifting plates to the victim by adding weight to the Soldier's fighting load carrier. The load added to the chest in Figure 12A would have a different effect on the task than a load added to the legs as in Figure 12B picture.

3. *The drag surface*. The different drag surfaces included a cinder track, a dirt/ sandy area, a dirt area with weeds, and areas paved with concrete.

4. *The handles on the victim.* The rescuer grasped the victim either by the shoulder straps of the body armor or the grab handle of their Fighting Load Carrier which is vest-like garment worn over the body armor.

In order to have a repeatable test, it was necessary to standardize the dummy being dragged, the grasping handles, the weight of the dummy and the surface the dummy was being dragged over. Although the Rescue Randy was an attempt at standardization, it is not suited for dragging. Rescue Randys are loaded with soft plastic pellets, are held together with steel cables and have a plastic "skin" that is not abrasion resistant. After a Rescue Randy has been dragged on concrete, pavement or gravel surfaces or "skin" wears through and they begin to leak pellets. When this happens the weight diminishes. Using humans as drag dummies is not a viable practice, as it is uncomfortable and may injure the 'victim'. In order to get to the required weight of 271 lb, a sizable amount of weight may need to be added to the victim, making this even more uncomfortable.

Figure 12. Examples of field-expedient dummy drag testing showing Rescue Randy manikins (top images, A&B) and Soldiers being dragged as simulated casualties (bottom images, C&D).

Figure 13. A Rescue Randy manikin.

To further investigate the forces involved in dragging a dummy, we measured the force that the person dragging the dummy exerts by having them pull the dummy using a Mark-10 Series 5-strain gage dynamometer (Mark-10 Corporation, Copiague, NY; Figure 14). The test administrator grabbed the two handles of the dynamometer and hooked the device to the dummy's harness. The device recorded the force applied to the harness during a 10-second long pulling trial. During these trials, the subject built up the force needed to start the dummy moving over approximately 2 seconds. When the dummy began moving they continued to pull at a steady pace for the remainder of the 10-second trial. The result from these drag force tests was the decision to standardize the type of dummy being dragged and the surface the dummy was dragged on for our testing (Figures 15 and 16, respectively). We used a "Survivor" dummy from Dummies Unlimited (Pomona, CA; Figure 17). The Survivor is made specifically to cope with the problems encountered when conducting drag training or testing. The Survivor is essentially a sand bag in the shape of a human. It has a main part comprised of a head, torso and arms with an attached pair of thighs and lower legs. The dummy is made of very durable, high strength and abrasion resistant synthetic fabric. The dorsal surface of the lower part of the dummy's body and the entire surface of the thighs and lower leg segments are coated with an abrasion resistant coating.

Figure 14. Field measurement of friction forces during a dummy drag test using a Mark-10 Series 5-strain gauge dynamometer.

Figure 15. Inline pulling force data during dummy drags on different test surfaces.

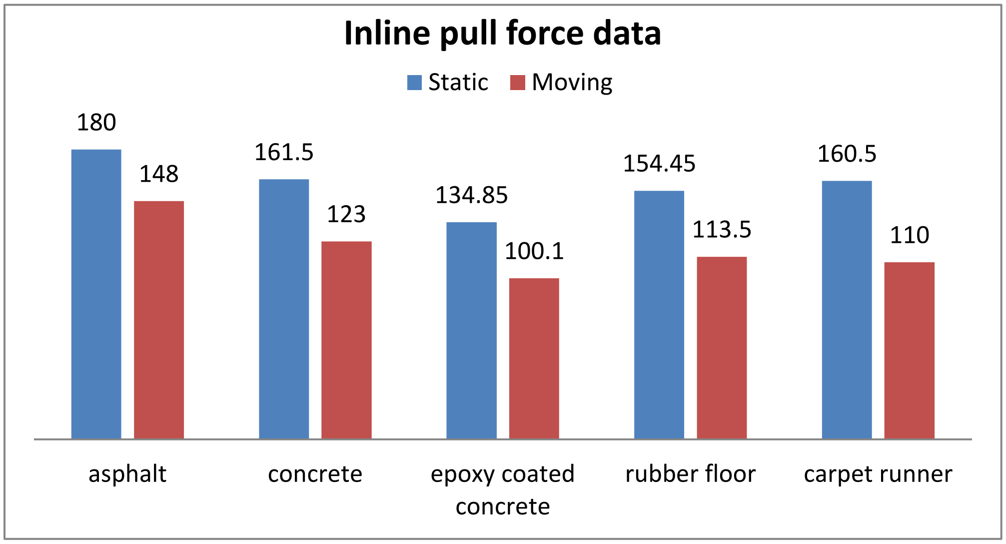


Figure 16. Comparison of drag times on two different surfaces. Similar distribution of times across surfaces: p=0.88

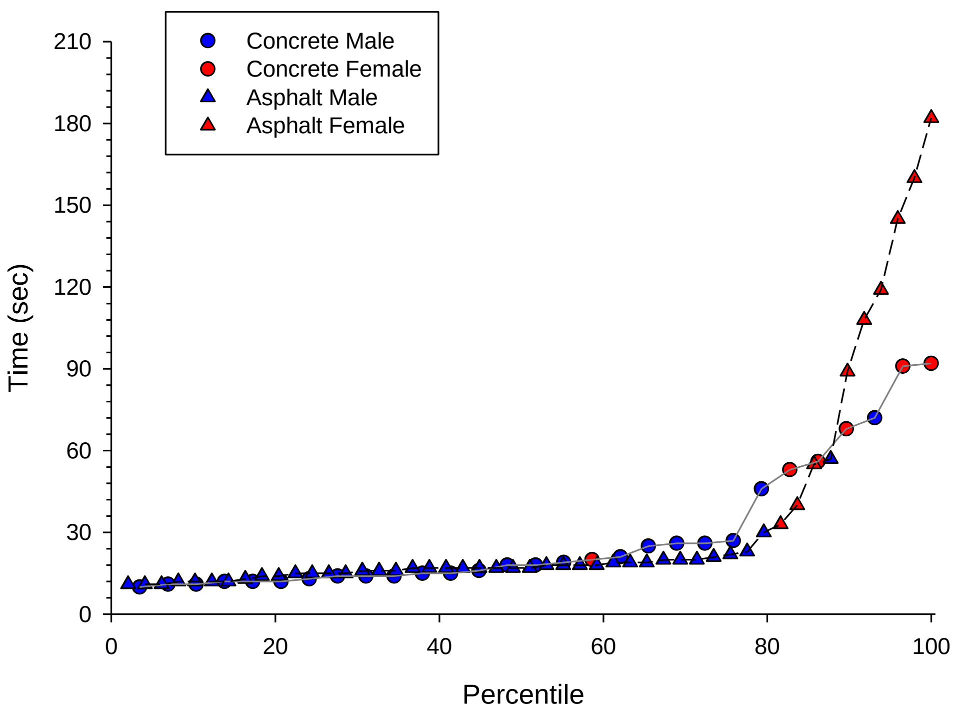
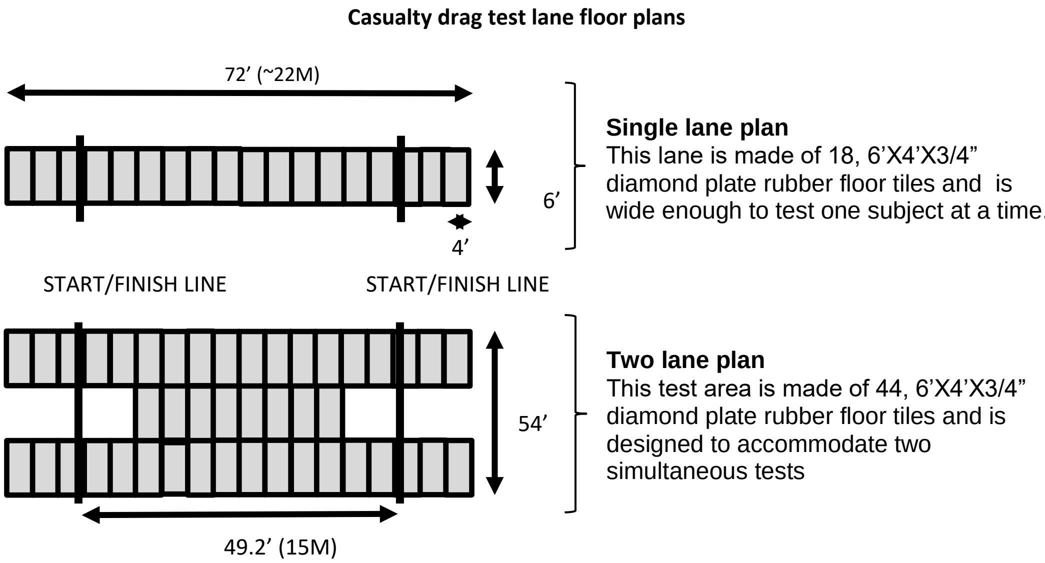


Figure 17. A Soldier executing the drag a casualty to immediate safety task with the Survivor dummy.

Initially, we used an off-the-shelf 175-lb Survivor and increased the weight by adding limb segments to it. This dummy worked very well for our developmental testing, but because of the need for a standardized test manikin we contracted the manufacturer of the Survivor dummies (Dummies Unlimited) to build Survivors weighing 271 lb. This was the weight designated by TRADOC as the weight of an average Soldier wearing a fighting load. This gave us a dummy that was standardized in weight and built to be durable enough to meet the demands of testing.

In order to standardize the drag test surface, we needed to find a surface that would have frictional characteristics that were in the range of surfaces that we would encounter in the Soldiering environment and that would be portable so that we could deploy it to any test site we would visit. We chose a rubber flooring material that is used in commercial gyms and weight rooms (Kodiaksports.com). This material is available with a smooth or diamond plate surface. We chose the diamond plate surface because we felt that it would not be as affected by dirt and particulate material tracked onto it during the course of testing. This flooring material was available in a 4' x 6' x ¾" tile format. These tiles had an interlocking edge that fixed the adjacent tiles to each other. This kept the testing surface intact and stable during all of the testing. These tile weigh approximately 100 lb each. While they are fairly heavy, a crew of four people can assemble the two lane drag test floor in about an hour (Figure 18). Further detailed descriptions of this task can be found in can be found in USARIEM Technical Report #T16-10 Development of a Physical Employment Testing Battery for Infantry Soldiers: 11B Infantryman and 11C Infantryman- Indirect Fire.[6]

Figure 18. Floor plans for single and double test lanes for dummy drag tests.



The diamond plate rubber flooring tiles used in these test lanes are from Kodiaksports.com and were priced at $76.99 each

Task 4b Remove a casualty from a wheeled vehicle (CASEVAC)

This test evolved from observations of training exercises for removing casualties from Bradley Fighting Vehicles (BFV) and Abrams tanks (Figures 19 and 20, respectively). The main difference between these two CASEVAC operations is the size and location of the hatchway that the victim is being extracted from. This task is an outgrowth of Task 4b: Remove a Casualty from a Vehicle (Mounted) and Task 20 Remove a Casualty from an Abrams Tank (Mounted). The standard for this task was originally designated to be a two person task with a 218-lb lift (188-lb Soldier with 30 lb of Vehicle Crewman Uniform and equipment). For Task 20, the load was a three-person lift with a total lift weight of 218-232 lb given a size range of XS-4XL. The task was to a lift an incapacitated crewman a vertical distance of 1.5 m from the commander's seat in the turret of these vehicles and 1-2 m horizontal distance to clear the victim from the turret hatchway.

Our field observations showed that there was a large amount of variability in the way that this task was administered. There were different types of victims that were used. Most often these were actual humans or a dummy, usually a Rescue Randy. Because the victims would get caught on equipment in the vehicle while getting pulled out of the hatchway, there was a significant skill and/or luck component in the outcome of these tests. It is apparent that Soldiers require training and experience to efficiently execute these types of rescues. Because we were going to test naïve Soldiers in our study were required to be simplified in order to test the real physical and physiological demands that are the core of this task. Because there are so many sources of variability in these “real world” rescue scenarios, the actual events are almost useless as tools to determine if a Soldier has the requisite physical capabilities needed to execute this type of rescue.

Figure 19. Soldiers removing casualties from turret hatchways.

Figure 20. Marines performing a casualty extraction from a turret hatchway.

In an attempt to make these tests a more reliable measure of the strength needed to rescue someone from these types of vehicles, the test was simplified to focus on the strength necessary to execute these lifts. First, the lifted object was changed from a human-like dummy to a semi-cylindrical bag. This bag was a commercially available, off-the-shelf item. This was a big-wall haul sack, a device that is used in the sport of mountaineering (Figure 21). The specific item was a Black Diamond brand Touchstone haul bag (Salt Lake City, UT), which is 32 x 38 x 76 cm (12.6 x 15 x 29.9 in) in size with a volume of 70 L (4272 cu in). The haul bag was modified by adding a pair of strap-like handles that were similar to the shoulder straps of either a fighting load carrier or body armor to the top of the bag. The straps provided a place to grab the bag during the lift test. The overall length of the lift bag (36”) was based on the 50th percentile value of the sitting height of a Soldier.[9]

Figure 21. Black Diamond brand Touchstone haul bag

When the testing was done with a vehicle, the seat in the Bradley or Abrams turret was adjusted such that the shoulder straps were at the height of the upper surface of the open hatch (Figure 22). As testing proceeded, we developed a lifting platform that mimicked the hatchway of a BFV or a M1A1 tank. In this simulator, the top of the lifting straps for the bag were flush with the surface that the subjects were standing on. Initially the hole in the upper surface of the lift platforms were sized to simulate either the hatch of a BFV or an Abrams M1 A2 tank. The variant of the test platform that was used during data collection at Ft. Stewart and Joint Base Lewis-McCord are presented in Figures 23 and 24, respectively.

Figure 22. A Soldier pulling the lift bag from the hatch of a BFV.

Figure 23. The CASEVAC simulator and teaching hatch in use at Joint Base Lewis-McCord.

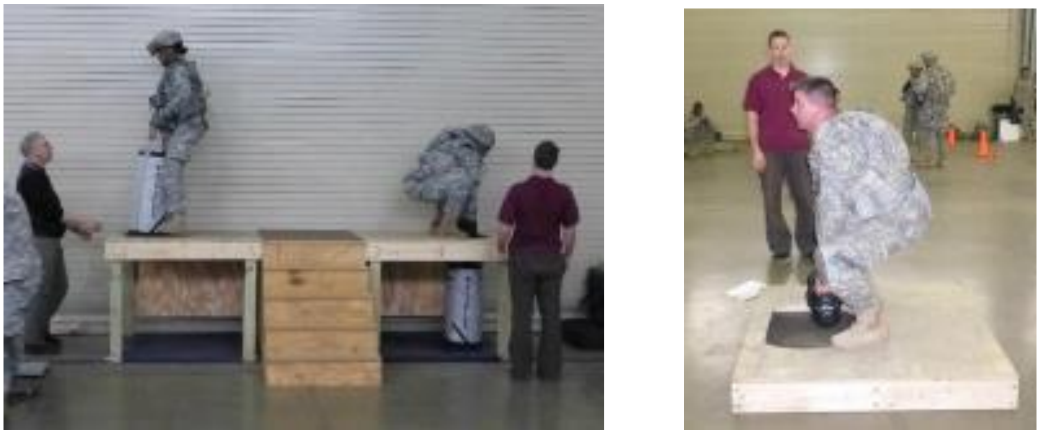
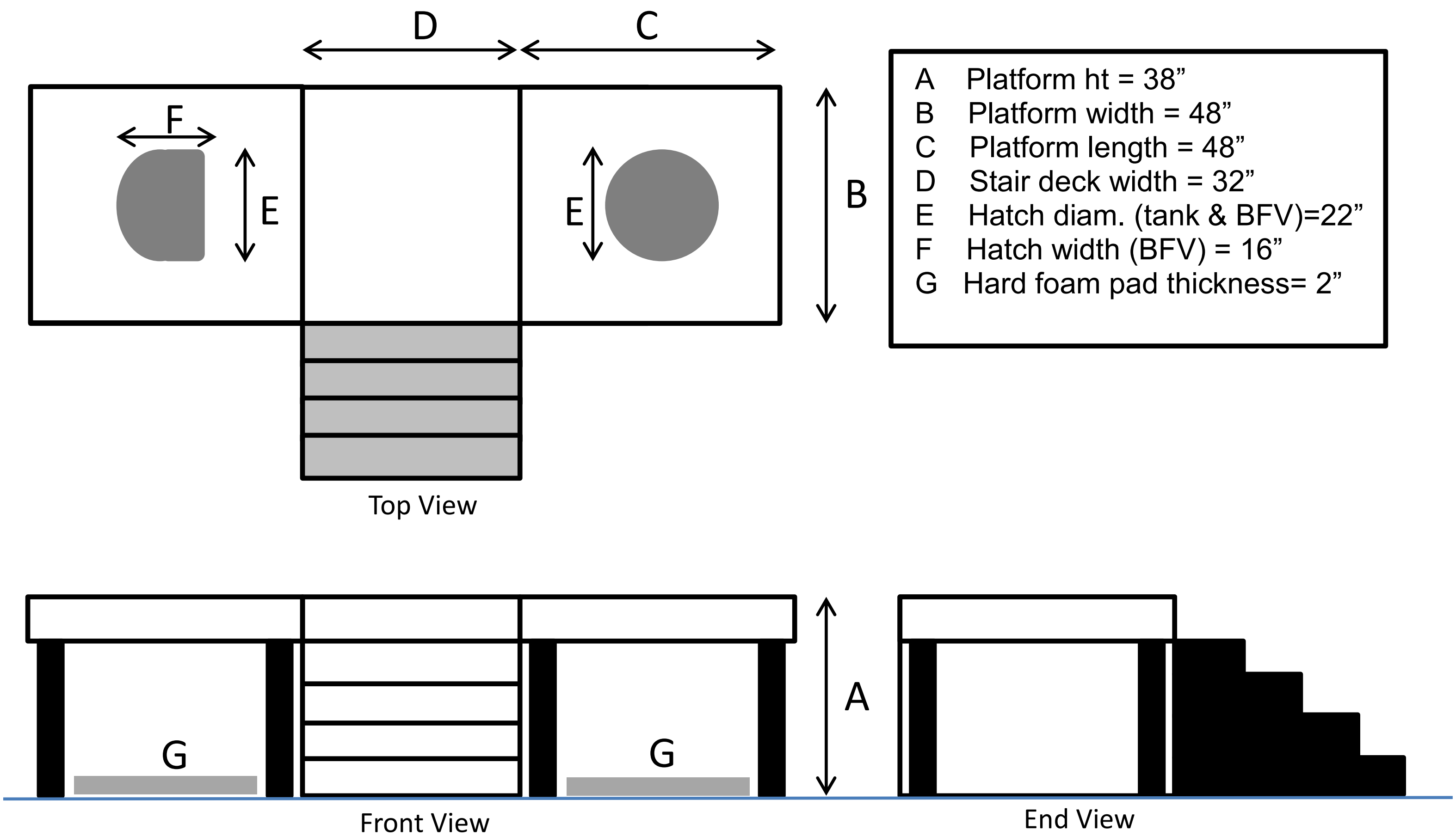


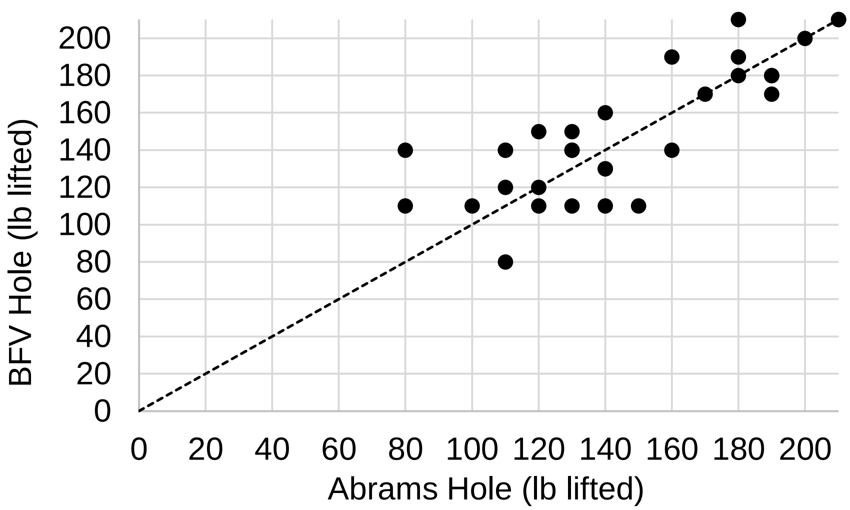
Figure 24. Dimensions of CASEVAC test platform for simultaneous use with two subjects.



The protocol for this lift test was that all Soldiers performed a set of warm-up squats. This was done on a low platform similar in dimensions to the test platform. These warm-up repetitions were completed by lifting two 30-lb kettlebells. The volunteers completed 6 to 10 lifts under the observation and coaching of a test administrator. This was done to make any correction to the volunteer's lifting form in an attempt to standardize the test and reduce the possibility of the volunteers injuring themselves during the tests.

In order to further simplify the testing, lifting performance on the two different hatches was compared using a subset of Soldiers performing lifts in both hatches (Figure 25). Performance on the two lifts were strongly correlated (r=0.81, p<0.01), and no significant differences were found (p=0.34); therefore, all subsequent testing was conducted with the larger Abrams-style hatch. To improve test throughput, a test platform was built that enabled the simultaneous testing of five volunteers and standardized loads were lifted (Figures 26 and 27). Previous to this, the Soldiers selected the size of the next load increment in the test

Figure 25. Impact of hatchway dimensions on lifting performance (N=31).



Dashed line: line of identity

Going forward the test procedure was as follows: volunteers climbed a set of stairs onto the platform to start the testing. They began at the lowest load (60 lb) and if they were successful moved onto the next lift in the order. The bags were loaded with the following weights: 60, 100,140, 180, and 220 lb. Each of the lifting stations on the platform had the same dimensions as those found in the two-person station. This platform and standardized loading system allowed the efficient testing of a large number of volunteers.

Possible drawbacks of this type of testing is that inexperienced Soldiers might not have their lifting form practiced enough to be able to safely execute these lifts in the short 5-lift test window allowed. These unskilled volunteers might not have enough coaching exposure to learn the correct lifting form enabling their maximal performance. In effect these volunteers would score lower than if they had more coaching or practice to perfect their lifting form. Additionally, the precision of the test is limited by only having the volunteers lift 5 discrete weights rather performing a true 1 repetition maximal lift. Further detailed descriptions of this task can be found in can be found in USARIEM Technical Report #T16-10 Development of a Physical Employment Testing Battery for Infantry Soldiers: 11B Infantryman and 11C Infantryman- Indirect Fire.[6]

Figure 26. Schematic of the five-station lifting platform.

A Platform height = 36.75”
B Platform section width = 48”
C Overall platform width= 20’
D Platform length = 96”
E Hatch diameter =22”

Construction is 2”x8” rim wall with 2”x6” floor joists 16” OC. 4’x4’ PT posts are used for support and are notched to hold rim wall of each section. Exterior grade plywood forms the decking. There are 36 “ tall and rail on stairs and deck sides and back. The front top side of the platform (the side with hatch hole) does not have rails.

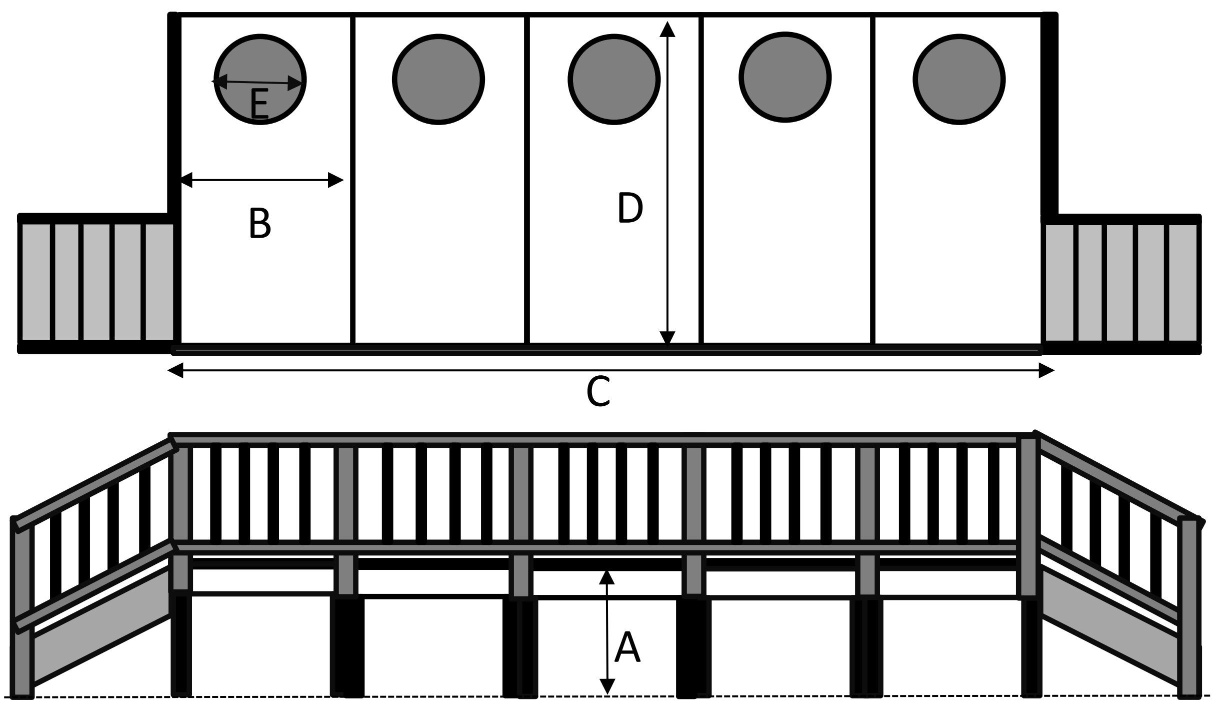


Figure 27. Volunteers using the 5-station CASEVAC simulator.

Task 10 Move Under Direct Fire

The purpose of the move under direct fire test is to simulate the physical demands of rapid non-linear movement of a loaded infantry Soldier on the battlefield. This activity is sometimes simulated by having a Soldier zig-zag from one position of cover to another in bursts of running that are 3-5 seconds in duration (or 3- to 5-second rushes) with a short rest interval between rushes (Figure 28).

During our visits to Ft. Bragg and Ft. Hood to observe Soldiers at work, we had the chance to see different versions of move under direct fire. This was usually referred to as 3- to 5-second rushes. The original description for Task 10: Move under direct fire has Soldiers rising from a prone, kneeling or crouching position, sprinting 3-5 seconds and returning to a prone, kneeling or crouching position. This was to be repeated for a distance of 100 m. Soldiers were to be wearing a fighting load of 76-91 lb. What we actually observed was a wide range of test conditions. Specifically, a different number of cycles of a Soldier rising from a lower position, running and dropping to a lower position. If Soldiers were left to define how many times they repeated this cycle, the distance that they rushed got longer as the test progressed. The overall distance that was covered, the number of rise and fall cycles and which low profile positions they assumed during this activity were different at virtually every test site and often between individual Soldiers. Additionally, the amount of time between each rise and fall cycle (the rest interval) was also different from site to site.

Therefore we standardized the test in terms of the overall distance that was covered (100 m), and the number and length of rise and fall cycles (15 rushes, 6.5-m long). Initially the pattern of low positions was prone, kneel, and crouch. The problem encountered was that while the prone and kneeling positions are easy to define (you are either face down on the ground or kneeling with one knee in contact with the ground), there is no clear definition of a crouching position. A crouch can be anything from a very low to a relatively high, nearly upright running position. After a period of testing the pattern of low positions was simplified to prone, kneel, kneel. This was repeated five times for a total of 15 rushes.

Figure 28. A volunteer part way through the move under fire course.

The next issue was to come up with a reliable timing system that not only provided an overall time for the test but also measured the split times for each rush and accounted for the static/rest time between individual rushes. We started out using two stop watches; one watch timed the interval from the start of each rush to the beginning of the next rush and the second watch measured a five-second down time from the end of a rush until the start of the next rush.

We adopted the use of the FitLight timing system (Aurora, Ontario, Canada), which had the advantage of cuing the Soldier to start each rush and measured their time for that rush (Figure 29). This system also allowed us to time the inter-rush interval and provided a reliable method to time each active segment of the test. This system uses a series of sensors or gates that send a signal to a tablet that is running the FitLight software.

Figure 29. The components of the FitLight system.

Left to right: the storage/charging case, the FitLights and the controller which is a dedicated tablet computer. The second photo shows a FitLight mounted on a stand similar to what was used in the study.

The timing gates were set up such that each of the 15 rushing stations had a gate on it facing toward the person being tested. The technician administering the test starts the test causing the first gate in the course to light up, signaling the volunteer to rise from a prone position and run to the next gate in the sequence. When the subject arrived at the gate, they broke a light beam and dropped into the next low position in the order. The FitLight system recorded the split time for that segment of the course and started counting down the rest interval time. When the rest interval time had elapsed, the next FitLight sensor on the course would light up signaling the volunteer to rush to that station. If enough space was available, the test venue could be set up with the sequence of stations flowing away from the start area (Figure 30A). If test space was limited the sequence of stations could be folded back on itself as seen in Figure 30B.

Figure 31 shows a volunteer being manually timed on the Move Under Direct Fire task. The Soldier has been signaled by the FitLight system to rise from a low position and move to the next station in the sequence. Upon arriving there, the Soldier will drop into the next low position in the sequence and will wait as the FitLight system times the rest interval and then triggers the next FitLight in the sequence cueing the Soldier to move to the next station.

When this system was used in an environment with steady, indirect light (indoors or outside, not in direct sunshine) we were able to reliably time the volunteers on the move under direct fire course. However, this system had two major problems associated with it. First, it required a highly-trained and skilled technician to program and operate it. When programmed correctly it provided a usable timing system that allowed us to program in predetermined rest intervals and also to automatically cue the volunteers to action during the test. We did encounter a more significant problem with this system in it’s sensitivity to bright and variable ambient lighting. The individual timing gates sense the presence of the person being timed when they either touch the device, or, as in our method, when the volunteer breaks a light beam associated with each station. When this system was used outdoors, bright sunshine or changing light conditions would sometimes trigger the individual timing gates.

This became enough of an issue that we stopped using the system and reverted back to the two watch system. Further, we ended up recording the volunteers overall time and cuing them to start each rush segment after a 5-second timed rest. Further detailed descriptions of this task can be found in can be found in USARIEM Technical Report #T16-10 Development of a Physical Employment Testing Battery for Infantry Soldiers: 11B Infantryman and 11C Infantryman- Indirect Fire.[6]

Figure 30. Move under direct fire course variant A and B.

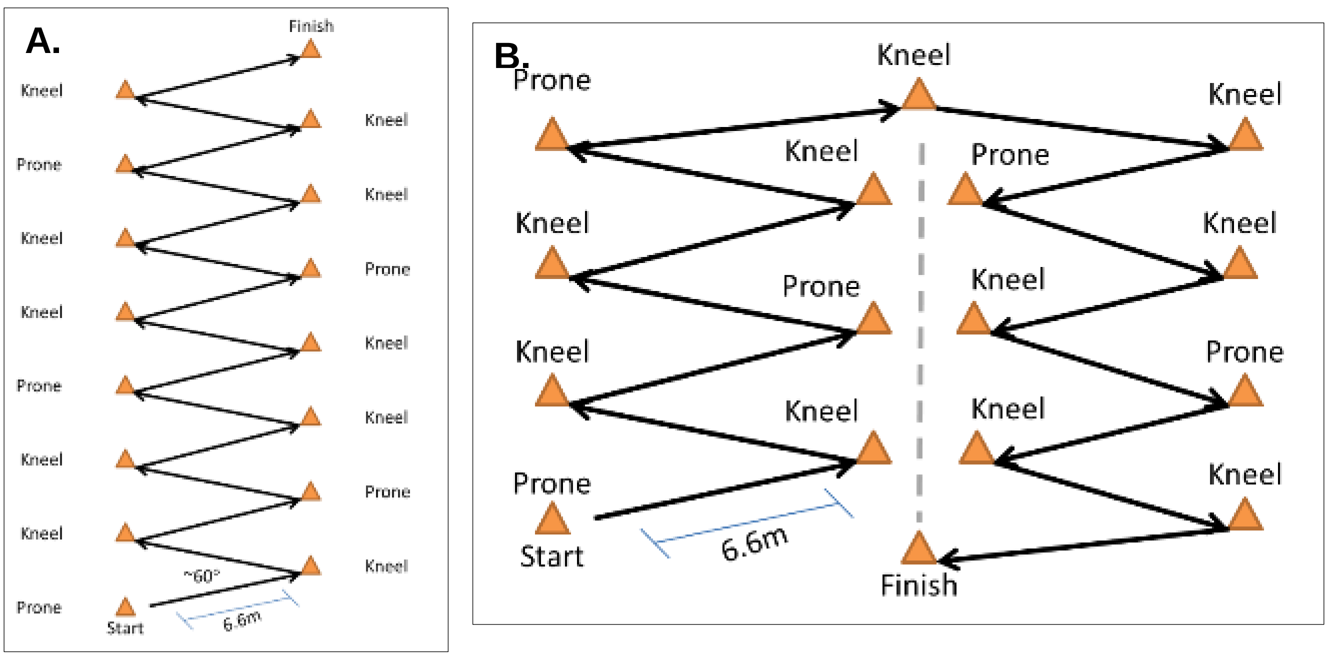


Figure 31. Hand timing the move under direct fire task.

MOS-SPECIFIC TASKS

Task 18 Stow ammunition on an Abrams tank (Stow ammo)

The original definition of this task had two variations, both of which were multi-person tasks. The standard was to move 36, 120mm multi-purpose anti-tank (MPAT) rounds weighing 55 lb each, from an ammunition storage point into the ready rack of an Abrams M1A1 tank. The time standard was 20 minutes to transfer 36 rounds.

This task was handled in two different ways. The first method required three Soldiers. The first picked up a round from a ground based storage rack and carried it 5 meters (Figure 32). At that point, the round was handed up to another Soldier standing on the tank hull. That Soldier then turned and handed the round to another Soldier inside the turret who was responsible for putting the round into the turret's ready rack (Figure 33). The other method only required two Soldiers. Here the ammunition was moved alongside the tank using a Heavy Expanded Mobility Tactical Truck (HEMTT). The ammunition was moved from the elevated deck of the HEMTT and was handed to a Soldier inside the turret of the tank and then the round would be placed into the ready rack of the tank.

Figure 32. A Soldier carrying a 155 mm tank round from the ammunition storage point to the tank hull.

Figure 33. A Soldier handing the tank round into the turret.

In order to simplify this task to become a single-person task, the hull-to-turret and turret-to-ready rack phases were eliminated. This left the most physically demanding phase of the original task. This was a heavy lift-and-carry task with the Soldier moving the 55-lb MPAT rounds from a simulated ammunition rack a distance of 5 m (simulated ammunition rack schematics, Figure 34). At that point, the Soldier handed the round to a test administrator or another Soldier standing on a platform designed to simulate the height of a Soldier standing on the hull of a Abrams tank (Figure 35). The height of this receiving platform was derived from measurements of an Abrams tank. This task was further simplified by cutting the number of rounds carried from 36 down to 18. Based on a round by round energy cost analysis, we found the VO_2 stabilized by the 18^{th} round (Figure 36).[3] The final score was the time to transfer of 18 rounds from the ammunition rack to the mock tank hull.

Figure 34. Plan for the ammunition rack and tank hull simulator for use in the stow ammo task

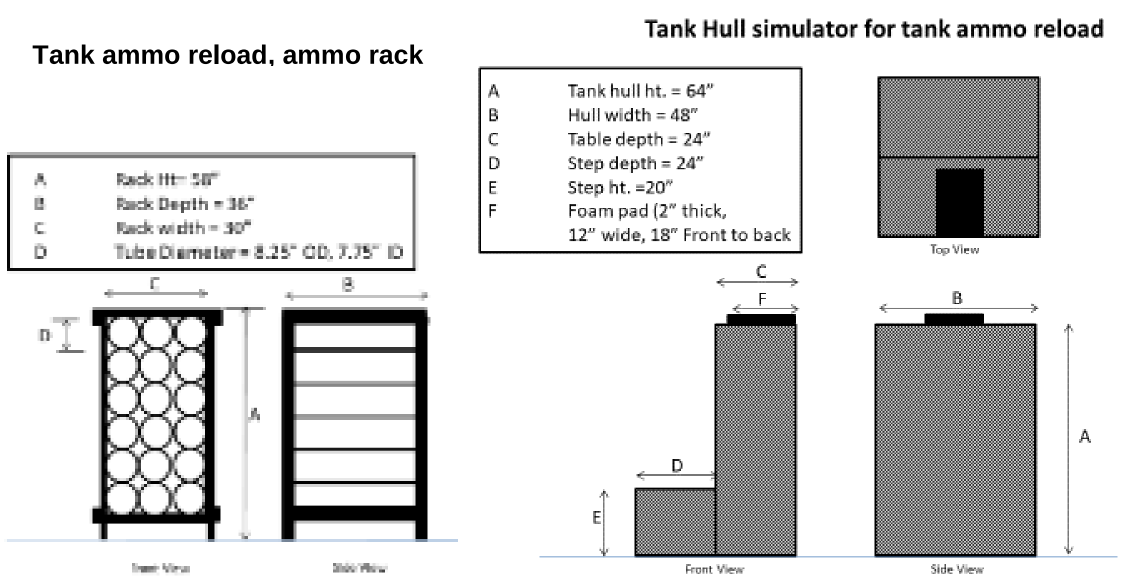
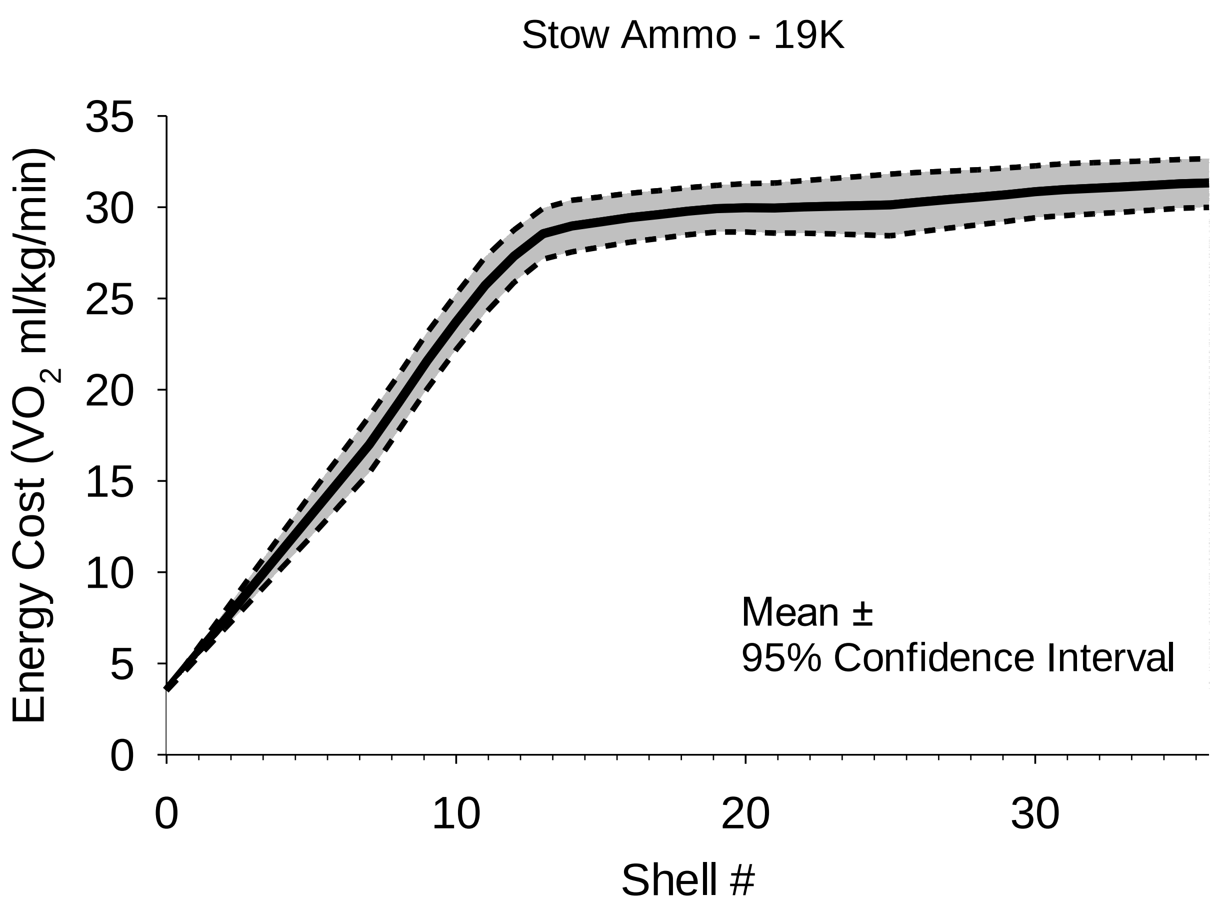


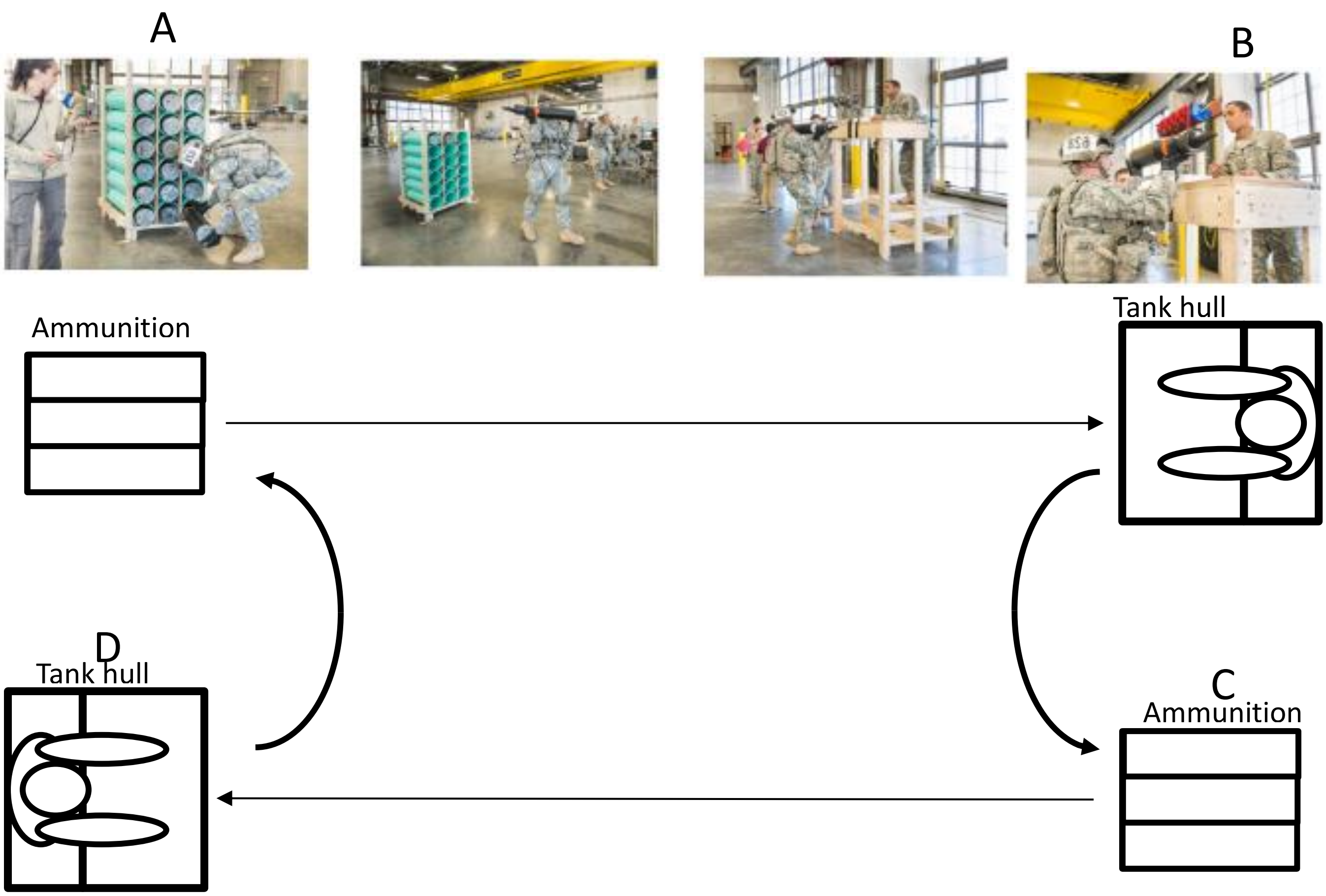
Figure 35. Soldiers transferring up to the hull of the Abrams M1A1 tank

Figure 36. Energy cost of stowing tank ammunition.



In order to facilitate the efficient testing of more subjects, two test set-ups were positioned next to each other as illustrated in Figure 37. As the rounds were handed up to the person on the mock tank hull (Figure 37A), they were then handed to a technician that loaded them into an adjacent ammo rack to be ready to repeat the test on the next test volunteer (Figure 37B). This next test iteration ran back toward the start of the first iteration. This allowed for testing of two Soldiers at once. Further detailed description of this task can be found in can be found in USARIEM Technical Report #T16-7 Development of a Physical Employment Testing Battery for Armor Soldiers: 19D Cavalry Scout and 19K M1 Armor Crewman.[3]

Figure 37. Diagram showing the test set up used to promote more efficient testing of multiple test volunteers.



Task 19 Load the main gun on an Abrams tank (Load the Main Gun)

In the original task description for this task each volunteer loads five, 120mm MPAT rounds from the ready rack of the Abrams tank into the breach of the 120mm main gun of the tank within 35 seconds. We observed video of this task being executed with live rounds and also had the opportunity to practice each phase of the task while inside the turret of an Abrams tank. Figure 38 shows the loader is placing a 120mm round into the breach of the main gun tube in preparation for firing.

Figure 38. The loader's position in the turret of the Abrams M1A1 tank.

The interior dimensions of the turret of the Abrams were measured enabling us to design the simulator to match the real turret's dimensions. The 7-second per round time standard is based on the performance standard of a live fire 5-round fire mission. Tank guns are made to have the rounds fired out the front of the barrel. When a round has been placed into the breach of the main gun of a tank and not fired it is difficult to rapidly remove the round from the breach. In order to safely test volunteers performing this task the simulator had to allow the rapid loading of rounds from the ready rack into a gun breach without the need for firing these rounds. The way we accomplished this was to build a simulated gun breach that had an opening in the side of the barrel such that, when a round was pushed into the breach and into the barrel, it rolled laterally out of the simulated gun tube before the next round was pushed into the breach.

Next we built a ready rack that was the correct height above the floor. In order to build an accurate simulation of the tank turret it was necessary to place the gun tube and ready rack into the proper relationship with each other. This was done by mounting the ready rack and the gun tube on top of separate tables. These tables were then easily maneuvered into the correct relationship and fixed to each other. This method of construction facilitated the easy breakdown, transportation, and setup of these simulators from one site to another.

Figure 39 shows the gun tube on the right and the ready rack on the left, as they appeared when mounted the correct distance from each other. The left picture of Figure 39 shows the spatial relationship of the ready rack to the simulated main gun tube. The right picture shows a volunteer removing a round from the ready rack. In this early phase of development, there was no roof on the simulator. Feedback was solicited from the armor community and they asked to have a roof included in the design of the simulator. This was done to more accurately simulate the cramped environment inside the turret. Figure 40 shows the side of the gun tube is open allowing the round to roll laterally on to the table after it had been pushed into the breach. Figures 41 and 42 show the final task simulator and schematics, respectively. The only change made to this simulator was to swap out the plastic barrel replacing it with a steel barrel (Figure 43). This was completed to make the device more durable. Further detailed descriptions of this task can be found in can be found in USARIEM Technical Report #T16-7 Development of a Physical Employment Testing Battery for Armor Soldiers: 19D Cavalry Scout and 19K M1 Armor Crewman.[3]

Figure 39. The early development of the Load the main gun task setup.

Figure 40. This picture shows a mock up round being placed into the breach of the main gun tube of the simulator.

Figure 41. The load the main gun simulator in the final developmental format.

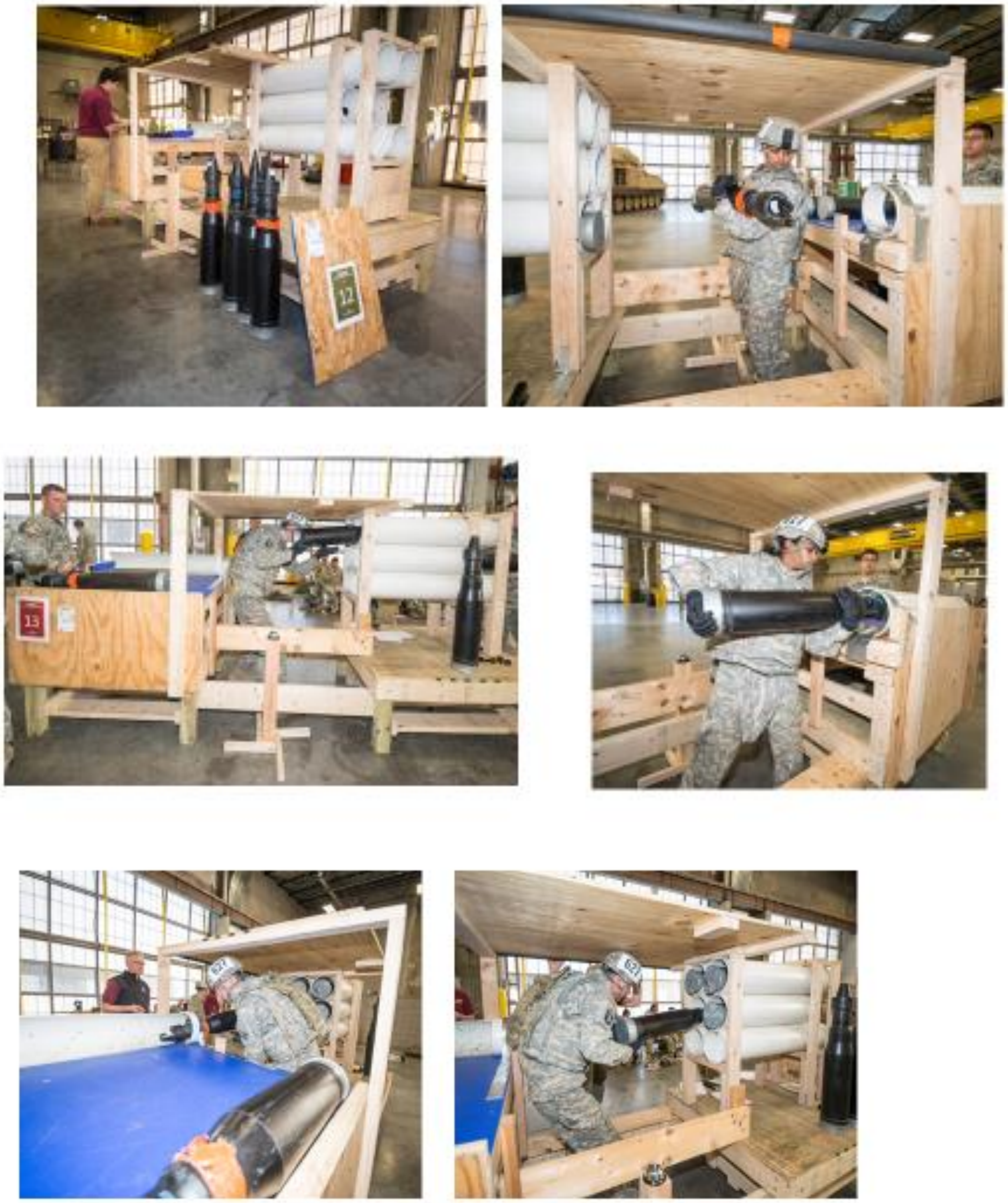
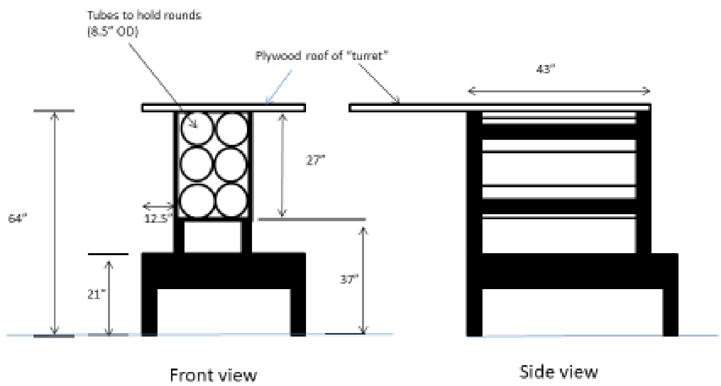
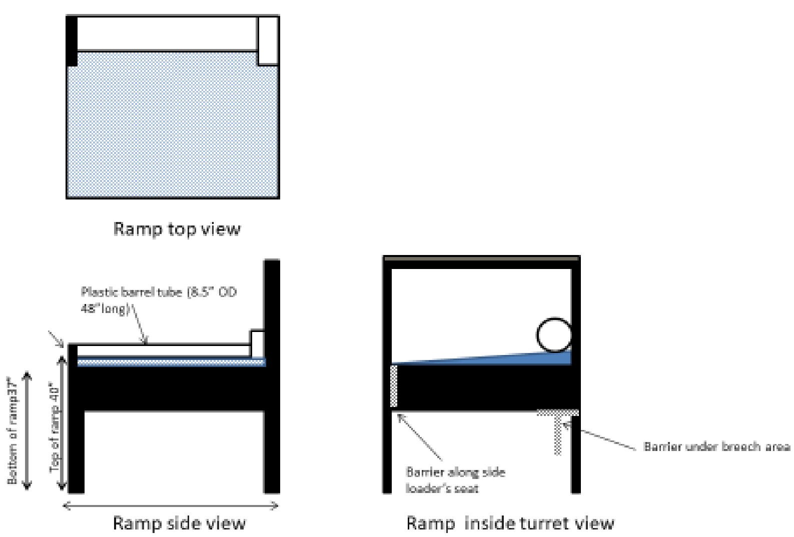


Figure 42. Schematic and measurements of the tank main gun simulator (3 images).

Bustle rack section of tank main gun simulator



Main gun Barrel ramp assembly



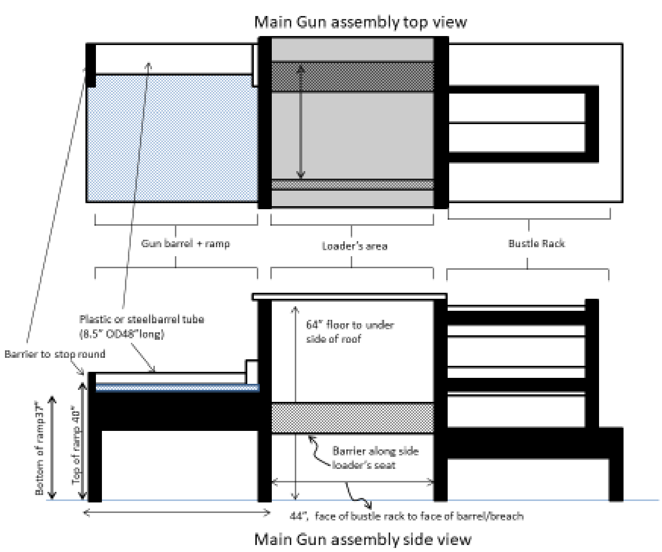


Figure 43. The final version of the tank main gun simulator complete with steel barrel.

Task 21 Transfer ammunition with an M992 Carrier (Field Artillery Ammunition Supply Vehicle or FAASV)

This task was originally defined as a three-person crew loading 90 rounds from a flat rack and moving the rounds 3 m into a M992 Carrier FAASV. Once the rounds are moved into the FASSV, they are loaded into the racks at the front of the vehicle (Figures 44 and 45, respectively). The crew has 45 minutes to load 90 rounds.

Because of the heavy weight moved during this task, the likelihood of injury is fairly high, this task was initially a three-person task with two Soldiers lifting and carrying the rounds and one person standing guard. Of the active Soldiers, one lifted the round from the supply platform, carried it over and placed it on the tailgate of the FAASV. The second active Soldier lifted the round from the tailgate, walked 10 feet to the bustle rack and loaded the round into the rack. The Soldiers were allowed to shift positions to avoid fatigue. The task was simplified to be a single person task by eliminating the phase where the Soldiers moved the rounds from the pallet up to the back door of the FAASV. Additionally, the number of rounds moved was reduced from the 90 moved by a three-person crew down to 30 rounds for one person. We made the assumption that all three Soldiers would load the same number of rounds. The task now had the Soldiers moving the 30 rounds from the tailgate of the FAASV into the storage racks.

We initially had considered building a simulator by having a set of racks that were positioned the same distance from the stockpile of rounds to the storage racks as would be from the back step of the FASSV to the storage racks. This would have eliminated the need to use the actual M992 vehicles for the testing and would have also made it easier to reset the task for each test iteration. The prime factor in deciding not to build a simulator was that we did not have the capability to construct racks that could safely handle the 3000-lb total load represented by the 30-round load.

The storage racks used for the task were set up such that the Soldiers did not have to lift rounds above their shoulders. This is standard operating procedure for Field Artillery personnel and helped to eliminate test bias favoring the taller volunteers. The ammo storage rack of the FASSV was set up so that subject loaded rounds into the central storage spaces shoulder height or lower. We blocked the spaces not to be used with clearly visible markers (Figures 46-48).

Further detailed descriptions of this task can be found in can be found in USARIEM Technical Report #T16-9 Development of a Physical Employment Testing Battery for Field Artillery Soldiers: 13B Cannon Crewman and 13F Fire Support Specialist.[4]

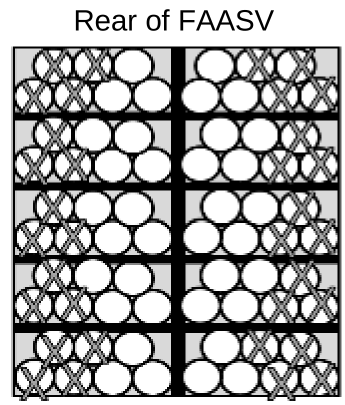
Figure 44. A FAASV positioned with the back door open and adjacent to a flat rack of mock 155mm artillery rounds.

Figure 45. The open back door of the FAASV showing the ammunition racks at the front of the vehicle.

Figure 46. This sequence of pictures shows a volunteer picking up a 155mm artillery round, carrying it to the front of the FAASV and placing the round into the storage rack.

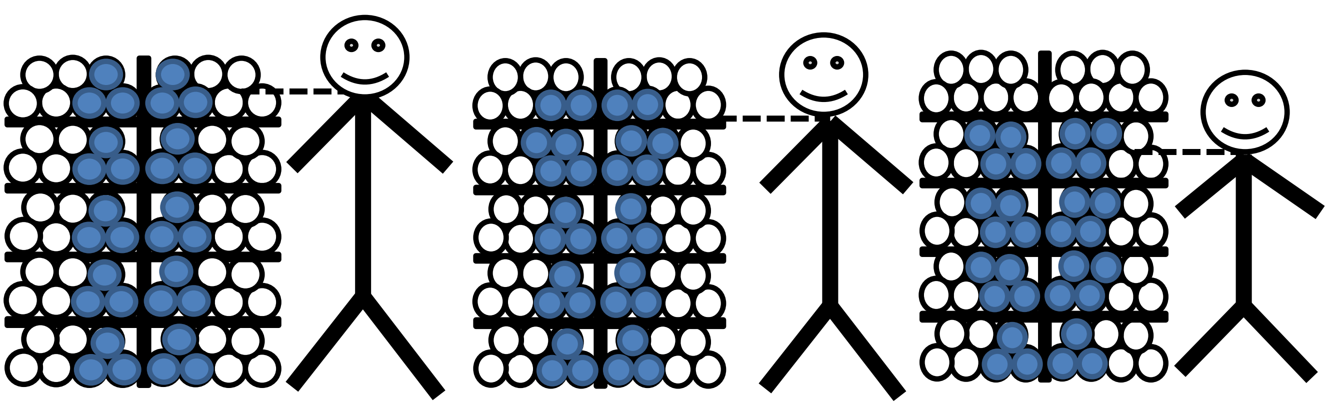
Figure 47. The FAASV ammunition rack with tape blocking the storage spaces that were not to be used.

Figure 48. The testing setup instructions for marking the FAASV storage rack.



- Prior to testing, tape off all but the 36 openings at the back of the FAASV used for testing. (Tape off X'd holes in figure to the right).
- Soldiers must be provided at least two familiarization trials before performing this task for record.

- Soldiers will only fill FAASV up to shoulder height.
  - Prior to testing, have Soldiers stand upright next to the bustle rack.
  - Identify the topmost row of tubes (using bottom of tube as marker) which line up with shoulder height.
  - If shoulder does not exactly line up with bottom of a tube, the top row will be the one at shoulder height. (i.e., bottom of topmost row of tubes being filled should not be above shoulder height).
  - Adjust the tape so that Soldiers are filling the appropriate tubes based on the diagrams below (filling the blue/gray tubes).



Appendix 1. Rating of Perceived Exertion Scale (6-20)

6	No exertion at all
7	
8	Extremely light
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

The Borg's RPE Scale Script

Instructions explaining The Borg RPE Scale to participants. Please read in entirety the first time and the brief section prior to each task.

Brief Instruction: "During the job task, we want you to pay close attention to how hard you feel the physical work rate is. This feeling should reflect your total amount of exertion and fatigue, combining all sensations and feelings of physical stress, effort, and fatigue. Don't concern yourself with any one factor such as leg pain, shortness of breath, or exercise intensity. It's your own feeling of effort and exertion that is important, not how it compares to other people or what other people think. Be as accurate as you can."

Continue for Initial Instruction:
"Look at this rating scale; we want you to use this scale from 6 to 20 where 6 means "no exertion at all," and 20 means "maximal exertion."

- 9 corresponds to "very light" exercise. For most healthy people it represents walking slowly at their own pace for several minutes.
- 13 corresponds to "somewhat hard" exertion, but it still feels OK to continue.
- 17 corresponds to "very hard" or difficult exercise. A healthy person can still go on but they really have to push themselves. It feels very strenuous and the person is very tired.
- 19 corresponds to very strenuous exercise. To most people it is the most strenuous exercise they have ever experienced.

Try to appraise your feeling of exertion as honestly as possible, without thinking about the actual job task or purpose of the task."

Investigator Notes:

***Participant needs to understand this scale is different from the CR10 scale.
***Responses should be private by pointing to a number or quietly saying the number.
***Confirm what the number means after the subject reports an RPE. Example: "13 means that you could continue for a much longer time, do you feel you could continue?"

(Adapted from: Adapted from 1998 Borg HK & ACSM's Guidelines for Exercise Testing and Prescription 7th Edition)

Appendix 2. Instructions for the 5 common occupational task simulations and the 3 MOS-Specific occupational task simulations described in the preceding report.

Task 1 Conduct a Tactical Movement (Road March)

Purpose of the Test:

- To determine the relationship between performance on a 4-mile road march and simple predictor tasks

Equipment needed:

- Polar heart rate monitor, RPE Scale (6-20), Scales, SPORTident Timing System, Car, cones, tables, chairs, GPS units, data collection sheets, clocks

<u>Before Testing</u>

Day(s) Before

- Set up SportIDENT

Day of Testing

- Ensure course is marked and timing gates are set up at each ½ mile marker

TEST DAY

- Arrive with gear
- Get heart rate monitor, weights
- Weigh-in
- Get SportIDENT stick
- Get weapon
- Go to Start Line
- Check-in at Start
- March to Finish and Check-in
- Return SportIDENT stick
- Weigh-in
- Return heart rate monitor, weights
- Return to unit

TEST DAY

Investigator Roles (may be combined/separated as needed):

1: Read Instructions, Logistics, Point man (ie the PI)
2 (2 people): Quartermasters (Hand Out & Collect, HR, weights)
3: Weigh In & Weigh Out
4: Hand Out & Collect SportIdent Sticks

5: Hand out and collect weapons
5 (2 people): Man Start/Finish Point

Responsibilities:

START

Investigator 1:

- Read test instructions to groups of 10 and orient Soldiers with RPE Scale (6-20) & discomfort scales prior to start of test.

Investigators 2:

- Instrument Soldier with Polar heart ratemonitor
- Distribute weights
- Tape IDs on Front of Helmet

Investigator 3:

- Weigh Soldier with gear. Soldier should be **wearing Approach March Load WITH WEAPON**

Investigator 4:

- Assign, explain use of, and clear SPORTident Stick

Investigators 5:

- Explain the route of the road march.
- *Immediately prior to starting*: Record Time, heart rate, and discomfort on the data sheet. Ensure subject inserts SPORTident Stick.
- Record temperature every hour.

FINISH

Investigator 5:

- *Immediately at check-in*: Ensure subject inserts SPORTident Stick. Record ID, heart rate, Time, RPE, and Pain Soreness and Discomfort on the data sheet.

Investigators 4:

- Print Out timing strip & Download Times to computer
- Collect SportIdent Sticks

Investigator 3:

- Collect End Weight

Investigator 2:

- Collect Hheart rateMonitors & Weights

Participant Instructions:

The purpose of the test is to determine the ability to perform a 4-mile road march. You will walk four miles as fast as possible without running or doing the airborne shuffle. Your weapon should be held at the ready in front of you at all times.   To start you will insert your SPORTident stick into the clear and test receptacles. You will report your heart rate, then insert your Sportident into the start receptacle. As soon as it beeps, your time is running. Walk on the right side of the road out and back. At each ½ mile and mile mark, there will be a set of cones. Walk in-between the two cones on the right side of the road. You should hear a beep from your stick as you pass, but you don't need to do anything. Do NOT stop to rest at the cones because your stick will keep recording times. Move at least 25 feet away before you stop. As you walk through the cones marked mile 4, check your heart rate and remember the number.

When you get to the finish cones, punch out with your SPORTident stick. Upon completion of the task, you will report your heart rate. You will also rate your physical effort on a scale from 6-20. This feeling should reflect your total amount of exertion, combining all sensations and feelings of physical stress and fatigue. Don't concern yourself with any one factor such as leg pain, shortness of breath, or exercise intensity. It's your own feeling that is important, not how it compares to other people. Be as accurate as you can. (show scale) Look at this rating scale: 6 means "no exertion at all," and 20 means "maximal exertion."

9 corresponds to "very light" exercise. For most healthy people it represents walking slowly at their own pace for several minutes.
13 corresponds to "somewhat hard" exertion, but it still feels OK to continue.
17 corresponds to "very hard" or difficult exercise. A healthy person can still go on but they really have to push themselves. It feels very strenuous and the person is very tired.
19 corresponds to very strenuous exercise. To most people it is the most strenuous exercise they have ever experienced.

Try to rate your feeling of exertion as honestly as possible, without thinking about the actual job task or purpose of the task.

To complete participation you will return the SPORTident stick, return your weapon to the supply closet, return your weights, and return your heart watch and strap to station 1. Do you have any questions>

Task 3 Prepare a Fighting position (Sandbag carry)

Purpose of the Test:

- To determine the relationship between performance of carrying and emplacing 16 filled sandbags and simple predictor tasks

Equipment needed:

- Polar heart rate monitor, RPE Scale (6-20), 16 sandbags filled with 40 lb of sand, tape, 1 Stopwatch.

Administrator Responsibilities:

- Mark the rectangular "fighting position" by placing sandbags down in the shape of the fighting position and placing tape around it. The position will be 4 bags wide x 2 bags deep x 2 bags tall (Figure 1)
- Mark starting line with tape/cones 10m from where the fighting position is to be built.
- Read test instructions and orient Soldier with RPE Scale (6-20) prior to the start of the test.
- Ensure heart rate monitor is functioning.
- Weigh Soldier with gear. Soldier should be wearing a **fighting load WITHOUT A WEAPON** (63.65 to 78.19 lb).
- At end of day, place stopwatch in a plastic bag with the investigators name and date on it for future downloading.

Testing Procedure

- Bring to start line and seat them. The start line will be opposite the sandbag pile.
- Read instructions
- Collect Pre-test heart rate prior
- Stand up, give "3,2,1 Go" Countdown and start the timer
- During the test, record split times for each sandbag carried (when the sandbag is properly placed down). Make sure to use additional stopwatch clicks when multiple bags are placed concurrently
- Stop the timer when the last bag is properly placed.

Test Scoring Instructions

- Record Subject ID, Date, Stopwatch Number, Stopwatch Record Number and Fighting Load minus Weapon Weight on top of the data sheet.
- Record Pre heart rate prior to the start of each test.
- Upon completion of the task, record time to finish, overall RPE and Post heart rate.
- Record splits and attach printout of subject data to the stopwatch collection sheet.

- Record Time of Day as the time at which the Soldier finished the test (i.e. 1400, 1300, etc.).

Participant Instructions:

The purpose of this task is to determine the relationship between performance of carrying and emplacing 16 filled sandbags and simple predictor tasks. Before we get started, make sure the chest strap of your heart rate monitor is tight and that your heart rate is displayed on the watch. When I say go, you will carry a total of 16 sandbags 10 meters where you will build a fighting position that is 4 sandbags wide, 2 sandbags deep, and two sandbags tall. You may carry no more than 2 sandbags at a time, and you must properly place the sandbags you are carrying within the marked outline before returning for the next bag.

Upon completion of the task, you will be asked for your heart rate. You will also rate your physical effort on a scale from 6-20. This feeling should reflect your total amount of exertion, combining all sensations and feelings of physical stress and fatigue. Don't concern yourself with any one factor such as leg pain, shortness of breath, or exercise intensity. It's your own feeling that is important, not how it compares to other people. Be as accurate as you can. (show scale) Look at this rating scale: 6 means "no exertion at all," and 20 means "maximal exertion."

9 corresponds to "very light" exercise. For most healthy people it represents walking slowly at their own pace for several minutes.

13 corresponds to "somewhat hard" exertion, but it still feels OK to continue.

17 corresponds to "very hard" or difficult exercise. A healthy person can still go on but they really have to push themselves. It feels very strenuous and the person is very tired.

19 corresponds to very strenuous exercise. To most people it is the most strenuous exercise they have ever experienced.

Try to rate your feeling of exertion as honestly as possible, without thinking about the actual job task or purpose of the task. Do you have any questions?

Figure 1. Design of fighting position.

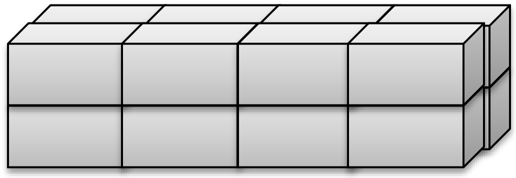
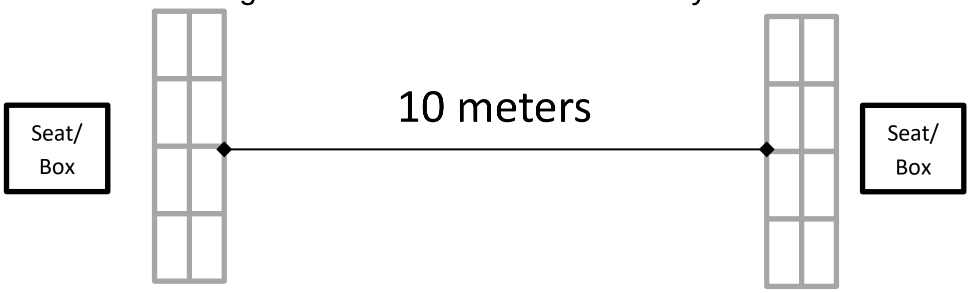


Figure 2. Overhead view of test layout.



Task 4a Drag a casualty to immediate safety (Dummy drag)

Purpose of Task:

- To determine how quickly a Soldier can drag a 270-lb casualty a distance of 15m.

Equipment Needed:

- 270-lb casualty or dummy
- Rubber flooring squares
- 4 cones
- Stopwatch
- Tape measure

Test Uniform:

- Fighting load with weapon

Items	Weight (lb)
Uniform	12.4
PPE + Weapon	63.03 to 77.57
Total	**75.43 to 89.97 lb**

- Further breakdown of PPE can be found on page 39

Testing Procedure:

- Measure a distance of 22m while placing down the rubber flooring. Mark the start and finish lines (15m apart) with tape and cones placed at each end of the start and finish lines. When measuring out the 15m, leave approximately 2.5m of space on both sides of the rubber flooring.
- Dummy should be seated with feet on starting line and back facing the finish line
- Read task instructions prior to start of test.
- Have Soldiers drag the dummy about 5-10 ft for familiarization (have all Soldiers in the group practice one after another and bring the dummy to the closest line (either start or finish).
- Reset the dummy so the feet are on the line with the back facing the opposite line.
- Say “3-2-1-Go” and start the timer.
- If the Soldier completes the test (defined as the dummy’s feet crossing the finish line, see Figure 3) in less than 60 sec, stop the clock and record the time. If the

Soldier did not complete the 15m in the allotted 60 sec, measure the distance traveled from the start of the dummy’s feet to the start line (see Figure 4).

- As time runs out, give them a countdown: “5, 4, 3, 2, 1, stop,” and instruct the Soldier to stop where they are.
- Ensure the dummy is lowered into a sitting position (head leaning toward feet) in order to prevent further movement when the test is over.
- Once the Soldier completes the test, reset the dummy at the finish line or nearest line so the feet are on the starting line with the back facing the opposite line to prepare the test for the next Soldier.

Test Scoring Instructions:

- The task is over when the dummy’s feet cross the finish line or when 60 sec has elapsed.
- When the dummy’s feet cross the finish line, stop the watch, record the finish time and initial the scorecard.
- If the Soldier did not drag the dummy 15m in 60 sec, measure the distance traveled from the start to the feet of the dummy using the tape and record time and initials on the scorecard.

Figure 3. If completed task (Record 15-m and actual completion time)

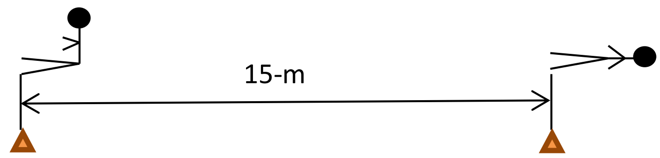


Figure 4. If task not completed (Record 60 sec and distance to feet)

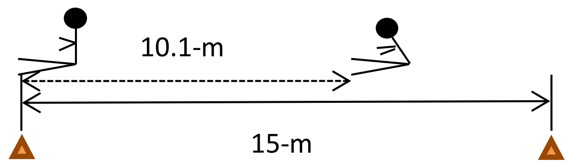


Figure 5. Photo of the Casualty Drag Simulation

Participant Instructions:

THE PURPOSE OF THIS TASK IS TO DETERMINE HOW QUICKLY YOU CAN DRAG A 270-LB CASUALTY A DISTANCE OF 15 METERS. THE INSTRUCTIONS WILL BE "3-2-1-GO!" ON THIS COMMAND, YOU WILL GRASP THE HARNESS STRAPS ON THE DUMMY WITH ONE OR TWO HANDS AND DRAG THE DUMMY AS QUICKLY AS POSSIBLE PAST THE 2ND SET OF CONES. THE FEET OF THE DUMMY MUST CROSS THE LINE BEFORE YOU STOP, SO DON'T STOP UNTIL I TELL YOU TO. YOU WILL HAVE 60 SECONDS TO COMPLETE THIS TASK AND I WILL COUNT DOWN THE LAST 5 SECONDS AND SAY 'STOP'. IF YOU CROSS THE FINISH LINE WITHIN 60 SECONDS, I'LL TELL YOU WHEN TO STOP. IF YOU DO NOT CROSS THE FINISH LINE WHEN I COUNT DOWN AND SAY 'STOP', STOP RIGHT WHERE YOU ARE AND WAIT UNTIL I TELL YOU TO RELEASE THE DUMMY. I WILL MEASURE HOW FAR YOU DRAGGED IT. YOUR TIME AND DISTANCE COMPLETED WILL BE RECORDED.

WATCH THIS DEMONSTRATION."

"DO YOU HAVE ANY QUESTIONS ABOUT THIS TEST?"

Task 4b Remove a casualty from a wheeled vehicle (CASEVAC)

Purpose of Task:

- To determine the ability a Soldier to remove a casualty from a vehicle (BFV, Stryker, Buffalo, Abrams)

Equipment Needed:

- 5 Modified, weighted haul bags (60-, 100-, 140-, 180-, 210 lb)
- Simulated hatch (type of vehicle hatch is MOS-dependent)
- 2 Kettlebells

Test Uniform:

- Fighting load minus weapon

Items	Weight (lb)
Uniform	12.4
PPE (without weapon)	51.03 to 66.6
Total	**63.43 to 79.0 lb**

- Further breakdown of PPE can be found on page 39

Testing Procedure:

- Ensure each of the simulated hatch holes has a haul bag filled at 60 lb, 100 lb, 140 lb, 180 lb, and 220 lb in sequential order (see Figure 7).
- Read task instructions prior to start of test.
- Prior to the actual test, a demonstration of good lifting form will take place on the ground. Soldiers will squat down with their head up and back straight, grasp the kettle bells and stand up using their legs and keeping their head above their hips. They will repeat this until their form is acceptable or at least 3 times.
- Begin the test with lifting the 60-lb bag for three consecutive repetitions. For the remaining bags, only one successful lift must be completed before moving up to the next weighted haul bag in the sequence. **Soldiers may not skip any weights.**
- If a Soldier displays poor form (rounded back, head down, or knees caving in/knocked knees), stop the test. Soldiers are allowed one additional attempt at each weight if they fail to lift the haul bag or use improper form.
- Soldiers will be provided no more than 1 min of rest after each lift.

- Several Soldiers may be simultaneously tested at different weights as long as the appropriate rest has been provided.
- There should never be more than 5 people at a time on the simulation deck. The Soldiers will walk up one set of stairs and exit down the stairs on the opposite end of the simulation deck.
- The highest weight a Soldier is permitted to lift is 220lb.

Test Scoring Instructions:

- A successful lift is when the bag clears the "hatch" and move onto top of the platform.
- Upon completion of each round, note the last weight completed. Record the weight of the final lift and initial on the scorecard.

PROPER LIFTING TECHNIQUE: ***Demonstrate and check before testing***

- *Starting Position*:
  - Place feet at edge of opening about shoulder-width apart.
  - Knees in line with toes.
  - Bend at hips, sticking your buttocks back so that your *back is flat or slightly arched.*
  - Head in neutral position with eyes facing forward.
  - Grab the bag with arm fully extended.

- *During Motion*:
  - Pull the bag straight up by extending the knees and hips at the same time.
  - The bag should remain as close to the body as possible.
  - Arms should stay extended until the knees and hips are fully extended.
  - Extend the knees and hips fully before using the arms to lift and tilt the bag out of the opening.
  - Once upright, the knees are allowed to bend again to finish the lift, if necessary.

- *Poor form includes*:
  - Rounding of the back during the lift.
  - Head/neck looking up or down.
  - Lateral/uneven side-to-side motion of the back.
  - Holding the breath. Soldiers should exhale simultaneously while picking up the bag.

Figure 6. Photos of the Casualty Evacuation task

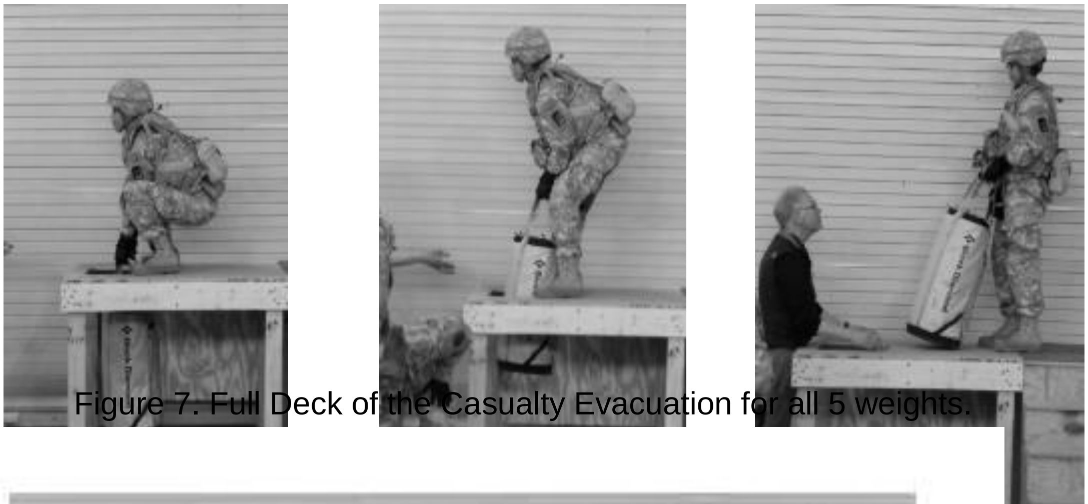


Figure 7. Full Deck of the Casualty Evacuation for all 5 weights.

Participant Instructions:

THE PURPOSE OF THIS TASK IS TO DETERMINE YOUR ABILITY TO PULL A SIMULATED CASUALTY FROM A VEHICLE. YOU WILL SQUAT DOWN, GRASP THE STRAPS AND PULL THE BAG OUT THROUGH THE HOLE SIMULATING A VEHICLE HATCH. YOU MUST LIFT THE BAG UP AND PLACE IT BESIDE THE HATCH (EITHER UPRIGHT OR ON ITS SIDE) FOR IT TO BE CONSIDERED SUCCESSFUL.

MAKE SURE YOU ARE WEARING GLOVES. PRIOR TO STARTING WE WILL REVIEW PROPER LIFTING TECHNIQUE WITH KETTLEBELLS/DUMBBELLS/SANDBAGS/ETC. YOU WILL BE REQUIRED TO USE GOOD TECHNIQUE ON EVERY LIFT TO PROTECT YOUR LOWER BACK. IF YOU SHOW POOR LIFTING TECHNIQUE, WE WILL STOP YOU AND YOU WILL NOT RECEIVE CREDIT FOR THAT WEIGHT. IF YOU FEEL ANY PAIN OR DISCOMFORT, YOU SHOULD RELEASE THE WEIGHT AND STOP PERFORMING THE TASK.

AFTER YOU HAVE COMPLETED THE 60 LB, THE NEXT WEIGHTS YOU WILL LIFT IS 100 LB FOLLOWED BY 140, 180, AND 220 LB (ALL IN THAT ORDER). IF YOU FAIL TO SUCCESSFULLY COMPLETE A LIFT, YOU MAY HAVE ONE MORE OPPORTUNITY TO COMPLETE THE LIFT AFTER 1 MIN OF REST. THE MAXIMUM PERMITTED

WEIGHT TO LIFT FOR THIS TEST IS 210 LB. YOU ARE NOT ALLOWED TO SKIP ANY OF THE WEIGHTS. UPON COMPLETION, YOUR FINAL LIFT WEIGHT WILL BE RECORDED. AFTER EACH SUCCESSFUL LIFT, YOU WILL BRING THE BAG BACK AND DROP IT INTO THE HOLE.

THERE SHOULD NEVER BE MORE THAN FIVE PEOPLE ON THE SIMULATION DECK AT ONE TIME. THE FIRST PERSON WILL WALK UP THE STAIRS TO THE FIRST WEIGHT, PERFORM THE LIFT, AND MOVE TO THE NEXT WEIGHT. ONCE YOU HAVE COMPLETED THE TASK, YOU WILL EXIT DOWN THE STAIRS ON THE OPPOSITE END FROM WHICH YOU ENTERED.

"WATCH THIS DEMONSTRATION."

"DO YOU HAVE ANY QUESTIONS ABOUT THIS TEST?"

Task 10 Move under direct fire

Purpose of Task:

- To assess performance of a simulated move under fire task.

Equipment Needed:

- Tape measure
- 16 cones and labels to mark each cone
- Stopwatch

Test Uniform:

- Fighting load with weapon

Items	Weight (lb)
Uniform	12.4
PPE + Weapon	63.03 to 77.57
Total	**75.43 to 89.97 lb**

- Further breakdown of PPE can be found on page 39

Testing Procedure:

- Lay out the course (Figure 8 or 9). Mark the start and finish line with tape or spray paint.
- Read task instructions prior to start of test.
- Give a countdown from three then start the timer.
- During the test, ensure that the Soldier achieved each position (laying prone, kneeling) by having their knees and stomach in contact the ground. Remind Soldiers that they should not be using their weapon to assist with getting up from either position.
- Cue the Soldiers to stand up and move to the next cone after 5 sec.
- During the test, ensure Soldiers do not leave before instructed to move.
- Stop the timer when Soldiers cross the finish line and record time on the scorecard.

Test Scoring Instructions:

- Upon completion of the task, record the finish time and initial on the scorecard.

Figure 8. Course Diagram Option 1

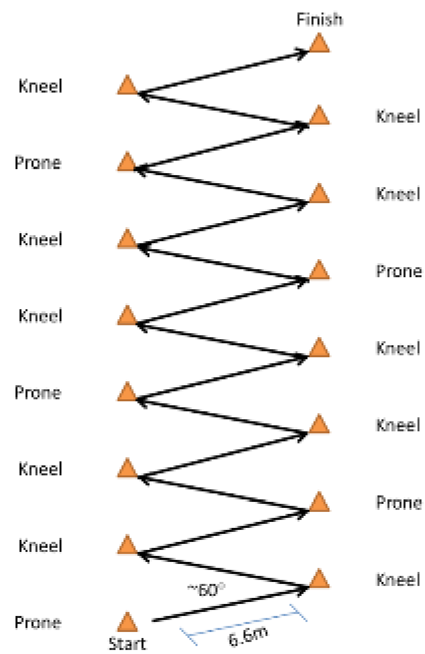
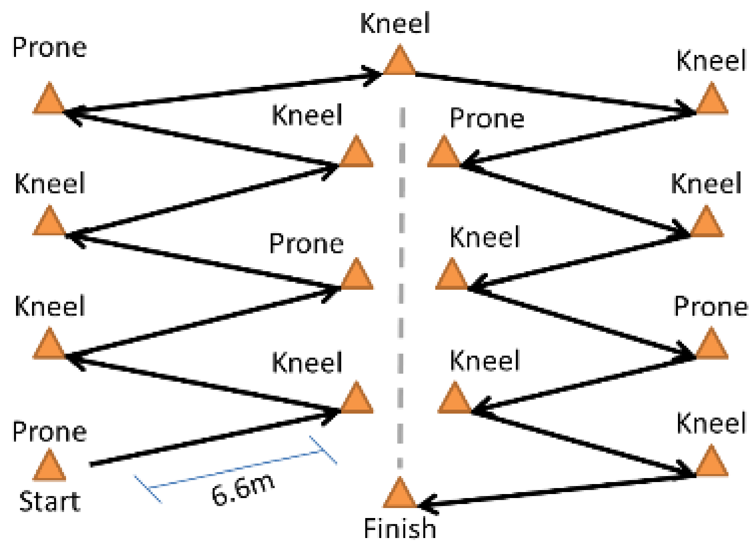


Figure 9. Course Diagram Option 2



Participant Instructions:

THE PURPOSE OF THIS TASK IS TO DETERMINE YOUR ABILITY TO MOVE UNDER FIRE. YOU WILL BEGIN THE TEST LYING IN AN UNSUPPORTED PRONE FIGHTING POSITION (ON YOUR STOMACH).

WHEN TOLD TO BEGIN, YOU WILL RISE AND SPRINT TO THE FIRST MARKER. GET RIGHT NEXT TO THE MARKER AND ASSUME A KNEELING FIGHTING POSITION. AFTER 5 SECONDS, WE WILL CUE YOU TO RUN TO THE NEXT MARKER. YOU WILL SPRINT, GET RIGHT NEXT TO THE 2ND MARKER, AND AGAIN ASSUME A KNEELING FIGHTING POSITION. YOU WILL CONTINUE SPRINTING BETWEEN MARKERS IN A SIMILAR MANNER, CYCLING BETWEEN 1 PRONE, AND 2 KNEELING POSITIONS, UNTIL YOU HAVE COMPLETED THE ENTIRE COURSE. THE SIGNS NEXT TO EACH CONE WILL INSTRUCT YOU WHETHER TO KNEEL OR GET PRONE. WHEN GETTING UP, YOU MAY NOT USE THE BARREL OF THE GUN FOR SUPPORT. ON THE FINAL SPRINT, RUN STRAIGHT THROUGH THE FINISH LINE.

YOU SHOULD PERFORM THE TASK AS QUICKLY AS POSSIBLE WHILE MAINTAINING YOUR SAFETY, BUT CHOOSE A PACE AT WHICH YOU CAN COMPLETE THE TASK. ONCE YOU START THE TEST, DO NOT STOP UNLESS IT IS AN EMERGENCY. YOU SHOULD CONTINUE EVEN IF YOU STUMBLE. UPON COMPLETION OF THE TASK, YOUR TIME WILL BE RECORDED.
“WATCH THIS DEMONSTRATION.”

“DO YOU HAVE ANY QUESTIONS ABOUT THIS TEST?”

Task 18 Stow ammunition on an Abrams tank (Stow ammo)

Purpose of Task:

- The ability of a Soldier to perform the reload tank task by transferring 18 rounds from the ground to a replicated Abrams tank hull.

Equipment Needed:

- Simulation tables with storage racks
- 18-120mm MPAT rounds
- Stopwatch

Test Uniform:

- Fighting load minus weapon

Items	Weight (lb)
Uniform	12.4
PPE (without weapon)	51.03 to 66.6
Total	**63.43 to 79.0 lb**

- Further breakdown of PPE can be found on page 39

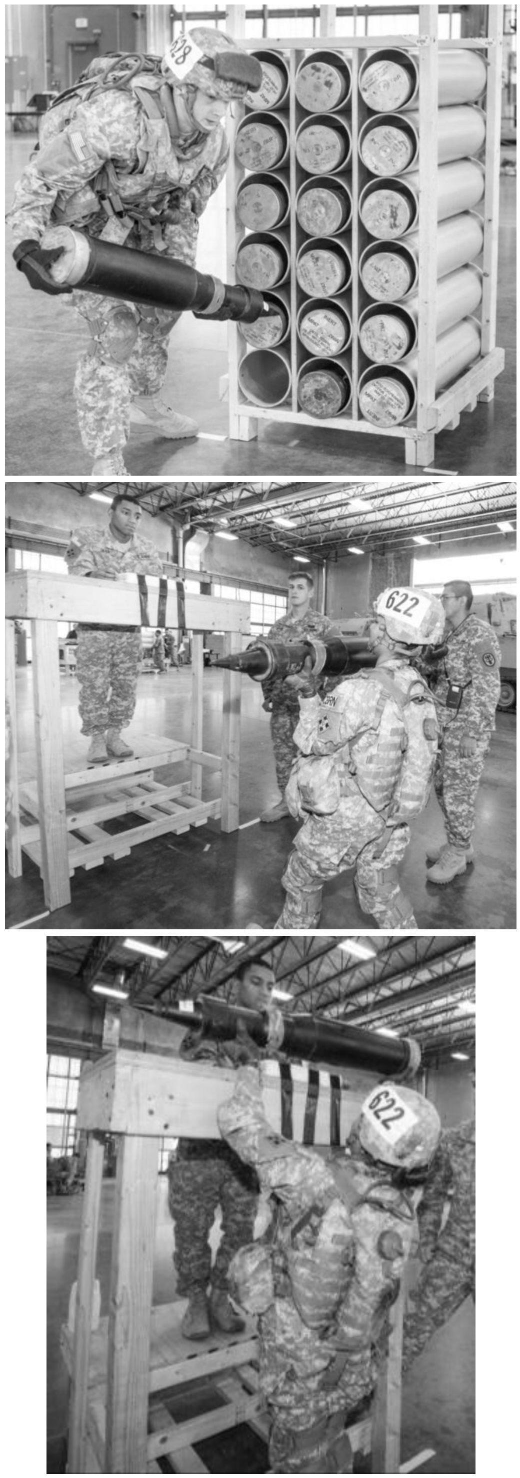
Testing Procedure:

- Practice loading the MPAT rounds one time prior to testing for record.
- Ensure rounds are in the appropriate position in the rack with sufficient amount of the back end sticking out to allow for easy grabbing.
- One administrator will be timing, a second administrator will be reloading rounds and a third administrator will stand behind the platform to receive the rounds from the Soldier.
- Read task instructions prior to start of test.
- Give a countdown “3, 2,1, Go” then start the timer.
- Ensure rounds are transferred in a safe manner. If the Soldier is unable to move the rounds correctly and safely, correct them and warn them that they will be stopped if they do not use correct lifting form. If the inappropriate lifting form continues, stop the test.
- Stop the time when the last round is on the table, when you stop the Soldier, when the Soldier is unable to continue or when 15 minutes have elapsed.

Test Scoring Instructions:

- If the Solider completes 18 rounds in less than 15 min, record the finish time. If the Soldiers does not complete 18 rounds in 15 min, or if the Soldier states they are unable to continue, record the number completed as well as the time.
- Upon completion of the task, record the finish time and initial on the scorecard.

Figure 10. Photos of the Stow Ammo Simulation



Participant Instructions:

THE PURPOSE OF THIS TASK IS TO DETERMINE YOUR ABILITY TO RELOAD AN A1 ABRAMS TANK. BEFORE WE BEGIN, MAKE SURE YOU ARE WEARING GLOVES.

DURING THIS TASK, YOU WILL LIFT AND CARRY 18 ROUNDS 5 METERS FROM THE SUPPLY RACK TO THE TANK AND LIFT THE ROUND ONTO THE TABLE. THIS SIMULATES HANDING THE ROUND UP TO A SOLDIER STANDING ON THE HULL OF THE TANK. WHILE CARRYING THE ROUND, ONE HAND SHOULD BE OVER THE AFT-CAP WHILE THE OTHER IS SUPPORTING THE WEIGHT (DEMONSTRATE). WHEN LIFTING THE ROUNDS AT THE TABLE, YOU SHOULD DO IT IN A SAFE MANNER. DO NOT THROW THEM OR SLAM THEM IN THE TABLE. THE ROUND SHOULD BE HANDED TO THE SOLDIER BEHIND THE PLATFORM. YOU WILL HAVE 15 MIN TO COMPLETE THIS TASK, BUT SHOULD PERFORM THE TASK AS QUICKLY AS POSSIBLE WHILE MAINTAINING YOUR SAFETY. CHOOSE A PACE AT WHICH YOU CAN COMPLETE THE TASK. YOU CAN REST AT ANY TIME. IF AT ANY POINT YOU FEEL YOU ARE UNABLE TO CONTINUE, THE TEST WILL BE TERMINATED. YOUR TIME OF COMPLETION AND TOTAL NUMBER OF ROUNDS MOVED WILL BE RECORDED.

“WATCH THIS DEMONSTRATION.”

“DO YOU HAVE ANY QUESTIONS ABOUT THIS TEST? ”

Task 19 Load the main gun on an Abrams tank (Load the main Gun)

Purpose of Task:

- To assess a Soldier's ability to load the main gun on an A1 Abrams tank.

Equipment Needed:

- 5- 120mm MPAT rounds
- Simulated A1 Abrams breach
- Stopwatch

Test Uniform:

- Task specific uniform: IOTV with ESAPI and ESBI and an Advanced Combat Helmet

Items	Weight (lb)
Uniform	12.4
Helmet	3.25
IOTV, w/ ESAPI and ESBI	26.89 to 41.43
Total	**42.54 to 57.08 lb**

Testing Procedure:

- There are two protocol options for this task. It is crucial to allow enough time to practice due to the task being a highly skilled task.
  - Option 1: Three days in total (highly suggested)
    - Day 1 and 2: Three practice attempts of moving 5 MPAT rounds
    - Day 3: One practice attempt moving 1-2 rounds; Three for record attempts moving 5 MPAT rounds.
  - Option 2: Two days in total (use ONLY if time constraint)
    - Day 1: Three practice attempts of moving 5 rounds.
    - Day 2: Three practice attempts moving 5 rounds; Three for record attempts moving 5 MPAT rounds.
- Practice attempts should NOT be performed at an all-out effort. The focus should be on correctly performing the movement.
- Place the 5- 120mm MPAT rounds on the simulated ready rack
- Read task instructions prior to start of test.
- Demonstrate technique and allow time for the Soldiers to practice the task.
- Give a countdown "3, 2, 1, Go" and start the timer on "Go".

- Stop the timer when the last round is loaded and record the time.
- Rotate the Soldiers through each attempt at 5 rounds in a round-robin style and ensure each Soldier has 3 attempts.

Test Scoring Instructions:

- Upon completion of the task, record the finish time and initial on the scorecard.

Figure 11. Photos of the Load Main Gun Simulation

Participant Instructions:

THE PURPOSE OF THIS TASK IS TO DETERMINE YOUR ABILITY TO RAPIDLY LOAD 5 ROUNDS INTO THE MAIN GUN OF AN A1 ABRAMS TANK. BEFORE WE BEGIN, MAKE SURE YOU ARE WEARING GLOVES.

INSIDE THE ABRAMS TANK SIMULATOR, YOU WILL MOVE FIVE 120MM MPAT ROUNDS. YOU WILL GRAB A ROUND FROM THE BUSTLE RACK, DO A PROPER FLIP OR TURN, AND THEN PUSH THE ROUND INTO THE SIMULATED BREACH. AFTER EACH ROUND YOU WILL HIT THE BUTTON SIMULATING THE FIRING OF THE GUN. YOU WILL THEN GRAB THE NEXT ROUND AND REPEAT THIS PROCESS UNTIL YOU HAVE LOADED ALL 5 ROUNDS. PRIOR TO STARTING, YOU WILL BE GIVEN AN OPPORTUNITY TO PRACTICE. EACH SOLDIER WILL COMPLETE 5 ROUNDS AND THEN GO TO THE END OF THE LINE. YOU WILL COMPLETE THE 5 ROUNDS, 3 TIMES. YOU SHOULD PERFORM THE TASK AS QUICKLY AS POSSIBLE WHILE MAINTAINING YOUR SAFETY, BUT CHOOSE A PACE AT WHICH YOU CAN COMPLETE THE TASK. IF AT ANY POINT YOU FEEL YOU ARE UNABLE TO CONTINUE, THE TEST WILL BE TERMINATED. YOUR TIME OF COMPLETION WILL BE RECORDED.

“WATCH THIS DEMONSTRATION.”

“DO YOU HAVE ANY QUESTIONS ABOUT THIS TEST?”

Task 21 Transfer ammunition with an M992 Carrier (FAASV)

Purpose of Task:

- To determine the ability of a Soldier to load 30-M795 HE rounds into the M992 Field Artillery Ammunition Supply Vehicle (FAASV).

Equipment Needed:

- 30 Inert M795 HE rounds (100 lb each)
- M992 Field Artillery Ammunition Supply Vehicle (FAASV)
- Stopwatch

Test Uniform:

- Task specific uniform: IOTV with ESAPI and ESBI plates, Advanced Combat Helmet, eye protection, and gloves

Testing Procedure:

- Two practice days are required and to be separated from the test day.
- Day 1: Practice loading the M795 HE Rounds for 5 min.
- Day 2: Practice loading the M795 HE Rounds for three 5 min periods.
- Day 3: Load the M795 HE Rounds for record.
- Ensure 30 rounds are outside the FAASV, the inside is clear, and the handles on the bustle racks are in the open position.
- Tape all openings in the bustle rack being used during testing (see figure below).
- Determine up to which rack row the Soldiers will fill (see figure below) and adjust the inserts so that it is clearly marked which openings need to be filled.
- Read task instructions prior to start of test.
- Have Soldier enter FAASV and give a countdown from three then start the timer.
- Provide warnings when 1 min and 30 sec and 15 sec are remaining in each shift as well as a countdown from the final 10 sec.
- Soldiers will work for 5 min, rest for 2 ½ min, work for five min, rest for 2 ½ min, and then work for a final 5 min. The task will end when a total of 30 rounds are loaded or the time runs out.
- Ensure the Soldier stops working for the rest period and will resume the task exactly where they left off. The Soldier may sit during the rest period.
- Record the total number of rounds completed at the end of each 5 minute round using a continuous running score (i.e., cumulative score).
- Soldiers will receive credit for 1/3 of a round for picking it up the first time and 1/3 for transporting it to the back of the FAASV.
- If the shell has begun to be entered into the rack when time stops, allow them to finish it off.

- When a 5 min working period is finished, stop the main watch and start the break watch. Once the 2 ½ min rest is finished, stop the break watch and restart the main watch.

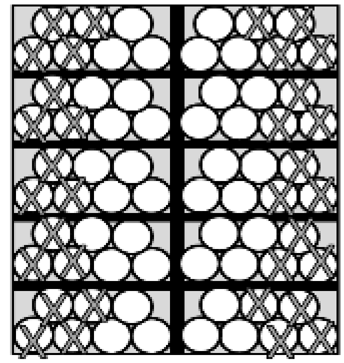
Test Scoring Instructions:

- Upon completion of the task, record the finish time, total number of rounds moved, and initial on the scorecard.

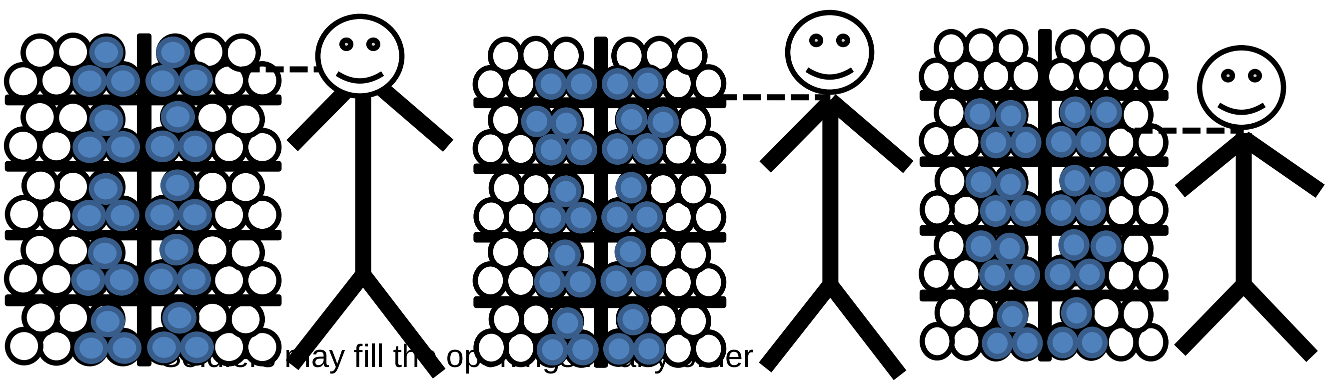
Notes:

- Prior to testing, tape off all but the 36 openings at the back of the FAASV used for testing. (Tape off X'd holes in figure to the right).
- Soldiers must be provided at least two familiarization trials before performing this task for record.

Rear of FAASV

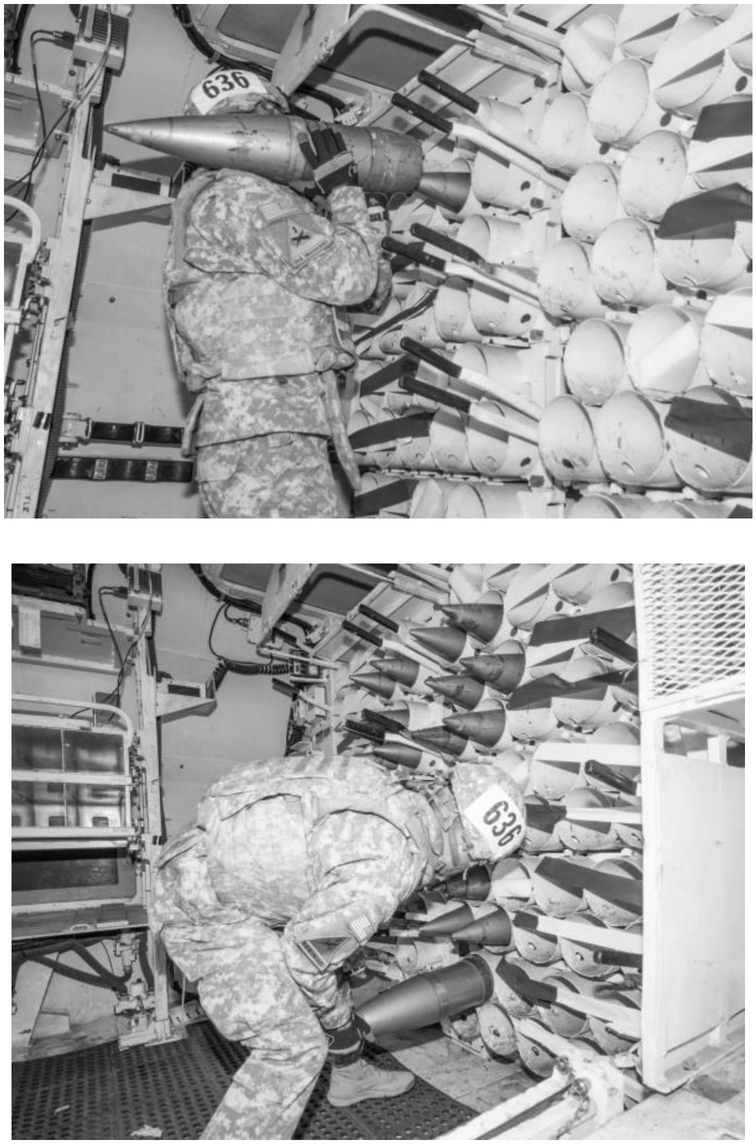


- Soldiers will only fill FAASV up to shoulder height.
    - Prior to testing, have Soldiers stand upright next to the bustle rack.
    - Identify the topmost row of tubes (using bottom of tube as marker) which line up with shoulder height.
    - If shoulder does not exactly line up with bottom of a tube, the top row will be the one at shoulder height. (i.e., bottom of topmost row of tubes being filled should not be above shoulder height).
    - Adjust the tape so that Soldiers are filling the appropriate tubes based on the diagrams below (filling the blue/gray tubes).



- Soldiers may fill the openings in any order
- Soldiers may NOT roll the rounds.

Figure 11. Photos of the Transfer Ammo with a FAASV Simulation



Participant Instructions:

THE PURPOSE OF THIS TEST IS TO DETERMINE YOUR ABILITY TO LOAD M795 HE ROUNDS INTO A FIELD ARTILLERY AMMUNITION SUPPLY VEHICLE OR FAASV. BEFORE BEGINNING, MAKE SURE YOU ARE WEARING GLOVES.

THIS TASK REQUIRES YOU TO LIFT THE ROUNDS FROM THE TAILGATE OF THE FAASV AND PLACE THEM IN THE AMMUNITION RACK IN THE SPECIFIED SLOTS. PRIOR TO TESTING, WE WILL CHECK YOUR HEIGHT IN THE FAASV, SINCE YOU WILL ONLY BE REQUIRED TO FILL UP TO SHOULDER HEIGHT. YOU MUST CARRY THE ROUNDS; YOU MAY NOT ROLL THEM. YOU WILL HAVE UP TO 20 MIN TO MOVE TO 30 ROUNDS. THE TIME WILL BE SPLIT INTO THREE WORK SHIFTS OF 5 MIN, WITH A MANDATORY 2 ½ MIN REST IN BETWEEN EACH SHIFT. I WILL PROVIDE WARNINGS WHEN TIME IS RUNNING OUT IN EACH SHIFT. WHEN I ALERT YOU THAT EACH SHIFT IS UP, YOU MUST SAFELY PLACE THE SHELL DOWN AT YOUR CURRENT POSITION. WHEN THE REST IS OVER, YOU WILL RESUME FROM THE POSITION WHERE YOU LEFT OFF.

YOU SHOULD PERFORM THE TASK AS QUICKLY AS POSSIBLE WHILE MAINTAINING YOUR SAFETY, BUT CHOOSE A PACE AT WHICH YOU CAN COMPLETE THE TASK. YOU CAN STOP AND REST AS NECESSARY. IF YOU ARE UNABLE TO CONTINUE EVEN AFTER A BREAK, TELL THE ADMINISTRATOR, AND WE WILL TERMINATE THE TEST. YOUR FINISH TIME AND TOTAL NUMBER OF ROUNDS MOVED WILL BE RECORDED.

“WATCH THIS DEMONSTRATION.”

“DO YOU HAVE ANY QUESTIONS ABOUT THIS TEST?”

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