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Physical Task Simulations

Performance Measures for the Validation of Physical Tests and Standards for Battlefield Airmen

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Preface

In January 2013, the Chairman of the Joint Chiefs of Staff and the Secretary of Defense rescinded the 1994 Direct Ground Combat Definition and Assignment Rule and mandated that "[v]alidated gender-neutral occupational standards will be used to assess and assign Service members not later than September 2015" (Dempsey and Panetta, 2013, p. 2). In support of this mandate, the U.S. Air Force asked the RAND Corporation to assist its development and validation of gender-neutral tests and standards for battlefield airmen (BA) specialties, which are the only occupational specialties that remain closed to women in the Air Force. This report describes RAND's assistance to the Air Force on two fronts: (1) designing physical task simulations (PTSs) to measure the occupationally relevant physical requirements for BA specialties and (2) setting standards for BA physical performance on the PTSs. This research will provide the foundation for Air Force performance measures and tests that fully meet scientific, technical, and best practice standards.

This report should be of interest to policy and research audiences with interests in gender-neutral standards and the validation of physical tests and standards for military occupations.

The work in this report was co-sponsored by the Air Force Directorate of Military Force Management Policy, Deputy Chief of Staff for Manpower, Personnel, and Services (AF/A1P), the Vice Commander in Air Education and Training Command (AETC/CV), the Vice Commander in Air Force Special Operations Command (AFSOC/CV), and the Directorate of Air and Space Operations (ACC/A3). This research was conducted within the Manpower, Personnel, and Training Program of RAND Project AIR FORCE as part of a fiscal year 2014 project, "SECDEF-Mandated Development and Validation of Physical Fitness Tests and Standards for Combat Integration of Women."

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Summary

In January 2013, the Chairman of the Joint Chiefs of Staff (CJCS) and Secretary of Defense rescinded the 1994 Direct Ground Combat Definition and Assignment Rule (DCAR) that excluded women from assignment to units and positions with the primary mission to engage in direct ground combat. The CJCS and Secretary of Defense mandated that the services develop and implement "validated, gender-neutral occupational standards" for currently closed units and positions with the goal of opening those units and positions by January 1, 2016 (Dempsey and Panetta, 2013).

In fiscal year (FY) 2012, the Air Force, with RAND Corporation support, established a process to identify and validate gender-neutral tests, standards, and physical requirements for the seven specialties affected by the elimination of DCAR: Combat Controller (CCT), Pararescue (PJ), Tactical Air Control Party (TACP), Special Operations Weather Team (SOWT)–Enlisted, SOWT–Officer,[1] Special Tactics Officer (STO), and Combat Rescue Officer (CRO) (Robson et al., 2017). Collectively, these specialties are referred to as battlefield airmen (BA) specialties. In FY 2014 and FY 2015, RAND was asked to once again support the Air Force's validation efforts.

The purpose of the FYs 2014–2015 study was to help the Air Force BA community develop scientifically valid performance measures that are representative of occupationally relevant physical demands. The Air Force asked RAND to assist in two areas. First, we were asked to help the BA community develop and pilot test physical task simulations (PTSs) using insights from the relevant scientific literature. PTSs are live-event simulations of physically demanding tasks performed in BA specialties and are meant to measure job-related capabilities. Second, we were asked to recommend a process for developing PTS standards—the scores that would be used to determine whether an airman passed or failed the performance measure—that would meet current standards for relevance, fairness, and objectivity. That is, we supported the development and measurement of job-related performance measures that could be used by the Air Force to evaluate the validity of different fitness tests for both men and women. This report contains a discussion of the results of our efforts.

Air Force Process for Developing Occupational Standards

The Air Force's occupational standards process was executed by the Air Force Exercise Science Unit (AF-ESU), which is led by an exercise physiologist. The AF-ESU used a multistep pro-

[1] The SOWT-Officer occupational specialty was eliminated as an official Air Force specialty during the course of this study.

cess to develop and test PTSs, identify potential predictive tests of PTS performance, and set minimum scores on predictive tests. Each step of the process is described in the following list:

1. **Identify physical job demands.** Document critical physical tasks (CPTs) performed by operators from each Air Force Specialty Code.
2. **Sample from list of CPTs.** Determine CPTs that meet best practice principles for designing PTSs.
3. **Design PTSs.** Draft a set of PTSs that capture the full range of important physical abilities required by BA operators.
4. **Construct and pretest PTSs.** Refine PTSs to maximize standardization.
5. **Execute validation phase of study.** Select physical tests (e.g., 1.5-mile run) that measure physical abilities needed to perform the PTSs (e.g., cardiorespiratory endurance).[2] Collect predictive test data and PTS data from research participants.
6. **Establish PTS performance standards.** Determine the minimally essential time (MET) for each PTS.
7. **Establish criterion-related validity.** Determine how well physical tests predict PTS performance.
8. **Develop predictive physical test battery prototype.** Establish minimum predictive physical test scores and total test battery score required.

In its validation study, the Air Force evaluated the performance of BA and non-BA Air Force personnel on a series of physical ability tests and PTSs. The Air Force analyzed the data from the study to determine which physical abilities (measured by tests, such as pull-ups) relate to operator performance (measured by PTSs). The results of the validation effort will inform the Air Force's implementation plan for establishing gender-neutral, occupational standards.

Our primary roles in the Air Force's validation efforts were to

- **Identify principles for PTS development (Step 2).** Based on a survey of the research literature concerning the design of job-related task simulations and subject-matter expertise, we identified five principles for developing PTSs.
- **Establish a process for developing PTSs (Step 3).** We established and led a three-step development process that relies on input from subject-matter experts (SMEs) in the BA community via workshops, reviews, and interviews.
- **Observe and provide scientific expertise throughout the pilot and validation phases (Steps 4 and 5)** of the study, including advising the Air Force on its sampling strategy. During the pilot-testing phase, we tested approaches for collecting information on the representativeness of the PTSs and standards for a minimally essential completion time.
- **Provide an objective methodology to establish MET for each PTS (Step 6).** This step, which requires the identification of minimally acceptable performance on each PTS, is crucial for determining predictive physical test standards that maximize the probability that anyone passing the predictive test standard can operate at an acceptable performance level.

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2 The AF-ESU systematically examined a wide range of predictive physical tests that could be used to determine eligibility requirements at different career stages: (1) entry into training pipelines, (2) progression standards in training, (3) exit standards from training, and (4) continuation standards to determine operational readiness.

The process for developing and testing PTSs has been a collaborative one between the Air Force and RAND, beginning back in 2012, when we established a process for the Air Force to use in identifying and validating gender-neutral tests and standards (Robson et al., 2017). The Air Force has taken the overall lead in executing the process, with our researchers assisting at each stage. This report, however, focuses on the results of our contributions in the four areas listed above.

Our Principles for PTS Development

We reviewed scientific literature on work simulations (also referred to as *work samples*) to identify principles for developing and using work simulations to measure job performance. Work simulations can be used both as selection tests and measures of job performance. Because they simulate job tasks, stakeholders, such as job incumbents, generally view work simulations as job-relevant. Work simulations are also useful when job tasks are difficult to observe, as is the case with many BA tasks on operational missions. However, work simulations do not directly measure job performance; they measure how one might perform on the job. Therefore, there is risk that individuals will not perform on the simulations the way they would on the job.

Because they are designed to simulate job tasks, work simulations may require job-relevant skills that novices do not have. In such cases, novices would require practice on the simulation before actual testing. Finally, work simulations can be expensive to develop, especially as they increase in realism (e.g., using equipment actually used on the job). Because of their costs, organizations may not want to finance too many work simulations—but limiting their numbers may increase the risk that important job tasks are not covered by the simulations. Therefore, it is important that work simulations measure critically important job tasks that differentiate good performers from poor performers. Table S.1 briefly summarizes the benefits and limitations of work simulations identified in the literature.

Expanding on these characteristics of work simulations and the broader scientific literature on personnel assessment, we developed the following five principles for developing PTSs:

1. **Develop PTSs where effective performance is influenced by physical ability.** PTSs should be based on the physical demands of BA specialties. Conduct a job analysis to determine the physical demands, which can be defined in terms of CPTs. Make sure

Table S.1
Benefits and Limitations of Work Simulations

Benefits	Limitations
Valid as selection tests (i.e., predictor measures) and measures of job performance (i.e., criterion measures)	Does not directly measure actual job performance like other common performance measures
Often viewed as job-relevant by stakeholders	May require participants to practice prior to implementation if job-relevant skills or experience is required
Can measure difficult-to-observe job tasks	Development and implementation can be expensive, increasing the risk that important job tasks will not be fully represented

to think about skill requirements of CPTs before developing PTSs to ensure that they measure physical abilities of BA and non-BA personnel.

2. **Develop PTSs that are representative of tasks, abilities, and mission types.** Because of cost limitations, not all CPTs can be covered by PTSs. Therefore, CPTs will be sampled. The sampling strategy should consider the types of physical abilities and tasks required on BA missions and types of missions that BA perform to ensure that a representative mix of tasks, abilities, and mission types is used in the PTSs.
3. **Standardize PTSs to the extent possible.** Standardization allows "apple-to-apple" comparisons among study participants because it ensures that instructions, simulation conditions, and evaluations are the same for all participants. There are four main elements to consider: environmental conditions (e.g., weather); PTS specifications (e.g., weight of equipment); techniques to be used by participants (e.g., type of swim stroke); and preexisting conditions of participants (e.g., fatigue, nutrition).
4. **To the extent possible, PTSs should reflect how tasks are performed in actual mission environments.** PTSs that reflect how CPTs are performed in actual mission environments will have high fidelity and wider acceptance by the BA community. However, realistic PTSs can be expensive to develop and negatively affect standardization goals. Determine whether a realistic feature is absolutely necessary to measure the underlying physical abilities needed to perform the CPTs being measured by the PTS. If the feature is not necessary, use a lower-fidelity feature with less negative effects on standardization.
5. **Design reliable and accurate measurement of PTS performance.** *Reliable measurement* refers to consistency in the scores or results on the PTSs, whereas *accurate measurement* refers to the measures correctly reflecting the underlying abilities of participants. To get reliable and accurate measurement of PTSs, measures need to capture participants' different performance levels and reflect important performance dimensions (e.g., speed, correct behaviors). If humans are used as evaluators, they need the opportunity to see relevant behavior by participants and have skill at evaluating participant performance.

Because PTSs are complex assessments, we recommended that the Air Force pilot test the PTSs before using them in a validation study. Pilot testing provides the opportunity to make sure the specifications of the PTSs are correct, assess whether participants understand instructions, and ensure that evaluators can accurately measure PTS performance. Pilot testing can save money by identifying PTSs that do not work well or have unnecessary equipment. Pilot testing can also reduce injury risk by ensuring that the PTSs are not too dangerous for the participants.

Developing Physical Task Simulations

To help the Air Force design and develop PTSs, we established a three-step development process that relies on input from SMEs in the BA community. We facilitated the process for the Air Force to make decisions about which PTSs to develop. In the first step, we hosted workshops with experts from each specialty[3] to develop an initial PTS list for each specialty. Each session included three to six participants. A majority of participants were experienced enlisted operators, and the others were junior BA officers. After workshops were completed, we asked workshop participants to review the PTS lists across specialties to identify PTS overlap and to provide justifications for PTS parameters (e.g., distance traveled). In the third step, we interviewed an independent sample of 31 operators and officers and hosted group discussions with BA leadership to confirm whether the PTSs represent enough of the CPTs and other mission requirements for BA specialties. The third step provided evidence with which to validate the linkages between CPTs and PTSs—also referred to as *content validation*.

The three-step process resulted in a set of 12 PTSs for use in pilot testing. The first two steps of the process identified a total of 18 relevant PTSs. During the third step, these 18 PTSs were cut to 12. Specifically, seven of the 18 original PTSs were eliminated, one PTS was added, and other PTSs were modified. Reasons for eliminating PTSs included that physical abilities and movements were already covered by other PTSs, the PTSs were too difficult to simulate, and disagreements about how the task is performed in a mission environment. Table S.2 describes the 12 PTSs and the specialties to which they were assigned. (Detailed descriptions of these PTSs are in Appendix A.)

Table S.2
PTSs Created by PTS Workshops

		BA Specialties		
PTS Title	**Description**	**PJ/CRO**	**CCT/STO SOWT**	**TACP**
Single Leg Vertical Rope Ascent	While wearing required safety equipment, 20-lb weighted vest, and climbing devices, ascend a 43-ft vertical rope while using ascension devices.	✓	✓	
Rope Bridge	While wearing required safety equipment and a 30-lb vest, traverse a 20-m rope bridge. The bridge will be on a five-degree incline. Use hand-over-hand technique and inverted body position.	✓	✓	
Airfield Operations	While wearing a 30-lb vest and 65-lb rucksack, move as quickly as possible down a 5,000-ft simulated runway. Turn 180 degrees and begin running back down simulated runway. Along runway, lift and move obstacle from runway, and then push an obstacle from the runway.		✓	
Rock and Ice Climbing	While wearing safety equipment and climbing gear, climb a simulated rock face for a total of 86 ft. At the top, pull simulated casualty from ground using a pulley system.	✓	✓	
Remove Debris and Survivor from Confined Space	While wearing a 30-lb vest, crawl into a simulated drainage tube and crawl 20 m to collect and move a 185-lb simulated casualty, which is also wearing a 30-lb vest. Remove simulated debris off simulated casualty and remove casualty from tube.	✓		

[3] In the case of similar officer and enlisted specialties, we combined them in one workshop. Specifically, we met with PJs and CROs in one group, TACPs and an ALO in another group, and CCTs and STOs in a third group. Because of their small size and similarities in CPTs, SOWTs were included in the CCT/STO group.

Table S.2—Continued

		BA Specialties		
PTS Title	**Description**	**PJ/CRO**	**CCT/STO and SOWT**	**TACP**
Rope Ladder	While wearing a 20-lb vest and a 50-lb rucksack, climb a 10-ft. rope ladder and pull self securely onto platform.	✓	✓	✓
Combat Rubber Raiding Craft Carry	While wearing a 20-lb vest and a 50-lb rucksack, pick up simulated craft weighing 110 lbs and carry it 20 m over gravel.	✓	✓	
Casualty Movement	While wearing a 30-lb vest and a 65-lb rucksack, complete a fireman's carry for 100 m, followed by a sled drag with simulated casualty for 250 m.	✓		✓
Swim to Inflatable Watercraft	Swim 275 m while wearing fins and booties and pushing or pulling a neutrally buoyant rucksack. Participants will also complete underwater tasks during the swim. In the final 25 m of the swim, participants will release the rucksack and pull a neutrally buoyant casualty. Participants will pull themselves into the watercraft and finally pull two rucksacks into the craft.	✓		
Surface Fin Swim	Complete a 2,000-m swim while wearing fins and booties and pulling or pushing a neutrally buoyant rucksack.	✓	✓	
Small Unit Tactics with Casualty Movement	Four-part simulation (A–D): A. Complete a 5-km ruck march with a 30-lb vest and a 65-lb rucksack. B. Complete a 20-m low crawl followed by dragging a 185-lb simulated casualty wearing a 30-lb vest for 50 m. C. Climb over four obstacles ranging in height from 2 ft to 5 ft high, move around cones, then climb over a wall (8 ft high with a 2-ft high box in front). D. Casualty movement (fireman's carry of casualty up stairs, sled drag for 100 m, followed by simulated litter carry for 100 m, with final movement with litter up ramp and completing the simulation by lift simulated litter to top of platform.	✓	✓	✓

NOTE: The weights of kits (lbs) are rough guidelines. Prior to and during pilot testing, BA SMEs provided more detail on the items that go into kits for different missions and the collective weight of those items.

Pilot Testing and Validation

Pilot-Testing Phase

In March 2015, the Air Force pilot-tested several physical ability tests and the 12 PTSs on 11 BA operators and ten BA trainees. The Air Force assessed PTS performance, the functionality of PTS equipment (e.g., ladders), and the administration of the PTSs (order of PTSs, length of administration, directions given to participants)—and made several adjustments to the PTSs as a result of pilot testing. Adjustments fell into three broad categories: PTS parameters (distance, length, weight of objects), equipment (e.g., changing type of object handled, adding safety features to equipment), and standardization (e.g., determining when test administrators can provide assistance to participants and how to document assistance provided on scoring sheet).

We observed the first week of pilot testing, focusing on the performance of the BA operators. During that time, the RAND team tested two approaches for collecting information on the representativeness of the PTSs and standards for a MET for completing each PTS. The first approach involved individually interviewing operators within a few minutes of completing each PTS. A RAND team member would ask the operator to rate how well the just-completed PTS represented the physical demands of the tasks the PTS was designed to approximate; describe possible changes to improve representativeness (if applicable); and estimate the amount of time it would take an operator who is minimally effective to complete the PTS. The second approach involved small group discussions with operators from the same specialty (officer and enlisted), during which participants would come up with a group consensus on a MET to complete a particular PTS. The individual estimates of METs were used as prompts in the group discussions.

We also analyzed the representativeness ratings and found that a majority of the 12 PTSs had average ratings at or above the middle of the scale (3.0), which is equivalent to the rating of "somewhat representative." The three PTSs that received average ratings below 3.0—Rope Ladder, Rope Bridge, and Surface Fin Swim—were particularly challenging PTSs. Moreover, we were able to obtain ratings from only five operators for the Surface Fin Swim because of limited time with operators following completion of the swim, limiting the usefulness of the results for that PTS. We also noted that TACPs, who had the least amount of CPTs overlap with other specialties, tended to have lower representativeness ratings. Although removing TACPs from the analysis increased the average ratings, the three PTSs with ratings below 3.0 remained below a rating of 3.0 even when the TACPs ratings were removed.

The small group discussions were not as useful as originally hoped. We held six group discussions with different specialties to cover completed PTSs. Although groups came to consensus on METs, individuals within and across groups used different frames of reference for developing their estimates. Also, when the initial METs were very different among members of a group, the group tended to satisfice to reach consensus. That is, they would find the MET that would not be faster than the slowest performance time in the group, even if that meant possibly selecting a MET that was too slow. (Most operators estimated METs that were slower than their PTS performance times.) A final issue with the group discussions was time. In the larger validation study, these discussions would be logistically challenging, as operators successively completing a PTS were not always from the same specialty. Therefore, operators would have had to commit additional time at the end of each day to participate in these group discussions. Based on all these issues, we recommended that the Air Force not use the group discussion format in the validation phase.

Validation Phase

Our role in executing the validation phase was limited. One of our main contributions was to help the Air Force with its sampling strategy. The Air Force wanted a large and representative sample for statistical modeling of PTS performance and physical ability test performance. Based on a power analyses, we recommended around 150 to 200 participants complete each physical ability test and each PTS. The Air Force tested 171 participants who volunteered to participate in testing for two weeks. We also recommended that non-BA participants be included to ensure enough of a spread in physical ability and skill level, and that both men and women be represented in the sample. Of the 171 participants, the Air Force tested 55 BA operators, 53 non-BA male trainees, and 63 non-BA female trainees.

Setting Standards for BA Physical Task Simulation Performance

We provided an objective methodology to establish METs for each PTS. Participants' physical performance in the validation study ranged along a continuum from highly ineffective to highly effective. During the Cross Load PTS, for example, some research participants were unable to lift a simulated casualty. Other participants were able to lift the casualty but took a very long time to complete all phases of the PTS, and some completed all phases of the PTS very quickly. Although measuring performance on a continuum can serve many objectives, including research purposes, decisionmakers often have to determine whether the task was performed at an acceptable level. Indeed, establishing pass/fail cutoffs is an important step in the process of identifying which physical fitness tests and standards are most effective in distinguishing between successful and unsuccessful performers.

Using SMEs to establish cutoff scores is a widely accepted practice across range of industries (Cizek, 2012). However, there is no gold standard for translating or aggregating SME inputs into a single cutoff score that differentiates successful from unsuccessful performance. Furthermore, much of the research on standard setting has been conducted with the purpose of identifying a minimally acceptable score on a written test (e.g., qualification exam). Therefore, we developed a procedure that integrates information from multiple sources. Specifically, to arrive at METs for each PTS, we combined SME estimates with information on operator performance times and presented the results to senior leaders (e.g., career field managers) in a workshop. The METs, which differentiate successful from unsuccessful PTS performance, provide the foundation for identifying fitness test standards. That is, fitness test standards can be set at a point in which those passing the fitness test have a high probability of performing CPTs to an acceptable level.

Conclusion

This study achieved several objectives to support the Air Force's efforts to examine the predictive validity of physical fitness tests and standards for BA. Specifically, our work provided the process for developing occupationally relevant physical fitness tests and standards.

The Air Force's validation study resulted in a set of performance measures (the physical task simulations) that were standardized to the extent possible by the AF-ESU with our guidance. The study also resulted in performance standards (the METs) developed by the Air Force (using our recommended process) that can be used to evaluate the physical capabilities required to perform CPTs in six BA occupational specialties. These performance measures were developed to address gaps in existing performance management systems used to evaluate the performance of airmen (existing performance measures, such as enlisted performance reports, are largely unsatisfactory because they are not designed to measure the physical performance of BA). Some performance measures do exist (e.g., ruck march) that apply to BA, but these often are limited to the training pipeline. Consequently, reliable measures of operators' capabilities to march while carrying heavy loads have not been systematically evaluated or documented.

The PTSs not only address this deficiency but also are grounded in occupationally specific, operationally relevant tasks (i.e., CPTs) drawn from Robson et al. (2017) and the AF-ESU's rigorous analysis of operator physical demands.[4] The resulting framework of CPTs, developed by AF-ESU with our guidance, provided the basis for developing PTSs that best approximate the physical demands of BA. With our guidance and leadership, each PTS was designed to ensure comprehensive coverage of physical movement patterns (e.g., push, lift, carry), as well as the underlying physical abilities required to perform the mission (e.g., muscular strength, cardiorespiratory endurance). Furthermore, the development of standardized PTSs, combined with the inclusion of women in the Air Force's validation study (as recommended by RAND), supports the broad objective for establishing gender-neutral occupationally relevant physical tests and standards that can stand up to scrutiny as the Air Force opens these previously closed occupations to women.

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[4] Please contact AF-ESU (AFPC/DSYX) for additional details or questions about the AF-ESU physical demands analysis (current point of contact is Neal Baumgartner).

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Brig Gen Brian Kelly at the Air Force Directorate of Military Force Management Policy, Deputy Chief of Staff for Manpower, Personnel, and Services (AF/A1P) was the project sponsor during the course of this research. Brig Gen Kelly adopted the recommendations and methodology to validate general-neutral occupational standards for battlefield airmen (BA) based on our prior work in fiscal year (FY) 2012 and FY 2014. Neal Baumgartner at the Air Force Exercise Science Unit (AF-ESU) (AFPC/DSYX) was directed to lead the execution of the validation study. Neal Baumgartner was our primary project monitor and was instrumental in all phases of the study, including the job and physical demands analysis; the physical task simulation (PTS) design and construction; and the actual execution of the pilot, validation, and cross-validation phases of the study. His commitment and drive were important factors in the overall success of the research. Lt Col Ryan Logan helped to ensure we had the latest information on changes to task simulation designs, which was necessary for documentation and diagram design.

SMSgt Ken Huhman, designated as our study liaison at AFSOC, was instrumental in facilitating meetings, providing useful operational feedback, coordinating full mission profiles, and communicating the importance of the study to other operators. We are also grateful for the time and feedback provided by career field managers CMSgt Ryan Shultz, CMSgt Marshall Farris, CMSgt Ronald Richards, CMSgt Michael Bender, Lt Col Travis Woodworth, and Lt Col Patrick O'Rourke.

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Abbreviations

AETC	Air Education and Training Command
AED	automated external defibrillator
AF/A1P	Air Force Directorate of Military Force Management Policy, Deputy Chief of Staff for Manpower, Personnel, and Services
AFB	Air Force Base
AF-ESU	Air Force Exercise Science Unit
AFSC	Air Force Specialty Code
AFSOC	Air Force Special Operations Command
ALO	Air Liaison Officer
AO	Airfield Operation
BA	battlefield airmen
CCT	Combat Controller
CJCS	Chairman of the Joint Chiefs of Staff
CLPE	Cross Load Personnel and Equipment
CM	Casualty Movement
CPT	critical physical task
CRO	Combat Rescue Officer
CRRC	Combat Rubber Raiding Craft
CV	vice commander
DCAR	1994 Direct Ground Combat Definition and Assignment Rule
FY	fiscal year
HMMWV	high-mobility multipurpose wheeled vehicle
JTAC	Joint Terminal Attack Controllers

KIM	knowledge in memory
KSA	knowledge, skills, and abilities
L&M	Lift and Move
MET	minimally essential time
PJ	Pararescue
PTS	physical task simulation
RB	rope bridge
RDSCS	Remove Debris and Survivor from Confined Space
RPE	Rating of Perceived Exertion
SFS	Surface Fin Swim
SLVA	Single Leg Vertical Rope Ascent
SME	subject-matter expert
SOWT	Special Operations Weather Team
SNCO	senior non-commissioned officer
STO	Special Tactics Officer
SUT	Small Unit Tactics
SWiC	Swim to Inflatable Craft
TACP	Tactical Air Control Party
WBGT	Wet Bulb Globe Temperature
WC	wall climb

CHAPTER ONE

Introduction

In January 2013, Chairman of the Joint Chiefs of Staff (CJCS) Martin Dempsey and then–Secretary of Defense Leon Panetta issued a memorandum rescinding the 1994 Direct Ground Combat Definition and Assignment Rule (DCAR), which excluded women from assignment to units and positions whose primary mission is to engage in direct combat on the ground. In the 2013 memorandum, Secretary Panetta and CJCS Dempsey mandated that "[c]urrently closed units and positions will be opened by each relevant Service . . . after the development and implementation of validated, gender-neutral occupational standards and the required notification to Congress" (Dempsey and Panetta, 2013, p. 2). To comply with this mandate, the Air Force, with RAND Corporation guidance, established a process in fiscal year (FY) 2012 to identify and validate gender-neutral tests, standards, and physical requirements for the six specialties affected by the elimination of DCAR. These specialties, referred to as battlefield airmen (BA), include Combat Controller (CCT), Pararescue (PJ), Tactical Air Control Party (TACP), Special Operations Weather Team (SOWT), Special Tactics Officer (STO), and Combat Rescue Officer (CRO). Appendix A provides a brief description for each of these occupational specialties.

In FY 2014 and FY 2015, we were asked by Air Force Directorate of Military Force Management Policy, Deputy Chief of Staff for Manpower, Personnel, and Services (AF/A1P) and Air Education and Training Command (AETC) to provide support and technical guidance on the following:

- identifying critical physical tasks (CPTs) that BA operators are expected to perform on missions
- examining links between BA training tasks and CPTs
- developing a research plan for the validation of physical tests and standards
- providing guidance to support the evaluation of the effectiveness of tests and standards considered for identifying the physical capabilities of BA.

More specifically, in FY 2015, we supported the development and measurement of job-related performance measures that could be used by the Air Force to evaluate the validity of different fitness tests for both men and women. In the context of opening these occupational specialties to women, there might be criticisms of the Air Force BA physical test standards, saying that the resulting standards are either too high or too low. Therefore, it is important for the Air Force to adopt a scientifically valid process for developing standards and document the process.

The purpose of this study was to help the Air Force BA community develop scientifically valid performance measures that are representative of occupationally relevant physical demands. First, we were asked to help the BA community develop and pilot test physical task simulations (PTSs) using insights from the relevant scientific literature. Second, we were asked to recommend a process for developing PTS standards (cutoff scores) that would meet current standards for relevance, fairness, and objectivity.

Using these PTSs as the standard for measuring occupationally relevant performance capabilities, the Air Force Exercise Science Unit (AF-ESU) systematically examined a wide range of predictive physical tests that could be used to determine eligibility requirements at different career stages: (1) entry into training pipelines, (2) progression standards in training, (3) exit standards from training, and (4) continuation standards to determine operational readiness. The process for developing occupationally specific, operationally relevant standards, based on our recommendations, comprises the following eight stages:

1. **Identify physical job demands.** Document CPTs performed by operators from each Air Force Specialty Code (AFSC).
2. **Sample from list of CPTs.** Determine CPTs that meet best practice principles for designing PTSs.
3. **Design PTSs.** Draft a set of PTSs that capture the full range of important physical abilities required by BA operators.
4. **Construct and pretest PTSs.** Refine PTSs to maximize standardization.
5. **Execute validation phase of study.** Select physical tests (e.g., pull-ups) that measure physical abilities tested by the PTSs (e.g., muscular endurance). Collect predictive test data and PTS data from research participants.
6. **Establish PTS performance standards.** Determine the minimally essential time (MET) for each PTS.
7. **Establish criterion-related validity.** Determine how well physical tests predict PTS performance.
8. **Develop predictive physical test battery prototype.** Establish minimum predictive physical test scores and total test battery score required.

Although the Air Force took the overall lead for the process as a whole, we collaborated with the Air Force throughout, playing more significant roles in Stages 2 through 6. An overview of the study plan for developing the PTSs, including processes, outcomes, and specific roles and responsibilities, is provided in Table 1.1.

The statistical analyses of the predictive physical tests and the extent to which they are gender-neutral were conducted by the Air Force; therefore, this report focuses primarily on the contributions we made to the development of performance measures (i.e., PTSs) for the validation study and the setting of performance standards based on PTS results. Specifically, our primary roles in the Air Force's validation efforts were to

- **Identify principles for PTS development (Stage 2).** Based on a survey of the research literature concerning the design of job-related task simulations and its own subject-matter expertise, we identified five principles for developing PTSs.

Table 1.1
Description of RAND and Air Force Roles

Stage	RAND Role	Air Force Role
1. Identify physical job demands	• Provided input on focus group and survey methodology used by the Air Force[a]	• Conducted focus groups and survey of operators • Established scoring approach to determine whether task was a CPT
2. Sample from list of CPTs	• Established guidelines for selecting CPTs • Led SME workshops to select CPTs	• Provided SME inputs on CPTs • Provided input on feasibility of designing PTS for specific CPT
3. Design PTSs	• Led SME workshop to identify PTS steps, distances, and equipment • Provided inputs on which PTSs to develop and design elements of those PTSs	• Provided crucial inputs on how CPTs are performed during missions • Made final decisions on which PTSs to develop and which features to include
4. Construct and pretest PTSs	• Provided inputs on number of pretest participants[a] • Provided inputs on redesigns as needed	• Constructed all PTSs • Executed all phases of the pretest • Made final decisions on how to redesign PTSs, as needed
5. Execute validation phase of study	• Provided guidance on the number of validation research participants[a] • Provided SME feedback tool to estimate minimally acceptable levels of PTS performance	• Executed all phases of the validation study, including recruiting participants, planning sequence of tests, and conducting tests and PTSs
6. Establish PTS performance standards	• Developed methodology for establishing METs • Led SME workshop to establish draft METs	• Reviewed distribution of PTS times for research participants from each AFSC • Senior leaders provided recommended METs
7. Establish criterion-related validity	• Provided guidance for developing an overall PTS performance score[a] • Provided guidance on evaluating test fairness[a]	• Conducted statistical analyses to evaluate validity of tests • Identified combination of tests to best predict performance on each PTS
8. Develop predictive physical test battery prototype	• Reviewed Air Force statistical analyses and provided feedback[a]	• Developed test battery prototype and established implementation plan for further evaluation

[a] These elements of the research involved providing informal advising and feedback on select elements of the Air Force's efforts. Such advising and feedback occurred periodically over the course of the project, on an as-needed basis. Because these efforts were informal, they are not discussed in detail in this report.

- **Establish a process for developing PTSs (Stage 3).** We established and led a three-step development process that relies on input from subject-matter experts (SMEs) in the BA community via workshops, reviews, and interviews.
- **Observe and provide scientific expertise throughout the pilot and validation phases (Stages 4 and 5)** of the study, including advising the Air Force on its sampling strategy. During the pilot-testing phase, we tested approaches for collecting information on the representativeness of the PTSs and standards for minimally acceptable performance.
- **Provide an objective methodology to establish a MET for each PTS (Stage 6).** This step, which requires the identification of minimally acceptable performance on each PTS, is critical for determining predictive physical test standards that maximize the probability

that anyone passing the predictive test standard can operate at an acceptable performance level.[1]

To evaluate tests and standards, the Air Force adopted our recommended process in this study to develop and validate performance measures for BA that adhered to scientific guidelines and the Secretary of Defense's (Dempsey and Panetta, 2013) guiding principles for validating occupational standards. The first step in developing job-related performance measures is to define the job performance domain of interest through job analytic methods. The Air Force conducted job analyses[2] for BA specialties in FYs 2014–2015 to update the results of job analyses of BA specialties conducted by Robson et al. (2017) in FY 2012. The job analyses resulted in sets of tasks (CPTs) that represent physical requirements that are important for BA to be able to perform on their missions. These CPTs provide the foundation for identifying and developing physical performance measures for BA.

Once the performance domain is defined, performance measures can be identified. For the Air Force validation effort, several BA performance measures were considered, including existing training evaluations, (on-the-job and mission-oriented) performance evaluations, and PTSs. Following discussions with career field managers and senior BA operators, we determined that available training and performance evaluations would be insufficient for validation because they do not discriminate relevant performance levels well and do not comprehensively and selectively measure the specific occupational requirements of BA. Consequently, we recommended developing PTSs that approximate the physical demands of BA.

Using the PTSs, the performance domain is then measured, with the performance measures being scientifically linked to ability measures that should drive successful performance. For the BA validation effort, the specific abilities of interest are physical such as muscular strength and cardiorespiratory endurance. A broad range of physical ability tests, such as a pull-up test, can measure the required physical abilities.[3] Figure 1.1 provides a simple representation of the process of linking physical abilities to operator performance.[4] This report addresses the process for developing PTSs and setting occupationally relevant physical performance requirements for BA.

Using the PTSs as a way to measure physical performance, the AF-ESU conducted a criterion-related validation study to identify occupationally relevant physical fitness tests and standards for BA specialties. The AF-ESU has evaluated the data from the study to identify an appropriate set of tests and standards, which was implemented in early 2018 for ALO and TACP.

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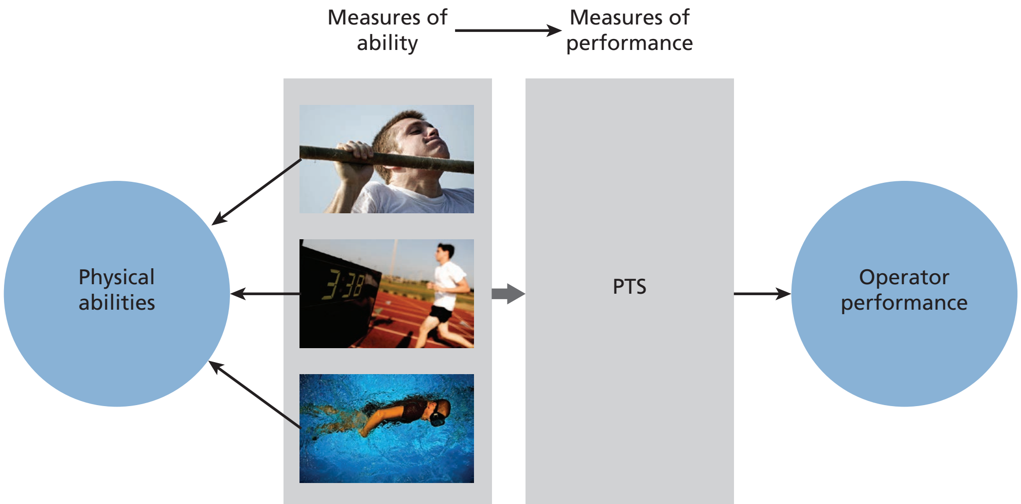
1 The Air Force completed its preliminary evaluation of physical tests and standards in summer 2015 and is currently working toward an implementation plan. For more information, please contact the Air Force's leader of the validation process, Neal Baumgartner, AF-ESU (AFPC/DSYX).

2 We use the term *job analysis* to refer to the broader methodology to identify job requirements. The Air Force prefers to use the term *physical demands analysis* specifically to refer to the methodology for identifying the physical requirements to perform tasks in a job.

3 We do not describe the process of selecting and modifying the physical ability tests in this report. Please contact AF-ESU (AFPC/DSYX) for details (current point of contact is Neal Baumgartner).

4 Throughout this report, we use the terms *BA* and *operators* interchangeably when referring to battlefield airmen.

Figure 1.1
Link Between Physical Abilities and Operator Performance



SOURCE: Photos courtesy of the Department of Defense.

Organization of This Report

The remainder of this report provides background on scientific guidance for designing and implementing work simulations, our process for developing PTSs, our role in the pilot-testing and validation phases of the Air Force's validation efforts, and the process for setting standards for occupationally relevant physical performance requirements. Chapter Two describes features of work simulations, their benefits and limitations, and five principles for developing PTSs. Chapter Three provides our three-step approach for developing the PTSs. Chapter Four describes the information we collected and analyzed during the pilot-testing phase that informed the refinement of the PTSs for the validation effort. Chapter Five discusses the process used to help the BA community set standards for its occupationally relevant physical performance requirements. Chapter Six provides a summary on the effectiveness of the PTSs and concludes with recommendations for expanding research efforts to include additional measures of physical performance. Four appendixes provide additional detail about the career fields (Appendix A), the PTSs (Appendix B), administrator checklists for the validation study (Appendix C), and validation study score sheets and feedback forms (Appendix D).

CHAPTER TWO

Principles for Developing Physical Task Simulations

The Air Force organizes, trains, and equips its BA operators to meet a variety of challenges in different operational environments. As a result, these operators perform different types of tasks, some of which are performed rarely or may be performed in very different ways depending on specific characteristics of the mission environment (e.g., terrain, enemy threat). Operators also work in teams, sometimes with other BA but also with special operations teams in sister services (e.g., Army Special Forces). These factors, characteristic of BA specialties, present challenges for systematic measurement of BA job performance using traditional performance evaluation tools. For example, missions may require working in austere environments or with other special operations forces personnel where Air Force supervisors are not able to directly observe and evaluate physical performance. Also, performance may be difficult to evaluate when external factors beyond an operator's control may negatively influence his performance (e.g., other team members' poor fitness results in late arrival at the objective).

Work simulations can address most of these types of challenges. Work simulations, or *work samples*, involve one or more activities designed to approximate performance in a work situation or scenario. Success at a work simulation requires participants to demonstrate the knowledge, skills, and abilities required for the situation (Lievens and De Soete, 2012; Thornton and Mueller-Hanson, 2004). Work simulations can be designed for a variety of domains, including those that are cognitive (e.g., developing an operations order) or physical (e.g., repairing an aircraft engine). If designed and implemented appropriately, work simulations are useful tools for systematically measuring important aspects of job performance.

In this chapter, we discuss the design and implementation of work simulations with a focus on PTSs. We identify some of the benefits and challenges of work simulation design and use in general and offer guidelines for designing and using PTSs for BA specialties.

Work Simulation Features

Because work simulations can cover a variety of domains (cognitive, personality, physical) and involve a variety of methods, identifying what is common among them can be difficult. However, the following seven features offer a way to identify commonalities and differences among work simulations (Lievens and De Soete, 2012):

1. behavioral consistency
2. content sampled
3. fidelity

4. interactivity
5. standardization
6. scoring
7. cost/scope.

Behavioral consistency reflects the simulation's ability to capture behavior that is consistent with the behavior one would expect on the job. Simulations work on the assumption of behavioral consistency. For example, a hands-on simulation, such as repairing an aircraft engine, should reflect the behaviors that an aircraft maintainer would perform when repairing an engine on the job. Lower-fidelity simulations, such as a situational judgment test, tend to measure participants' knowledge of procedures associated with performance. An example of a situational judgment test would have participants watch video vignettes of workplace interpersonal interactions and then answer questions about how they would react to situations they observed (e.g., coworkers having an argument). The participants are not actually reacting to the situation but instead indicating how they would react. However, most work simulations for physical job performance use the hands-on approach.

Content sampled refers to the types of content that the simulation is designed to capture. A situational judgment test like the one described above measures content related to interpersonal knowledge and managing one's emotions. Work simulations for physical performance can tap into any number of psychomotor characteristics (e.g., finger dexterity) and physical abilities (e.g., muscular strength, muscular endurance, agility). Understanding what content simulations should cover is an important step in designing work simulations and will be discussed later in this chapter.

Fidelity means how closely a simulation represents the aspects of the job it is designed to measure. Fidelity includes physical and psychological aspects. Physical fidelity means that the simulation closely replicates the actual work tasks. Psychological fidelity reflects the degree to which (1) simulation tasks and knowledge, skills, and abilities (KSAs) required to accomplish the tasks match the tasks and KSAs expected on the job and (2) responses of simulation participants represent how they would respond on the job (Lievens and De Soete, 2012). Work simulations that have a forced-choice format (e.g., multiple choice) and measure knowledge on how to complete tasks, not behavior, tend to be low fidelity. Simulations with dynamic stimuli and open-response formats tend to be higher fidelity.

Interactivity is a feature of simulations that directly relates to simulation fidelity. Interactivity is the degree to which participants' responses are based on dynamic, rather than static, cues. For example, a simulation that requires participants to react to the different actions of role players is an interactive simulation. An example of a simulation with low interactivity would require each participant to repair a piece of equipment without assistance from others and while following a standardized set of procedures. Simulations with high interactivity tend to have higher fidelity than simulations with low interactivity.

Standardization refers to both how the simulation stimuli are presented and how the participant responses are evaluated. Simulations with high degrees of standardization present the same stimuli in the same order to participants. Participants may be given forced-choice format for responses, and responses are evaluated using the same scoring key developed before the simulation is administered. Simulations with higher fidelity and interactivity are generally more difficult to standardize because they offer a more dynamic situation and provide participants more freedom in how they respond. As discussed later in this chapter, increased standardization for high-fidelity simulations can be achieved via pilot testing and training individuals who will evaluate participants.

High-fidelity simulations are generally scored using a consensus method. The consensus method involves two or more evaluators rating each participant on one or more performance dimensions. The level of agreement in the ratings is determined, and ratings with high levels of disagreement are discussed and resolved. Training evaluators on having the same standards prior to conducting simulations can help reduce high levels of differences in their ratings.

Simulations are among the more-expensive occupational assessments to develop and implement. Even low-fidelity simulations require experts to develop, implement, and score responses. High-fidelity simulations, such as the ones being developed for BA specialties, also require such subject-matter expertise as well as a variety of stimulus materials (e.g., equipment), personnel (evaluators and participants), and staging areas. Despite the costs, simulations like these can be less costly in the long run if they identify performance standards that improve selection and development of personnel.

Benefits and Limitations of Work Simulations

Scientific research has identified a number of benefits and limitations of work simulations in occupational assessment. In Table 2.1, we outline benefits and limitations that would apply to work simulations in the physical domain. We discuss each in turn.

Benefits

For many years, work simulations have been considered among the most valid predictors of job performance used in research. An oft-cited meta-analysis of work simulation studies estimated a mean validity of 0.54, which translates to a high-positive average correlation between work simulation scores and scores for job performance measures (Hunter and Hunter, 1984). In this context, *validity* refers to the strength of the relationship between a test and an important outcome.[1] Validity coefficients range from –1.00 to +1.00, with coefficients closer to 1 (positively related) or –1 (negatively related) representing a stronger relationship. However,

Table 2.1
Benefits and Limitations of Work Simulations

Benefits	Limitations
Valid as selection tests (i.e., predictor measures) and measures of job performance (i.e., criterion measures)	Does not directly measure actual job performance like other common performance measures
Often considered face valid by stakeholders	May require participants to practice prior to implementation if job-relevant skills or experience is required
Can measure difficult-to-observe job tasks	Development and implementation can be expensive, increasing the risk that important job tasks will not be fully represented

[1] Other sources of validity evidence can be accumulated through content validity and construct validity studies. For additional information on validation strategies, see Farr and Tippins, 2013.

a more recent meta-analysis revised the 0.54 validity estimate down to 0.33 (Roth, Bobko, and McFarland, 2005). Although lower than the previous 0.54 estimate, the revised validity estimate of 0.33 reflects a moderate positive relationship between work simulations and job performance measures.

Work simulations as criterion measures (i.e., representations of job performance) have been more common in the physical domain and for law enforcement and public safety occupations, such as firefighter and police officer. Work simulations can be highly valid measures of physical job performance for these types of occupations (e.g., Arvey, Nutting, and Landon, 1992; Gebhardt and Baker, 2010; Jackson, 2000, Wigdor and Green, 1991). For example, a study of firefighter physical performance found that a battery of strength and endurance measures (e.g., dragging a fire hose, dummy drag, arm lift test) predicted firefighters' performance on a fire suppression simulation (Sothmann et al., 2004). A later study using fire academy students also showed strong statistical relationships between strength and endurance measures (e.g., bench press, grip strength, lean body mass) and firefighter physical-performance measures, such as an axe-chopping exercise (Henderson, Berry, and Matic, 2007). Although studies of work simulations as criterion measures are much more limited in number and type than studies of work simulations as predictor (selection) measures, the available evidence supports use of work simulations in both contexts.

Because simulations attempt to mimic responses to actual job activities, stakeholders, such as incumbents, supervisors, and job applicants, tend to accept work simulations as *face valid*. Face validity refers to the perceived similarity between the content of the job measure and the content of the job. Because work simulations often "look like" the job, stakeholders tend to view them as job-related and fair (Callinan and Robertson, 2000). Indeed, a meta-analysis of studies on applicant perceptions about selection methods found that applicants generally perceived work simulations and interviews more positively than other types of selection measures, such as cognitive ability tests and personality inventories (Hausknecht, Day, and Thomas, 2004). Although face validity does not provide evidence that a job measure predicts job performance, face validity can play an important role in occupational assessment. Legal challenges to the fairness of employment tests partly rest upon how job-related they appear. Because work simulations benefit from apparent job-relatedness, they may not be subjected to as many legal challenges as other types of occupational assessments or, if challenged, more likely to be successfully defended (Terpstra, Mohamed, and Kethley, 1999).

The last benefit we discuss is particularly relevant for the BA context. Because of the various conditions under which BA perform their missions, it is difficult for outside experts to observe their performance. Moreover, some of their tasks are not often performed or may differ significantly depending on the mission. Given these limitations, work simulations provide a way to observe BA perform important aspects of their jobs. Simulations also have the added benefit of providing a way to standardize the scenario to allow direct comparisons between individual operators. As noted earlier in the chapter, performance evaluations on actual missions are limited in teasing out the individual performance of operators.

Limitations

As with any performance measure, work simulations have some limitations. One limitation of work simulations as criterion (i.e., job performance) measures is that they are not directly measuring job performance. Instead, work simulations attempt to replicate the behaviors and the KSAs that would be expected on the job (Hogan, 1991). In contrast, job performance criterion measures, such as supervisor ratings and attrition records, directly tie to incumbents' behaviors on the job. Because of their indirect tie to job performance, work simulations require careful development and implementation to ensure that the simulation elicits participant responses that are consistent with performance behaviors. Later in this chapter, we offer five guidelines for developing physical task simulations for BA specialties. These guidelines will help ensure that the simulations represent important physical aspects of BA work.

Another limitation of work simulations is that they may require participants to have certain skills or experience to be successful at the simulation. For example, a simulation of repairing an aircraft engine would be especially difficult for a participant with limited aircraft maintenance experience. If simulations with skill or experience requirements are designed with applicants or trainees in mind, participants will need an opportunity to practice before completing the simulation. The more practice that participants need, the more time and expense required for the simulation.

As noted earlier in the chapter, work simulations can be expensive to develop and implement (Lievens and De Soete, 2012). Because of their financial costs, work simulations are often tailored to a limited set of tasks for a small set of specialties. For example, a simulation of dragging a fire hose up a ladder works well for measuring one aspect of physical performance for firefighters but does not adequately represent the set of physically demanding tasks that firefighters perform. A lack of representativeness limits the validity of the simulations as measures of job performance (Callinan and Robertson, 2000).

Not only do financial costs associated with work simulations increase the risk that important job tasks within an occupation are not represented, financial costs may also limit how many specialties or jobs are covered by the simulations. The fire-hose simulation, for example, does not reflect the content of police officer work and therefore would not be used as a police officer performance measure. However, steps can be taken to identify job content overlap between specialties, so that a single work simulation could apply to more than one occupation. For the BA simulations we describe in this report, simulations that could be used across BA specialties have been identified. Using a simulation for multiple specialties helps increase the pool of participants for the work simulations and can reduce financial costs because fewer simulations are needed to cover the CPTs performed by BA.

Principles for PTS Development

Expanding on effective practices identified in the work simulation literature, we summarize five important principles for developing PTSs for BA specialties:

1. Develop PTSs where effective performance is influenced by physical ability.
2. Develop PTSs that are representative of tasks, abilities, and mission types.
3. Standardize PTSs to the extent possible.
4. To the extent possible, PTSs should reflect how tasks are performed in actual mission environments.
5. Design reliable and accurate measurement of PTS performance.

Each principle is described in the following sections.

Develop PTSs Where Effective Performance is Influenced by Physical Ability

The PTSs should be based on the physical demands of BA specialties. Otherwise, BA specialties run the risk of setting entry standards that are either too low (increasing the risk of injury) or too high (increasing the risk that others will challenge the standards and that BA manpower requirements will be too difficult to meet). The first step to identifying the physical demands of BA specialties is to conduct a thorough job analysis, which the Air Force conducted. During the job analysis, the Air Force identified a set of CPTs on which the BA PTSs are based. The CPTs provide a link from the PTSs to underlying physical abilities required to successfully perform physical BA work. However, some CPTs are affected by the skills or techniques that operators learn in training or on the job. Therefore, care must be taken to develop PTSs that tap physical abilities required by BA work while minimizing skill requirements.

One way to reduce skill or technique requirements is to develop "crawl, walk, and run" phases of PTSs. The crawl phase would require the fewest physical demands, whereas the run phase would require the most. For example, a rope climbing simulation may have a crawl phase where participants climb 10 feet without any equipment. If participants pass the crawl phase, they progress to the walk phase of climbing up 10 feet of rope with a light load on their backs (ruck). Participants who pass the walk phase can move on to the run phase of climbing 20 feet with a heavier load.

If a skill or technique in a PTS cannot be avoided, participants need opportunities to practice the aspects of the PTS that require the skill or technique. For example, climbing a caving ladder can be accomplished in different ways, some of which reduce physical demand. Participants should be allowed to try climbing a caving ladder a few times before they complete the simulation. Otherwise, evaluators will find it difficult to determine whether successful performance on the PTS is due to physical ability, technique, or both.

Develop PTSs that are Representative of Tasks, Abilities, and Mission Types

Developing PTSs for every CPT is not feasible given the costs. To ensure the PTSs represent the physical demands of BA work, PTS developers should sample from CPTs. The sampling strategy should consider the physical abilities that BA work requires and the different types of missions that BA perform. For example, building PTSs based on CPTs that only measure muscular strength would not adequately represent the physical abilities required for BA work. Likewise, PTSs based solely on CPTs performed in water environments would miss the many other mission environments in which BA operate.

Although PTSs for BA specialties are meant to reflect the physically demanding aspects of their performance, PTSs can include less or non-physical aspects that are influenced by physical ability. For example, if being able to communicate clearly to teammates while performing a particular CPT is important for successful BA performance, an activity that measures communication skill could be embedded in the PTS for that CPT. Like the physical activities of the PTS, non-physical activities should have limited skill or technique requirements.

Standardize PTSs to the Extent Possible

To ensure reliable and accurate measurement of operator performance on PTSs, PTSs need to be standardized to the extent possible. Standardization enables apple-to-apple comparisons among participants because it ensures that instructions, simulation conditions, and evaluation are the same for all participants. Standardization benefits include the following:

- increases confidence that participants' performance is due to their underlying physical ability
- increases confidence in the amount of physical ability required to perform the CPT under known conditions
- decreases opportunities for others to challenge standards based on PTS performance
- decreases the sample-size requirements to scientifically compare participants' performance levels.

There are at least four PTS elements to consider for standardization: environmental conditions, specifications of the PTS, technique, and preexisting conditions of participants.

Environmental conditions refer to weather conditions, time of day, altitude, or any other physical environmental condition that could affect PTS performance. While all conditions are not controllable (especially weather), they should be taken into account during PTS assessment. For example, two participants with the same underlying physical abilities may differ in how long they take to complete a PTS because one performs the PTS in rainy conditions and the other in dry conditions. These conditions should be noted during PTS assessment.

Specifications of the PTS, such as the type and weight of equipment that participants would wear or carry and the distance they need to travel, should be standardized. For example, participants should wear similar clothing and equipment (e.g., rucksacks) during a PTS. If specifications differ among participants (e.g., size of body armor), those differences should be noted during PTS assessment.

Technique is another element to consider standardizing in a PTS. Participants should be instructed to use the same technique if technique can affect performance. For example, during a swimming-based PTS, participants may be told to use a combat stroke. If more than one technique is acceptable to successfully perform the PTS, the technique that the participant chooses should be documented as part of the assessment.

The fourth element for standardization, preexisting conditions of participants, is perhaps one of the most difficult to control. Preexisting conditions that could affect PTS performance include sleep deprivation and skill related to the PTS activities. For participants in training or other structured military environments, having the PTSs performed at the same time of day could help minimize sleep and nutrition differences. Skill-based differences can be assessed prior to PTS implementation. As with other elements that cannot be fully standardized, preexisting conditions should be documented and factored into the PTS evaluations.

To the Extent Possible, PTSs Should Reflect How Tasks are Performed in Actual Mission Environments

PTSs that reflect how CPTs are performed in actual mission environments will have high fidelity and likely have wider acceptance by the BA community. However, higher fidelity (realism) comes with trade-offs. Cost is an obvious trade-off: The more that specialized equipment is required to resemble actual mission environments, the more financial costs will be incurred. Other than cost, risks to the participants' health and well-being can increase with greater realism. For example, a live-fire exercise would put participants at greater risk than using fake ordnance. Also, a lengthy PTS, such as a 24-hour reconnaissance mission, will invite fatigue effects that can affect performance and participant health.

Another major trade-off of increased realism is reduced standardization. Realistic mission conditions are often characterized by uncertainty, chaos, and dynamic fluidness. For example, if a teammate is injured during a movement, one or more teammates may carry the injured teammate to safety, while another teammate carries the equipment that the injured teammate can no longer carry. This situation induces physical demands that vary from individual to individual. Therefore, creating realistic PTSs can make it challenging to standardize PTSs. When standardization and realism are in opposition, standardization should receive greater priority.

Design Reliable and Accurate Measurement of PTS Performance

A simulation as a job performance criterion assessment is of limited value without reliable and accurate measurement of participant performance. Reliable measurement refers to consistency in the scores or results. For example, a participant rated by two or more evaluators should receive similar ratings if the measure is reliable. PTS measures should also accurately reflect the underlying abilities of participants.

For PTS assessments to be reliable and accurate, different performance levels of participants need to be detectable. For example, if a four-person team is carrying a litter and one person loses his or her grip, an assessor can observe that behavior and attribute it to the individual. However, care must be taken when selecting tasks where performance may be significantly affected by factors outside the individual's control. In the litter-carry example, the person may lose his or her grip because another team member steps on the person's foot or the equipment fails. Unless there is other evidence about this person's physical capabilities to perform the task, he or she should not be assessed as physically incapable of performing the task based on this situation alone. Not all factors outside an individual's control can be avoided in a PTS but should be documented and part of the evaluation. If there are significant external factors affecting performance, follow-on sensitivity analyses should be conducted to evaluate whether including these scores negatively affects estimates of the relationship between tests and PTS performance.

Another important feature to ensure reliable and accurate PTS measurement is to design PTSs and PTS evaluation tools so that important performance dimensions are identified. Performance dimensions include speed, accuracy, and safety. Prior to PTS development, the dimensions important to CPT performance need to be identified and their measurement included in the PTS for that CPT. For example, BA operators who climb a caving ladder faster than others might be considered more successful at that task. Therefore, speed is an important performance dimension, and time to completion should be measured as part of a caving ladder PTS. In addition to what dimensions are important to measure, performance standards need to be described. In the caving ladder example, how fast is fast enough? What is considered too slow? Can someone fall off the ladder, get back on the ladder, climb to the top and still be considered successful? Questions like these need to be addressed prior to PTS implementation so that they can be included in PTS assessment.

Reliable and accurate measurement requires the opportunity to evaluate performance. For some performance dimensions, such as speed, measurement can be simplified using technology like GPS trackers. However, other performance dimensions like accuracy may require human evaluators to rate participant performance. These evaluators need to be able to observe a participant's behavior during the PTS. For example, if a PTS involves a nighttime movement through the woods, evaluators will need to move along with the participants and will require viewing aids, such as night vision goggles. If a participant's performance cannot be observed or otherwise tracked via technology, it cannot be adequately measured.

Finally, if human evaluators are needed for PTS measurement, the evaluators should have relevant expertise (e.g., training evaluation, physiology, occupational measurement) and be trained on how to evaluate performance on the PTS. Training should cover the performance dimensions that will be measured, the evaluation format (identifying specific behaviors that demonstrate different levels of performance on each dimension), and practice making ratings. Additional practice should come in the form of PTS pilot testing. Pilot testing gives evaluators the opportunity to practice evaluating participants before the PTS goes live.

The Importance of Pilot Testing

Because PTSs are complex assessments, pilot testing is important to ensure successful implementation. One area of concern that can be addressed through pilot testing is the difficulty of each PTS. The crawl, walk, and run phases of a PTS can be tested to determine whether all phases are needed. For example, if none of the BA operators who are considered successful at their jobs can successfully complete the run phase, then the run phase is too difficult. Conversely, if all participants, including novices, can complete the run phase without any problems, then the PTS is too easy. In both cases, the PTS will need to be adjusted to ensure the PTS can differentiate relevant performance levels between individuals or the PTS will need to be abandoned if it cannot be modified or is deemed unnecessary.

Pilot testing is also invaluable for testing the "testers" (i.e., evaluators). Evaluators should rate pilot test participants using evaluation tools designed for the PTS assessment. Evaluators should also provide feedback on their abilities to observe participants during the PTS and whether the evaluation tool (e.g., checklist) is easy to use. Comparisons of evaluators' ratings can identify calibration problems that require adjustment before the PTS is implemented. More specifically, steps can be taken to measure not only the interrater reliability of evaluators but also the test-retest reliability of performance on each PTS. Although these steps are considered best practice and can be important in identifying and mitigating potential problems, limited resources, including insufficient time and personnel, sometimes limit the extent to which reliability can be scientifically established.

Although pilot testing requires resources in the short term, it can also save resources in the long term. If some PTSs do not work out for whatever reason, they will not be implemented. Pilot testing also identifies whether evaluation tools or evaluator training need adjusting, which helps ensure reliable and accurate measurement during actual PTS testing. Pilot testing can also identify safety hazards not considered during PTS development. Reducing the time burden and injury risk of future participants is often well worth the investment required to pilot test complex simulations, such as the PTSs for BA specialties.

Conclusion

Work simulations offer a useful way to measure job performance in occupations with complex demands, such as BA specialties in the Air Force. Work simulations as performance measures have benefits of scientific validity, face validity, and utility as measures of difficult-to-observe job tasks. They do come with limitations, including indirect ties to actual job performance, skill requirements for participants, potentially high financial costs to develop and implement, and difficulty in standardizing environmental conditions when testing is conducted outdoors. However, these limitations can be offset by careful development as outlined in our five principles for PTS development. In Chapter Three, we describe our approach to developing PTSs and our role in the pilot-testing effort executed by the Air Force. The pilot-testing effort allowed the Air Force to modify the PTSs prior to the validation-testing phase, which helped to ensure that each PTS was designed in a way that allowed for discrimination between individuals on relevant task-related performance.

CHAPTER THREE

Developing Physical Task Simulations

To develop the initial set of PTSs for BA occupational specialties, we followed a three-step process outlined in this chapter. First, we hosted workshops with SMEs (senior operators and junior officers) across the BA specialties to develop an initial PTS list. Second, after all the workshops were completed, we asked those experts to review the PTS list to identify overlap among PTSs developed for the different specialties and to provide justifications for PTS parameters (e.g., distance traveled). Third, we interviewed an independent sample of operators and held group discussions with BA leadership to confirm whether the PTSs are representative and sufficiently comprehensive of the CPTs and other mission requirements for BA specialties. The third step offers evidence of *content validation* of the linkages between CPTs and PTSs. The result of our three-step process was a set of PTSs for use in pilot testing, which is described in Chapter Four.

Three-Step Process to Develop Initial Set of Physical Task Simulations

Step 1: Host PTS Workshops to Develop Initial PTSs

In coordination with AF-ESU (AFPC/DSYX)'s Neal Baumgartner, who was directed to lead the execution of the validation study, and his team, we hosted one- to two-day workshops for the BA specialties in the study. Because the Air Force's job analysis results suggested significant overlap in the CPTs for some of the specialties, we combined specialties with overlapping CPTs in the same workshops. In summer 2014, we hosted the following three workshops:

- PJ and CRO—Moody Air Force Base (AFB) in Georgia
- TACP—Fort Stewart in Georgia
- CCT/STO and SOWT—Randolph AFB in Texas.

For each workshop, we requested two to five senior non-commissioned officers (SNCOs) and at least one officer, each with operational deployments within the past five years. The PJ and CRO workshop included one CRO (a captain) and two senior enlisted PJs (senior master sergeants). The TACP workshop included one Air Liaison Officer (ALO; in this case, a captain) and three senior enlisted TACPs (master sergeants).[1] The CCT, STO, and SOWT workshop included one STO (a captain), three CCTs (a staff sergeant, senior master sergeant, and command master sergeant), and two enlisted SOWT participants (a staff sergeant and a tech-

[1] ALOs are the officer counterparts to TACPs. Although not the focus of the study, ALOs can provide insights into the work requirements for TACPs.

nical sergeant). At the beginning of each workshop, participants were provided an overview of the Air Force process to validate the occupationally relevant physical standards for the BA specialties. Participants were next provided an overview of the five principles for PTS development described in Chapter Two. The remainder of the workshop involved participants reviewing their specialties' CPTs; identifying CPTs amenable to simulation; and creating draft PTSs for CPTs.

To assist participants in identifying CPTs to simulate, we facilitated the discussion by asking questions aligned with the five principles. For example, we asked participants whether CPTs

- differed in how they were performed depending on the conditions
- were amenable to measurement (e.g., performance could be observed and evaluated)
- distinguished between successful and less successful operators
- had overlap in physical demands with other CPTs?

We also asked about the CPT list as a whole—whether the CPTs selected for simulation adequately covered the range of physical abilities, tasks, and conditions that are important to BA performance.

After selecting CPTs to simulate, participants discussed specifications for the PTSs, including types of equipment used, distance traveled, and environments. The goal was to use as much of the actual materiel and conditions used in mission environments as feasible. However, logistical, standardization, and safety considerations were also evaluated. For example, most water operations occur in natural bodies of water—oceans and rivers. However, conditions in natural bodies of water can vary (e.g., ocean currents), making standardization difficult. Also, the opportunity to safely observe and evaluate participants is lower in natural bodies of water than in a pool. Therefore, the simulations involving water operations were designed to be conducted in a pool.

Once the initial set of PTSs was developed, participants were asked to describe performance dimensions (e.g., speed, accuracy) that would be important to measure for each PTS. We also asked participants to rank the PTSs in order of importance to the mission. This was done to ensure that PTSs would be developed for the most important CPTs in case financial or logistical constraints prevented the study from using all PTSs. However, feedback following the ranking on PTSs indicated that the question was not clear enough to differentiate between importance to the mission and importance to the study. For our second and third workshops, we showed the previous workshops' PTS descriptions for shared CPTs between specialties. That is, some PTSs designed for the different specialties represent approximations of common CPTs that are shared across specialties. For example, two specialties may want a casualty movement, but one specialty initially described a longer distance than the other. To reduce the number of PTS versions, the specialties were asked if there was a common distance that was still representative of how the CPT was performed in an operational environment (e.g., one distance for a casualty movement). This process helped to reduce the total number of PTSs across the BA specialties. Eighteen PTSs were developed by the end of the first step. Table 3.1 provides brief descriptions of the 18 PTSs and notes which PTSs apply to which BA specialties.

Table 3.1
PTSs Created by PTS Workshops

		BA Specialties		
PTS Title	**Description**	**PJ/CRO**	**CCT/STO and SOWT**	**TACP**
Single Leg Vertical Rope Ascent	While wearing a kit weighing up to 25 lbs and a 20-lb vest, ascend a 100-ft vertical rope while using simulated ascension devices.	✓	✓	
Rope Bridge	While wearing a kit weighing 76–140 lbs, traverse a rope bridge up to 100 ft long. The bridge will be on a 5-degree incline. Use hand-over-hand technique and inverted body position.	✓	✓	
Landing Zone Ops	While wearing a kit weighing 76–140 lbs, move as quickly as possible down a 6,000-ft simulated runway. Turn 180 degrees and begin running back down simulated runway. Along runway, remove three sets of debris (spaced at 1,500-ft intervals) off runway. At end of runway, move two .50-caliber ammo crates off the runway.		✓	
Lead Climber	While wearing a kit weighing up to 25 lbs, climb a simulated rock face for a total of 75 ft. At the top, pull simulated casualty from ground using a pulley system.	✓	✓	
Remove Debris and Survivor from Confined Space	While wearing a kit weighing up to 25 lbs and a helmet, crawl into a simulated drainage tube and crawl 20 m to collect and move a simulated casualty weighing 185 lbs. Remove simulated debris off simulated casualty and remove casualty from tube.	✓		
Cross Load Personnel and Equipment	While wearing a kit weighing 26–75 lbs, move two simulated casualties (each weighing 185 lbs and wearing a kit weighing 26–75 lbs) and then equipment (radios and weapons) from “damaged” vehicle to “recovery” vehicle (e.g., high-mobility multipurpose wheeled vehicles [HMMWVs]).	✓		✓
Caving Ladder	While wearing a kit weighing 76–140 lbs, climb a 10-m caving ladder out of pool and up onto a platform.	✓	✓	
Casualty Movement	While wearing a kit weighing 26–75 lbs, begin casualty movement by using a one-handed buddy-drag technique to drag a simulated casualty in kit for 50 m, with a turn at the 25-m point. After a two-minute rest, lift simulated casualty into fireman’s carry and move with casualty for 100 m. Place simulated casualty on ground and take a two-minute rest. Complete movement by pulling a sled with simulated casualty for 100 m.	✓		✓
Swim to Watercraft and Motor Mount	While in a dry suit and dive gear, swim 300 m using fins to an inflatable watercraft in the pool. Once at the watercraft, pull self into watercraft and remove dive gear. Lift and move a simulated motor engine (up to 125 lbs) 4 ft to the transom. Place simulated motor on marked platform.	✓		
Surface Fin Swim	While wearing a kit weighing 26–75 lbs without armor plates, fins, mask, and snorkel, swim up to 5,000 m while pulling/pushing a neutrally buoyant ruck using a tow strap. After swim, push ruck into a watercraft and pull self into watercraft.	✓	✓	

Table 3.1—Continued

		BA Specialties		
PTS Title	Description	PJ/CRO	CCT/STO and SOWT	TACP
Tire Change	While wearing a kit weighing 26–75 lbs, lift and place simulated tire weighing up to 85 lbs onto simulated vehicle mount (e.g., a rack on a wall at the same vertical height as a mount on a HMMWV).		✓	✓
Litter Carry Over Adverse Terrain	While wearing a kit weighing 26–75 lbs, carry simulated Israeli litter weighing up to 125 lbs up and down a 10-m ramp for a total of 50 m. At final ascent, place simulated litter on top of platform up to 7 ft above ramp.	✓		
T-Duck Carry to Aircraft	While in a dry suit and dive gear, carry a simulated T-duck package weighing up to 188 lbs for 40 ft. Next, push a 250-lb package on a pallet up to 10 m.	✓		
Jump Preparation	While wearing a kit weighing 26–75 lbs, walk 400 m to a simulated plane ramp. Step onto ramp and walk up 12-ft ramp. While on platform, sit down. On the mark, stand and walk onto an unstable platform. Stand on platform for 20 minutes.	✓		
Hold on Tow Bar or Risers	While wearing a kit weighing up to 25 lbs and a vest weighing up to 78 lbs, maintain a hanging position on a horizontal bar until exhaustion.	✓		
River Swim	While wearing a kit weighing 26–75 lbs with armor plates removed, boots, and a simulated weapon over the shoulder, complete a 100-m swim using breaststroke or sidestroke.		✓	
Moving Equipment	While wearing a kit weighing up to 25 lbs, lift and move two pelican cases weighing up to 100 lbs each onto the back of a truck bed. Carry one case at a time for a total of 20 ft.			✓

NOTE: The weights of kits (lbs) are rough guidelines. Prior to and during pilot testing, BA SMEs provided more detail on the items that go into kits for different missions and the collective weight of those items.

Step 2: Review PTSs to Identify Overlap Across Specialties and Offer Justification for PTSs

To ensure participants from earlier workshops had the opportunity to review the modifications to PTSs from later groups, we emailed the revised PTS list for each set of specialties (PJ/CRO, TACP, and CCT/STO-SOWT) to their respective participants. We asked participants to review the lists and comment on whether modifications would suit the needs of their specialties. By the end of the participants' review, eight of the 14 PJ/CRO PTSs, four of the five TACP PTSs, and seven of the nine CCT/STO-SOWT PTSs overlapped with at least one other specialty. This overlap can be seen in the last three columns of Table 3.1.

At the same time that we asked participants to review the modified PTSs, we asked them to offer justifications for the parameters of the PTSs. These justifications should be based on BA mission experience and official documents (e.g., tactics, techniques, and procedures manuals; Air Force instructions; after-action reports). Parameters included distances, routes, and terrain; types and weight of clothing and equipment participants will wear; and dimensions of objects encountered (e.g., walls) or manipulated (e.g., weight of simulated casualties that will be carried). The goal of this process was to ensure that the PTSs adequately reflect how the

CPTs could be performed in a mission environment and do not reflect "one-off" (i.e., very rare) versions of the CPTs.

After this step of the process was complete, we identified PTS features that still required justification or description. If the feature was minor, we worked with Neal Baumgartner's team to make decisions about what those features should be. Otherwise, we identified features to cover in discussions as part of Step 3.

Step 3: Validate PTS Content with Independent Sample of Experienced BA and Leaders

Because the PTS workshops consisted of small numbers of experts, we sought to validate the PTSs that the workshops created. We selected a content validation method by having other operators and BA leaders independently review and confirm that the PTSs accurately represent the CPTs they are designed to measure and adequately cover the BA physical performance domain, i.e., cover enough CPTs and future mission requirements identified by the BA community.

Interviews with BA Operators and Officers

We first conducted interviews with operators and officers across BA specialties. Senior leaders recommended participants from the major commands representing each specialty. Specifically, SNCOs and officers with operational deployment experience within the past seven years were requested for the interviews. Operators who participated in the PTS development workshops were ineligible for the interviews. We conducted one-hour phone interviews with 31 operators and officers in fall 2014. Interviewees included five CCTs, four STOs, three enlisted SOWT participants, one SOWT officer, seven PJs, three CROs, and eight TACPs. Except in one case, all enlisted interviewees were SNCOs. Except in one case, all officers were at the rank of major or below.

Prior to each interview, we sent each interviewee a document describing the goals of the interview, a list of CPTs linked to PTSs, descriptions (with diagrams) of the PTSs for his specialty, and a list of CPTs not covered by PTSs. Each document was tailored for each specialty, with the exception that similar enlisted and officer specialties (e.g., PJ and CRO) were combined. During an interview, we asked the interviewee to review the link between CPTs and PTSs to let us know if they saw any errors (missing CPTs or misclassified CPTs). Next, we asked the interviewee to review a specific PTS and describe whether it reflects the CPTs it is designed to measure and the physical movement patterns of the CPTs. We also asked for justification in the form of policy, doctrine, or other official documents for the types of equipment, distances, movements, and other factors used in the PTS. We further asked what would be appropriate ways to measure performance on the PTSs. Because of time constraints, we could not discuss all PTSs with each interviewee. We instead covered anywhere from one lengthy PTS to seven short PTSs (median number covered = 3). We arranged our interviews so that each PTS would be covered by each relevant specialty.[2] Finally, we asked the interviewee to review the list of CPTs not covered by any PTSs and identify whether any of the CPTs could be covered by PTSs.

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[2] Not all PTSs were relevant to each specialty. Therefore, we did not attempt to cover PTSs with interviewees from specialties for which those PTSs were not relevant.

Group Discussions with BA Leaders

After the interviews were completed, we held conference calls with BA leaders to discuss the PTSs. The primary goal of these discussions with leaders was to ensure the PTSs were not deficient in covering future mission capabilities for BA and did not measure skills that could be learned readily in training. A secondary goal was to gain leadership buy-in for the PTSs. We held four conference calls with leaders: STO (n = 7), SOWT officer (n = 2), CRO (n = 7), and ALO (n = 9). All participants were officers and ranged from first lieutenant through colonel. The ALO and SOWT officer groups, in particular, had higher representation of junior officers because of the limited availability of senior officers.

During each leadership discussion, the leaders were asked to review the same materials provided to the interviewees but with the addition of questions that we added based on the interview results. The questions were tailored to each PTS and focused on what BA leaders would expect operators to perform. For example, one type of question asked for leaders to specify the minimum number of operators they would expect to perform a particular task. These questions were designed as prompts for the discussion. We also asked the leaders to review the linkage of CPTs and PTSs to ensure that current and future capabilities were being adequately addressed by the PTSs.

Results of Three-Step Process

Based on the final step of our PTS development process, seven of the 18 PTSs were dropped from further consideration: Hold on to Tow Bar or Risers, Jump Preparation, Litter Carry Over Adverse Terrain, Moving Equipment, River Swim, T-Duck Carry to Aircraft, and Tire Change. Tire Change was recommended for elimination because of difficulties standardizing the task, disagreements about how the task is completed on missions, and agreement that the physical demands of this PTS were adequately covered by other PTSs. Jump Preparation, Litter Carry Over Adverse Terrain, Moving Equipment, River Swim, and T-Duck Carry to Aircraft significantly overlapped the physical abilities and movements covered by other PTSs and were thus recommended for removal. T-Duck Carry to Aircraft was also eliminated because it proved too difficult to simulate given that the task involved a team lifting a palletized load. Hold on to Tow Bar or Risers was dropped because it would prove difficult to simulate on dry land and conducting the simulation in water would cost too much in time and resources. Furthermore, the physical abilities (e.g., grip strength) required to perform this task were already represented by a combination of other PTSs.

In addition to PTSs being eliminated, the interviews and leadership discussions resulted in a new PTS and modifications to other PTSs. Some of the PTS names were also changed to reflect the nature of the CPT better. Interviewees identified the new PTS, Combat Rubber Raiding Craft Carry, as covering CPTs not covered by other PTSs. In this PTS, the participant will pick up the simulated combat rubber raiding craft, a 110-pound barrel with rubber handle, and move it 10 meters along a flat and open grass area, then 10 meters through a gravel pit, and another 10 meters along a grass area consisting of three short obstacles. The participant will then walk around a cone and return along the same route to the starting position (see Appendix B for a detailed description).

Many of the modifications involved changes in distances, lengths, and weights of objects. In some cases, the changes were significant. For example, Surface Fin Swim no longer included the movement into a watercraft and was shortened from 5,000 meters to 2,000 meters. In another example, the Swim to Inflatable Watercraft (formerly, Swim to Watercraft and Motor Mount) was updated to involved a slightly shorter swim but to also include underwater tasks to simulate tying knots under a watercraft in open water and swimming with a simulated casualty to approximate saving a casualty in open water. The final list of 12 PTSs is provided in Table 3.2.

Table 3.2
PTSs by BA Specialties

	BA Specialties			
PTS Title	**PJ/CRO**	**CCT/STO**	**SOWT**	**TACP**
Single Leg Vertical Rope Ascent	✓			
Rope Bridge	✓	✓	✓	✓
Airfield Operations	✓	✓	✓	
Rock and Ice Climbing	✓	✓	✓	
Remove Debris and Survivor from Confined Space	✓			
Cross Load Personnel and Equipment	✓	✓	✓	✓
Rope Ladder	✓	✓	✓	✓
Combat Rubber Raiding Craft Carry	✓	✓	✓	
Casualty Movement	✓	✓	✓	✓
Swim to Inflatable Watercraft	✓	✓	✓	
Surface Fin Swim	✓	✓	✓	
Small Unit Tactics with Casualty Movement	✓	✓	✓	✓

In a few cases, PTSs were dropped or added by certain specialties. For example, the CCTs and STOs dropped Single Leg Vertical Rope Ascent (SLVA) because of the rarity with which CCTs or STOs perform that type of task. Conversely, the PJs and CROs added Airfield Operations (formerly, Landing Zone Ops) to their list, citing the expectation that they be able to perform airfield operations tasks if on a team with CCTs and STOs that involved airfield operations activities. Detailed descriptions of the final versions of the PTSs are provided in Appendix B.[3]

In addition to finalizing the PTSs during Step 3 of the development process, we learned that all of the PTSs would be best measured in terms of completion, time to completion, and, for more complex PTSs, number of segments completed (e.g., completed three or four segments). The operators we interviewed did not think measuring specific behaviors for accuracy would be necessary because, in a mission environment, you fail if you do not finish the mission within the specified amount of time. Therefore, during the pilot-testing and validation phases,

[3] The 12 PTSs underwent modifications during the pilot-testing phase. Because of space limitations, we do not describe all of the PTS changes (mostly minor) in this report.

participant performance was measured in terms of completion and time to completion. For the more complex PTSs (longer, multiple activities), completion and times were taken for segments (e.g., the four parts of SUT with Casualty Movement). In cases where participants did not complete a task, the decision was made to document the amount of time they spent on the task and then mark them as non-completers for the task.

CHAPTER FOUR

Support to Pilot Testing and Validation

Pilot testing supplies a crucial link between PTS development and PTS use in a validation study. Pilot testing provides information that is part of a formative evaluation, or an evaluation to help form the final simulations (Thornton and Mueller-Hanson, 2004). The point of pilot testing is to get feedback from evaluators, participants, and others involved in administering the PTSs on what is working and what is not working. Participants can provide feedback on the clarity of instructions and difficulty of the PTS. Evaluators can comment on how well they are able to observe participants and how well the evaluation rating forms work. Evaluators and other experts involved with the PTSs can also comment on the utility of the PTSs, including how representative are PTSs of the aspects of job performance they are intended to measure.

This chapter focuses on our contributions to the Air Force's pilot-testing and validation phases. We do not offer a detailed description of all the pilot-testing and validation activities because those will be described elsewhere by the Air Force.[1] The goal of this chapter is to note how the PTSs were used and measures we developed and tested that would be used to ensure the PTSs were valid assessments of the CPTs for BA specialties. Our primary role during the pilot-testing phase was to provide support to the Air Force in collecting data and evaluating the representativeness of the PTSs and to develop a methodology for establishing MET standards for the PTSs.

Pilot-Testing Phase

To capitalize on the benefits of pilot testing, the Air Force pilot-tested 63 physical ability tests and 12 PTSs in March 2015. The 21 participants included 11 BA operators and ten BA trainees. Because the primary goal of the pilot was to ensure that the PTSs were representative of operational tasks, women were not included in the pilot testing. Among the BA operator sample, two to three participants represented each enlisted BA specialty. The officer specialties of CRO and STO had one participant each.

During the pilot-testing phase, the Air Force assessed PTS performance, the functionality of PTS equipment (e.g., ladders), and the administration of the PTSs (order of PTSs, length of administration, directions given to participants). We do not provide a review of the Air Force's pilot-testing work. We do note, however, that several adjustments were made to the

[1] Please contact AF-ESU (AFPC/DSYX) for additional details or questions about the pilot-testing phase (current point of contact is Neal Baumgartner).

PTSs as a result of pilot testing—consistent with the purpose of conducting the tests. Many of these adjustments were a result of direct feedback from operators going through the PTSs.

The adjustments fall into three broad categories: PTS parameters (distance, length, weight of objects), equipment, and standardization. PTS parameter issues typically involved changes to the distance of movements and weights of objects being handled or worn by participants. For example, operator feedback on the distance for climbing a rope ladder resulted in an adjustment from 30 feet to 20 feet. Moreover, the weight of the ruck that the participants had to wear while climbing the rope ladder proved too heavy, so a lighter ruck was used. Equipment changes generally involved making sure objects in the simulation were more closely in line with those encountered on BA missions. For example, during the Swim to Inflatable Watercraft PTS, operators noted that the simulated casualty's legs would sink and drag on the bottom of the pool, unlike the legs of a real casualty. As a result, additional flotation was applied to the simulated casualty's legs to make it more buoyant.

The third category of adjustments involved threats to standardization, often a result of equipment issues. For example, the simulated casualties (dummies) meant to be used for the fireman's carry tasks did not have flexible torsos, making them difficult to manipulate and lift from the ground. As a result, the dummies were placed on short platforms. The participant would sit on a bench next to the platform and members of the Air Force pilot-testing team would maneuver the dummy onto the shoulders of the participant. A related issue with this activity was that not all participants could stand up after the dummy was placed on their shoulders. The Air Force team running the pilot tests decided to assist participants who could not stand on their own. In such cases, a note was made of those who needed assistance, which was recorded in the data sheets to further evaluate in statistical models.[2]

Our Data Collection and Evaluation

Type of Information Collected

During the first week of pilot testing, members of the RAND team observed operators performing the PTSs and tested a process of obtaining feedback from BA operators about the PTSs. To collect feedback from individual operators, a RAND team member approached each operator to ask him the following questions regarding the completed PTS:

1. Your time to complete [simulation name] was [time estimate provided by Air Force evaluator]. Please estimate how much time it would take for a minimally effective performer (successful but just above borderline) to complete this simulation.
2. How well does this simulation represent the physical demands of task(s) that you would be expected to perform in a mission environment? Please answer on a scale of 1–5, with 1 being "not at all representative," 2 being "slightly representative," 3 being "somewhat representative," 4 being "very representative," and 5 being "extremely representative."
3. What would you recommend changing to make the simulation better represent the physical demands of the task(s) you perform on missions?

The RAND team recorded the responses in a notebook. Later, we analyzed the responses on the representativeness ratings from Question 2. Information from the other questions was

[2] Contact AF-ESU (AFPC/DSYX) for more details on adjustments made during the pilot period and during the validation period of the effort (current point of contact is Neal Baumgartner).

used as a means to an end. Specifically, responses to the first question about METs was used as a starting point for group sessions on that topic (see next paragraph) and responses to the third question regarding changes to simulations were used to provide feedback to the Air Force team on ways to adjust the PTSs.

In addition to the individual operator assessments, we conducted six small group discussions with operators from the same specialty to determine whether the group could agree on a MET for completing the PTS under discussion.[3] These sessions lasted about 10 to 20 minutes. We began the session by telling them what estimates they each provided for the MET on the PTS (i.e., answer to Question 1 in the previous list). We then opened up for discussion the idea of coming to a consensus on a MET. We also asked them what type of information they used to anchor their estimate (e.g., used his own time to complete the PTS as anchor for other operators in the specialty).

Representativeness of PTSs

The representativeness ratings from the 11 BA operators are based on a 1–5 scale, as outlined in the previous section. A higher value reflects perceptions of greater representativeness of PTSs to the physical demands of BA missions. Table 4.1 provides the sample sizes, means, and standard deviations for representativeness ratings on each PTS during the pilot-testing phase. The PTSs

Table 4.1.
BA Operator Ratings of PTS Representativeness During Pilot-Testing Phase

PTS	Sample Size	Mean	Standard Deviation
SUT with Casualty Movement	11	4.82	0.40
Airfield Operations	11	4.73	0.47
Cross Load Personnel and Equipment	11	4.73	0.47
Casualty Movement	10	3.95	0.90
Rock and Ice Climbing	11	3.45	1.04
Remove Debris and Survivor from Confined Space	11	3.36	1.12
Swim to Inflatable Watercraft	11	3.27	1.56
Combat Rubber Raiding Craft Carry	11	3.18	0.98
Single Leg Vertical Rope Ascent	11	3.18	1.60
Rope Ladder	11	2.73	1.01
Rope Bridge	11	2.27	1.01
Surface Fin Swim[a]	5	2.10	1.14

[a] Surface Fin Swim is based on only five operators. Some operators' data were not able to be collected on the Surface Fin Swim; therefore, interpret results with caution.

[3] For purposes of this study, similar enlisted and officer specialties were considered together. Enlisted-officer pairings include: PJ and CRO, CCT and STO, SOWT enlisted and SOWT officer. In some cases, TACPs and ALOs are combined. However, ALOs were not part of pilot testing.

are listed in order of descending mean representativeness. Interpret the results for Surface Fin Swim with caution because they are based on five responses. Because of delays in operators completing this PTS, the RAND team could not collect information from all of the operators.

As shown in Table 4.1, all but three PTSs received average representativeness ratings above 3.0, meaning that operators felt that those nine PTSs were at least somewhat representative of the physical demands of BA missions. The three PTSs that received average ratings below 3.0—Rope Ladder, Rope Bridge, and Surface Fin Swim—were particularly challenging PTSs. Rope Ladder and Rope Bridge had the highest non-completion rates during testing. In addition, equipment challenges may have influenced the ratings for Rope Bridge in particular, which used a steel cable rather than the type of ropes used operationally. The steel cable was used to eliminate the need to recalibrate the tension and angle of the rope between each participant. Although this modification likely increased standardization, the change resulted in lower fidelity and subsequently lower ratings from operators.

Representativeness ratings did vary by BA specialty. In particular, TACP participants tended to have lower representativeness ratings. This is not surprising, given that most TACPs do not conduct special operations and therefore do not perform as many of the CPTs measured by these PTSs as the other specialties do. Table 4.2 provides the sample sizes, means, and standard deviations of representativeness ratings without the three TACPs included. Except for Surface Fin Swim, which did not include ratings from TACPs, all of the other PTSs' mean ratings increased and standard deviations decreased when TACPs are removed. Some PTSs saw large increases in mean representativeness ratings. For example, the mean representativeness rating for Rock and Ice Climbing increased from 3.45 to 3.75. Except for Rope Bridge and Rope Ladder, the PTSs starting with Rock and Ice Climbing are strongly linked to PJ/CRO CPTs, less so to CCT/STO and SOWT CPTs, and even less so (if at all) to TACP

Table 4.2
BA Operator Ratings of PTS Representativeness During Pilot-Testing Phase (TACPs not included)

PTS	Sample Size	Mean	Standard Deviation
SUT with Casualty Movement	8	4.88	0.35
Airfield Operations	8	4.75	0.46
Cross Load Personnel and Equipment	8	4.75	0.46
Casualty Movement	8	4.00	0.93
Rock and Ice Climbing	8	3.75	1.04
Remove Debris and Survivor from Confined Space	8	3.88	0.64
Swim to Inflatable Watercraft	8	4.00	1.07
Combat Rubber Raiding Craft Carry	8	3.38	0.74
Single Leg Vertical Rope Ascent	8	3.75	1.39
Rope Ladder	8	2.88	1.13
Rope Bridge	8	2.63	0.92
Surface Fin Swim[a]	5	2.10	1.14

[a] Surface Fin Swim is based on only five operators. Interpret results with caution.

CPTs. Conversely, three of the top four PTSs (exception: Airfield Operations) are strongly linked to TACP CPTs, as well as CPTs from other specialties. The strength of the ties to CPTs likely explains some of the differences between BA specialties, particularly between TACP and other specialties.

Group-Based Estimates of Minimally Essential Time

In all of the discussions of METs for a particular PTS, group members were able to come to consensus. However, the RAND team noted two issues that present challenges to interpreting the results of these group sessions. One challenge for interpreting these results is that different anchors were used to determine estimates. Some operators used their own performances on the PTSs as anchors, generally providing METs that are slower than their performance times. Other operators used the assumed performance of other operators they had known in training as an anchor. Yet other operators used their performance on similar tasks in training as an anchor. These different anchors were used within and across groups.

Another challenge with interpreting the results is that groups tended to satisfice to get a consensus in situations where the group members' estimates were very different initially. For example, in one group discussion with three operators, one operator provided a MET of 11 minutes and 30 seconds, another operator estimated 14 minutes, and the third operator estimated 18 to 20 minutes. The operator who offered the fastest time wanted to compromise, so he suggested 15 minutes to the group. However, the operator who initially offered the estimate of 18 to 20 minutes pointed out that he did not finish the PTS in 15 minutes but considers himself to be a successful operator. At this comment, the third operator offered 18 minutes to the group. The three settled on 18 minutes without much discussion.

Based on the time needed to conduct the sessions (minimum of 10 minutes) and the questionable validity of the results following the group meeting, the RAND team and the Air Force team conducting the validation effort decided not to continue the group discussions during the main validation phase. The specific procedures used to establish METs for the validation study are discussed in detail in Chapter Five.

Validation Phases

After pilot-testing analyses were completed, the AF-ESU, with our assistance, discussed pilot-testing results with BA senior leaders.[4] This discussion, along with the pilot-testing results, paved the way for the main validation phase, which began in April 2015 and continued through June 2015. The main validation phase involved 39 physical ability tests and the 12 PTSs from the pilot-testing phase (but with adjustments made based on the pilot-testing results, as described in the previous sections). Our role in executing the validation phase was limited. One of our main contributions was to help the Air Force with its sampling strategy.

For this validation phase, the Air Force wished to have a large enough sample size to conduct regression models to empirically link performance on the physical ability tests (e.g., 1.5-mile run) with performance on the PTSs (e.g., completion of the rope ladder PTS). Based

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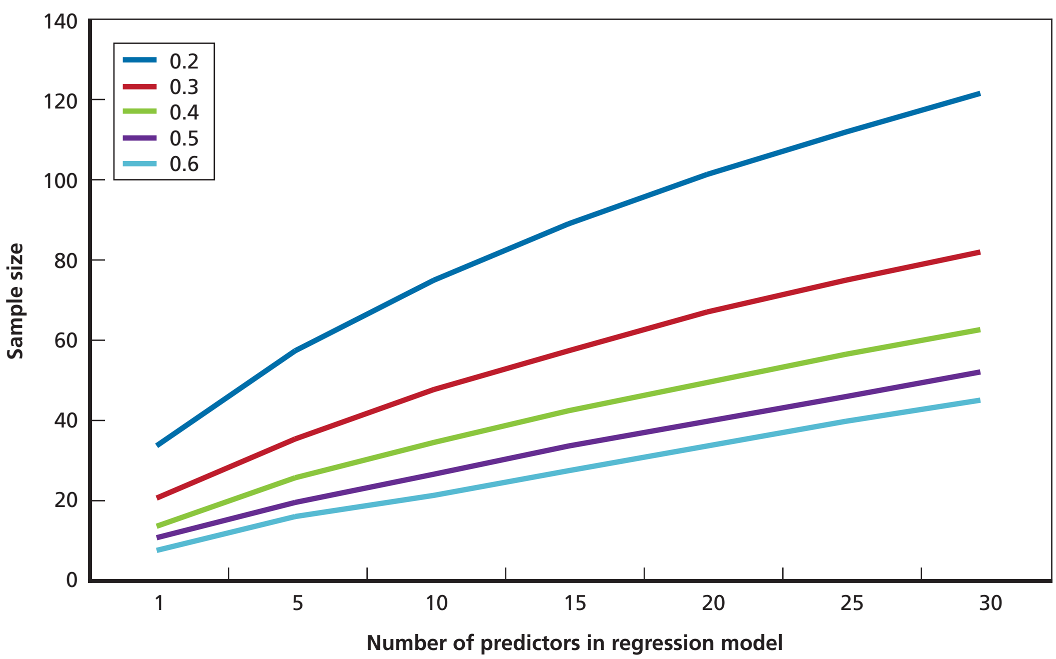
[4] Air Force researchers from the AETC Studies and Analysis Squadron conducted the statistical analyses evaluating the tests considered during the pilot phase. For more information about the analyses or specific tests considered, please contact the Air Force's leader of the validation process (Neal Baumgartner with the AF-ESU [AFPC/DSYX]).

on analysis of the statistical power required to detect multiple regression model effects using a conservative effect size estimate (R-squared value) of 0.20,[5] we recommended that 150 to 200 participants should be included in the validation tests. Statistical power analyses can be used to estimate the minimum sample size (i.e., number of participants) needed to have a reasonable probability of success in detecting a parameter's effect (Faul et al., 2007; Faul et al., 2009). Specifically, statistical power analyses require making decisions on what will be considered a reasonable probability of success (i.e., power), the statistical test criterion (i.e., how unlikely a result must be to reject the null hypothesis of no effect, referred to as "alpha"), and the magnitude of the overall effect of the predictor factors expected in the population (i.e., anticipated effect size). In our analyses, we assumed an 80-percent power, 0.05 alpha, a range of R-squared values from 0.20 to 0.60,[6] and models that would include multiple predictors (i.e., at least one physical fitness test and at least one participant characteristic, such as gender). As seen in Figure 4.1, an effect size of 0.20 with five predictors would require a sample size of 58; however, we recommended a larger sample size to account for potential subgroup analyses (e.g., model differences between men and women) and anticipated non-completions.

Figure 4.1
Power Analysis Results



SOURCE: Authors' analysis.

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5 For a multiple regression model, R-squared provides an estimate of the amount of variance in the outcome scores that is explained by the predictors in the model. R-squared values range from 0 to 1, with higher values indicating more variance explained. An R-squared value of 0.20 means that 20 percent of the variance in outcome scores is explained by the model predictors.

6 Our R-squared estimates were based on meta-analytic estimates of the average size of relationships between physical strength tests and work simulation criteria (Anderson and Robson, 2013).

Using this guidance, the Air Force tested 171 participants on a range of physical fitness tests and each of the PTSs (see Appendixes C and D for administrator checklists and score sheets developed by the Air Force for use in the validation study). The Air Force made a concerted effort to sample specific subgroups (BA operators, male non-BA, and female non-BA) to ensure the validation results could be generalized to potential future candidates for BA specialties. Participants included BA operators (n = 55) and non-BA trainees (n = 53 male participants, n = 63 female participants).[7] Table 4.3 provides a description of research participants' age and gender for each AFSC. Compared with BA operators, non-BA trainees have less familiarity with the tasks represented by the PTSs and, in general, have lower levels of physical ability. Although the sample sizes for specific subgroups of non-operator men and women is slightly lower than what is typically observed in personnel selection research (Aguinis et al., 2005), the sample sizes should be large enough to detect moderate to large gender effects that would influence how well the regression models work for both men and women.

Nonetheless, we recommend that the Air Force further examine the percentage of successful classification rates for both men and women once the test standards have been identified. This step requires calculating percentages of men and women in four ways:

1. meets minimum physical test standards and met minimum standards on the PTS
2. meets minimum physical test standards but does not meet minimum standards on the PTS
3. does not meet minimum physical test standards but meets minimum standards on the PTS
4. does not meet minimum physical test standards and also does not meet minimum standards on the PTS.

The percentages can be aggregated to compare the overall classification rates for men and women.

Table 4.3
Description of Participants in Validation Study

AFSC	Gender	Number of Participants	Mean Age	Minimum Age	Maximum Age
CCT/STO	Male	13	31.38	24	41
PJ/CRO	Male	14	28.36	22	39
SOWT	Male	6	26.67	21	32
TACP	Male	23	27.91	20	44
Non-BA	Female	62	29.69	20	42
Non-BA	Male	53	27.04	18	45

[7] The data for one female participant were dropped because of lack of motivation as evidenced through test administrator observations and her PTS performance was a significant outlier.

As part of the data collection efforts during the validation phase, the Air Force collected ratings on the representativeness of each PTS from the operators participating in the study (Table 4.4). The same 1–5 point scale used in the pilot phase was also used in the validation phase. Representativeness ratings were on average .57 points higher compared with ratings collected during the pilot phase. Higher representativeness ratings were expected to some extent because of changes made to the PTSs during the pilot phase. Overall, the pattern of ratings provides moderate to strong evidence that the physical demands required by the PTSs were a reasonable approximation of the physical demands experienced by operators during missions with these types of CPTs.

We also explored the number of participants completing each PTS as a check for the appropriate level of difficulty (Table 4.5). With the exception of the Rope Bridge and Rope Ladder PTSs, the majority of BA operators completed each PTS. We discuss some of the limitations specific to the Rope Bridge PTS below. The patterns of completion for the Rope Ladder PTS were discussed with BA career field managers and the AF-ESU, which suggested completion rates might reflect a combination of individual ability and occupational specialty strengths. For example, PJs/CROs may train more frequently on climbing tasks, which could have contributed to their higher completion rates on the Rope Ladder.

Following the main validation phase, the Air Force team conducted an additional validation check on the effects of fatigue on performance on the physical ability tests. The Air Force team led by Neal Baumgartner attended two full mission profiles, which are training events that prepare operators to perform specific BA missions. We did not participate in this additional validation effort.

Table 4.4
BA Operator Ratings of PTS Representativeness During the Validation Phase

PTS	Sample Size	Mean	Standard Deviation
SUT with Casualty Movement	54	4.67	0.43
Airfield Operations	55	4.64	0.60
Cross Load Personnel and Equipment	54	4.62	0.71
Casualty Movement	55	4.63	0.46
Rock and Ice Climbing	55	3.80	0.79
Remove Debris and Survivor from Confined Space	55	4.08	0.84
Swim to Inflatable Watercraft	51	3.87	0.77
Combat Rubber Raiding Craft Carry	55	3.55	1.04
Single Leg Vertical Rope Ascent	55	3.70	0.97
Rope Ladder	55	3.78	1.11
Rope Bridge	55	3.47	1.07
Surface Fin Swim	50	3.76	1.09

Table 4.5
Number of Participants Completing Each PTS in the Validation Phase

	PJ/CRO		SOWT		CCT/STO		TACP		Non-BA Male Participants		Non-BA Female Participants	
PTS	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**
Single Leg Vertical Rope Ascent	0	14	0	6	1	12	2	21	17	36	27	36
Rope Bridge	8	6	3	3	6	7	17	6	43	10	60	3
Airfield Operations	1	13	0	6	0	13	0	23	5	48	53	10
Wall Climb and Haul	0	14	1	5	7	6	10	13	30	23	46	17
Part A–Wall Climb, Ascent	0	14	1	5	7	6	10	13	30	23	44	19
Part B–Wall Climb, Haul	0	14	0	6	0	13	0	23	0	53	22	41
Remove Debris, Survivor from Confined Space	0	14	0	6	0	13	0	23	0	53	0	63
Cross Load Personnel and Equipment	2	12	1	5	4	9	12	11	30	23	61	2
Rope Ladder	3	11	4	2	7	6	18	5	49	4	62	1
Combat Rubber Raiding Craft Carry	0	14	0	6	0	13	0	23	4	49	39	24
Casualty Movement	0	14	0	6	0	13	1	22	7	46	46	17
Part A–Casualty Movement Fireman's Carry	0	14	0	6	0	13	1	22	6	47	46	17
Part B–Casualty Movement Sled	0	14	0	6	0	13	0	23	1	52	1	62
Swim to Inflatable Craft	0	14	0	6	0	13	1	22	1	52	11	52
Surface Fin Swim	0	14	0	6	0	13	0	23	4	49	5	58
SUT Total	1	13	0	6	0	13	2	21	14	39	55	8
SUT Part A–Ruck March	1	13	0	6	0	13	2	21	1	52	5	58
SUT Part B–Reaction Course	1	13	0	6	0	13	2	21	7	46	32	31
SUT Part C–Maneuver Course	1	13	0	6	0	13	2	21	7	46	52	11
SUT Part D–Casualty Movement	1	13	0	6	0	13	2	21	11	41	39	23

NOTE: Shaded rows indicate the primary PTS for PTSs with multiple segments.

Although we offered guidance to the Air Force on analysis of the validation data, the final models were developed by the Air Force. Information on these analyses can be obtained by contacting AF-ESU (AFPC/DSYX).[8]

Limitations of the Validation Study

We observed a number of limitations in the validation study that should be considered when evaluating the predictive validity of the fitness tests and when designing future validation studies. Ideally, interrater reliability for evaluators (i.e., timers) and test-retest reliability for each PTS would be established during the pilot testing. However, because of the time required to complete each PTS coupled with the necessary modifications, there was insufficient time and available participants to conduct a test-retest reliability study to ensure consistency of individual performance on a PTS (i.e., take similar amount of time to complete on two or more trials).

Interrater reliability also was not computed for similar reasons. The AF-ESU had a limited number of personnel assigned to its team for conducting each phase of the study. Assigned personnel needed to ensure that all stations were covered and that research participants' safety was maintained. Furthermore, the research team instituted a timing protocol that would minimize possible variability in timing. Specifically, all timers were trained by Neal Baumgartner, who "walked" through each event with specific instructions for when timing begins and ends for each segment. Neal Baumgartner also had considerable oversight through the entire study, ensuring that factors that could have influenced an individual's performance was recorded and further explored during the analysis of the results. Even if a timer misinterpreted exactly when to stop one segment and begin the next, the variation would be minimal (e.g., seconds) compared with the overall time required to complete a PTS. These arguments are further supported by the results, consistent with prior research, demonstrating strong correlations between fitness tests and PTS performance. Any unreliability in timing would result in an underestimate of the validity coefficients. Although we cannot be certain that some timing anomalies did not occur, any effects of these potential anomalies would not affect the general findings from the study.

There may also be a question of how motivated the research participants were to give their maximal effort throughout the two weeks of testing for each participant. Although we cannot guarantee that all the research participants were fully motivated all the time, the test administrators only noted one participant who consistently appeared to lack the motivation to try very hard. This individual's data were removed from further analysis as the data were also found to be a consistent outlier in the time required to complete the PTSs. The research participants were also volunteers and could have withdrawn from the study at any time. Consequently, the test administrators and Air Force study lead generally found that motivation levels to perform well were quite high.

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8 The current point of contact at the AF-ESU (AFPC/DSYX) is Neal Baumgartner.

CHAPTER FIVE

Setting Standards for BA Physical Performance

Participants' physical performance in the validation study ranged along a continuum from highly ineffective to highly effective. For example, some research participants were unable to lift a simulated casualty during the Cross Load PTS. Other participants were able to lift the casualty but took a very long time to complete all phases of the PTS, and some completed all phases of the PTS very quickly. Although measuring performance on a continuum can serve many objectives, including research purposes, decisionmakers often have to determine whether the task was performed at an acceptable level. Indeed, establishing pass/fail cutoffs is an important step in the process to identify which physical fitness tests and standards are most effective in distinguishing between successful and unsuccessful performers.

Using SMEs to establish cutoff scores is a widely accepted practice across a range of industries (e.g., Cizek, 2012). However, there is no gold standard for translating or aggregating SME inputs into a single cutoff score that differentiates successful from unsuccessful performance. Furthermore, much of the research on standard setting has been conducted with the purpose of identifying a minimally acceptable score on a written test (e.g., qualification exam). Therefore, to assist the Air Force in identifying minimally acceptable scores for the PTSs, we developed a procedure that integrates information from multiple sources. Specifically, we combined information on operator performance times in the validation study with operator estimates of minimally acceptable PTS times and presented the combined information to senior leaders (e.g., career field managers) in a series of workshops. The senior leaders were asked to arrive at PTS times for minimally acceptable performance. This workshop and the sources of information are described in more detail in the remainder of this chapter.

Information Provided to Senior Leaders

Estimates of Minimally Acceptable Performance

Previous research on setting performance standards has emphasized the importance of defining a minimally acceptable performer (Plake and Cizek, 2012). As previously mentioned, few research studies have extended these concepts for use in developing standards for physical test performance. One notable exception is a study by Sothmann et al. (2004) that was designed to establish minimum performance standards for entry-level firefighters. To identify minimally acceptable performance on a fire suppression task simulation, the researchers developed videotapes of a firefighter performing the simulation at various paces. A sample of firefighters was then selected to judge the acceptability of the pace of performance demonstrated in each video. The minimally acceptable pace was selected as a pace that approximately half of the judges (firefighters) indicated was acceptable, which corresponds to a pace that is one standard deviation slower than the average firefighter completing the fire suppression task simulation in the study.

Although there is considerable value in using an independent panel of judges as SMEs to observe varying paces of performance in establishing a minimally acceptable pace, the number of task simulations and time required of judges to evaluate performance levels was not feasible in the current study.[1] Therefore, we adapted this approach by asking operators participating in the study to estimate the time required by a minimally acceptable operator to complete each PTS. This approach might introduce the potential for biased estimates, as we expected operators would be highly unlikely to judge their own performance on a task simulation as unsatisfactory. That is, few operators were expected to provide estimates of METs faster than their own performance times. An examination of actual times and estimates provided in the study confirmed this expectation. Approximately 96 percent of operators provided METs that were slower than their own performance times. The average MET was approximately 1.4 times slower than the average performance time across the PTSs. Slower estimates are not a problem to the extent that METs represent a level that distinguishes a minimally acceptable operator from an unsuccessful operator, and that operators providing METs represent a sample of operators currently successful on the job. In other words, the minimum standard for a PTS should not be set at a level that would eliminate a substantial percentage of currently successful operators.

Using operators from the research study to provide METs results in at least two other benefits. First, the PTSs used in the current study are both time-intensive and complex, making it important to gather estimates from operators who completed each PTS. Using their own performance as a frame of reference, the operators could take into account their own levels of motivation, how hard they pushed themselves, and whether their performances were affected by external factors, such as a minor injury. Second, operators selected for the study had performed these types of tasks either in the training pipeline or operationally and were considered the best source of information while taking into account how performance can be affected by study design limitations. For example, the Rope Bridge PTS was designed using a steel cable, rather than the ropes used in an operation, in order to increase standardization; a steel cable eliminates changes in the amount of slack an operational rope would likely incur over time. Operators could take the difference between the steel cable and rope into account if they felt it affected their performance times.

Actual PTS Performance Times

A second critical source of information for establishing minimally acceptable PTS performance times was the distribution of PTS performance times from operators who participated in the validation study. Performance distributions from current employees are often used as a benchmark to set standards using a norm-referenced approach. Using such an approach, minimum PTS times would be set at a level corresponding to the percentage of current employees

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[1] The time required to view all PTSs at one selected pace could take up to six hours and potentially up to 24 hours to observe four selected paces for all PTSs. In contrast, the Sothmann et al. study (2004) used one task simulation that required about 10 minutes of time to view one video. Some PTSs in the Air Force study were particularly long (e.g., Surface Fin Swim) and may not require judges to observe the full PTS. However, methods for identifying how much of a PTS needs to be observed to ensure reliable judgments are not currently available.

considered successful. For example, if 90 percent of current operators were considered successful then the corresponding minimally essential PTS time would be set at the 10th percentile—the bottom 10 percent would be considered unsuccessful.

When used as the sole source of information, a norm-referenced approach has some important limitations. In particular, assumptions must be made about how well the operators participating in this study represent the entire population of successful operators. If the operators in the study are, on average, more physically fit than other successful operators, the PTS standard might be set too high. In contrast, if the operators in the study are less fit on average, then the PTS standards might be set too low. Despite these limitations, how well operators performed on each PTS provided an important source of information to guide the development of PTS standards. Scientific and professional guidelines specify that "[c]utoff scores should be consistent with normal expectations of acceptable proficiency with the work force" (Cascio, Alexander, and Barrett, 1988, p. 22). Given that the operators recruited for the study were selected from among those considered fully qualified, it follows that their PTS times would serve as an important source of information for specifying a level of acceptable proficiency on each PTS. However, feedback from at least one of the operators during the study indicated that they were recovering from an injury; therefore, some of the average times may be somewhat slower than expected.

The average times for each BA specialty and the non-BA participants are provided in Table 5.1. The times provided represent the average times only for those participants who fully completed that specific PTS. Consequently, some average times are based on a very few participants who were able to complete the PTS (e.g., Rope Ladder). Overall, the pattern of performance times is consistent with expectations regarding occupational specialty strengths in addition to gender differences. As expected, the BA operator times were faster than non-BA research participants on almost all of the PTSs. Also, as expected, the male research participants were faster across all PTSs. It is important to avoid generalizing these times to the broader population of either BA or non-BA. Because of the time commitments required by this study, the research participants are not likely a representative sample from these different subgroups.

Senior Leader Decisions for PTS METs

Workshops

We held a series of sequential workshops with groups of senior leaders representing each occupational specialty.[2] The purpose of each workshop was to present information on operator estimates of METs, as well as the distribution of operator times for each PTS. To facilitate the presentation of this information, we provided density plots for the target career field compared with all BA operators who completed the PTS. An example of a density plot for the SLVA PTS is provided in Figure 5.1. The plot also included the average time to completion for operators in the target career field (represented by a vertical green line) and a range of METs from the 90th percentile to the 50th percentile (represented by two dotted purple lines). The 90th percentile was selected to eliminate outliers (extreme slow estimates). The 50th percentile was selected for presentation as faster estimates increased the probability of potentially setting the standard too

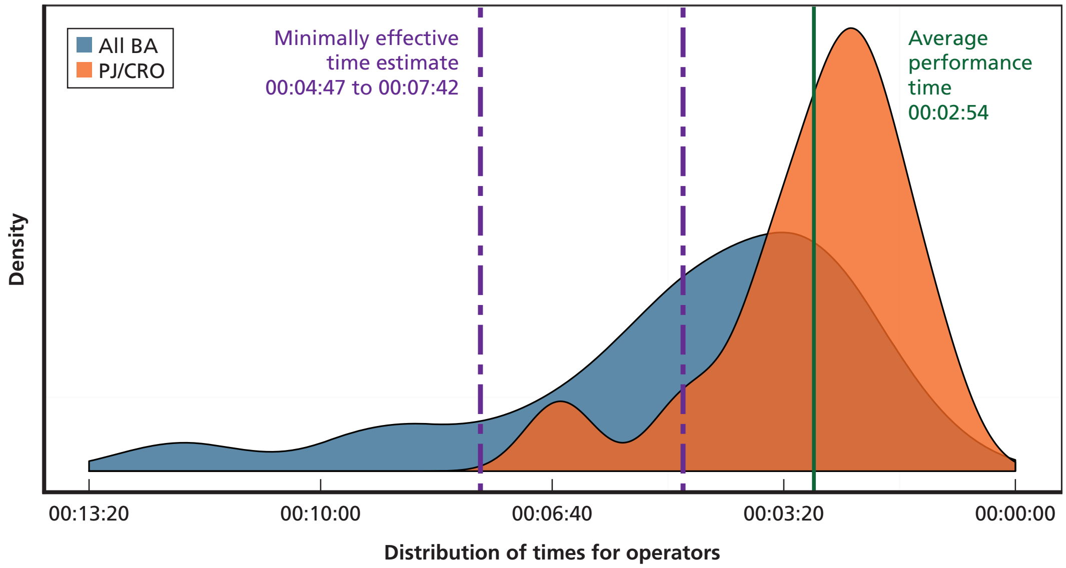
[2] Matching enlisted and officer specialties (e.g., PJ and CRO) were in the same workshops.

Table 5.1
Average PTS Times by AFSC

PTS	PJ/CRO	SOWT	CCT/STO	TACP	Non-BA Male Participants	Non-BA Female Participants
Single Leg Vertical Rope Ascent	0:02:56	0:06:20	0:05:02	0:05:34	0:06:12	0:10:10
Rope Bridge	0:01:00	0:01:14	0:00:52	0:01:06	0:01:14	0:02:33
Airfield Operations	0:26:10	0:27:03	0:25:42	0:26:34	0:28:38	0:36:18
Wall Climb and Haul	0:04:51	0:06:57	0:07:18	0:05:47	0:06:54	0:12:35
Part A–Wall Climb, Ascent	0:02:46	0:04:40	0:05:05	0:03:36	0:03:53	0:06:26
Part B–Wall Climb, Haul	0:02:05	0:02:11	0:02:13	0:02:47	0:03:55	0:07:29
Remove Debris, Survivor from Confined Space	0:01:31	0:01:05	0:01:33	0:01:38	0:02:05	0:04:02
Cross Load Personnel and Equipment	0:01:49	0:02:41	0:02:10	0:02:19	0:02:45	0:05:39
Rope Ladder	0:00:47	0:01:29	0:01:20	0:01:18	0:00:50	0:05:31
Combat Rubber Raiding Craft Carry	0:00:54	0:00:56	0:00:52	0:01:07	0:01:31	0:07:22
Casualty Movement	0:07:07	0:07:53	0:07:22	0:07:26	0:07:46	0:11:38
Part A–Casualty Movement Fireman's Carry	0:01:49	0:01:56	0:01:52	0:01:50	0:02:01	0:03:11
Part B–Casualty Movement Sled	0:03:17	0:03:57	0:03:24	0:03:36	0:04:08	0:07:34
Swim to Inflatable Craft	0:10:02	0:10:18	0:10:32	0:12:11	0:12:49	0:14:59
Surface Fin Swim	0:56:02	0:54:26	0:54:53	1:07:20	1:09:08	1:17:50
SUT Total	1:09:42	1:13:34	1:09:35	1:10:31	1:17:10	1:45:28
SUT Part A–Ruck March	0:48:00	0:50:21	0:46:19	0:47:00	0:51:41	1:06:41
SUT Part B–Reaction Course	0:06:32	0:06:56	0:07:05	0:07:37	0:09:00	0:16:47
SUT Part C–Maneuver Course	0:04:22	0:04:58	0:04:57	0:04:50	0:06:33	0:10:58
SUT Part D–Casualty Movement	0:09:59	0:10:16	0:10:19	0:10:10	0:11:46	0:17:31

NOTE: Shaded rows indicate the primary PTS for PTSs with multiple segments.

Figure 5.1
Example Estimate of METs for PJ/CRO



SOURCE: Based on analysis of validation study data by authors.
NOTE: Vertical green line = average time to completion for operators in the target career field; two dotted purple lines = range of METs from the 90th percentile to the 50th percentile.

high as to misclassify successful operators as unsuccessful. The workshops resulted in a set of preliminary METs specific to each BA specialty and PTS.

Further Review and Modification of METs

Following the meetings, we provided senior leaders with a summary of the METs that they established for the PTSs during the workshops. The METs were specific to each PTS and specialty. Senior leaders were also provided with a spreadsheet containing PTS performance times at the 1st, 5th, and 10th percentiles in each career field. These percentiles were used to ensure PTS standards were not set at a level that would effectively disqualify a significant portion of currently successful operators in the career field. The total number of METs achieved was also computed and compared across the different groups of research participants (see Figure 5.2 to Figure 5.5). For example, Figure 5.3 shows that 24 non-BA research participants did not complete any PTSs to the CCT/STO MET. The CCT/STO research participants completed eight to 14 PTS segments to the CCT/STO MET. In general, these plots show that most of the BA from each specialty, with the exception of TACPs, were able to meet a majority of the METs for their own specialty. The relatively low number of TACPs meeting the desired METs may, in part, be a reflection of the fact that TACPs do not currently have annual fitness standards for their specialty. Nonetheless, further evaluation is needed to ensure that any predictive physical test standards based on these results are not only realistic but reflect required TACP task and mission requirements.

The METs were further reviewed and modified to ensure each career field's standards met requirements for interoperability. That is, senior leaders calibrated their performance expectations to ensure operators within their career fields would maintain the capability to perform in teams with operators from other specialties. For example, the standard for a ruck march may have been adjusted by one of more of the career field managers to ensure a common perfor-

Figure 5.2
Number of CCT and STO METs Achieved by Research Participants

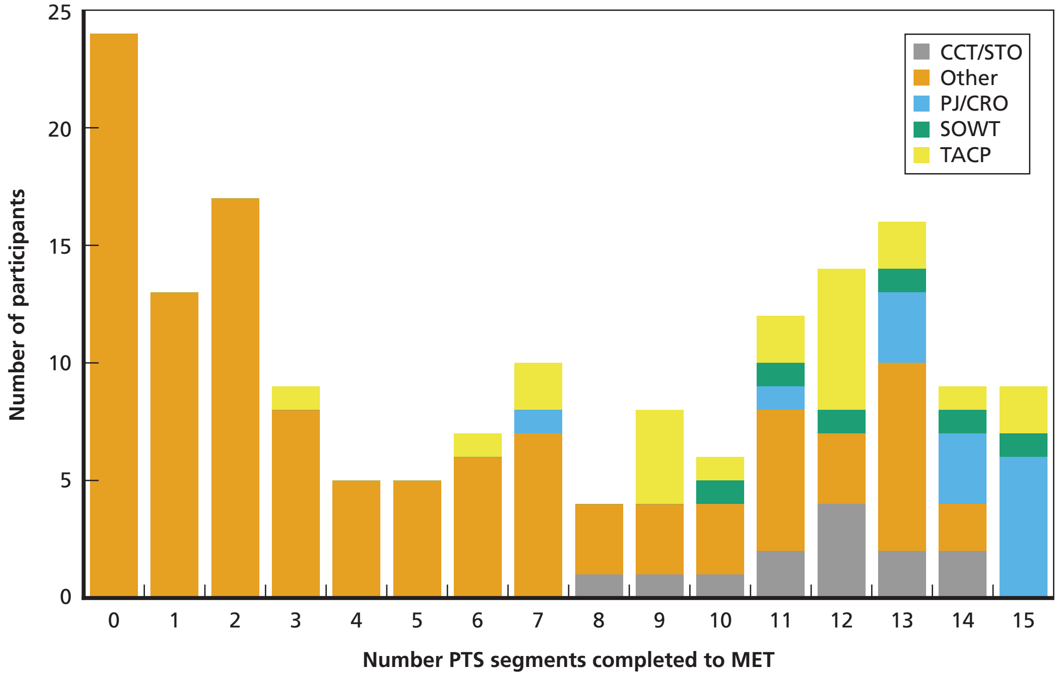


Figure 5.3
Number of PJ and CRO METs Achieved by Research Participants

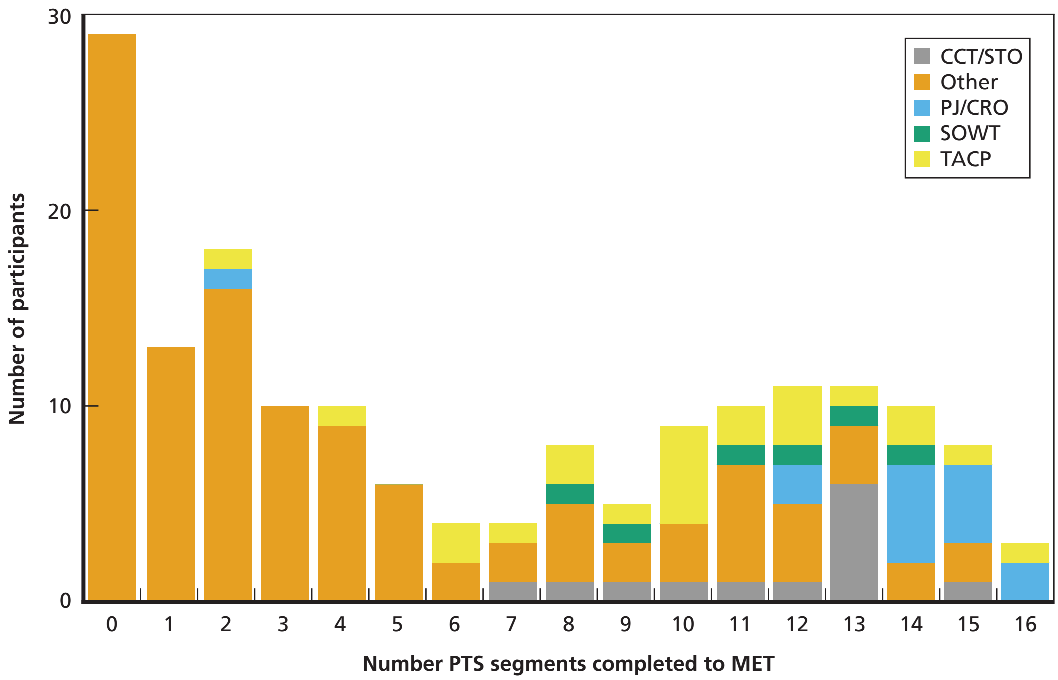


Figure 5.4
Number of SOWT METs Achieved by Research Participants

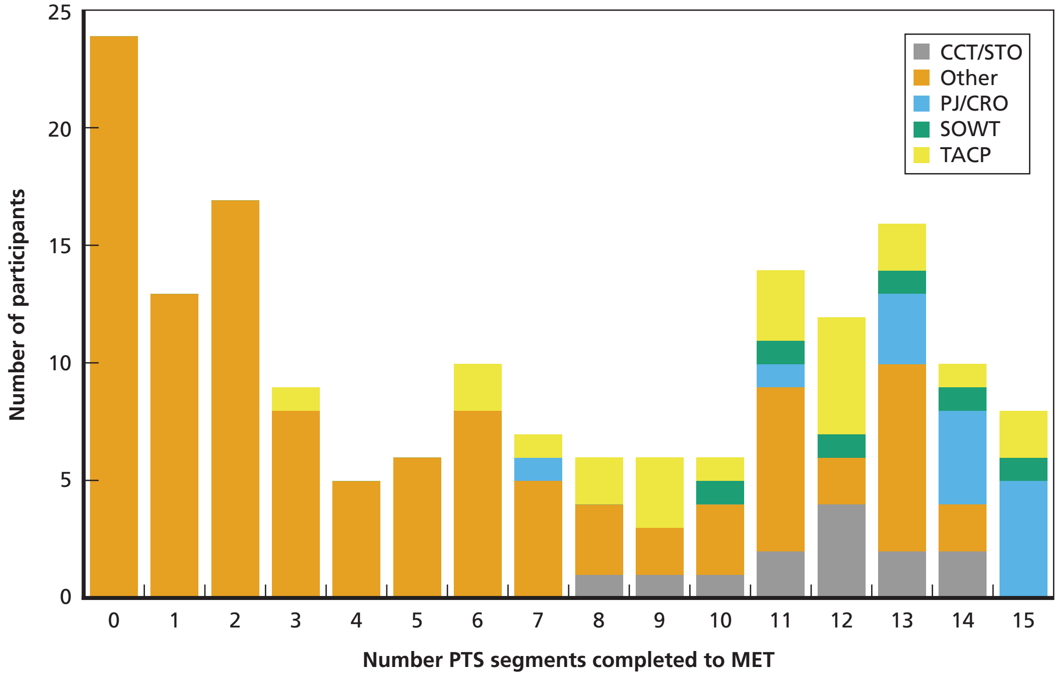
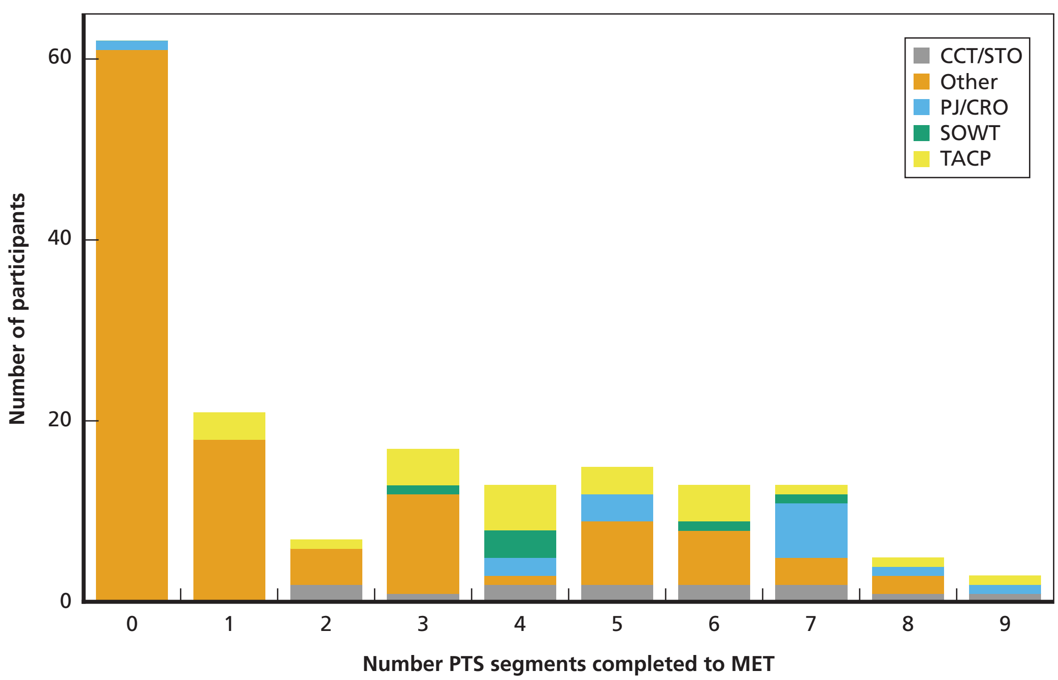


Figure 5.5
Number of TACP METs Achieved by Research Participants



mance expectation (i.e., MET) for members of a special tactics team comprised of operators from multiple specialties. Overall, only a few changes were made to the times decided during the senior leader workshops. The final PTS times are presented in Table 5.2.

Table 5.2
Physical Task Simulation Minimally Essential Times by AFS

PTS	PJ/CRO	SOWT	CCT/STO	TACP
Single Leg Vertical Rope Ascent	3:50	3:50	3:50	X
Rope Bridge	X	X	2:00	2:00
Airfield Operations	35:00*	35:00	35:00	X
Wall Climb and Haul	8:00	8:00	8:00	X
Part A–Wall Climb, Ascent	4:30	4:30	4:30	X
Part B–Wall Climb, Haul	3:30	3:30	3:30	X
Remove Debris, Survivor from Confined Space	2:15	X	X	X
Cross Load Personnel and Equipment	4:00	4:00	4:00	4:00
Rope Ladder	2:00	2:00	2:00	2:00
Combat Rubber Raiding Craft Carry	1:30	1:30	1:30	X
Casualty Movement	8:30	8:30	8:30	8:30
Part A–Casualty Movement Fireman's Carry	2:00	2:00	2:00	2:00
Part B–Casualty Movement Sled	4:30	4:30	4:30	4:30
Swim to Inflatable Craft	13:30	13:30	13:30	X
Surface Fin Swim	1:10:00	1:10:00	1:10:00	X
SUT Total	1:32:15	1:32:15	1:33:00	1:32:15
SUT Parts B+C+D	30:15	30:15	31:00	30:15
SUT Part A–Ruck March	1:02:00	1:02:00	1:02:00	1:02:00
SUT Part B–Reaction Course	10:30	10:30	10:30	10:30
SUT Part C–Maneuver Course	8:15	8:15	8:15	8:15
SUT Part D–Casualty Movement	11:30	11:30	12:15	11:30

NOTE: Shaded rows represent an overall PTS comprised of two or more subordinate parts. Senior leaders for the PJ and CROs later added a MET for Airfield Operations. This PTS was not originally tied to a PJ/CRO CTP, but it was identified as a required capability for interoperability; therefore, a MET has been added to this table for Airfield Operations, although analyses provided in this report did not include this PTS for PJ/CROs.
X = A PTS not relevant to that AFSC.
* = Senior PJ and CRO leaders later added a MET for Airfield Operations. This PTS was not originally tied to a PJ/CRO CTP but was identified as a required capability for interoperability; therefore, a MET has been added to this table for Airfield Operations, although analyses provided in this report did not include this PTS for PJ/CROs.

Next Steps: Identifying Test Standards

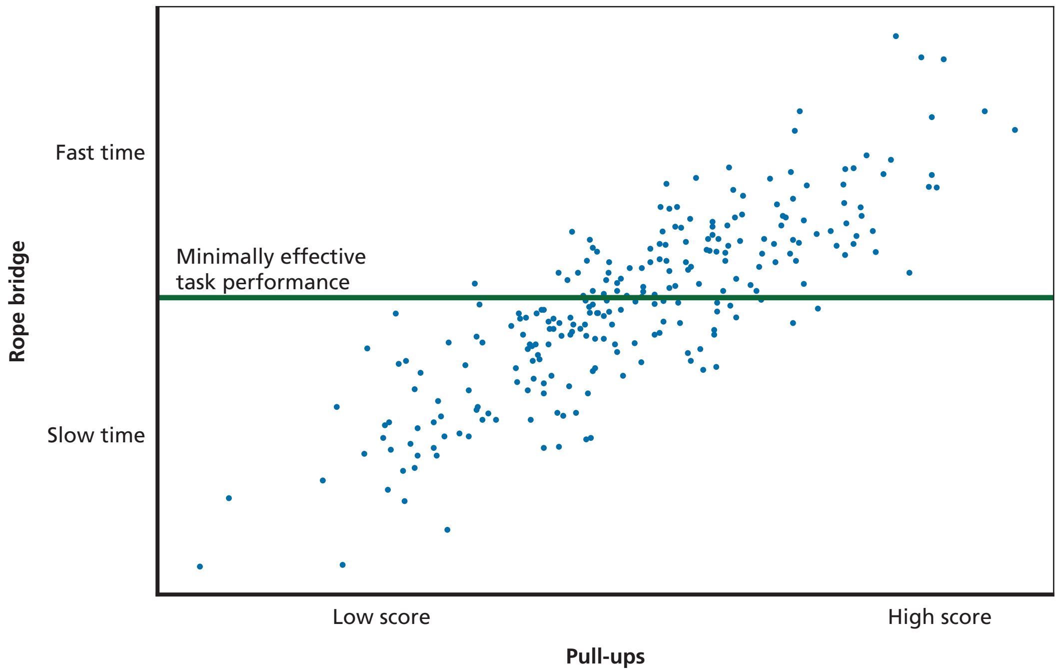
Using the METs as a benchmark to differentiate successful from unsuccessful performers, statistical analyses can be conducted to identify optimal test standards for maximizing the probability of successful performance. Although the steps in conducting these analyses are beyond the scope of this report, we present the basic concept and an example to demonstrate the importance of establishing the METs and how crucial they are to establishing effective test standards. The AF-ESU will be implementing similar steps in their process to evaluate and recommend occupationally relevant fitness tests and standards for BA specialties. The steps in developing standards for a full test battery are somewhat more complicated than what is discussed below and require further decisions on how to combine test scores to determine the physical readiness of an individual. Specifically, a decision needs to be made whether tests will be combined using a compensatory or a non-compensatory method, or some combination of both.

In a compensatory model, a composite predictor score that combines scores across different fitness tests is computed. More specifically, tests scores are first standardized to be on the same scale and then summed to form a composite using different weights for different fitness tests. The different weights are often determined using statistical procedures, which optimize the prediction of PTS performance. Rational weights determined using expert judgment are another option that may be considered to avoid complicated models that may not generalize well to a broader sample of participants. In either case, the weighting system should be further evaluated and tested to determine how well it predicts performance for the target population (i.e., BA operators). One of the major benefits of using a compensatory model is that it allows an individual with low scores on one test to compensate with higher scores on another test. Such a system makes sense when one ability (e.g., muscular strength) may help overcome, to some extent, a weakness in another ability (e.g., lower aerobic endurance). An alternative approach to differentially weighting tests is to provide equal weight to each test, which may be a better option when certain statistical relationships are observed (Guion, 1996).

In a non-compensatory model, minimum cut scores are set for each test. Therefore, an individual who fails to meet any test standard would not be classified as physical ready. Identifying the specific cutoffs can be a difficult task. Setting individual test standards too high can result in a high number of failures, especially when the tests are uncorrelated. Setting test standards too low does not allow for meaningful distinctions to be made between high and low levels of physical readiness. In practice, many organizations use some combination of multiple cutoffs and a compensatory approach to ensure that individuals do not score too low on any one fitness test. Discussions with the AF-ESU indicated that this approach may be particularly important in determining physical readiness to avoid imbalances between different abilities and regions of the body. Consequently, the Air Force will evaluate such a combined approach in the next stage of its research. Interested readers are referred to Guion (1996) for additional information on combining test scores.

Recognizing the complexities in establishing a valid operational test battery, we present a simple illustration of how standards might be set for an individual test. Figure 5.6 displays a hypothetical relationship between a fitness test (i.e., pull-ups) and a PTS (i.e., Rope Bridge). Each of the points in the plot represents an individual who completed fitness tests and PTSs in the hypothetical study. The general pattern in this plot shows that individuals performing more pull-ups tend to complete the Rope Bridge PTS faster than individuals who perform fewer pull-ups. The green horizontal line illustrates the MET for this PTS. Any individual

Figure 5.6
Hypothetical Relationship Between a Fitness Test and a PTS



below the green line was unsuccessful on the Rope Bridge; whereas, individuals at or above the green line would be considered successful.

Using the MET standard, it is possible to examine the effects of varying fitness test standards (e.g., ten pull-ups versus 15 pull-ups) on selecting individuals with a high probability of succeeding on a physical task. Figure 5.7 presents one scenario that establishes a pull-ups requirement that is very effective in selecting individuals who will likely succeed on this task (upper right quadrant) and minimizes the number selected who would perform poorly (bottom right quadrant). However, this requirement results in rejecting a high number of individuals who would likely be successful on the task (upper left quadrant). This is a simple demonstration of the potential trade-offs that may occur when setting test standards. The trade-offs should be considered in context of an organization's objectives. An ideal selection system would minimize or eliminate all possible incorrect decisions. One important step in achieving this goal is to select a combination of fitness tests that yield the highest validity. However, no combination of tests will perfectly predict successful and unsuccessful hires. Consequently, organizations must often decide which type of incorrect decision is less problematic. For example, a high percentage of missed opportunities may be especially problematic for undermanned career fields or for career fields that have difficulty recruiting potentially qualified applicants. On the other hand, selecting individuals who perform below a minimally acceptable level of performance (i.e., poor selections) may be particularly problematic when the consequence of poor performance is severe (e.g., potential loss of life) or for career fields that have no mechanism to address poor performance in training. Ultimately, weighing the consequences of a poor decision, either missed opportunities or poor selections, must be made by senior leaders who fully understand the risks.

Figure 5.7
Hypothetical Fitness Test Standard and Potential Outcomes

CHAPTER SIX

Conclusions

This report achieved several objectives to support the Air Force's efforts to examine the predictive validity of physical fitness tests and standards for BA. Specifically, we used well-documented scientific principles to establish a process for developing physical performance measures (i.e., PTSs) and facilitated the process for developing those measures, which would then be used by the Air Force to set occupationally relevant physical fitness tests and standards. Prior to the activities described in this report, the Air Force conducted an extensive job and physical demands analysis to develop CPTs for the BA specialties. The Air Force updated and expanded upon an initial job analysis study conducted by Robson et al. (2017) in FY 2012, by conducting a series of focus groups, observations, senior leader interviews, and a survey of more than 700 BA operators. Using the results from the survey, the Air Force identified CPTs by combining responses about each physical task along four dimensions: (1) repetition, (2) duration, (3) intensity, and (4) importance. A full list of the CPTs for each BA specialty is available on the U.S. Department of Defense website.[1]

With this analysis in hand, this report focused on our contributions to the development of performance measures for the validation study and standards for measuring results. The following points summarize our contributions and additional research that would benefit the Air Force's continued work in this area.

Based on a Review of the Scientific Literature, We Identified a Set of Five Principles for Designing Occupationally Relevant PTSs, Which the Air Force Adopted

Our research identified five important principles for developing a PTS:

1. Develop PTSs where effective performance is influenced by physical ability.
2. Develop PTSs that are representative of tasks, abilities, and mission types.
3. Standardize PTSs to the extent possible.
4. To the extent possible, PTSs should reflect how tasks are performed in actual mission environments.
5. Design reliable and accurate measurement of PTS performance.

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[1] For more information, see Department of Defense's (2015) "Physical Fitness Test and Standards for Battlefield Airmen Study: Executive Summary."

Guided by These Five Principles, PTSs for Each BA Specialty Were Designed to Approximate How CPTs Are Performed in a Mission Environment

We established and led a three-step process for developing PTSs that relied on input from SMEs in the BA community via workshops, post-workshop reviews, and small group interviews. The Air Force assisted in the development process and, with our guidance, selected 12 PTSs that represent the CPTs that BA must perform. The Air Force conducted a pilot test during which 11 BA operators—and 55 BA operators in the validation phase—systematically evaluated the representativeness of each PTS.

We Supported the Development of METs for Each PTS

Following the pilot and validation phase, we hosted a series of meetings and discussions with senior leaders to determine minimally acceptable levels of performance on each PTS. These METs were established following a thorough review of performance times on each PTS. To facilitate discussion and identification of an acceptable cutoff on each PTS, we presented and discussed performance time distributions of BA operators. This stage of the study was particularly important because setting PTS times too fast may subsequently result in setting the predictive physical test scores too high. On the other hand, setting PTS cutoff times too slow may subsequently result in increased operational risks because of insufficient physical readiness. Therefore, careful monitoring and follow-up will be needed to ensure physical readiness decisions correspond with observed operator performance in actual operational or training missions.

We Provided Guidance on How to Set Cutoff Scores for the Predictive Physical Ability Tests

We discussed several options for how the Air Force might combine test scores and develop minimum cutoff scores to balance costs and benefits of different cut points. Specifically, we demonstrated that as the cutoff point for a valid test increases, the percentage of successful selections also tend to increase. That is, a very selective physical ability test should yield a high probability of success on occupationally relevant physical tasks. However, a very selective cutoff point will also result in a cost—there will be missed opportunities through rejections of individuals who would otherwise be capable of performing occupationally relevant physical tasks. This trade-off is common to all tests, but can be minimized by selecting the combination of tests that have the highest correlation with performance (i.e., test battery with the highest predictive validity). Even when the validity is high, the Air Force must consider the risks of each type of decision error (e.g., rejecting potentially good operators versus sending potentially unfit operators on a demanding mission).

Future Research

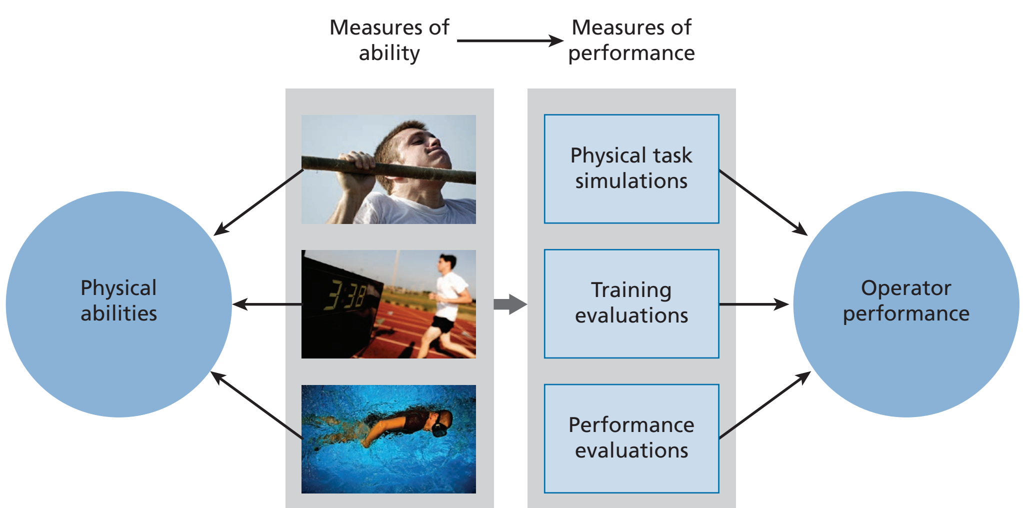
The PTSs and associated occupational standards will serve as a strong foundation for evaluating whether airmen can meet the physical demands of the BA specialties. However, we recommend that the Air Force conduct additional research in several areas.

Explore Development of Other Measures of Physical Performance

Although the PTSs were found to be reasonable approximations of the physical demands required to successfully perform the CPTs required by operators, there are at least two additional performance measures that should be included in future studies. As illustrated in Figure 6.1, training evaluations and performance evaluations can be used to provide additional validation evidence for tests, standards, and other personnel decisions affecting BA.

Currently, both of these types of performance measures are used to evaluate BA trainees and airmen but are deficient in ways that would limit their usefulness in a validation study. For example, training evaluations often use a dichotomous measure (pass/fail) that does not allow for discrimination in performance levels among those who pass or among those who fail. Similarly, annual performance evaluations in the Air Force do not distinguish very well between airmen who may be performing at different levels. Moreover, current performance evaluations are generic and not tied to the specific job requirements of each BA specialty. That is, the specific performance attributes (e.g., stress tolerance) and CPTs are not sufficiently measured. Therefore, future studies attempting to expand the performance domain in a validation study should consider developing new performance and training measures specific to the study's purpose that target performance on relevant physical tasks and encourage evaluator's to accurately distinguish between airmen who perform at different levels.

Figure 6.1
An Expanded Model Linking Physical Abilities to Operator Performance



SOURCE: Photos courtesy of the Department of Defense.

Examine the Relationship Between Physical Ability Test Performance and Other Important Organizational Outcomes

Although this study provides the foundation for addressing a number of crucial issues related to setting standards on predictive physical tests, there are many other issues that should be further explored. Specifically, the Air Force should consider addressing the following questions in future research:

- How do scores on the predictive physical tests correlate with other important organizational outcomes, such as injuries, promotion rates, and retention?
- How can individuals best prepare physically for testing and training in each specialty?
- How can individuals best prepare to perform the CPTs in each specialty?
- How much do individuals' scores on the predictive physical tests change over time and the course of their careers?
- Does individuals' improvement on the predictive physical tests correspond to improvement in performance on occupationally relevant physical tasks?

The Air Force is encouraged to explore such questions and periodically reexamine its physical readiness standards to help ensure operators are physically prepared and capable of performing occupationally relevant CPTs. For example, the Air Force may find changing cutoffs for entry-level training can mitigate certain injuries, increase training efficiency, or increase operator physical readiness.

Summary

The Air Force's validation study, with our guidance and assistance, provided a set of performance measures (PTSs) and performance standards (METs) that can be used to evaluate the physical capabilities required to perform critical physical tasks in six BA occupational specialties (CCT, CRO, PJ, SOWT, STO, and TACP).

Following our guidance, the Air Force developed the PTSs to address gaps in existing performance management systems used to evaluate the performance of airmen (existing performance measures, such as enlisted performance reports, were largely found unsatisfactory because they are not designed to measure the physical performance of BA). Some performance measures do exist (e.g., ruck march); however, these are often limited to the training pipeline. Consequently, reliable measures of operators' capabilities to march while carrying heavy loads have not been systematically evaluated or documented.

The PTSs not only address this deficiency but also are grounded in occupationally specific, operationally relevant tasks drawn from our and the AF-ESU's[2] rigorous analyses of operator physical demands. The resulting framework of CPTs, which was developed by the AF-ESU with our guidance, provided the basis for developing PTSs that best approximate the physical demands of BA. Each PTS was designed to ensure comprehensive coverage of physical movement patterns (e.g., push, lift, carry), as well as the underlying physical abilities required to perform the mission (e.g., muscular strength, cardiorespiratory endurance). Furthermore,

[2] Please contact AF-ESU (AFPC/DSYX) for additional details or questions about the AF-ESU physical demands analysis (current point of contact is Neal Baumgartner).

the development of standardized PTSs combined with the inclusion of women in the validation study (based on our guidance) supports the broad objective for establishing gender-neutral occupationally relevant physical tests and standards that can stand up to scrutiny as the Air Force opens these previously closed occupations to women.

APPENDIX A

Descriptions of Battlefield Airmen Specialties

Brief descriptions of the occupational specialties included in this study are provided below. Because the officer specialties have some overlap in their duties with the enlisted specialties, we combined the officer and enlisted descriptions.

Combat Controller and Special Tactics Officers

Combat Controllers (CCTs) originated before the Air Force was a service, when Army pathfinders were sent to provide guidance for airdrops during World War II. They deploy into hostile or combat areas to establish airfields and assault zones. As qualified air traffic controllers, CCTs also direct air traffic and provide command and control, as well as fire support. The majority of CCTs also qualify as Joint Terminal Attack Controllers (JTACs). They deploy with special tactics teams, and they not only serve as air traffic controllers but are also experts at infiltration and exfiltration methods, including fast rope methods and free fall parachuting; rubber raft techniques; and survival, evasion, and resistance skills. As part of their air traffic control and communication duties, they also carry heavy communication equipment while on mission (U.S. Air Force, 2010c).

Pararescue and Combat Rescue Officer

Air Force pararescuemen, also known as PJs, are the only Department of Defense elite combat forces specifically organized, trained, equipped, and postured to conduct full-spectrum personnel recovery, including both conventional and unconventional combat rescue operations. Their primary mission is to rescue, recover, and return U.S. or allied forces in times of danger or extreme duress. To accomplish this mission, PJs are qualified and trained in many areas, including advanced weapons and small unit tactics (SUT), airborne and military free fall, specialized parachute operations, combat dive, high angle/confined space rescue operations, small boat/vehicle craft utilization, rescue swimming, and battlefield trauma/paramedics (U.S. Air Force, 2010b).

Special Operations Weather Team

Special Operations Weather Team (SOWT) airmen provide meteorological, oceanographic, and space environment information while deployed in hostile or denied areas (Headquarters, U.S. Air Force, 2017). They collect, evaluate, and interpret information from the environment (air, water, terrain) and forecast potential effects on operations. Special reconnaissance and surveillance missions are used to collect some of the environmental data. SOWT airmen are assigned to Air Force Special Tactics teams or squadrons working with Army Special Operations (U.S. Air Force, 2010a).

As special operators, SOWT airmen are expected to conduct missions in different climates and under various conditions (e.g., day or night, hot or cold, at altitude). These weathermen are trained in infiltration and exfiltration, insertion and extraction, and warfighter tactics, techniques, and procedures (e.g., hand-to-hand combat) (Headquarters, U.S. Air Force, 2012). These duties require SOWT airmen execute a variety of physical tasks as part of their work.

Tactical Air Control Party

Primarily assigned to U.S. Army installations, Tactical Air Control Party (TACP) personnel track, target, and engage enemy forces in close proximity to friendly forces and assess strike results. They plan, coordinate, and direct manned and unmanned, as well as lethal and nonlethal, air power through the use of advanced technologies and weapon systems. They also control and execute air, space, and cyber power across the full spectrum of military operations and provide airspace deconfliction; artillery; naval gunfire; intelligence, surveillance, and reconnaissance; and terminal control of close air support to shape the battlefield.

In addition to operating in austere combat environments independent of an established air base or its perimeter defenses, TACPs engage in small unit tactics; engage in a variety of physical tasks, including infiltration, surface movement, and exfiltration with combat maneuver forces; and engage enemy forces with individual weapons (Headquarters, U.S. Air Force, 2017).

APPENDIX B

Descriptions of Physical Task Simulations[1]

The purpose of this appendix is to provide a description of the physical task simulations (PTSs) developed to simulate the physical demands of critical physical tasks (CPTs) required for Battlefield Airmen (BA). The 12 tests described in the following sections are intended to simulate the physical demands required of BA operators throughout the course of specific special operations tasks. The PTS descriptions were designed to isolate the physical demands of such tasks while removing an emphasis on techniques or other skills in which BA operators train to develop. While the operational environments and conditions in which such tasks are conducted vary widely, each PTS was designed to support the greatest level of standardization possible, such that the same PTS could be replicated in different locations and at different times to support equivalent testing amongst subjects.

This appendix is organized into 14 sections. The first section provides an overview of procedures that were common to the conduct of all PTSs. The second section shows which PTSs apply to each BA specialty. Each section that follows includes details about the 12 PTS tests performed as a part of a larger study. Each of those sections is broken into the following five sections:

1. **Operational relevance:** This section describes what BA operational task(s) were examined to create the respective PTS. Where appropriate, a description of sequential mission relevant tasks is provided that mirror the simulation.
2. **Facilities and equipment arrangement:** This section outlines how the facilities and equipment required to run the test are arranged at the beginning of each PTS including diagrams of the simulation layout.
3. **Task and overview:** This section includes an overview of the PTS. It states the specific tasks to be accomplished during the test and a general description of the components of the simulation.
4. **Execution:** This section breaks down the PTS in terms of segments and performance steps. Segments are the portions of the simulation for which individual times are measured and recorded. Performance steps are discrete activities required to execute each segment.
5. **Equipment and support requirements:** This section lists resources that are required to set up and conduct the PTS that are not common amongst all other simulations.

[1] The photos in Appendix B are courtesy of the Air Force Exercise Science Unit and RAND researchers.

General Procedures for All Task Simulations

The following procedures are required to conduct each PTS:

- Dedicated medics/safety personnel will be assigned to monitor participants throughout each simulation. They will look for signs of fatigue, injury, or risky behaviors that could lead to injury (e.g., moving simulated casualty in potentially harmful ways).
- Each PTS test will be preceded by an oral description, a demonstration, and a short practice period. During the oral description, participants will be given instructions on proper techniques and procedures for the respective simulation. An individual wearing the same gear and using the same equipment will then give participants a physical demonstration of the PTS and, when appropriate for time available, performing each PTS step that the participants will be expected to do. An opportunity to practice and receive feedback on techniques prior to starting the simulation test will be provided to each participant in order to minimize the effects that technique or skill might have on the performance of any individual activity.
- Each PTS test will be followed by the collection and recording of data, including times for each PTS segment, overall PTS time, and level of completion for each segment. Additional physiological data being recorded may also be collected, such as participant heart rate.
- PTS administrators should direct participants who do not wish to complete the PTS to an administrator who will escort them to a safe area for debriefing. If needed, the administrator will seek a safety monitor for assistance.
- For any task simulation requiring swimming, participants will be prescreened using a brief swim skill test.
- Participants will be required to wear equipment specific to each simulation. The specific equipment for respective PTSs is provided in the following sections.

PTS by BA Specialty

Not all PTSs are relevant to each BA specialty. Feedback from each BA community resulted in different combinations of PTSs by specialty, although there is significant overlap among specialties. Table B.1 shows which PTSs apply to which BA specialties.

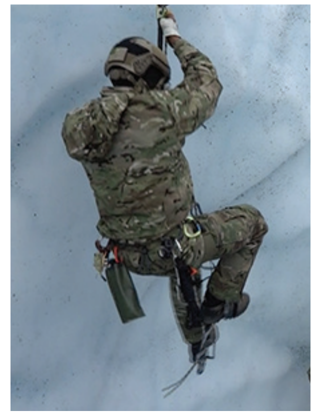
Table B.1
Draft PTSs by BA Specialties

PTS Title	BA Specialties			
	PJ/CRO	CCT/STO	SOWT	TACP
Single Leg Vertical Rope Ascent	✓			
Rope Bridge	✓	✓	✓	✓
Airfield Operations	✓	✓	✓	
Rock and Ice Climbing	✓	✓	✓	
Remove Debris and Survivor from Confined Space	✓			
Cross Load Personnel and Equipment	✓	✓	✓	✓
Rope Ladder	✓	✓	✓	✓
Combat Rubber Raiding Craft Carry	✓	✓	✓	
Casualty Movement	✓	✓	✓	✓
Swim to Inflatable Watercraft	✓	✓	✓	
Surface Fin Swim	✓	✓	✓	
SUT with Casualty Movement	✓	✓	✓	✓

Single Leg Vertical Rope Ascent

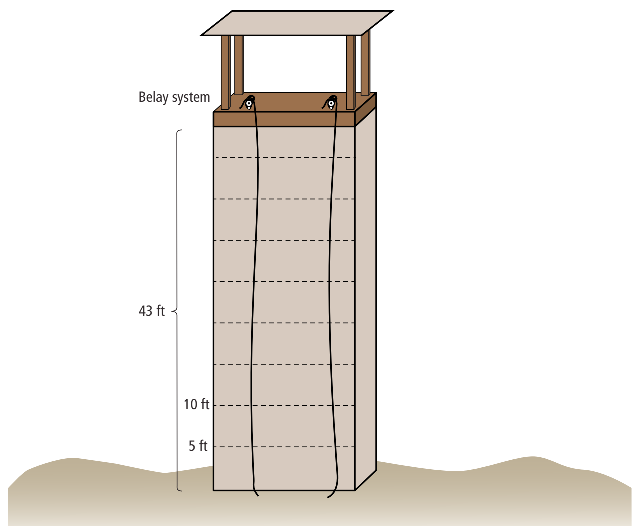
Operational Relevance

The Single Leg Vertical Rope Ascent (SLVA) PTS was designed from PJ and CCT CPTs that identify the requirement to ascend a vertical pitch and/or a rope using various techniques. One common technique is the use of an ascender (jumar) and/or prusik knots that can hold the operator's weight on a climbing rope and permits the sequential transfer of their weight up the rope. In order to move up the rope, the operator uses a single leg to push himself or herself further up the rope. He or she then moves the ascension device or knot further up the line and repeats the process until he or reaches the intended height. The distance an operator must gradually ascend or descend the rope is highly dependent on the terrain but it is not uncommon that the distance is greater than 40 feet. Depending on the situational context, an operator in a more permissive environment may be able to perform such a task while taking minimal weapons and gear with them.



Facilities and Equipment Arrangement

An open side of a rappel tower is used as the foundational structure for this simulation. The tower is 43 feet tall and capable of supporting two lanes. A climbing rope and a separate belay system is secured to the top of the tower where a marker is placed 43 feet off the ground.

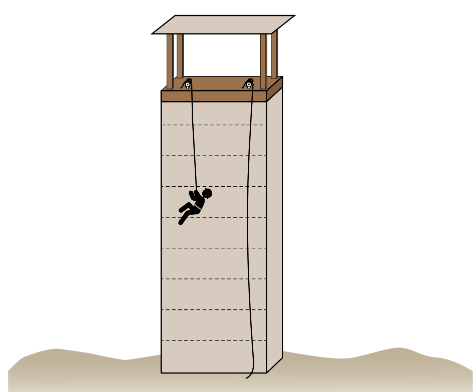


Task and Overview

This simulation includes a single segment with one performance step.

Segment 1: Ascend Rope

Once the participant has donned the required safety equipment, weighted vest, and climbing devices, the participant will use the approved technique to ascend 43 feet.



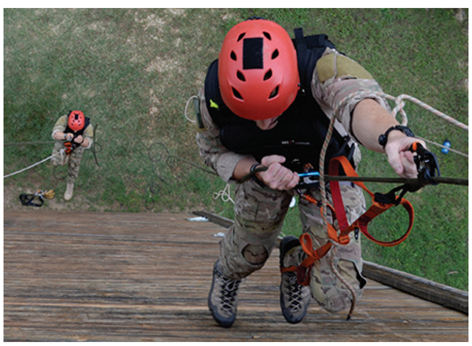
Execution

Participant Personal Gear Set Notes

- Participants will wear:
  - uniform
  - helmet
  - boots or running shoes
  - climbing harness
  - 20-lb vest
  - gloves (optional).
- Participants will not wear climbing shoes.

Administrator Instructions Specific to PTS

- Assist participant in donning safety equipment. Ensure belay and safety systems are worn properly.

Segment	Performance Step
Segment 1: Ascend Rope 	• Ascend 43 ft using ascension device

Equipment and Support Requirements

- 43-foot tower capable of supporting climbing rope and belay system
- Climbing harness
- Safety helmets of various sizes
- Automatic-belay system
- Climbing rope
- 20-pound vest
- Minimum of two test administrators with stopwatch (one at bottom and one at top of tower)
- Medical and safety personnel.

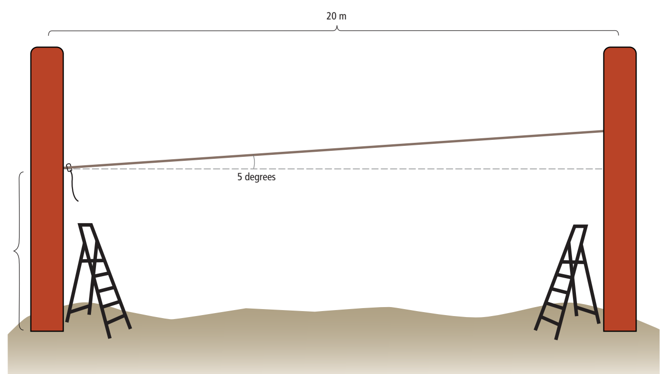
Rope Bridge

Operational Relevance

The Rope Bridge PTS was designed to simulate the physical demands associated with a number of CPTs related to maneuvering through, over, or around obstacles including the execution of an inverted hand-over-hand crossing of a gap. BA may choose, or be forced, to move across rivers, canyons, or other natural obstacles throughout the course of tactical movements. When the situation requires that the crossing take place as quickly as possible, a single rope may be used to create a bridge from one side to another, and operators would likely maintain control of their personal protective equipment and weapons while transiting across the rope bridge. The length of a rope bridge will depend on the terrain that must be negotiated and could be anywhere from a few feet to a few hundred feet. BA operators carry one type of rope, which is 11 millimeters in diameter.

Facilities and Equipment Arrangement

A 20-meter metal cable (7/16 inches in diameter) is secured between two secure posts, with a 5-degree incline in the direction of the crossing. Starting height is 5 feet, 6 inches, and ending height is 11 feet, 5 inches. Stepladders are placed at each post to assist with mounting and dismounting. The cable also includes a safety rope attached with a carabineer that can be connected to the participant's safety harness.

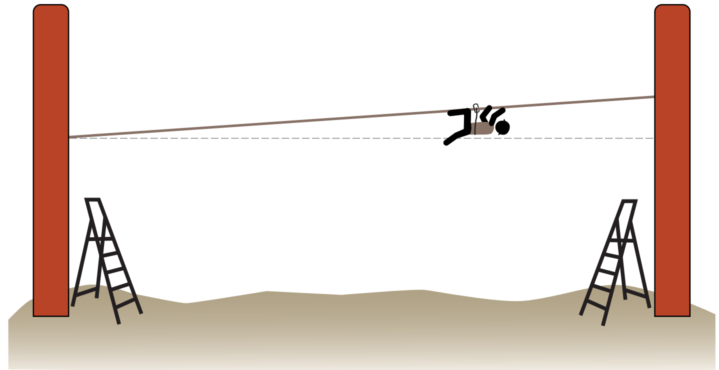


Task and Overview

This simulation includes a single segment with one performance step.

Segment 1: Traverse Rope Bridge

Once the participant has donned the required safety equipment and weighted vest, the participant will traverse a 20-meter-long rope bridge using an inverted body position and hand-over-hand technique to cross a simulated obstacle on the ground.



Execution

Participant Personal Gear Set Notes

- Participants will wear a
  - uniform
  - helmet
  - boots or running shoes
  - chest (safety) harness
  - gloves
  - 30-lb vest.
- Participants will not wear climbing shoes.

Administrator Instructions Specific to PTS

- Assist participant in donning safety equipment. Ensure safety rope is attached to chest harness properly.
- Administrators may assist participant in mounting and dismounting rope bridge cable with the use of stepladders.

Segment	Performance Step
Segment 1: Traverse rope bridge 	• Traverse 20 m of the rope bridge cable using an inverted position and hand-over-hand technique

Equipment and Support Requirements

- Metal cable (20 meters in length, 7/16 inches in diameter)
- Two secure posts capable of holding rope bridge and participant
- Chest harness
- Safety helmets of various sizes
- Safety rope with carabineer
- Two stepladders
- 30-pound vest
- Test administrator with stopwatch
- Medical and safety personnel.

Airfield Operations

Operational Relevance

The Airfield Operations PTS was primarily designed to simulate the physical demands represented in nine CPTs associated with CCT, STO, and SOWT specialties. However, other BA operating as a part of a larger team would likely be required to participate in these tasks, many of which closely resemble other BA CPTs, such as those related to moving equipment.

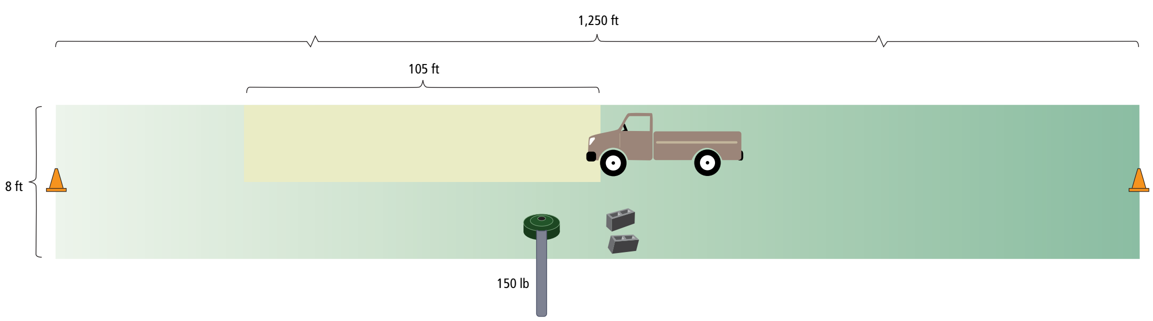
The specific CPTs used to design this PTS encompass the tasks required to prepare a hasty airfield or landing zone for aircraft. In order for fixed-wing aircraft to land in an area without established infrastructure and control personnel on the ground, BA operators may have to insert into the area (e.g., by skydiving) and prepare the area. This requires an operator to walk or run the length of the potential runway once to measure the distance using a pace count and once again to remove debris and obstacles from the landing area.

The length of the potential runway can vary. Estimates from BA leadership range from 3,000 to 5,000 feet in length for a single runway depending on the terrain and types of aircraft intending to land there. On the second traverse of the runway, the operator may be faced with a wide variety of obstacles that must be removed from the area. These obstacles may include injured jumpers (in cases of skydive inserts), vehicles, large rocks, trees, and equipment brought with operators, such as motorcycles, communications equipment, and supplies. Depending on the situation, operators must accomplish these tasks in a short period in order to get the aircraft with needed personnel and/or supplies on the ground as quickly as possible. Furthermore, as the operational environment may not be fully secure, operators should be prepared to carry all of their equipment and personal weapon systems with them throughout the duration of this task.

Facilities and Equipment Arrangement

The course for the Airfield Operations PTS includes a large, flat, rectangular field that is 1,250 feet long and 12 feet wide. A cone marks each end of the field, and an area marked for obstacle removal is in the middle of the field.

On one side of the field is a 45-pound barbell with an additional 105 pounds of weights on one end of the barbell. The other end of the barbell is attached to a "Landmine" device that allows the weighted end to rotate freely, while the unweighted side remains fixed in place on the ground. An area 180 degrees from the bar's starting position is cleared, with the exception of two standard cinder blocks positioned as obstacles to step over in the path of the freely rotating bar. On the other side of the field is a Ford Ranger truck placed in neutral with equal tire pressures (35 psi). The truck is positioned at the beginning of a section of the course marked with a distance of 105 feet of level pavement.

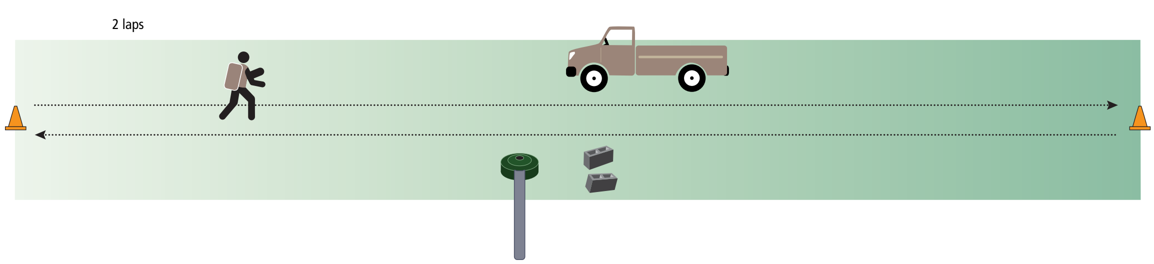


Task and Overview

This simulation includes three, consecutive segments with multiple performance steps.

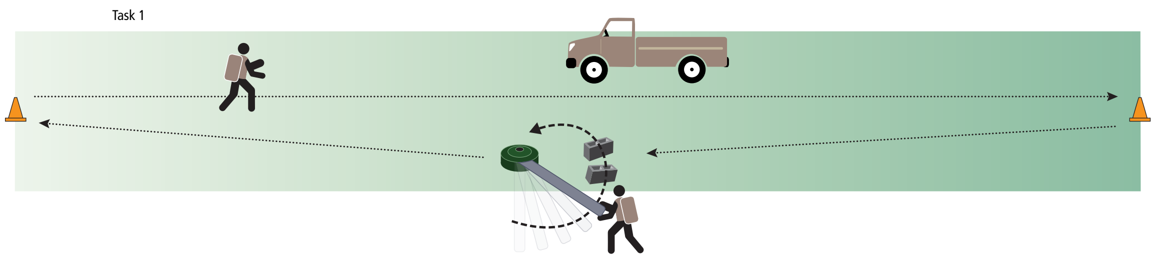
Segment 1: Traverse Distance of Runway

The participant will start at one end of the runway course and run two full laps (down and back twice) by moving between cones positioned at the far ends of the course. After completing the second lap, the participant will move immediately into the next segment.



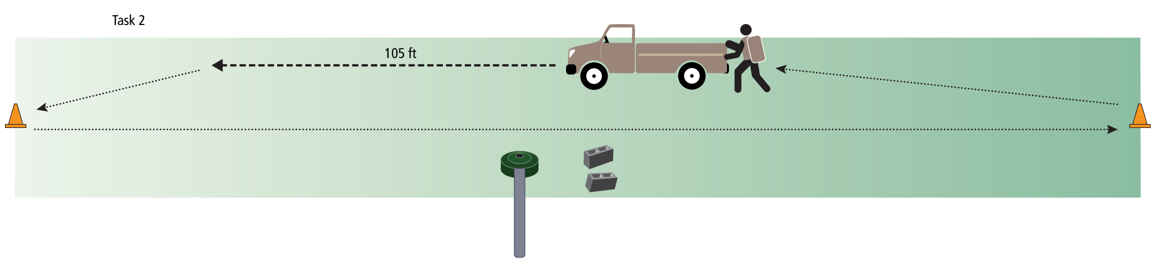
Segment 2: Lift and Move Obstacle from Runway

The participant will run the length of the runway course again, but, on the return to the starting position, they will stop halfway at the lift-and-move station. At this station, the participant will pick the barbell up off the ground and carry it 180 degrees to the opposite side of the Landmine device. To do so, the participant will be required to hold the barbell off the ground while they step over two cinder blocks. After moving the bar a total of 180 degrees, the participant will complete the lap and return to the starting cone for Segment 3.



Segment 3: Push Obstacle from Runway

Starting from the original end of the runway, the participant will again traverse the length of the course, move around the far cone, and run to the truck located halfway down the course. Upon reaching the truck, the participant may use any technique desired to physically push the truck parked in neutral for a distance of 105 feet. After moving 105 feet, the participant will complete the lap by returning to the starting position.



Execution

Participant Personal Gear Set Notes

- Participants will wear:
  - uniform
  - 30-lb. vest
  - 65-lb. rucksack
  - boots or running shoes
  - gloves (optional).

Administrator Instructions Specific to PTS

- Ensure Landmine device and truck are positioned correctly.
- Ensure truck is in neutral gear and has even tire pressure at 35 psi for all tires.

Segment	Performance Step
Segment 1: Traverse distance of runway 	• Run two full laps of the simulated runway course
Segment 2: Lift and move obstacle from runway 	• Run one length of the simulated runway course • Run to lift-and-move station • Lift barbell and move the weighted end 180 degrees over two cinder blocks • Complete lap by running to starting position

Segment 3: Push obstacle from runway

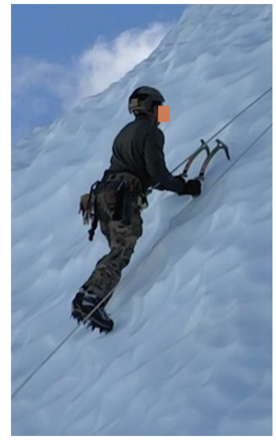
- Run one length of the simulated runway course
- Run to truck station
- Push truck 105 ft
- Complete lap by running to starting position

Equipment and Support Requirements

- Flat, grass-covered course, 1,250 feet long and 12 feet wide
- Two cones
- Ford Ranger truck
- Barbell with 105 pounds of additional weights
- Landmine device
- Rucksack weighing 65 pounds for participant
- 30-pound vest for participant
- Test administrator with stopwatch
- Medical and safety personnel.

Rock and Ice Climbing

Operational Relevance

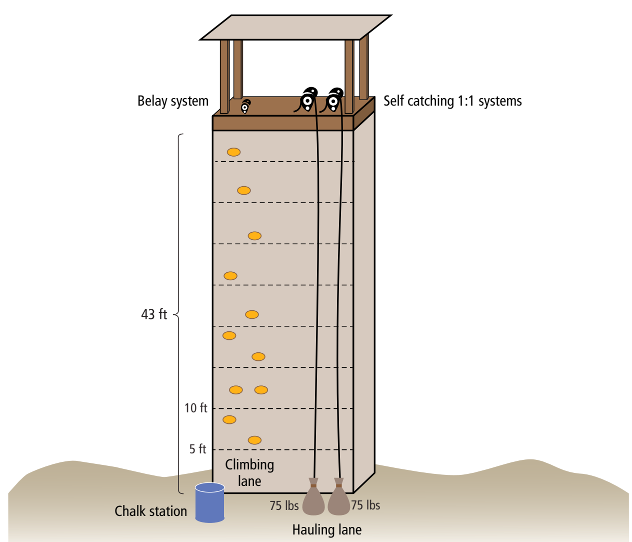


The Rock and Ice Climbing, or Lead Climber, PTS combines a number of CPTs that can be categorized as lead climber duties and the requirement to haul loads from atop a vertical edge. The first portion of the PTS simulates the physical demands a BA operator faces when ascending a vertical pitch using various climbing techniques along various types of terrain. An operator may be required to ascend steep grades using the surface of a building, rock face, or ice wall. Often, as a lead climber, an operator would receive no climbing assistance but would also not be required to climb with large amounts of gear other than that required for the climb itself.

The second portion of the PTS simulates the physical demands of hauling a rescue system with a casualty or hauling equipment to the top of a vertical pitch that has recently been ascended. This task would likely be shared with other operators or be assisted with the mechanical advantage of a pulley system. Once the weight is pulled up the vertical surface the operator would then be required to lift the litter or equipment up and over the edge of the surface prior to continuing with the mission or repeating the task for another load. The height of a single pitch required for portions of this task was estimated to be approximately 75 feet, although the distances in an operational environment would vary from pitch to pitch and the number of pitches required to complete the task varies depending on the situation.

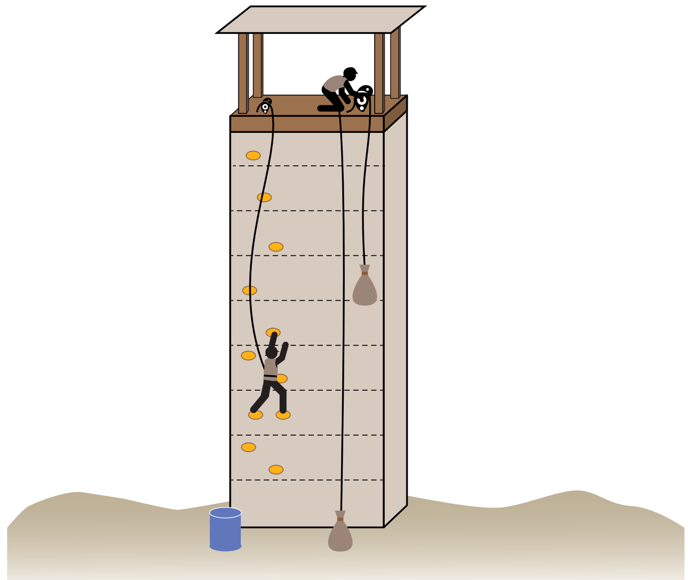
Facilities and Equipment Arrangement

A simulated rock wall built into the side of a rappel tower is used as the foundational structure for this simulation. The tower is 43 feet tall and capable of supporting two lanes. The climbing lane consists of various climbing handholds arranged for a difficulty rating of approximately 5.8 and an “automatic belay” safety system. The hauling lane consists of two separate self-catching, 1:1 pulley systems, each with a rope and a 75-pound sand bag attached and placed at the bottom of the tower. A small amount of chalk was made available at the bottom of the climbing lane, and markers were inserted at every 5-foot vertical level.



Task and Overview

This simulation includes three, consecutive segments with multiple performance steps.



Segment 1: Perform Lead Climb

Participant will start from ground level and climb 43 feet to the top of the tower. Using the self-belay system, the participant will then descend the climbing wall to the chalk station at the bottom of the tower.

Segment 2: Perform Lead Climb

After reapplying chalk to hands as desired, the participant will repeat the climb to the top of the 43-foot tower.

Segment 3: Pull Up Simulated Casualty Vertical Pitch

Upon reaching the top of the tower after the second climb, the participant will move to the hauling lane. From the top of the tower the participant will pull two 75-pound sand bags up a 43-foot vertical pitch one at a time using any technique desired.

Execution

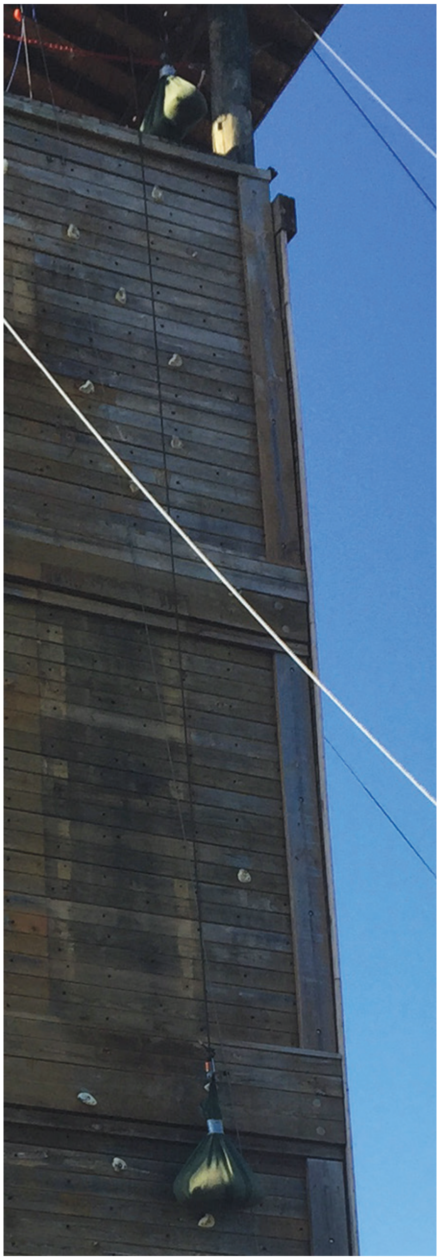
Participant Personal Gear Set Notes

• Participants will wear:
  • uniform
  • helmet
  • boots or running shoes
  • climbing (safety) harness
  • gloves (optional during the climbing portion, but are mandatory during the hauling portion).
• Participants will not wear climbing shoes.

Administrator Instructions Specific to PTS
• Assist participant in donning safety equipment. Ensure belay and safety systems are worn properly. • Provide chalk at the bottom of the climbing wall.

Segment	Performance Step
Segment 1: First Wall Climb 	• Climb 43 ft without assistance • Self-belay to bottom of tower • Minimum of 10 seconds on ground to rest and/or apply chalk to hands
Segment 2: Second wall climb 	• Climb 43 ft without assistance • Pull self over edge of tower

Segment 3: Haul load



- Haul first 75-lb sand bag up vertical surface
- Pull first 75-lb sand bag over edge
- Haul second 75-lb sand bag up vertical surface
- Pull second 75-lb sand bag over edge

Equipment and Support Requirements

- 43-foot tower capable of supporting rock climbing hand holds
- Rock climbing handholds capable of being arranged for a difficulty rating of approximately 5.8
- Climbing chalk
- Climbing harness
- Safety helmets of various sizes
- Automatic-belay system
- Two self-catching, 1:1 pulley systems
- Climbing rope
- Two 75-pound sand bags
- Minimum of two test administrators with stopwatch (one at bottom and one at top of tower)
- Medical and safety personnel.

Remove Survivor from Confined Space

Operational Relevance

This PTS was designed to simulate the physical demands of having to move to a casualty in a confined space, extract that casualty from a limited amount of debris, and then pull that casualty out of the confined space where other team members could assist with follow on tasks. The simulation is related to a number of challenging CPTs across each AFSC, including the physical requirements to maneuver over, around, and under obstacles; remove debris, objects, and obstacles to gain patient access; recover survivors, remains, and sensitive materials; and drag casualties over adverse terrain without a litter.

Given the limited space available in many collapsed buildings, damaged vehicles, or downed aircraft, BA operators often have to conduct such confined space tasks by themselves and would only receive assistance once they have extracted the casualty or materials from the confined space. The operational environment for such tasks is likely to vary greatly, but it would be common for such extractions to be conducted in areas with uncertain or active enemy activity or with uncertain structural conditions for surrounding infrastructure. Thus, it would not be unusual for such tasks to be conducted while wearing at least the minimal amounts of personal protective equipment.

Facilities and Equipment Arrangement

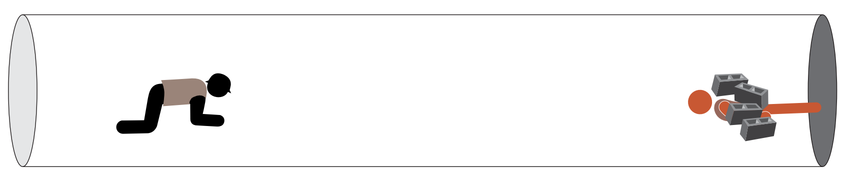
A smooth-surfaced culvert (20 meters in length and 4 feet in diameter) is used to simulate the confined space. For safety reasons, the culvert is open at both ends. At one end, a simulated casualty weighing 185 pounds and wearing a 30-pound vest is positioned such that its feet are at the edge of the culvert but not extending outside of the culvert. On top of the simulated casualty are four standard cinder blocks: one on top of the upper legs, one on the chest, and one on each arm. The simulated casualty's vest has an 8-foot webbing strap attached.

Task and Overview

This simulation includes three segments, each of which includes a single performance step.

Segment 1: Crawl Through Culvert to Simulated Casualty

Starting from outside of the culvert at the opposite end of the simulated casualty, the participant will enter the culvert and use any technique to crawl to the simulated casualty.



Segment 2: Remove Debris from Simulated Casualty

Upon reaching the simulated casualty the participant will remove the cinder blocks in any order and place them anywhere in the culvert (the cinder blocks cannot be removed from the culvert).

Segment 3: Pull Simulated Casualty Out of Culvert

Using any technique desired, the participant will drag the simulated casualty through the culvert back to the side where the participant entered the culvert. The simulated casualty must be pulled completely out of the culvert.

Execution

Participant Personal Gear Set Notes	

• Participants will wear:
  • uniform
  • 30-lb. vest
  • boots or running shoes
  • knee pads and gloves (optional).	

Administrator Instructions Specific to PTS	
• Sweep out dust and mud from culvert between each simulation. • Ensure cinder blocks and simulated casualty are repositioned in the appropriate position before each simulation.	
Segment	**Performance Step**
Segment 1: Crawl through culvert	• Crawl from one end of the culvert to the other where simulated casualty is located
Segment 2: Remove debris 	• Remove cinder blocks from simulated casualty
Segment 3: Pull casualty out of culvert 	• Pull casualty out of the opposite side of culvert from its original position

Equipment and Support Requirements

- Culvert with smooth surface on inside, 20 meters in length and 4 feet in diameter
- Simulated casualty weighing 185 pounds wearing 30-pound vest
- 30-pound vest for participant
- Four standard cinder blocks
- Test administrator with stopwatch
- Medical and safety personnel.

Cross Load Personnel and Equipment

Operational Relevance

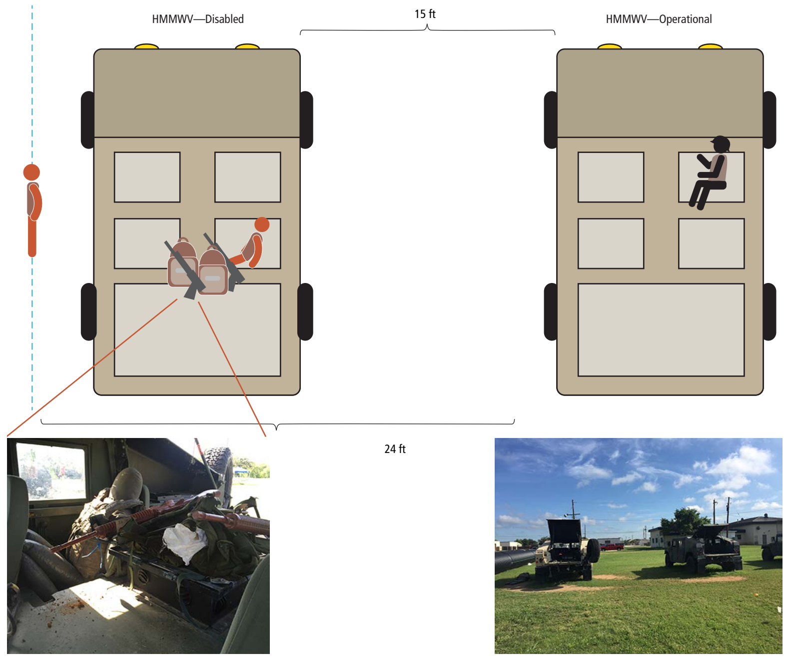
The Cross Load Personnel PTS was designed because of the necessity for operators to be able to cross load personnel and equipment from a disabled vehicle to an evacuation vehicle or aircraft. This represents a very specific and physically demanding CPT. It simulates the physical demands that may be required after a tactical vehicle is disabled because of the vehicle striking a mine, an improvised explosive device detonating nearby, or the vehicle being attacked by rockets and/or other weapon systems.

In such instances, it is possible that one or more occupants of the vehicle will have become non-ambulatory casualties. These casualties, along with sensitive materials and weapons that would be damaging to lose to enemy forces, must be moved from the disabled vehicle to another vehicle or aircraft in order to be evacuated. Given the context of a recent or ongoing attack, it is important to complete such a task as quickly as possible and it is highly likely that operators would at a minimum be wearing their basic personal protective equipment and carry their personal weapon systems. It is also likely that an operator would not receive assistance for any individual action if multiple casualties are present and other team members are required to provide security. It is assumed, however, that once a casualty is moved to the back of a secure, operational vehicle some assistance in pulling the casualty into the vehicle would be available from inside the vehicle.

In addition to the specific cross loading task a number of other CPTs are also simulated during this simulation. For example, multiple techniques for moving casualties, recovering survivors, remains, and sensitive materials, extracting personnel out of a vehicle, and maneuver, move, and lift items are all individual CPTs that have physical demands simulated in this PTS.

Facilities and Equipment Arrangement

Two high-mobility multipurpose wheeled vehicles (HMMWVs) are positioned facing the same direction and separated by 15 feet between near sides of vehicles. The disabled vehicle contains two 65-pound rucksacks placed in the center of the vehicle each with one 10-pound simulated rifle on top of them. The disabled vehicle also contains one simulated casualty weighing 185 pounds wearing a 30-pound vest sitting upright in the rear right seat of the disabled vehicle. All doors in the disabled vehicle are closed and its tailgate is open. On the far side of the disabled vehicle, a simulated casualty weighing 185 pounds wearing a 30-pound vest is laid face up such that it is next to the rear left door and positioned 24 feet from the near side of the operational vehicle. The operational vehicle has all doors shut and its tailgate open.

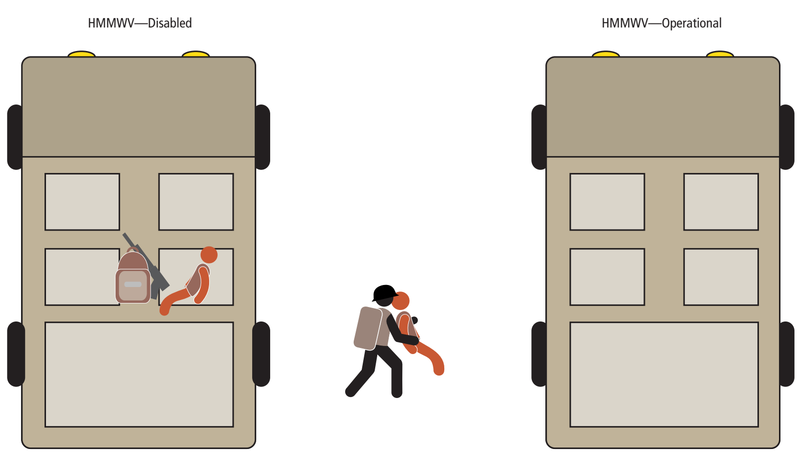


Task and Overview

This simulation includes three, consecutive segments with multiple performance steps.

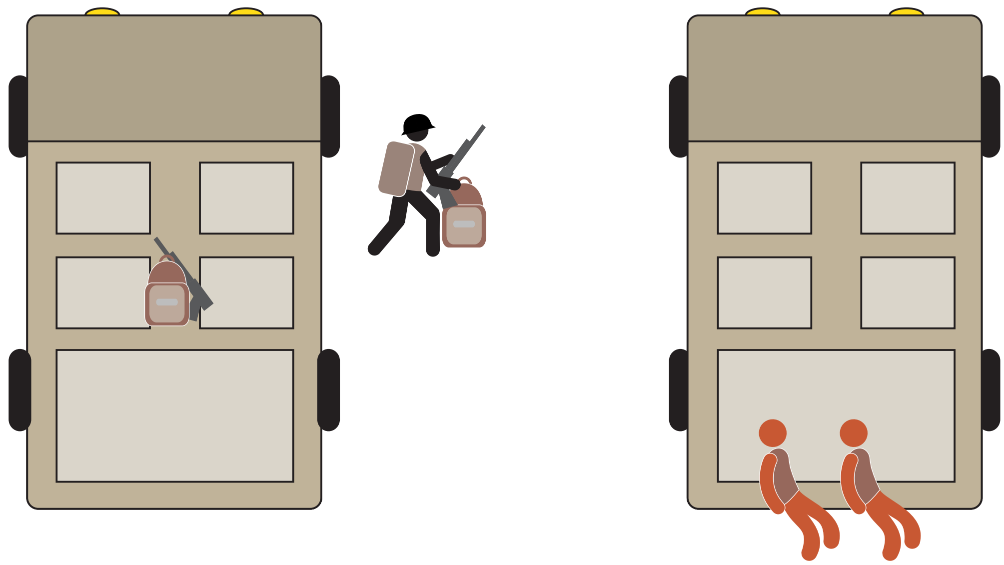
Segment 1: Cross Load Simulated Casualties

After exiting the passenger seat of the operational vehicle, the participant must move one simulated casualty from the ground on the far side of the disabled vehicle to the back of the operational vehicle and place the simulated casualty on the tailgate. Another simulated casualty must be extracted from within the disabled vehicle and also moved to the tailgate of the operational vehicle.



Segment 2: Cross Load Equipment

The participant will remove the two rucksacks and two simulated weapons from within the disabled vehicle and transport them in as many trips as needed to the operational vehicle. All equipment must be placed in the rear left seat of the operational vehicle and the door must be closed after equipment is securely inside the operational vehicle.



Segment 3: Return to the Operational Vehicle

Once all equipment and simulated casualties are secure in the operational vehicle, the participant returns to the passenger seat of the operational vehicle and closes the passenger seat door.

Execution

Participant Personal Gear Set Notes

• Participants will wear:
  • uniform
  • 30-lb vest
  • boots or running shoes
  • gloves (optional).

Administrator Instructions Specific to PTS
• Ensure equipment and simulated casualties are repositioned in the appropriate position before each simulation. • Ensure all doors on vehicles are closed and both tailgates are open prior to beginning simulation.

Segment	Performance Step
Segment 1: Cross load simulated casualties 	• Move one simulated casualty from the rear right seat of disabled vehicle to the tailgate of the operational vehicle • Move one simulated casualty from the ground on the far side of the disabled vehicle to the tail-gate of the operational vehicle
Segment 2: Cross load equipment 	• Move rucksacks and simulated weapons from the center of the disabled vehicle to the rear left seat of the operational vehicle • Close rear left door of operational vehicle
Segment 3: Return to the operational vehicle 	• Return to the front right seat of the operational vehicle • Close the front right door of the operational vehicle

Equipment and Support Requirements

- Two unarmored HMMWVs with functioning doors and tailgates
- Two simulated casualties weighing 185 pounds wearing 30-pound vests
- Two rucksacks weighing 65 pounds
- Two simulated rifles weighing approximately 10 pounds
- 30-pound vest for participant
- Test administrator with stopwatch
- Medical and safety personnel

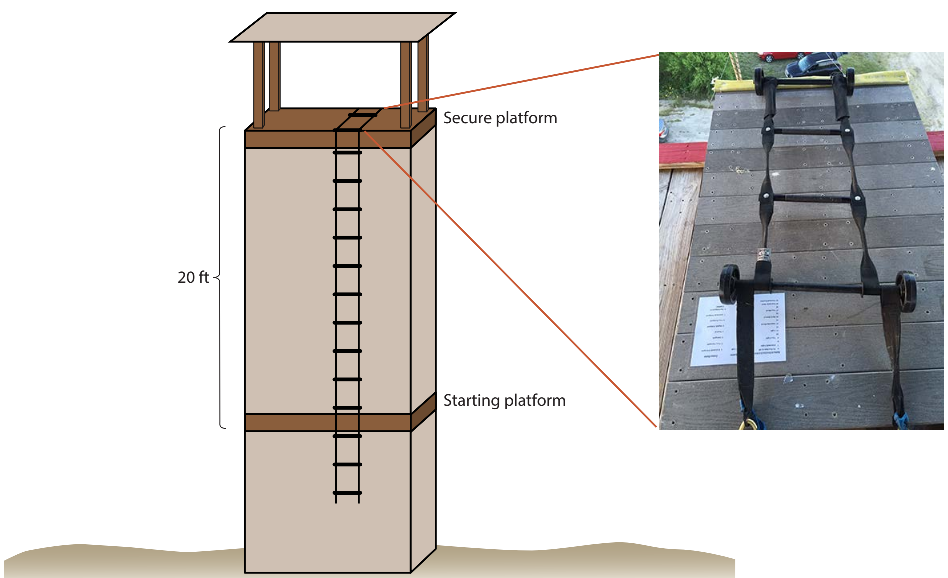
Rope Ladder

Operational Relevance

This PTS was designed to simulate the physical demands required by BA operators when ascending a rope or caving ladder and transitioning one's body over the edge of a vessel or aircraft. These CPTs are conducted in a wide range of operational environments including from land, the top of a building, or from open water into an aircraft hovering above or from open water on to a sea vessel. The time permitted to board an aircraft or vessel will depend on many factors, but it is often limited by the aircraft's ability to remain hovering in a single location or the urgency of the tactical situation during vessel boarding operations. Similarly, the height required to climb during operations will vary greatly, but it is often at least a 20-foot ladder. Given the potential urgency of the situation, it is possible that operators will be required to carry all of their personal and team equipment and weapons while ascending the rope or caving ladder. Upon reaching the aircraft or vessel, the operators will then have to lift themselves up and over the ledge from which the ladder is secured.

Facilities and Equipment Arrangement

Twenty feet of a 43-foot tower are used to secure a platform resembling the inside of an aircraft. A rope ladder in excess of 20 feet is secured 5 feet behind the edge of the platform and hangs freely over the edge. The rope ladder is not secured with any additional weight at the bottom of the ladder. An automatic-belay system is established above the platform for safety purposes.



Task and Overview

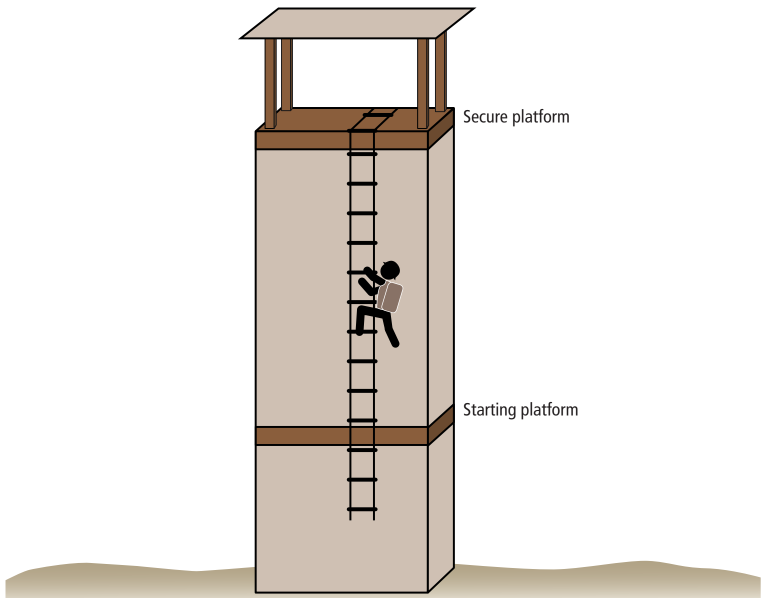
This simulation includes two segments.

Segment 1: Climb Rope Ladder

Participants will mount the rope ladder and use any desired technique to climb 20 feet to the secure platform from which the ladder is secured.

Segment 2: Transition over Edge

Participants will use any technique to move themselves and their equipment over the platform from which the ladder is secured until they and their equipment are fully on top of the platform.



Execution

Participant Personal Gear Set Notes	
• Participants will wear: • uniform • helmet • 20-pound vest • 50-pound rucksack • boots or running shoes • gloves (optional). • Participants will not wear climbing shoes.	
Administrator Instructions Specific to PTS	
• Assist participant in donning safety equipment. Ensure belay and safety systems are worn properly.	
Segment	**Performance Step**
Segment 1: Climb rope ladder 	• Mount rope ladder while wearing vest and rucksack • Climb 20 ft using any technique to the platform from which the rope ladder is secured
Segment 2: Transition over edge	• Pull self over edge of platform until the entire body and rucksack are secure on top of platform

Equipment and Support Requirements

- Tower tall enough to hang 20 feet of rope ladder
- Rope ladder greater than 25 feet long
- Safety helmets of various sizes
- Automatic-belay system
- Minimum of two test administrators with stopwatch (one at bottom and one at top of rope ladder)
- Medical and safety personnel.

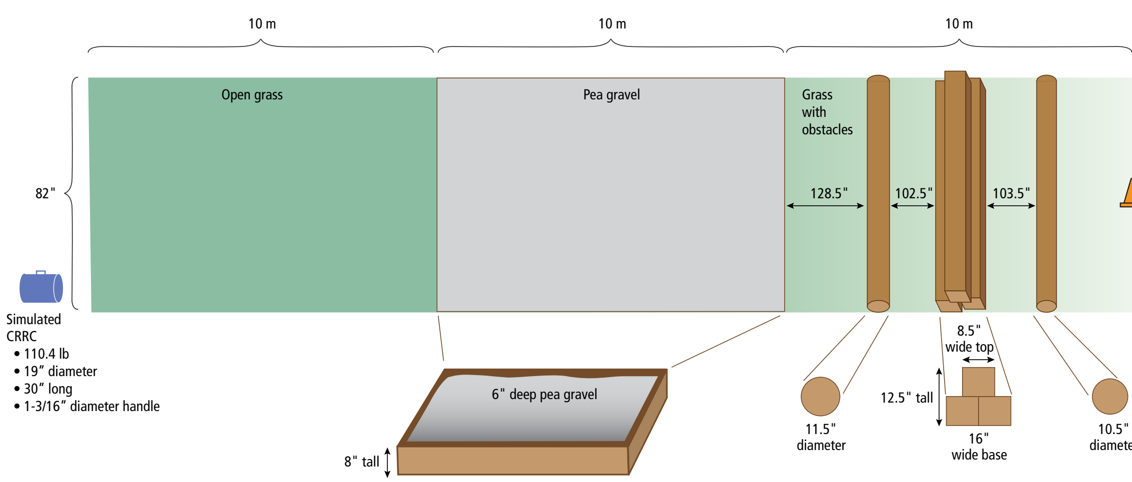
Combat Rubber Raiding Craft Carry

Operational Relevance

This PTS was designed to simulate the physical demands of the individual effort required to carry a Combat Rubber Raiding Craft (CRRC) as part of a four-man team. A single CRRC with a motor (but without sand, water, and mission specific equipment) weighs approximately 440 pounds. These raiding crafts must be carried over a variety of terrain and obstacles in order to get them from the land to the water and again from the water to a secure location on land. The situational context will determine how many personnel will be available to assist in carrying a CRRC and how far it must travel. Given the operational necessity of some team members to simultaneously conduct mission specific or security tasks, a common expectation is that four BA operators would be capable of picking up and moving a single craft at least 60 meters over varied terrain.

Facilities and Equipment Arrangement

The CRRC Carry PTS is conducted on a 30-meter-long, flat course that consists of 10 meters of open grass, followed by 10 meters of an 8-inch tall pit simulating soft sand filled with pea gravel. The gravel pit is followed by 10 meters of grass with three small obstacles. The first obstacle is an 11.5-inch diameter log placed 128.5 inches from the edge of the gravel pit. The second obstacle consists of three wooden blocks stacked in a pyramid shape with a total height of 12.5 inches, base of 16 inches, and top distance of 8.5 inches placed 102.5 inches from the first obstacle. The third obstacle is a 10.5-inch diameter log placed 103.5 inches from the second obstacle. Five feet past the third obstacle is a cone. The width of the course is 82 inches. The simulated CRRC is placed at the beginning of the first 10-meter section and consists of a 110.4-pound barrel that is 19 inches in diameter and 30 inches long with a rubber handle (1 3/16-inch diameter) secured to the center of the barrel.

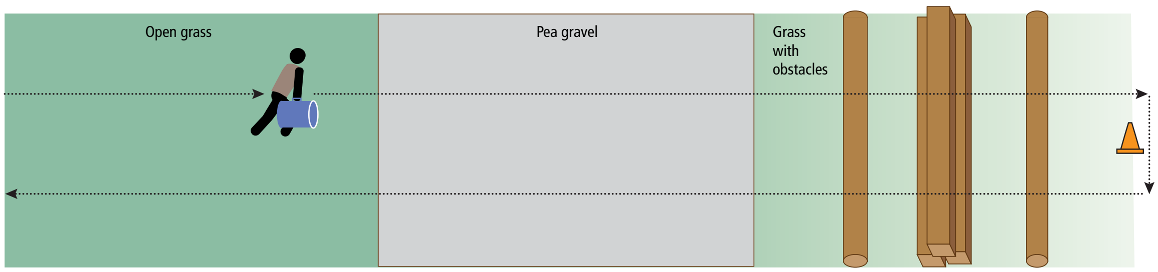


Task and Overview

This simulation includes a single segment with multiple performance steps related to different types of terrain.

Segment 1: Carry Individual Portion of a Simulated CRRC

The participant will pick up the simulated CRRC and move it 10 meters along a flat and open grass area, then 10 meters through a gravel pit, and another 10 meters along a grass area consisting of three short obstacles. The participant will then walk around a cone and return along the same route to the starting position.



Execution

Participant Personal Gear Set Notes	

• Participants will wear:
  • uniform
  • 20-lb vest
  • 50-lb rucksack
  • boots or running shoes
  • gloves (optional).	

Administrator Instructions Specific to PTS	
• Rake gravel pit between each simulation to ensure pea gravel has smooth surface.	
Segment	**Performance Step**
Segment 1: Carry individual portion of a simulated CRRC 	• Pick up simulated CRRC and carry over 10 m of flat ground • Carry simulated CRRC over 10 m of pea gravel with one hand • Carry simulated CRRC over three obstacles with one hand • Carry simulated CRRC around cone with one hand • Carry simulated CRRC over three obstacles with one hand • Carry simulated CRRC over 10 m of pea gravel with one hand • Carry simulated CRRC over 10 m of flat ground with one hand

Equipment and Support Requirements

- 110.4-pound barrel with handle
- 20-pound vest
- 50-pound rucksack
- 10-meter-long gravel pit
- Three short obstacles with dimensions listed above
- Cone
- Rake
- Test administrator with stopwatch
- Medical and safety personnel.

Casualty Movement

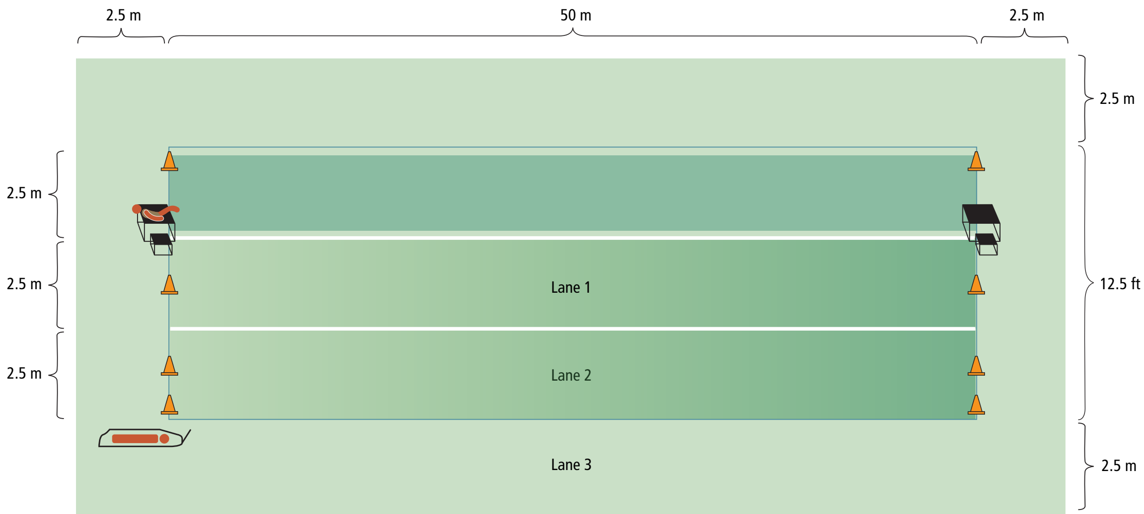
Operational Relevance

All BA AFSCs include numerous CPTs related to the movement of casualties. The Casualty Movement PTS simulates the physical demands present during two common techniques for moving casualties to safety and follow-on medical care. Casualties caused by direct enemy engagement can be both non-ambulatory and in enduring danger because of ongoing enemy contact. During such situations, it is imperative that the operational team orients much attention on enemy combatants and continues to fight until the enemy is killed or contact is broken. This requirement may leave a very limited number of personnel to assist in moving non-ambulatory casualties out of harm's way and demands that it is accomplished as quickly as possible. An effective and fast technique to do so is for operators to place casualties on their shoulders in the fireman's carry position and move the casualties to a safe position. If more operators are available to assist, it is possible that the operators could switch between carrying the casualties and providing security while continuing to move to a safe position.

Once out of immediate danger, a casualty may be placed in a sled and be dragged along the ground to reduce the physical demands of moving the casualty over a longer distance as the security and terrain conditions allow. When other personnel are available to assist, there may be a total of two people simultaneously pulling such a sled. In both situations, it is possible that an operator moving casualties would either not have time to remove personal equipment or would be required to move that equipment with him or her throughout the task.

Facilities and Equipment Arrangement

The Casualty Movement PTS is conducted on a flat, grass surface in a rectangular-shaped course measuring 55 meters long and 17.5 meters wide. Three lanes are clearly designated with spray paint and cones. The first two lanes are 50 meters long, while the third lane constitutes an outer lap of the overall course. At both ends of the first lane are two plyo boxes (18 inches and 36 inches tall). On top of one of the 36-inch plyo boxes is a simulated casualty weighing 155 pounds wearing a 30-pound vest. At the beginning of the third lane is a sled with a total of 107.5 pounds of weight to simulate half of the weight of a casualty and personal equipment.

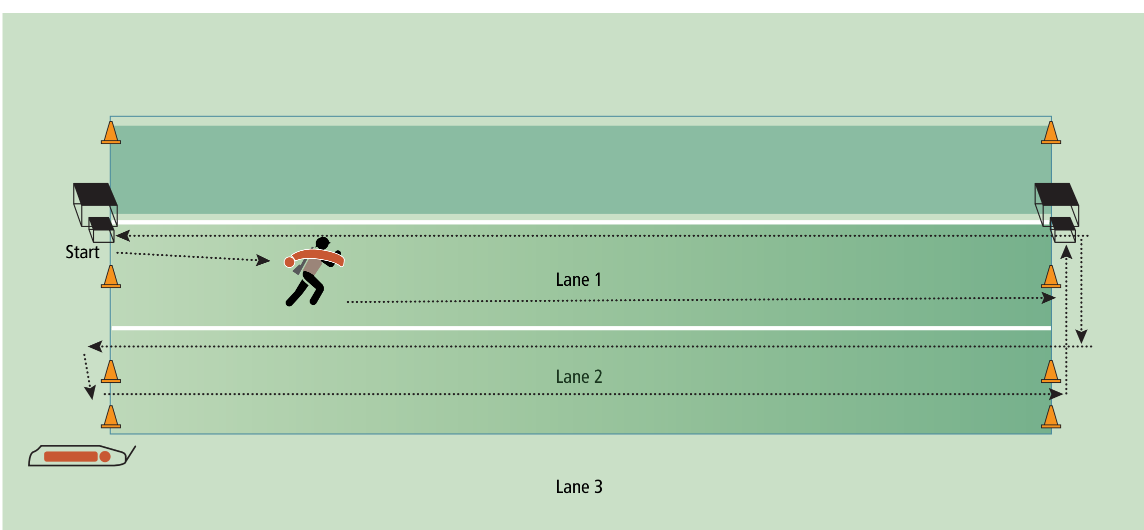


Task and Overview

This simulation includes three segments with varying numbers of performance steps.

Segment 1: Conduct Fireman's Carry

The participant will be assisted in assuming a fireman's carry stance with a simulated casualty and then carry the casualty 50 meters down Lane 1. After placing the simulated casualty on the opposite plyo box, the participant will then move 100 meters total in Lane 2 (down and back) with all of their personal equipment but without the simulated casualty to represent a period of time in which another team member could carry the casualty, while the operator moves the same distance without the extra load. Finally, the participant will again place the simulated casualty in the fireman's carry and move another 50 meters in Lane 1.

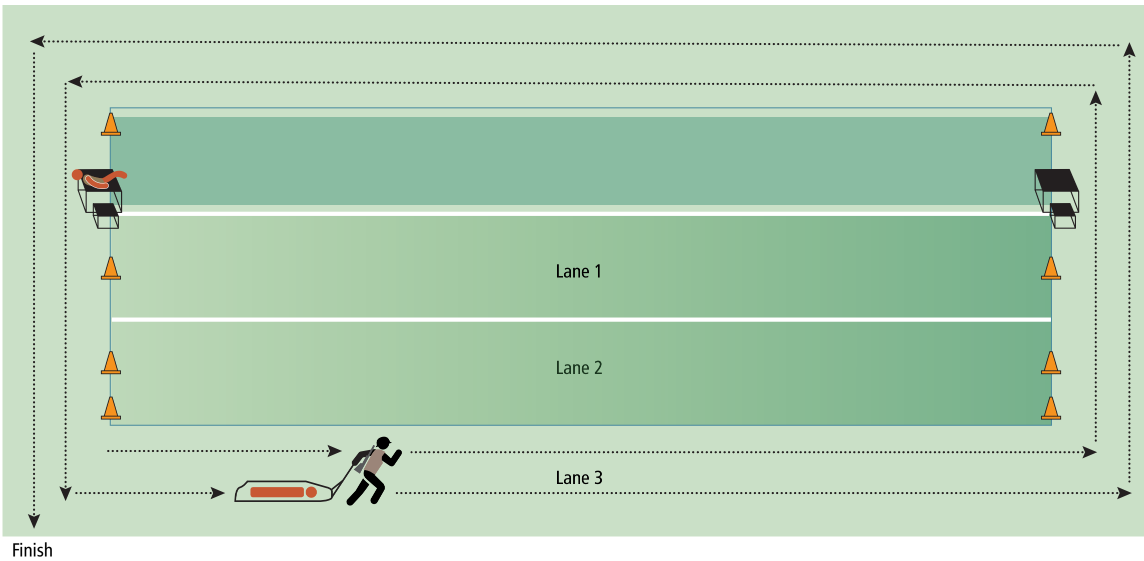


Segment 2: Rest

During this segment, the participant will be given two minutes to sit down and rest to simulate the amount of time it could take to secure a casualty in a sled. During this two-minute period, the participant will also assume the position for the beginning of the third segment.

Segment 3: Pull Sled

The participant will pull a sled with the weight of a simulated casualty for a total of 250 meters by conducting two full laps in Lane 3.



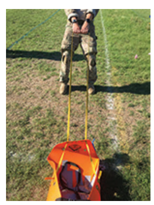
Execution

Participant Personal Gear Set Notes

- Participants will wear:
  - uniform
  - 30-lb. vest
  - 65-lb. rucksack
  - boots or running shoes
  - gloves (optional).

Administrator Instructions Specific to PTS

- Ensure equipment and simulated casualty and sled are repositioned in the appropriate position before each simulation.
- Administrators may assist the participant placing the simulated casualty in the fireman's carry with participant sitting on the smaller plyo box.

Segment	Performance Step
Segment 1: Conduct fireman's carry 	• Move simulated casualty from larger plyo box to a fireman's carry position • Carry simulated casualty in a fireman's carry position 50 m • Place simulated casualty down on the opposite larger plyo box • Move 100 m without simulated casualty, continuing to wear personal vest and rucksack • Move simulated casualty from larger plyo box to a fireman's carry position • Carry simulated casualty in a fireman's carry position 50 m • Place simulated casualty down on the original larger plyo box
Segment 2: Rest  	• Rest in sitting position on smaller plyo box for first 90 seconds of two-minute break • Prepare to drag sled during final 30 seconds of two-minute break
Segment 3: Pull sled 	• Drag sled around the Lane 3 portion of the course two times using any approved technique

Equipment and Support Requirements

- Flat, grass-covered course, 55 meters long and 17.5 meters wide
- Eight cones
- Spray paint
- Simulated casualty weighing 155 pounds and wearing 30-pound vest
- Sled weighing 107.5 pounds
- Rucksack weighing 65 pounds for participant
- 30-pound vest for participant
- Test administrator with stopwatch
- Medical and safety personnel

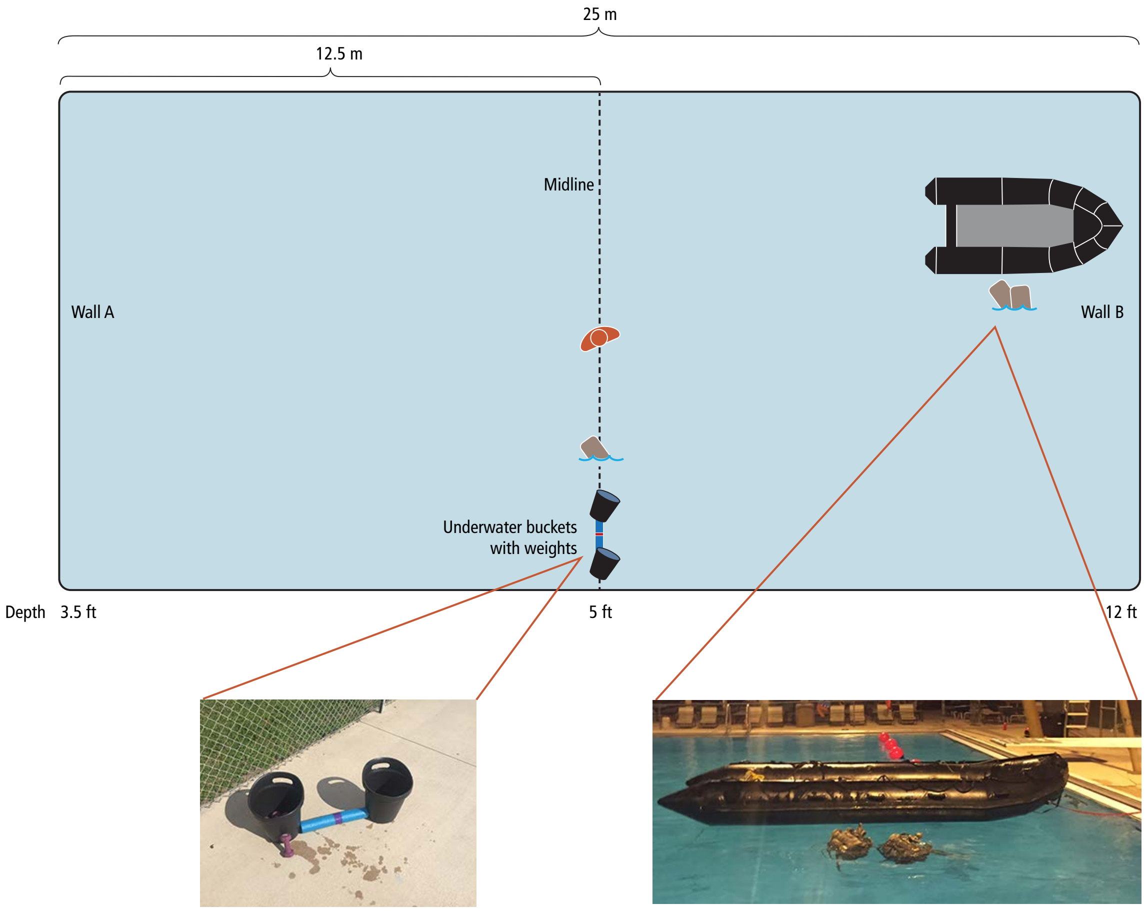
Swim to Inflatable Watercraft

Operational Relevance

The Swim to Inflatable Watercraft PTS is designed to replicate the physical demands associated with numerous water tasks. Participants will simulate executing a surface fin swim to a "package," in this case a CRRC. The PTS replicates the requirement for BA to be capable of such short swims while moving a rucksack and/or a casualty. One component of the PTS tests the ability to conduct a short underwater task, a requirement in many common waterborne operations. Finally, the PTS concludes with BA interactions with a CRRC, such as pulling oneself into the craft from the water, moving items into the craft from the water, and moving items around while inside the craft. In addition to these common watercraft tasks, the physical demands of related CPTs also helped inform the design of this PTS, including Lift and Mount Motor on Transom and Maintain Body Control, Posture/Stability in Challenging Conditions.

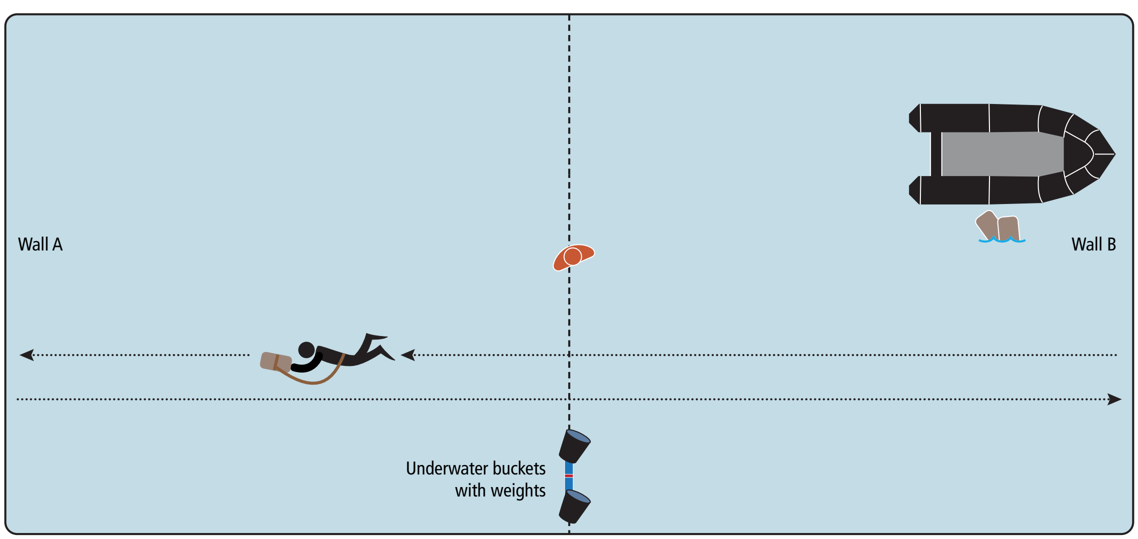
Facilities and Equipment Arrangement

In a 25-meter-long pool, far ends are labeled as Wall A and Wall B, respectively. The midline is measured and marked halfway between Wall's A and B. A 50-pound buoyant rucksack with 8-foot tow rope, a 190-pound buoyant simulated casualty, and two underwater buckets with weights are positioned at the midline. The two buckets are submersed 5-foot underwater separated by 18 inches. Six weights, weighing 3 pounds each, are placed in one bucket. A CRRC is positioned with the bow close to, but not touching, Wall B. Two 50-pound buoyant rucksacks are located in the water toward the stern starboard side of the CRRC.



Task and Overview
This simulation includes three, consecutive segments with multiple performance steps.

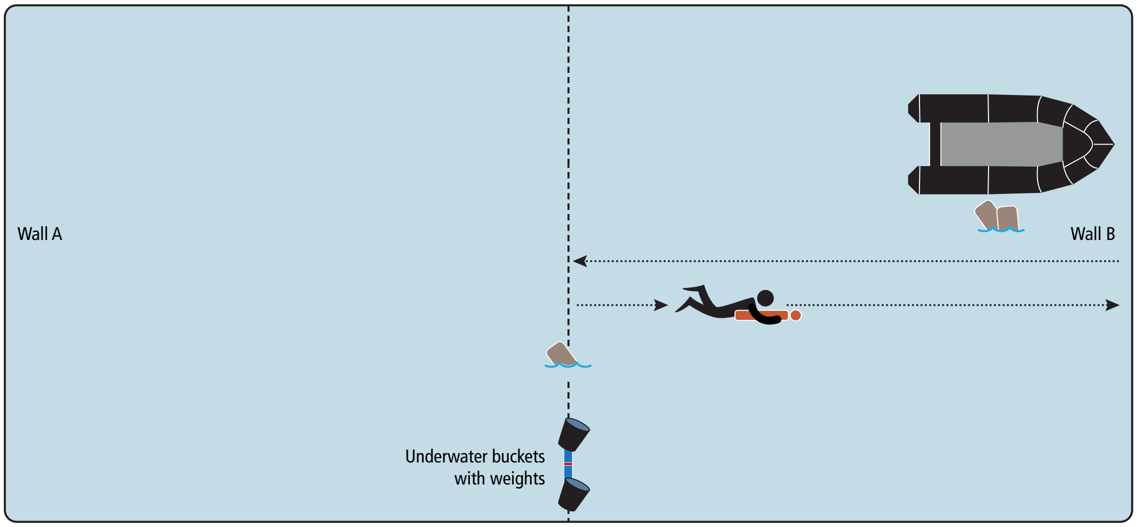
Segment 1: Surface Swim with Rucksack and Underwater Sorting Tasks
Starting from the midline of the pool, the participant will conduct a surface swim for a total of 275 meters while pushing or pulling a neutrally buoyant rucksack. Participants will also



complete an underwater sorting task (moving weights from one bucket to the other) two times during this segment, after the first 100 meters and after the second 100 meters.

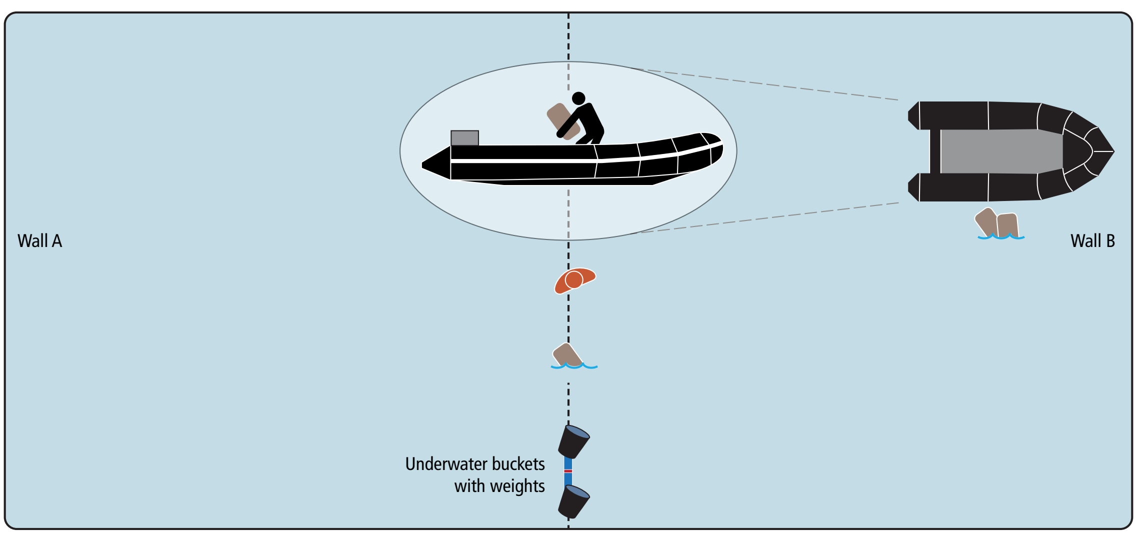
Segment 2: Surface Swim with Simulated Casualty

The participant will release the rucksack and conduct a surface swim for a total of 25 meters, while pulling a neutrally buoyant simulated casualty from the midline to Wall B.



Segment 3: Watercraft (CRRC) entry

The participant will swim to the CRRC without the simulated casualty and hoist himself or herself into the watercraft. Once inside the CRRC, the participant will pull the two neutrally buoyant rucksacks from the water and into the rear of the watercraft. After both rucksacks are inside the CRRC, the participant will move both rucksacks to the front (bow) of the CRRC and touch the front of the watercraft.



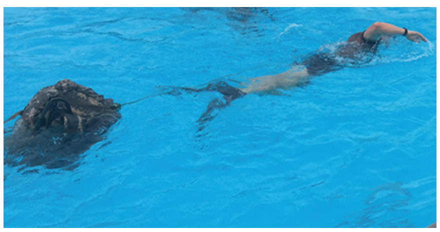
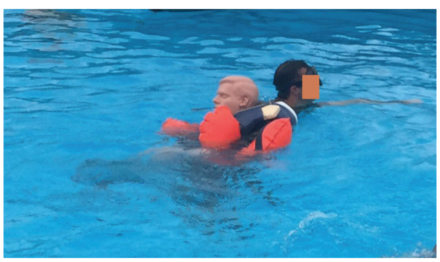
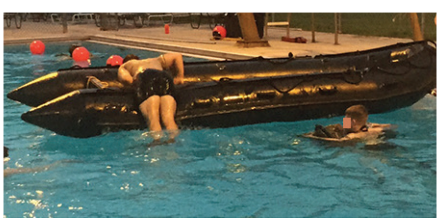
Execution

Participant Personal Gear Set Notes

- Participants will wear:
  - swim shorts
  - T-shirt
  - fins with booties
  - diving mask (does not have to be worn over face).
- Participants will not wear personal swim goggles or swim caps.

Administrator Instructions Specific to PTS

- If needed, assist participant in donning swim equipment.
- Ensure tow strap is secured to ruck and participant's waist and has length adjusted such that the ruck will remain behind participant's fins if being pulled while swimming.

Segment	Performance Step
Segment 1: Surface swim with rucksack and underwater sorting 	• Swim 100 m (two laps) while pushing or pulling a neutrally buoyant ruck • Perform underwater task moving six weights into alternate bucket • Swim 100 m (two laps) while pushing or pulling a neutrally buoyant ruck • Perform underwater task moving six weights into alternate bucket • Swim 75 m (1¾ laps) while pushing or pulling a neutrally buoyant ruck • Detach ruck and assume rescue stroke position with simulated casualty
Segment 2: Surface swim with simulated casualty 	• Swim 25 m (half lap) while pulling simulated casualty
Segment 3: Watercraft (CRRC) entry 	• Swim to CRRC • Enter the CRRC from the water • Pull two rucks into the CRRC from the water • Move two rucks to front of CRRC

Equipment and Support Requirements

- 25-meter pool
- Inflatable watercraft (CRRC) tethered/anchored in pool
- Three neutrally buoyant, 50-pound rucks, one with an 8-foot-long tow strap secured to ruck
- Neutrally buoyant, 190-pound simulated casualty
- Materials for underwater tasks (two buckets with handles, six weights of 3 pounds each, 18-inch measuring tool)
- Buoys (or other similar markers)
- Test administrator with stopwatch
- Medical and safety personnel.

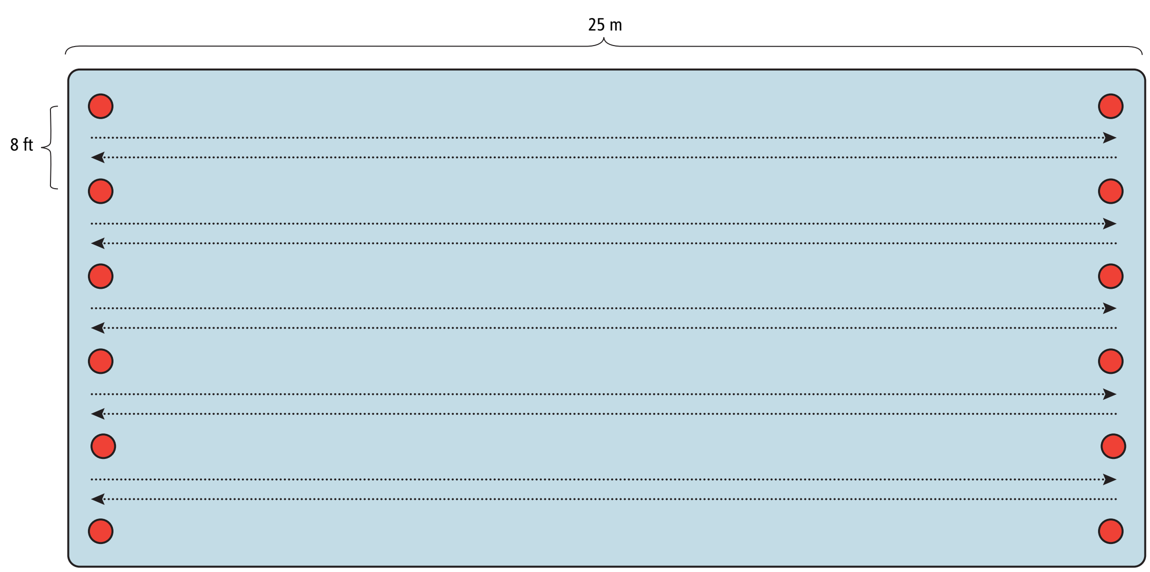
Surface Fin Swim

Operational Relevance

The Surface Fin Swim PTS is a relatively direct simulation of the physical demands from such CPTs as executing a surface fin swim in combat gear to a package, transiting via swim, and swimming to an objective. As it makes up one-third of all domains in which they operate, BA must be fully capable of conducting operations from, in, and to the sea. This often includes surface swims for thousands of meters while pulling or pushing personal and mission equipment. Such swims are likely to be aided by the use of a swim mask, snorkel, and fins, and they are often conducted in open waters under varying sea state conditions.

Facilities and Equipment Arrangement

A pool 25 meters in length is split into as many 8-foot-wide lanes as possible to allow for multiple participants. Lanes are marked with floating buoys at each end of the pool. Each participant requires one 50-pound neutrally buoyant rucksack with an 8-foot tow strap attached to the rucksack and an adjustable belt on the other end.

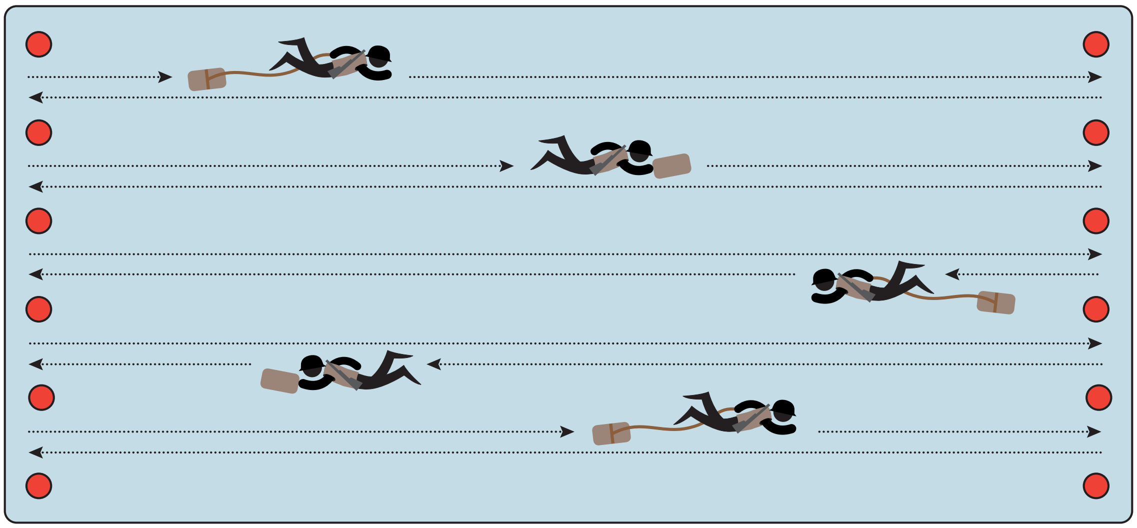


Task and Overview

This simulation includes a single segment with one performance step.

Segment 1: Conduct Surface Fin Swim

The participant will don swimming equipment, secure the neutrally buoyant rucksack as desired, and swim 2,000 meters without touching the walls or bottom of the pool or resting on rucksack.



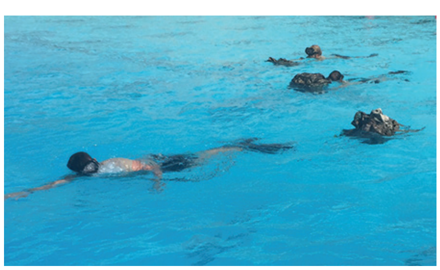
Execution

Participant Personal Gear Set Notes

- Participants will wear:
  - swim shorts
  - T-shirt
  - fins with booties
  - diving mask (does not have to be worn over face).
- Participants will not wear personal swim goggles or swim caps.

Administrator Instructions Specific to PTS

- If needed, assist participant in donning swim equipment.
- Ensure tow strap is secured to ruck and participant's waist and has length adjusted such that the ruck will remain behind participant's fins if being pulled while swimming.

Segment	Performance Step
Segment 1: Conduct surface fin swim tasks 	• In a 25-m pool, swim 40 laps without putting weight on walls, pool bottom, or rucksack and without using any backstroke techniques. Push or pull rucksack full distance

Equipment and Support Requirements

- 25-meter pool
- neutrally buoyant, 50-pound rucksack, with an 8-foot tow strap connected to an adjustable belt
- buoys (or other similar markers)
- test administrator with stopwatch
- medical and safety personnel.

Small Unit Tactics with Casualty Movement

Operational Relevance

The Small Unit Tactics with Casualty Movement PTS was informed by more than 40 different CPTs. These CPTs include such tasks as conducting patrols and traversing adverse terrain, moving under and over obstacles, maneuvering to cover and transitioning from prone to standing positions, conducting offensive and defensive maneuvers, and numerous casualty movement tasks.

This PTS simulates the physical demands associated with four general situations that operators may experience in the course of conducting small unit tactics. The first situation is considered an overland movement to an objective. A ground hike, or ruck, is a common insertion/extraction technique in a wide range of environments and over varied terrain. Similarly, the distance required to be traveled and the amount of weapons and equipment to be carried will depend greatly on the situation and environs. It is quite realistic, however, that BA operators may be expected to travel many miles by foot while carrying around 100 pounds of gear and weapons over mountainous terrain at high altitude or through thick jungle vegetation.

In the second scenario, operators may need to react to contact with enemy forces if they are exposed (e.g., during an insertion/extraction). Depending on the situation, the team may attempt to break contact with the enemy by repeatedly returning fire and moving to covered positions from which team members can again return fire. If the team has a non-ambulatory casualty while in contact, an operator will also have to move his or her teammate from one covered position to another. If possible, an operator may seek a covered position that requires him or her to maintain a low crawl in order to move to a safer location.

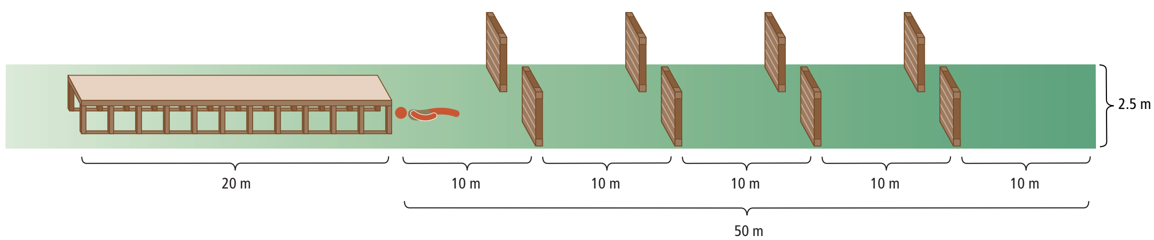
The third situation simulated in this PTS is that of individual movement and agility required to move in the most expeditious manner possible while in contact or immediate threat of contact. Such movements would require operators to move over and around obstacles of different sizes. This would often be accomplished while carrying their personal equipment and weapons until operators assess their situation to be safe enough to travel along a less-challenging route.

Finally, this PTS simulates the physical conditions associated with moving a non-ambulatory casualty over varied terrain using different techniques. Having reacted to contact initiated by the enemy, the team will be required to react within the current terrain and use only the equipment team members have with them. For example, a fireman’s carry may be required to move a casualty up and down stairs inside of a building or up a hill. Once in relatively safer conditions, the team may be able drag the casualty using a sled at which time two operators would ideally be used to drag the sled, while other members of the team provide security and conduct other operational tasks. Similarly, two operators may carry a casualty on a litter. If the movement of a casualty is required over difficult terrain or a long distance, team members may rotate between assisting the casualty carry and providing security during which they would continue to move while carrying their own equipment and weapons. Some of this terrain would likely include inclines. Lifting a litter over obstacles or up onto the platform of an aircraft for extraction is also a fundamental physical task of such a movement.

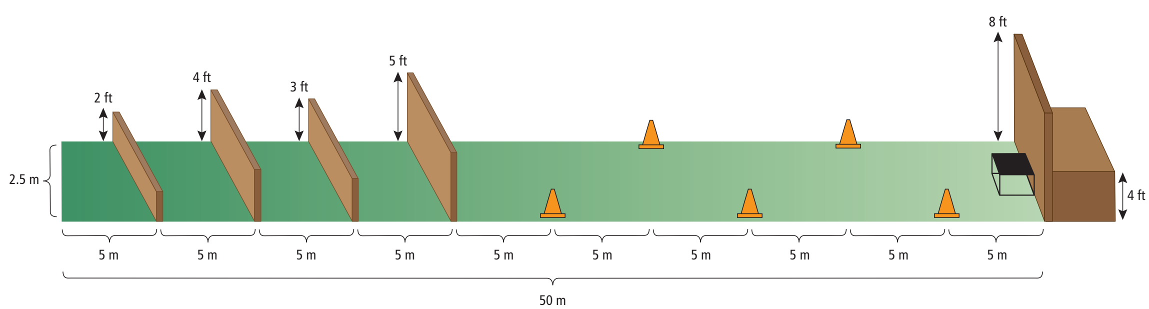
Facilities and Equipment Arrangement

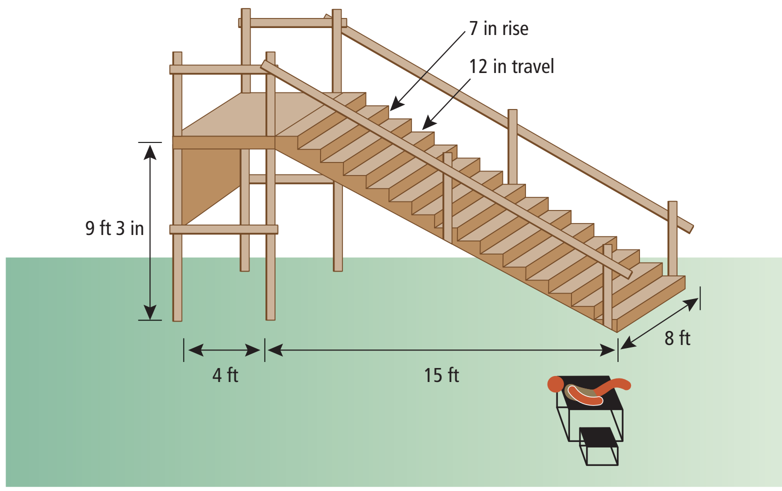
In order to simulate the four situations described above, a single continuous course is designed to include tasks associated with these four situations. The first is a flat, well-marked 5-kilometer ruck/hiking trail, which can be constituted by a shorter route for which multiple laps can be counted until a total of 5 kilometers is traveled.

At the end of the 5-kilometer ruck route is the beginning of a low-crawl platform that is 20 meters long and 2 feet high with dirt underneath. At the exit of the low-crawl platform is a 185-pound simulated casualty wearing a 30-pound vest lying on the ground. A straight 50-meter-long course is marked with four sets of pallets, each placed 10 meters apart along the course.



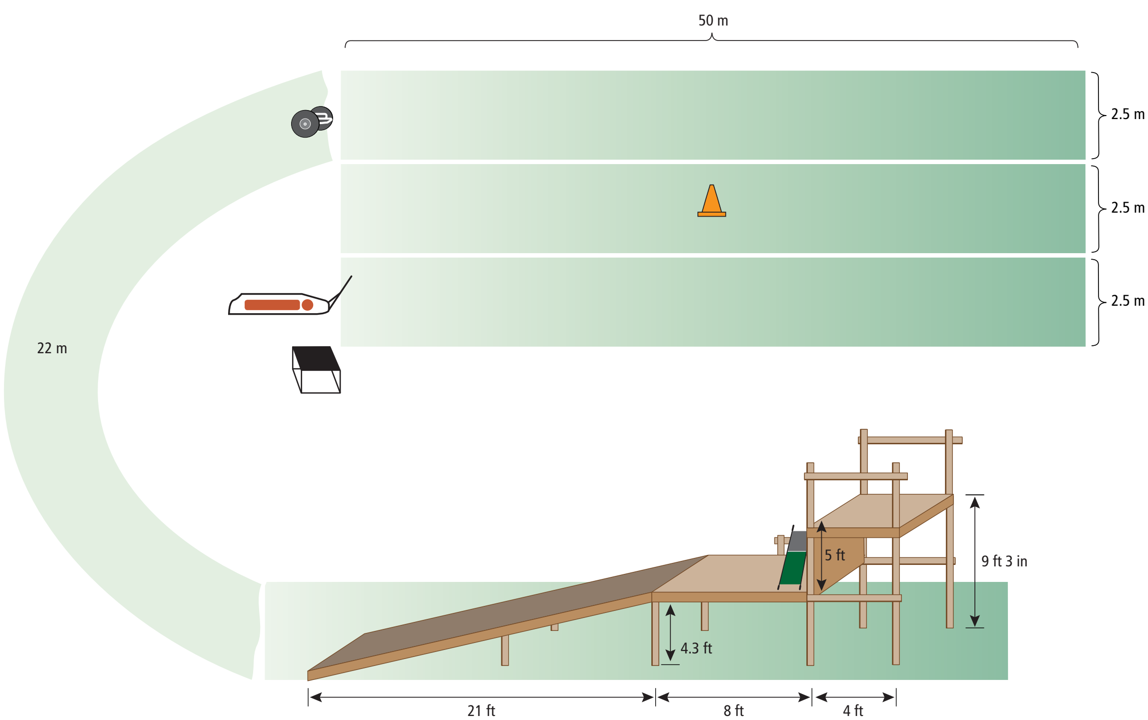
After the 50-meter course with pallets, there is another 50-meter course adjacent and parallel to the first 50-meter lane with a width of 2.5 meters. In this second course, the first 20 meters includes four walls of differing heights placed 5 meters apart. In order from the beginning of the course, the walls' heights are 2 feet, 4 feet, 3 feet, and 5 feet, respectively. After the 5-foot wall, there are five cones placed on alternate edges of the lane placed five m further down the lane from one another. At the end of this lane is an 8-foot-high wall with a 2-foot-high plyo box in front of it. On the backside of the 8-foot wall is a 4-foot-high platform.



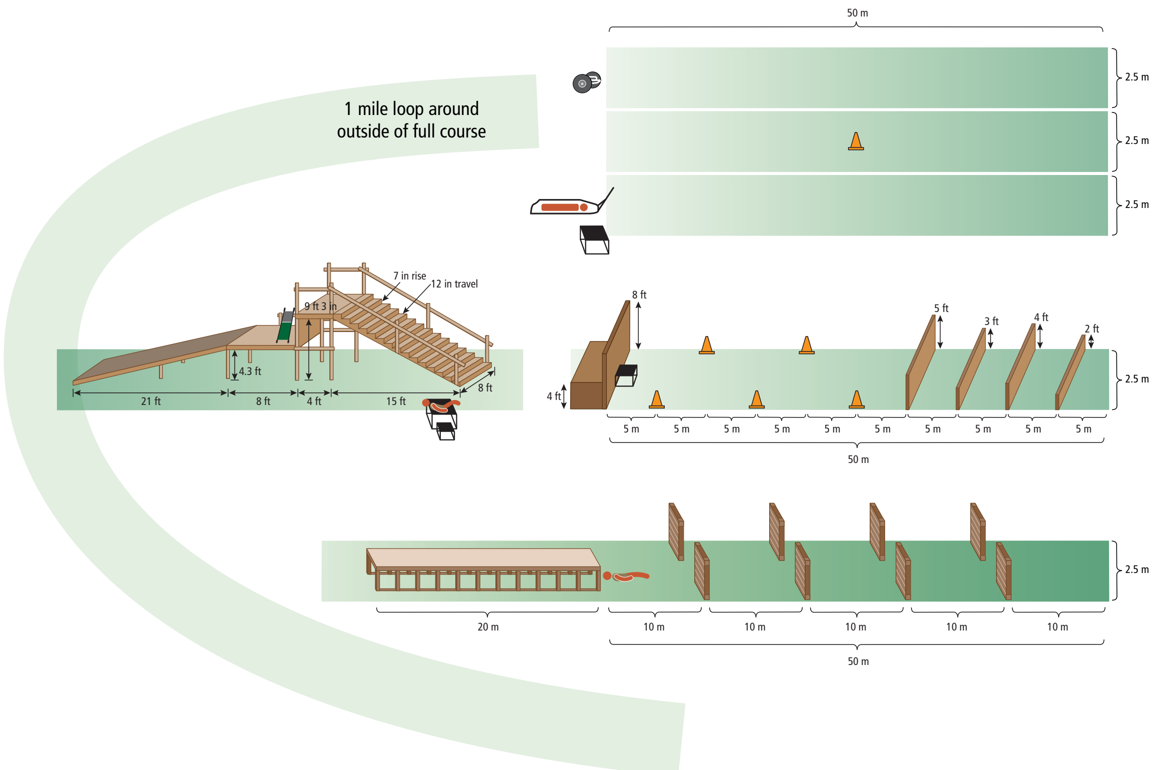


Immediately after the 8-foot-high wall is a 3-foot-high plyo box with a simulated casualty weighing 185 pounds lying on it and an 18-inch-tall plyo box next to it. Next to the plyo box with a simulated casualty is a set of 15 stairs (each step is 12 inches long by 7 inches tall) that in total are 15 feet in length; 9 feet, 3 inches in height; and 8 feet wide. Each step has a treaded surface along the top of it. A secure railing is placed on both sides, and a 4-foot-long platform at the top extends from the top step. At the bottom of the stairs, on the opposite side as the plyo box with the simulated casualty is another 18-inch plyo box.

Next to the 18-inch plyo box is a course with three 2.5-meter lanes parallel to each other extending a total of 50 meters in length. At the beginning of the first lane is a sled with a 107.5-pound simulated casualty. In the middle of the second lane is a cone. At the beginning of the third lane is a simulated litter weighing 107.5 pounds. Attached to the third lane is a marked course extending 22 meters along the flat ground to the opposite side of the stairs where a ramp is located. The ramp is painted with a non-skid surface, is 8 feet wide and 21 feet long, and extends from the ground to a height of 4 feet, 3 inches. At the top of the ramp is an 8-foot-long platform that is 5 feet below the top of the stair platform described previously. On



one edge of the platform is a litter weighing 107.5 pounds with one side attached to the base of the platform by a Landmine device and the other side moving freely. All four sections are positioned to allow for one continuous course.



Task and Overview

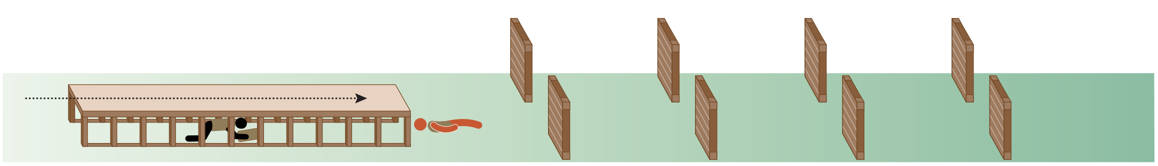
This simulation includes nine, consecutive segments with multiple performance steps.

Segment 1: Conduct Ruck March

Participant will don equipment and move along a flat, marked 5-kilometer course as quickly as possible.

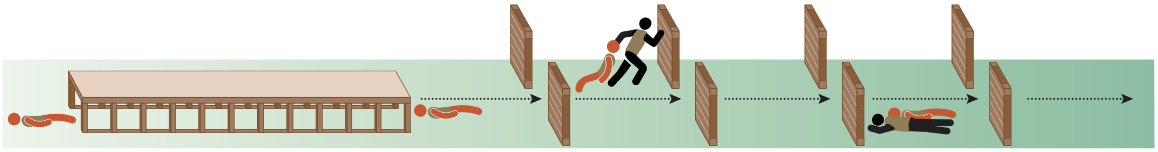
Segment 2: Perform Low Crawl

Immediately after completing the ruck march, the participant will use any technique to crawl under the 2-foot-high platform for a total distance of 20 meters with a rucksack.



Segment 3: React to Contact

During this segment, the participant will alternate between dragging a simulated casualty to a covered position and simulating a prone firing position. The participant will begin by dragging a simulated casualty using the buddy drag technique until the simulated casualty is fully behind a pallet. Once the simulated casualty is behind the pallet, the participant will lie flat on the ground with his or her stomach facing down for a minimum of five seconds. After five seconds, the participant will stand up and drag the simulated casualty to the next pallet where the task is repeated until the end of the react to contact course.



Segment 4: Move over Obstacles

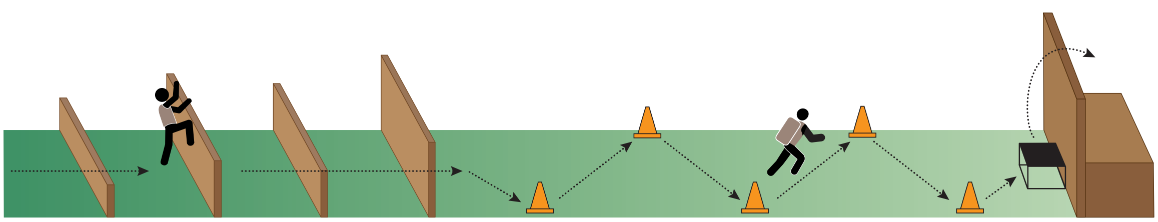
After the participant moves the simulated casualty past the last marker of the Segment 3 course, the participant will move without the simulated casualty to a series of walls that must be negotiated. Participants must move themselves and their rucksacks over four walls of differing heights.

Segment 5: Negotiate Agility Course

Immediately following the last wall, participants will move themselves and their rucksacks through an agility course outlined by five cones.

Segment 6: Climb over 8-Foot-High Wall

At the far end of the agility course, the participant will use a small platform to assist climbing over an 8-foot-high wall. The participant must also move his or her rucksack over the wall by first placing it on top of the wall, climbing over the wall, and then pulling the rucksack down once he or she is on the platform on the opposite side of the wall.

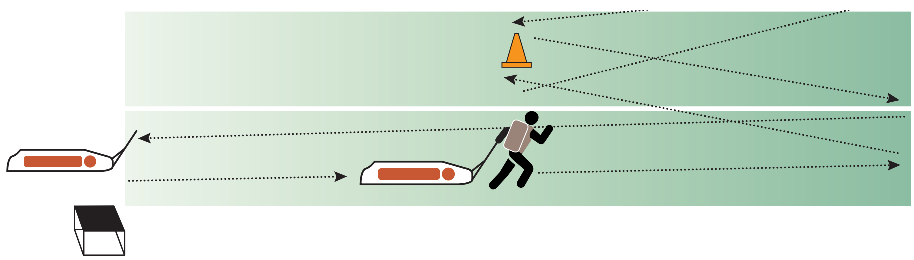


Segment 7: Conduct Fireman's Carry

The participant will put the rucksack back on and then be assisted in assuming a fireman's carry stance with a simulated casualty. Once the participant has all of the weight of the simulated casualty on his or her back, he or she will carry the simulated casualty up a flight of stairs. The participant will lay the simulated casualty on the platform at the top of the stairs before descending the stairwell with only personal equipment and rucksack having left the simulated casualty at the top of the stairs.

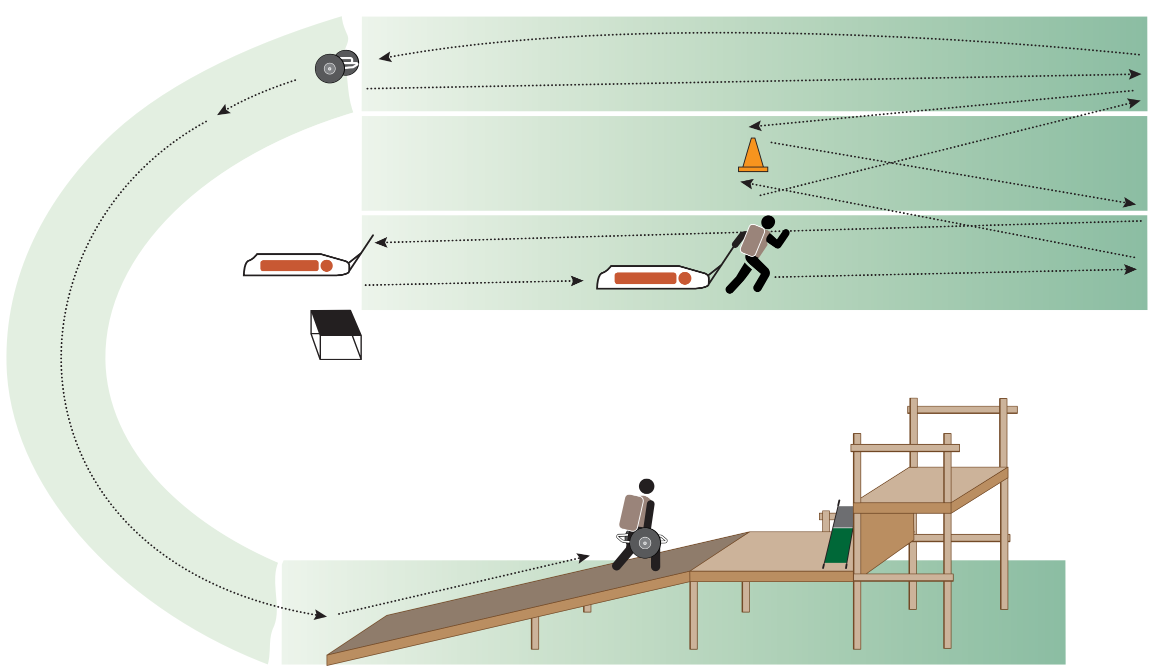
Segment 8: Pull Sled

The participant will pull a sled with the weight of a simulated casualty for 50 meters to the opposite end of the course, where the participant will release the sled. Next, the participant will run around the cone in the middle of the course and back to the sled for a total of 50 meters. The participant will then drag the sled another 50 meters back to the starting position.



Segment 9: Carry Simulated Litter

As soon as the participant completes dragging the sled, he or she will pick up the simulated litter adjacent to the sled. The participant will carry the simulated litter for 50 meters to the opposite end of the course, where the participant will release the simulated litter. Then the participant will run around the cone in the middle of the course and back to the simulated litter for a total of 50 meters. The participant will then carry the simulated litter another 50 meters back to the starting position. Still holding onto the simulated litter, the participant will carry the simulated litter to the ramp, carry it up the ramp, and set it down on the first platform. The participant will then lift one side of a litter attached to a Landmine device on the first platform high enough such that the participant's wrists are aligned with the taller platform while still holding the litter handles.



Execution

Participant Personal Gear Set Notes

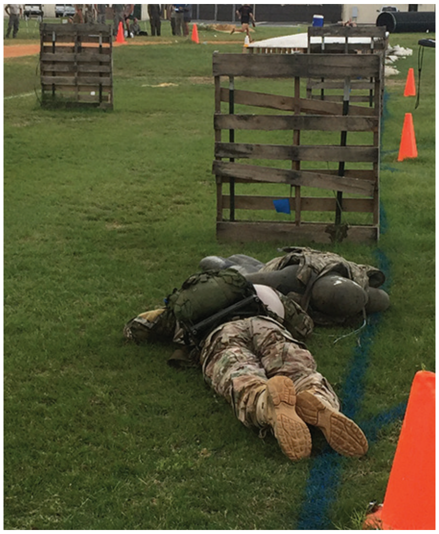
- Participants will wear:
  - uniform
  - 30-lb vest
  - 65-lb ruck
  - boots or running shoes
  - gloves (optional)

Administrator Instructions Specific to PTS

- Ensure equipment and simulated casualties are repositioned in the appropriate position before each simulation.

Segment	Performance Step
Segment 1: Conduct ruck march 	• Ruck 5 km with rucksack
Segment 2: Perform low crawl 	• Crawl 20 m under platform with rucksack

Segment 3: React to contact



- Drag simulated casualty to covered position behind pallet
- Lie in prone position behind pallet for at least five seconds
- Stand and drag simulated casualty to the next pallet
- Repeat dragging simulated casualty and lying in prone performance steps until completed with Segment 3 course

Segment 4: Move over obstacles

- Move rucksack and self over four walls (2 ft, 4 ft, 3 ft, 5 ft)

Segment 5: Negotiate agility course

- Move rucksack and self around five cones

Segment 6: Climb over 8-ft wall  	• Move rucksack and self over wall (8 ft)
Segment 7: Conduct fireman's carry 	• Move simulated casualty from larger plyo box to a fireman's carry position • Carry simulated casualty in a fireman's carry position up flight of stairs • Place simulated casualty down on the top platform and walk down flight of stairs
Segment 8: Pull sled 	• Drag sled 50 m • Run without sled for 50 m • Drag sled 50 m

Segment 9: Carry simulated litter

- Carry simulated litter for 50 m
- Run without simulated litter for 50 m
- Carry simulated litter for 50 m
- Carry simulated litter up ramp and set down on platform
- Lift litter handles up to top of taller platform

Equipment and Support Requirements

- 30-pound vest for participant
- 65-pound rucksack for participant
- One-mile hike route
- Low crawl platform (20 meters long, 2 feet high)
- Two simulated casualties, each weighing 185 pounds and wearing 30-pound vests
- Four pallets
- Five reinforced walls of different heights: 2 feet, 3 feet, 4 feet, 5 feet, and 8 feet
- Four plyo boxes
- Ten cones
- Full flight of stairs
- Sled weighing 107.5 pounds
- 45-pound Trap bar with 25 pounds of plates (x2); 2.5-pound plates (x2); collars (x2); bar (45 pounds)
- Wooden ramp
- Israeli litter attached to landmine device secured to top of ramp incline weighting a total of 107 pounds
- Spray paint
- Test administrator with stopwatch
- Medical and safety personnel.

APPENDIX C

Administrator Checklists

This appendix contains checklists created by the Air Force in May 2015 to assist administrators with the preparation and execution of each Physical Task Simulation (PTS). By the time of this writing in August 2015, slight modifications had been made between what is represented in some checklists and what is now described as the final description of each PTS throughout the body of this report.

Single Leg Vertical Rope Ascent (SLVA)

Test Subject Kit: 20 lb. vest; helmet

Equipment:

______ Rope equipment (e.g., ropes, belay system, Etrier (webbing loops), carabiners); verify rope master has all required ropes and safety equipment
______ 20 lb. vests, (4 total)
______ Safety helmets (at least 3 helmets in each size (S/M/L))
______ Climbing harnesses (10 total)
______ Safety gloves (at least 6 pairs of various sized gloves)
______ Heart Rate Monitors
______ Stopwatches (ensure Timers equipped w/stopwatch and backup watch)
______ Automated external defibrillator (AED)/medical kit (brief team on location in case of emergency)
______ PTS **Data Form**
______ BA Questionnaire **Data Form** (only required for BA operators)
______ Weather **Data Form**
______ Weather Devices (Kestrel and WBGT)
______ Rating of Perceived Exertion (RPE) Chart
______ Clipboards and ballpoint pens
______ Water/cups for test subjects

Manpower Requirements (3 personnel):

______ Proctor
______ Assistant/Timer (x1); back-up Timer and collect/document weather conditions
______ Rope Master

Purpose: To ascend a vertical, 43 foot rope using ascension devices as quickly as possible.

Procedure: This is a timed event.

1. The rope master will provide a demonstration showing how to use the climbing devices prior to starting this event.

2. You will be wearing a 20 lb. vest for this event. Prior to ascending, the rope master will assist you with donning the climbing and ascension gear to ensure proper and safe fit. You will be given two minutes to familiarize yourself with the ascension device prior to your official start.

3. You will be given the command, "Ready, Go." On the command "Go," you will begin climbing. You will ascend the rope as fast as possible. Timing stops when you touch the 43 foot mark on the wall. Be prepared to provide your heart rate and RPE once you reach the top. Keep in mind, you'll need to yell loudly to ensure the Proctor is able to hear you!

4. To descend, you will remove the Etrier and release the ascension device as instructed. Additionally, you will be securely belayed and the rope master will guide your descent to the ground.

Post-SLVA Checklist:

______ Proctor secures Data Collection Form
______ Proctor secures Weather Data Forms
______ Proctor secures BA Questionnaire
______ Return Weather devices (Kestrel and WBGT)
______ Secure (neatly organize) the following items in Tower Storage:
- ____ vests
- ____ helmets
- ____ harnesses
- ____ gloves
- ____ all rope climbing gear (ropes, belay system, Etrier (webbing loops), carabiners)

______ Police Tower area for trash
______ Lock Tower Storage unit

Rope Bridge (RB) Test

Subject Kit: Bravo Kit

Equipment:

______ Inspect steel cable to ensure it is tight and not frayed; inspect poles and ensure cables are securely attached to anchors
______ 30 lb vests (4 total)
______ Safety helmets (at least 3 helmets in each size (S/M/L))
______ Chest harness (3 total)
______ Safety rope (attaches to subject and pulley/tag line)
______ Carabiner and pulley/tag line
______ Petzl gloves (at least two pair of various sizes available)
______ Stepladder (place at end of obstacle to assist subjects during dismount)
______ Heart Rate Monitors
______ Stopwatches (ensure Timers equipped w/stopwatch and backup watch)
______ AED/medical kit (brief team on location in case of emergency)
______ PTS **Data Form**
______ BA Questionnaire **Data Form** (only required for BA operators)
______ Weather **Data Form**
______ Weather Devices (Kestrel and WBGT)
______ Rating of Perceived Exertion (RPE) Chart
______ Clipboards and ballpoint pens
______ Water/cups for test subjects

Manpower Requirements (2 personnel):

______ Proctor
______ Assistant/Timer

Purpose: To traverse a 20 meter rope bridge using an inverted body position and hand-over-hand technique to cross simulated obstacle on the ground.

Procedure: This is a timed event.

1. Prior to mounting rope, an assistant will check to ensure your chest harness is secure. You will be equipped with a safety attachment to the cable in case you fall.

2. Upon initially mounting the rope, you will be allowed one minute to familiarize yourself with the "feel" of the rope and the weight distribution. You will start in the inverted position with both hands securely holding the rope and one foot touching the cable. You will be given the command, "Ready, Go." On the command "Go," time starts once your second foot makes contact with the cable and you will begin

traversing the rope bridge in an inverted position using hand over hand technique as quickly as possible.

3. Timing stops when you touch the black rubber at the end of the rope. A spotter will assist you in dismounting the rope bridge. Be prepared to provide your heart rate and RPE once you complete this event.

Post-RB Checklist:

______ Proctor secures Data Collection Form
______ Proctor secures Weather Data Form
______ Proctor secures BA Questionnaire
______ Secure (neatly organize) the following items in Storage Unit #1:
    ____ weather devices (Kestrel and WBGT)
    ____ vests
    ____ helmets
    ____ chest harnesses
    ____ Carabiner and pulley/tag line
    ____ gloves
______ Return stepladder to Storage Unit #2
______ Police RB area for trash

Airfield Operations (AO)

Test Subject Kit: Charlie Kit

Equipment:

______ 65 lb rucks (8 total)
______ 30 lb vests (8 total)
______ Ensure yellow distance course markers (250 – 2500 feet) are accurately placed and orange cone placed at turnaround point

______ **Lift and Move (L&M)** (x2); ensure secured to ground and properly weighted with (150 lbs); each L&M will have the following:
- ___ Bar = 45 lbs
- ___ 45 lb plates, (x2)
- ___ 5 lb plates, (x2)
- ___ Collars (x2) (weight approx. 5 lbs)
- ___ Ensure entry path from ruck course to L&M is clearly marked
- ___ Ensure L&M start and stop marks are clearly marked
- ___ Ensure two cinder blocks per L&M are correctly placed

______ **Truck Task**
- ___ Ensure truck is parked (in Neutral gear) and in the correct spot
- ___ Tire gauge; check tire pressure on all four tires (35 psi)
- ___ Tire pump; have available in case tires below 35 psi
- ___ Ensure blue distance markers (0 – 105 feet) are accurately placed to record distance subject pushed the truck

______ Heart Rate Monitors
______ Stopwatches (ensure Timers equipped w/stopwatch and backup watch)
______ AED/medical kit (brief team on location in case of emergency)
______ PTS **Data Form**
______ BA Questionnaire **Data Form** (only required for BA operators)
______ Weather **Data Form**
______ Weather Devices (Kestrel and WBGT)
______ Rating of Perceived Exertion (RPE) Chart
______ Clipboards and ballpoint pens
______ Water/cups for test subjects

Manpower Requirements (6 personnel):

______ Proctor
______ Assistant/Wingman (x3)
______ Note: One Wingman assigned per test subject & tasked with following duties:
- Accompany subject for duration of AO

  - Monitor subject for signs of dehydration, heat stress, or other issues
  - Carry cell phone in case of emergency
  - Carry subject's bottled water
  - Call out subject's last name, lap completed and heart rate to Proctor

______ Truck Spotter/Timer (x1)
  - Ensures proper truck placement for each test subject
  - Maintains supporting data collection form for "Truck Split Time

______ L&M Spotter/Timer (x1)
  - Ensures proper truck placement for each test subject
  - Maintains supporting data collection form for "Truck Split Time

Purpose: To quickly traverse and clear a runway of simulated debris.

Procedure: This is a timed event. You will cover a distance of 2,500 feet and encounter two tasks; one task on third lap and second task on fourth (final) lap. Test subject start time will be staggered and you will be paired with a Wingman for safety and accountability.

1. For this simulation, you will be wearing a vest (30 pounds) and a ruck (65 pounds). Five minutes prior to your start time, your Wingman will escort you to the staging area and ensure you are properly fitted in your vest and ruck. You will determine your own pace as your Wingman will maintain a distance of 2-3 steps behind you allowing you to traverse the best path/tangent on the course.

2. You will be given the command, "Ready, Go." On the command "Go," you will ruck the course for a total of four laps.

3. Upon completing each lap, your Wingman will check your heart rate.

4. On the third lap, you will be directed to slightly veer off the course and enter a marked path towards Task #1, Lift and Move (L&M).

   Note: the L&M is a ground-based rotational training device which simulates an inoperable motorcycle (or other FOD-foreign object debris) that you've encountered on the runway.

   To complete this task, you must safely pick up the L&M and navigate from point A to point B while clearing two obstacles (cinder blocks). The L&M bar must not touch the cinder blocks. You must safely lower the L&M bar to the ground (do not drop it). Upon completion of Task #1, you will return to the course using the same path you entered from.

5. On the fourth and final lap, you will encounter Task #2 (moving a small disabled truck parked in Neutral gear from the path of the simulated runway). You will move the truck 105 feet. Once you've moved the truck, proceed to the end of the course to complete the fourth and final lap. As a reminder, your Wingman will check your heart rate and you should be prepared to provide your RPE.

Post AO Checklist:

______ Proctor secures Data Collection Form
______ Proctor secures Weather Data Form
______ Proctor secures BA Questionnaire
______ Return L&M, weights & cinder blocks to Storage Unit #3
______ Lock truck doors; roll up windows
______ Secure truck key in Storage Unit #1
______ Secure (neatly organize) the following items in Storage Unit #1:
- ____ weather devices (Kestrel and WBGT)
- ____ vests (hang on drying rack)
- ____ rucks (neatly arranged; not stacked on top of each other)
- ____ tire gauge
- ____ tire pump

______ Police AO area for trash

Rock and Ice Climbing - Wall Climb (WC)

Test Subject Kit: Alpha Kit (Slick)

Equipment:

______ Rope equipment (e.g., ropes, belay system, carabiners); verify rope master has all required ropes and safety equipment
______ A-Bag (x2) loaded with 75 lbs
______ Safety helmets (at least 3 helmets in each size (S/M/L))
______ Climbing harnesses (10 total)
______ Safety gloves (at least 6 pairs of various sized gloves)
______ Chalk
______ Heart Rate Monitors
______ Stopwatches (ensure Timers equipped w/stopwatch and backup watch)
______ AED/medical kit (brief team on location in case of emergency)
______ PTS **Data Form**
______ BA Questionnaire **Data Form** (only required for BA operators)
______ Weather **Data Form**
______ Weather Devices (Kestrel and WBGT)
______ Rating of Perceived Exertion (RPE) Chart
______ Clipboards and ballpoint pens
______ Water/cups for test subjects

Manpower Requirements (5 personnel):

______ Proctor
______ Rope Master
______ Ropes Safety Assistant
______ Assistants (x2)
    ______ Tower Assistant/Split Timer
    ______ Ground safety/back-up timer/weather data monitor

Purpose: To ascend a vertical climbing wall (86 feet) and haul equipment (86 feet) quickly as possible.

Procedure: This is a timed event. Note: This is a 43-foot tower. Therefore, all subjects will complete two climbs and two equipment pulls to complete the required 86 feet.

1. The rope master will provide a demonstration showing how to use the climbing devices and the most ideal route prior to starting this event.

2. Prior to ascending the wall, an assistant will help you don climbing gear to ensure proper and safe fit. You will be allowed to familiarize yourself with the wall but may

not climb any higher than 10 feet. The green tape marks on the wall indicate the ideal climbing path.

3. You will be given the command, "Ready, Go." On the command "Go," you will begin climbing your first ascent. You will climb the wall as fast as possible and touch the top of the tower at the 43-foot mark. Timing will stop and you will be immediately lowered to the ground by the rope master and belay system.

4. Once both feet touch the ground, timing starts again and you will immediately begin your second ascent. Once you reach the top, hoist yourself over the ledge. There will be a one-minute equipment transition upon your arrival at the top of the Tower.

5. After one minute, the Rope Master will give you the command "Go" and you will pull the 75-pound equipment bag for the first ascent. Once the first bag reaches the 43-foot mark, you will be given ten seconds to transition to the second bag. To complete the task, the second bag must be completely pulled over the ledge. At this point, time will stop and your heart rate and RPE will be recorded.

6. If you fall during the wall climb, you will be given two attempts. On the third fall, you will be lowered to the ground where the ground safety assistant will immediately disconnect your carabiner from the belay. You will proceed up the Tower stairs where the rope master will direct you the area to simulate hauling equipment. You will have a one minute equipment prep upon your arrival at the top of the Tower and then you will proceed with Step #5.

Note to Fitness Team:
Subject is allowed "two falls" for the entire 86 feet.
Examples:

Subject completes 43 feet on WC #1. On WC #2, subject falls at 40 foot marker (this is considered "first fall"). Subject is allowed second attempt. On second attempt of WC #2, subject achieves 5 feet. Record the "best" distance. In this case, 43 + 40 = 83 feet and is recorded as "Fail/83 feet."

Subject completes 20 feet on WC #1 ("first fall"). On second attempt of WC #1, subject completes to 43 feet. On WC #2, subject falls at 30 feet. Best time is 43 + 30 = 73 feet and is recorded as "Fail/73 feet."

On WC #1, subject falls at 5 feet ("first fall"). Attempts WC #1 again, falls at 35 feet ("second fall"). Best time is 5 + 35 feet. Recorded as "Fail/40 feet."

Post-WC Checklist:

______ Proctor secures Data Collection Form
______ Proctor secures Weather Data Form
______ Proctor secures BA Questionnaire
______ Return Weather devices (Kestrel and WBGT) to Land site
______ Secure (neatly organize) the following items in Tower Storage:
____ vests

____ helmets
____ harnesses
____ gloves
____ all rope climbing gear (ropes, belay system, Etrier (webbing loops), carabiners)

______ Police Tower area for trash
______ Lock Tower Storage unit

Remove Debris and Survivor from Confined Space (RDSCS)

Test Subject Kit: Bravo Kit

Equipment:

______ 2 Gumbies (1 per culvert) in Bravo kit; ensure vest is secured with strap through groin area
______ Rope attached to rear Kevlar vest (subject may be used to pull casualty)
______ Cinder blocks (4 per culvert); place 1 block on each arm; 1 block on chest; and 1 block across thighs
______ Tape Measure *(to be used to mark distance of casualty if subject does not complete task; reference point is the casualty's head)*
______ Vests (30 lbs) (ensure at least 4 available)
______ Inspect culverts (remove any debris)
______ Mop (to wipe down debris between test subjects)

Manpower Requirements (4 personnel; 2 per culvert):

______ Proctor
______ Assistant/Timer

Purpose: This simulation requires that you safely remove a simulated casualty that is covered with debris (4 cinderblocks) from a confined space (20 m culvert).

Procedure: This is a timed event.

1. Once the Proctor ensures you are in correct gear, you will stand in front of the culvert with hands on top of the culvert. You will be given the command, "Ready, Go." On the command "Go," you will enter the culvert and proceed to the casualty.

2. Once you reach the casualty, move the cinder blocks from the casualty. Do not throw the blocks outside the culvert. If you do, you must retrieve the block(s) and pull them back into the culvert. Once all cinder blocks are removed, remove the casualty.

3. To complete the task, you must completely remove the casualty and yourself from the culvert. You may rest as needed, however this will affect your overall time.

Post-RDSCS Checklist:

______ Proctor secures Data Collection Form
______ Proctor secures Weather Data Form
______ Proctor secures BA Questionnaire

______ Return all cinder blocks to outside of culverts
______ Return Gumbies to Storage Unit #3
______ Return the following items to Storage Unit #1
 ___ Tape Measure
 ___ Vests
 ___ Mop
______ Police culvert area for trash

Cross Load Personnel and Equipment (CLPE)

Test Subject Kit: Bravo Kit

Equipment:

Note: This checklist assumes you are conducting two test subjects at once.

______ 4 high mobility multipurpose wheeled vehicles (Humvee)
______ 4 Gumbies (ensure Gumbies outfitted in Bravo kit)
______ 4 rucks and 4 weapons (2 per vehicle)
______ Placement of casualties, rucks and weapons:
- ___ One Gumby seated in right rear seat
- ___ One Gumby laying on its back; on ground next to driver's side rear tire
- ___ Rucks (x2) in back seat; rucks face down (harnesses facing up)
- ___ Weapons (x2); one weapon placed on top of each ruck

______ Heart Rate Monitors
______ Stopwatches (ensure Timers equipped w/stopwatch and backup watch)
______ AED/medical kit (brief team on location in case of emergency)
______ PTS **Data Form**
______ BA Questionnaire **Data Form** (only required for BA operators)
______ Weather **Data Form**
______ Weather Devices (Kestrel and WBGT)
______ Rating of Perceived Exertion (RPE) Chart
______ Clipboards and ballpoint pens
______ Water/cups for test subjects

Manpower Requirements (4 personnel):

Note: Manning level assumes you are conducting two test subjects at once. If you are only testing one subject at a time, you will only need one Proctor. However, maintain two assistants that are physically capable of repositioning the Gumbies, rucks, and weapons.

______ Proctor (x2)
______ Assistants (x2)

Purpose: To simulate moving casualties and their equipment from a disabled vehicle to your operable vehicle while in a hostile environment setting.

Procedure: This is a timed event.

1. An assistant will ensure you are properly and safely fitted in the 30 pound vest. To begin, you will be seated in the passenger seat of the operable vehicle with the door closed. Once you are ready, the Timer will give the command, "Ready, Go." On the

command "Go," you will exit the vehicle and proceed to move both casualties from the disabled vehicle. Both casualties must be moved before the equipment.

2. To complete the casualty part of the task, both casualties must be placed on the tailgate your vehicle with the hip joints in line with the outermost portion of the bed of the tailgate. The Proctor will carefully monitor your progress with each casualty. Once you reach the tailgate, you will have up to two minutes to load the casualty to the vehicle.

3. Once casualties are loaded, you will return to disabled vehicle to retrieve the two rucks and the two weapons. Multiple trips are allowed to transport equipment. All equipment must be placed in the back seat of your vehicle using either back door and should not be placed on top of the casualties. Do not toss equipment in the back hatch. Do not forcefully throw or toss the weapons or rucks.

4. Once all equipment is in the back seat, ensure all doors are shut on your vehicle and return to the passenger seat with the door closed. Time will stop once you shut your passenger door and Proctor will record your heart rate and RPE.

Post-CLPE Checklist:

______ Proctor secures Data Collection Form
______ Proctor secures Weather Data Form
______ Proctor secures BA Questionnaire
______ Secure (neatly organize) the following items in storage unit #3
    ___ Gumbies
    ___ Rucks
    ___ Dummy weapons
______ Place vests on drying racks in storage unit #1
______ Police area for trash

Rope Ladder (RL)

Test Subject Kit: 20 lb vest and 50 lb ruck

Equipment:

______ Rope equipment (e.g., ropes, belay system, carabiners); verify rope master has all required ropes and safety equipment
______ 20 lb vests, (3 total)
______ 50 lb rucks, (2 total)
______ Safety helmets (at least 3 helmets of each size (S/M/L))
______ Climbing harnesses (10 total)
______ Safety gloves (at least 6 pairs of various sized gloves)
______ Heart Rate Monitors
______ Stopwatches (ensure Timers equipped w/stopwatch and backup watch)
______ AED/medical kit (brief team on location in case of emergency)
______ PTS **Data Form**
______ BA Questionnaire **Data Form** (only required for BA operators)
______ Weather **Data Form**
______ Weather Devices (Kestrel and WBGT)
______ Rating of Perceived Exertion (RPE) Chart
______ Clipboards and ballpoint pens
______ Water/cups for test subjects

Manpower Requirements (6 personnel):

______ Proctor
______ Rope Master
______ Rope master assistant
______ Assistants (x3)
____Assistant 1: on 20-foot deck for safety
____Assistant 2: on 30 foot deck for safety
____Assistant 3: on 40 foot deck for safety; capture heart rate and RPE

Purpose: To ascend 20-foot rope ladder wearing 20 lb vest and 50 lb ruck simulating a helicopter extraction.

Procedure: This is a timed event.

1. Prior to ascending the wall, the rope master will assist you with donning climbing gear to ensure proper and safe fit, and will demonstrate the procedure. You will be allowed to familiarize yourself with the footing of the Rope Ladder.

2. Once you've demonstrated you are familiar with the climbing procedure, you will be given the command, "Ready, Go." On the command "Go," you will begin climbing.

Timing starts once you put your second foot in contact with the Rope Ladder. Climb the ladder as fast as possible. You may not intentionally stand on any of the landings.

3. Once you reach the top, you must hoist yourself (including your equipment) over the ledge and timing will stop. Assistant will read your heart rate, be prepared to provide RPE.

Team NOTE: reference mark for less than complete distance is the subject's feet (different than SLVA and WC)

Post-Rope Ladder Checklist:

______ Proctor secures Data Collection Form
______ Proctor secures Weather Data Form
______ Proctor secures BA Questionnaire
______ Return Weather devices (Kestrel and WBGT) to Land site
______ Secure (neatly organize) the following items in Tower Storage:
    ____ vests
    ____ helmets
    ____ harnesses
    ____ gloves
    ____ all rope climbing gear (ropes, belay system, carabiners)
______ Police Tower area for trash
______ Lock Tower Storage unit

Combat Rubber Raiding Craft (CRRC) Carry

Test Subject Kit: Delta Kit

Equipment Requirements:

______ 50 lb rucks, (2 total)
______ 20 lb vests, (3 total)
______ Simulated CRRC "gunnel" (110.4 lbs)
______ Rakes (x2) for pea gravel (must rake after every subject goes through)
______ Stopwatches (ensure Timers equipped w/stopwatch and backup watch)
______ AED/medical kit (brief team on location in case of emergency)
______ PTS **Data Form**
______ BA Questionnaire **Data Form** (only required for BA operators)
______ Weather **Data Form**
______ Weather Devices (Kestrel and WBGT)
______ Rating of Perceived Exertion (RPE) Chart
______ Clipboards and ballpoint pens
______ Water/cups for test subjects

Manpower Requirements (2 personnel):

______ Proctor
______ Assistant

Purpose: This task simulates carrying a combat rubber raiding craft (CRRC), or "Zodiac" as most commonly known, across a beach head and over obstacles.

Procedure: This is a timed event.

1. This simulation task requires that you lift a large drum simulating the gunnel of a Zodiac watercraft for a total of 60 meters. You will be wearing a 20 lb vest and 50 lb ruck. You will be given the command, "Ready, Go."

2. On the command "Go," lift up the gunnel and proceed across the firm ground (10m), through the pea gravel (10m), over the three obstacles (10m), around the orange cone, and return (30m) to the finish line.

3. You may stop, put the gunnel on the ground, and switch hands as many times as you like however, time will not stop, so you are encouraged to move as fast as possible. You must use only one hand when traveling with the drum; you may use two hands to lift or reposition the drum, but you and the drum must be stationary when using two hands. You may not use the "high carry" for this event.

4. Time will stop when you and the drum cross the finish line at the end of the 60 meters. Assistant will read your heart rate, be prepared to provide RPE.

Post-CRRC Checklist:

______ Proctor secures Data Collection Form
______ Proctor secures Weather Data Form
______ Proctor secures BA Questionnaire
______ Secure (neatly organize) the following items in storage unit #1:
- vests (hang on drying rack)

______ Secure (neatly organize) the following items in storage unit #3:
- rucks (neatly arranged; not stacked on top of each other)

______ Secure rakes in Storage Unit #2:

Casualty Movement (CM)

Test Subject Kit: Charlie

Equipment:

______ Skedco (weighted with sandbags, weight 107.5 lb)
______ Simulated Casualty in Bravo (Larry 154 lb + Kevlar vest 30 lb)
______ Large and small plyo boxes
______ 65 lb rucks (4 total)
______ 30 lb vests (4 total)
______ Stopwatches (ensure Timers equipped w/stopwatch and backup watch)
______ AED/medical kit (brief team on location in case of emergency)
______ PTS **Data Form**
______ BA Questionnaire **Data Form** (only required for BA operators)
______ Weather **Data Form**
______ Weather Devices (Kestrel and WBGT)
______ Rating of Perceived Exertion (RPE) Chart
______ Clipboards and ballpoint pens
______ Water/cups for test subjects

Manpower Requirements (3 personnel):

______ Proctor
______ Assistant (x2); loading casualty and split timers

Note: Ensure both assistants are physically capable of properly loading Larry onto test subject

Purpose: To move casualty as quickly as possible.

Procedure: This is a timed event.

1. For this simulation, you will be wearing a vest (30 lb) and a ruck (65 lb).

2. You will start in the seated position where our assistants will load a casualty on your upper back and shoulders. Once the casualty is positioned, the Proctor will ask if you're ready and give you the command, "Ready, Go." Time will start when you rise from the seated position.

3. You will fireman's carry the casualty for 50 meters. At the 50 meter mark, you will carefully sit down on the plyo box and gently release the casualty. Do not drop the casualty.

4. Next, you will walk, jog, or run without the casualty for 100 meters. After the 100 meter movement, you will return to the plyo box and be seated to once again have the casualty loaded on your upper back.

5. Once the casualty is positioned, you will immediately fireman's carry the casualty 50 meters. At the 50 meter mark, you will sit down on the plyo box and gently release the casualty (again, do not drop casualty).

6. Once you release the casualty, you will remain seated for a two-minute simulated equipment prep rest.

7. At the 90-second mark, you will proceed to the beginning of the 250 meter course where you will be given a Skedco sled loaded with a simulated casualty weight. You may pull the Skedco facing forward or backward, with both hands, or with one hand. You may not place the strap over your shoulder, chest or waist, or attach the Skedco to your ruck.

8. Once the two-minute rest period has elapsed, you will move the Skedco for two laps (250 meters) clearly maneuvering around each corner cone. You may rest, however this counts against your total time. You must completely drag the Skedco across the finish line. The Proctor will obtain your heart rate and RPE once you cross the finish line.

Post-CM Checklist:

______ Proctor secures Data Collection Form
______ Proctor secures Weather Data Form
______ Proctor secures BA Questionnaire
______ Secure (neatly organize) the following items in storage unit #3:
    ___ rucks (neatly arranged; not stacked on top of each other)
    ___ Larry (simulated casualty)
    ___ Skedco
______ Secure (neatly organize) the following items in storage unit #1:
    ___ weather devices (Kestrel and WBGT)
    ___ vests (hang on drying rack)
______ Police CM area for trash

Swim to Inflatable Craft (SwIC)

Test Subject Kit: Pool Kit

Location: JBSA Lackland, outdoor Warhawk pool (25-meter)

Equipment:

______ Combat Rubber Raiding Craft (CRRC; aka: "Zodiac") (Note: 342d owns this CRRC)
______ "Randy" (casualty dressed in flight suit, lifeguard flotation, and flotation devices on legs)
- Do not drag Randy across pavement; lift with two people to limit damage to Randy
- Perform "operational check" (ensure flotation devices work; no sinking)

______ Buckets (x4) (place three, 5 lb plates in each bucket to hold the buckets in place when placed at the bottom on the pool) [*template for bucket spacing on pool bottom*]
______ 3-pound dumbbells (x12); place 6 in two buckets
______ Rucks (50 lbs; neutrally buoyant); (6 total)
___ Two rucks located at CRRC (Zodiac) for subjects to load
___ Four rucks available for conducting multiple test subjects
___ Perform "operational check" (ensure rucks are neutrally buoyant and do not sink)
______ Rigger belts (at least 4 available)
______ Ropes for towing rucks (at least 4 available)
______ Scuba Jet-Pro fins
______ Booties (for fins)
______ Masks
______ Sunscreen
______ Mylar thermal blankets
______ Heart rate monitors, waterproof model ______
______ Stopwatches (ensure Timers equipped w/stopwatch and backup watch)
______ AED/medical kit (brief team on location in case of emergency)
______ PTS **Data Form**
______ BA Questionnaire **Data Form** (only required for BA operators)
______ Weather **Data Form**
______ Weather Devices (Kestrel and WBGT)
______ Rating of Perceived Exertion (RPE) Chart
______ Clipboards and ballpoint pens
______ Water/cups for test subjects

Manpower Requirements (4 personnel):

______ Proctor (ensure you capture overall time and split time for Randy rescue)

______ Certified Safety Swimmer
______ Assistant (x2)
Assistant #1: responsible for placement of Randy
Assistant #2: responsible for placement of rucks and CRRC (rucks at starboard stern)

Purpose: To swim, perform underwater tasks, rescue casualty and mount combat rubber raiding craft (CRRC) as fast as possible.

Procedure: This is a timed event.

1. You will start at the far west, 5 foot depth mark (12.5 meter length point) of the pool. You will swim a total distance of approximately 300 meters. On the command "Go" you will complete the following tasks:

   - Swim 2 laps (100 meters); with ruck
   - Perform underwater task #1 (buckets)
   - Swim 2 laps (100 meters); with ruck
   - Perform underwater task #2 (buckets)
   - Swim 75 meters
   - Release ruck
   - Pick up/rescue swim w/Randy for 25 meters; use over chest under far arm hold on Randy
   - Drop off Randy
   - Swim to CRRC (Zodiac)
   - Hoist self in CRRC
   - Pull two rucks into craft
   - Move two rucks and body to front (bow) of CRRC

2. You may use any swim stroke. You may pull your ruck behind on a tag line or you may push the ruck in front of you. You may not rest your chest or chin directly on the ruck. Your feet must not make intentional contact with the bottom of the pool. You may push off the side of the pool.

3. Task is completed once you move yourself, and the two rucks, to the bow of the CRRC. The Proctor will obtain your heart rate and RPE before you exit the water craft.

Post-SwIC Checklist:

______ Proctor secures PTS **Data Form**
______ Proctor secures Weather **Data Form**
______ Proctor secures BA Questionnaire **Data Form**
______ Secure Zodiac (CRRC)
______ Ensure the following equipment is locked/secured:
___ rucks (neatly arranged; not stacked on top of each other)
___ Randy (simulated casualty)

____ Black buckets (x4) (and weights)
____ 3-pound weights (x12); place 6 in two buckets
____ Rigger belts and ropes for towing rucks
____ Swim Fins
____ Booties (for fins)
____ Masks
____ Sunscreen
____ Mylar thermal blankets
____ Lap counters
____ Heart rate monitors

______ Lock up all pool equipment
______ Lock entrance to pool
______ Note: As of 22 May, the Warhawk Pool will open to the public. We must ensure ALL of gear is neatly stowed AND locked at all times!

Surface Fin Swim (SFS)

Test Subject Kit: Pool Kit

Location: JBSA Lackland, outdoor Warhawk pool (25-meter)

Equipment:

______ Rucks (50 lbs; neutrally buoyant); (9 total)
___ Perform "operational check" (ensure rucks are neutrally buoyant and do not sink)
______ Rigger belts (at least 9 available in various S/M/L sizes)
______ Ropes for towing rucks (at least 9 available)
______ Scuba Jet-Pro fins
______ Booties (for fins)
______ Masks
______ Buoys (x10) w anchors; 4 placed in 3 feet end; 4 placed in 12 foot end of pool
______ Lane ropes/markers (may be used in lieu of buoys)
______ AED/medical kit (brief team on location in case of emergency)
______ Sunscreen
______ Mylar thermal blankets
______ Heart Rate Monitors, waterproof model ______
______ Lap Counters (9 total)
______ Stopwatches (ensure Timers equipped w/stopwatch and backup watch)
______ AED/medical kit (brief team on location in case of emergency)
______ PTS **Data Form** (note: each Timer should have their own sheet; Proctor consolidates data)
______ BA Questionnaire **Data Form** (only required for BA operators)
______ Weather **Data Form**
______ Weather Devices (Kestrel and WBGT)
______ Rating of Perceived Exertion (RPE) Chart
______ Clipboards and ballpoint pens
______ Water/cups for test subjects

Manpower Requirements (3-6 personnel; varies depending on how many subjects per heat):
______ Proctor
______ Safety Swimmer (certified)
______ Timers (at minimum, 1 Timer per two test subjects)

Purpose: To simulate open water swim with ruck for 2,000 meters.

Procedure:

1. You will start and finish in the shallow end of the pool. On the command "Go" you will leave the wall and begin your 2,000 meter fin swim (40 laps).

2. You may use any swim stroke. Your ruck may be pulled behind you or you may push the ruck in front of you. You may not rest directly on the ruck. You may not "turtle back" (swim on your back with your head or body resting on your ruck, you may not wear the ruck).

3. Your feet must not make intentional contact with the bottom or sides of the pool (e.g., no pushing off the sides or bottom of pool during laps).

4. For Step #4, read appropriate guidance:

5. If using buoys: You will swim to the deep end (12 feet) and navigate yourself, and your ruck, around the buoy without touching the sides of the pool and return to the shallow end (3 feet). You will slap the edge of the pool with your hand upon completing each lap. This is one lap.

6. If using lap lanes: You will swim to the deep end (12 feet) and navigate yourself, and your ruck, to turn around within your designated lane without touching the sides of the pool and return to the shallow end (3 feet). You will slap the edge of the pool with your hand upon completing each lap. This is one lap.

7. The Timer will keep track of your distance and time. As you complete each lap, the Timer will call out your last name and the number of laps you've completed.

8. A Safety Swimmer will monitor the safety of subjects in the pool at all times.

Post-SFS Checklist:

______ Proctor secures PTS **Data Form** (collect all data forms from each Timer)
______ Proctor secures Weather **Data Form**
______ Proctor secures BA Questionnaire **Data Form**
______ Ensure the following equipment is locked/secured:
____ rucks (neatly arranged; not stacked on top of each other)
____ Rigger belts and ropes for towing rucks
____ Swim Fins
____ Booties (for fins)
____ Masks
____ Sunscreen
____ Mylar thermal blankets
____ Heart Rate monitors
____ Weather Devices (Kestrel and WBGT)

______ Lock up all pool equipment
______ Lock entrance to pool
______ Note: as of 22 May, the Warhawk Pool will open to the public. We must ensure ALL of gear is neatly stowed AND locked at all times!

Small Unit Tactics with Casualty Movement

Small Unit Tactics A: Ruck March

Test Subject Kit: Charlie Kit

Equipment:

______ 65 lb rucks (8 total)
______ 30 lb vests (8 total)
______ Ensure distance markers are visible clear marked course
______ KIMs (Knowledge-in-memory) list
______ KIMs items
______ Heart rate monitors
______ Stopwatches (ensure Timer(s) equipped w/stopwatch and backup watch)
______ AED/medical kit (brief team on location in case of emergency)
______ Tent (Staging Area)
______ Chairs
______ Set up other tents to provide shade as needed
______ Water and cups for test subjects
______ Cooler with ice and Gatorade
______ Clipboards and ballpoint pens
______ Sunscreen
______ PTS **Data Form**
______ BA Questionnaire **Data Form** (only required for BA operators)
______ Weather **Data Form**
______ Weather Devices (Kestrel and WBGT)
______ Rating of Perceived Exertion (RPE) Chart

Manpower Requirements:

______ Proctor
______ Assistant/Wingman (x3)
______ Note: One Wingman assigned per test subject & tasked with following duties:

- Accompany subject for duration of SUT-A
- Monitor subject for signs of dehydration, heat stress, or other issues
- Carry cell phone in case of emergency
- Carry subject's bottled water
- Call out subject's last name, lap completed and heart rate to Proctor

Purpose: This simulation is one of four consecutive Small Unit Tactics (SUT) events. The purpose of SUT-A is to complete a 5K (3.1 mile) ruck while maintaining situational awareness

Procedure: This is a timed event.

1. For this simulation, you will be wearing a vest (30 pounds) and a ruck (65 pounds).

2. Ten minutes prior to your start time, your Wingman will escort you to the Staging Area and ensure you are properly fitted in your vest and ruck. You will sit under the canopy until your start time begins.

3. Prior to beginning the ruck, you will be given a "Knowledge-in-Memory (KIM)" list of 25 potential items that may be placed along the 5K course. You will be given this list two minutes prior to your start time. Ten items from the list will be situated no further than 1 meter away from course. You must maintain a mental checklist of the items you see throughout the course. You are not allowed to collaborate with other subjects or write anything down during the simulation. At the completion of SUT-D, you will be given a KIM recall test to identify the ten items.

4. Once two minutes has elapsed, you will be given the command, "Ready, Go." On the command "Go," you will ruck the course for a total of 3 laps. You will determine your own pace as your Wingman will maintain a distance of 2-3 steps behind you allowing you to traverse the best path/tangent on the course.

5. When completing each lap, your Wingman will check your heart rate and you should be prepared to provide your RPE.

6. Upon completing your final lap, you will directly proceed to SUT-B.

Post SUT-A Checklist:

______ Proctor secures Data Collection Form
______ Proctor secures Weather Data Form
______ Proctor secures BA Questionnaire
______ Store all KIMs items in storage unit #2
______ Police SUT-A area for trash
______ Note: all other equipment (e.g., vests, rucks, stopwatches, heart rate monitors, etc.) will be properly secured at completion of SUT-D.

Small Unit Tactics B: Low Crawl / React to fire / Casualty (Buddy) Drag

Test Subject Kit: Charlie Kit

Equipment:

______ 2 Gumbies (dressed in Bravo Kit) weighing 215 lbs. placed at the end of low crawl
______ Ensure there are no fire ant beds in the path of the subjects
______ Check all pallets; ensure they are secure (stable and upright) and remove any protruding nails or sharp pieces of wood
______ Data Collection Form
______ Note: Maintain standard equipment from previous SUT (e.g., water, stopwatches, AED/medical kit, clipboards, weather devices, weather form, etc.)

Manpower Requirements (2 personnel):

______ Proctor
______ Timer

Purpose: To complete a reaction course simulating a hostile environment in which you low crawl and perform casualty drag.

Procedure: This is a timed event.

1. Immediately following SUT-A, you will begin SUT-B with a 20 meter low crawl. You have the option of wearing the ruck on your back, or removing the ruck and pushing or pulling it throughout the low crawl. Be careful when lowering yourself to the ground with your ruck on (e.g., don't let it hit the nape of your neck).

2. Upon exiting the low crawl, you will encounter a casualty. You must drag the casualty (face up) and take cover by stopping at each of the five pallets. At each pallet you must drag the casualty completely behind the pallet and drop to the prone position for a minimum of five seconds to simulate returning fire. You must not rest on any portion of the casualty. The Timer will provide you with a 5-second count.

   Note for Team: if subject does not complete low crawl, use their head as reference point to determine total distance achieved.

3. After the five second countdown, you will get up and continue the buddy drag through all five pallets. You may rest longer than five seconds however this counts against your overall time. The Proctor will closely monitor your physiological stress and progress of performing the casualty drag.

4. Once you drag the casualty past the final line, this will conclude SUT-B and you will immediately transition to SUT-C.

Post SUT-B Checklist:

______ Proctor secures Data Collection Form
______ Proctor secures Weather Data Form
______ Proctor secures BA Questionnaire
______ Return all Gumbies to Storage Unit #3
______ Replace any damaged pallets with functional ones for next week
______ Note: all other equipment (e.g., vests, rucks, stopwatches, heart rate monitors, etc.) will be properly secured at completion of SUT-D.

Small Unit Tactics C: Agility Course

Test Subject Kit: Charlie Kit

Equipment:

______ Inspect each wall; ensure walls are free of water and inspect support beams to ensure padded insulation is serviceable and not ripped or torn
______ Ensure all sandbags are covering the exposed metal structures of support beams
______ Ensure all cones for the agility portion of SUT-C are in correct location
______ Data Collection Sheet

Manpower Requirements (2 personnel):

______ Proctor
______ Timer

Purpose: To maneuver over obstacles and around simulated obstructions in your path.

Procedure: This is a timed event.

1. Immediately following SUT B, you will begin SUT C. During this simulation, you will maneuver yourself and your ruck over five walls. You MUST remove your ruck for the 4 foot, 5 foot, and 8 foot walls. You must keep positive control of your ruck as it contains simulated sensitive items (e.g., radios). You may secure your ruck on both shoulders, sling it over one shoulder, or carry it between walls.

2. After the fourth wall, you will proceed to the agility portion of SUT C. You will traverse through the marked cones with your ruck and travel around the outside portion of the cone.

3. The fifth, and final, wall of SUT-C is an 8 foot wall. You must remove your ruck and place on top of the wall. To hoist yourself over the wall, you may use the 24-inch box situated near the wall simulating a "buddy assist." Once your body is over the wall and on the extended platform, grab your ruck and lower it to the platform. You will safely jump to the ground and don the ruck using the platform to support your ruck. SUT-C is complete once your is securely on your back. You will immediately proceed to SUT-D.

Post SUT-C Checklist:

______ Proctor secures Data Collection Form
______ Proctor secures Weather Data Form
______ Proctor secures BA Questionnaire

______ Return plyometric boxes to Storage Unit #3

______ Note: all other equipment (e.g., vests, rucks, stopwatches, heart rate monitors, etc.) will be properly secured at completion of SUT-D.

Small Unit Tactics D: Fireman's Carry / Sled Drag / Litter Carry

Test Subject Kit: Charlie Kit

Equipment:

______ 1 Larry (in 30lb Bravo vest-weigh vest) on 36" Plyo box
______ 1 18" Plyo box sitting directly in front of 36" Plyo box
______ 2 Skedcos loaded with 107.5 pounds (in sandbag weight strapped down with duct tape)
______ 4 cones (placed at 50m marks-for Skedco/Litter carry lanes)

______ 2 trap-bars at start position of Litter carry lane with the following weight on each: 25 lb plates (x2); 2.5 lbs plates (x2); collars (x2); bar (= 45 lbs)

______ Israeli Litter and land mine set up on the end of the ramp incline

______ Attach weight on top of Israeli Litter (must total 107 lbs)

______ Place sandbags underneath the handles of Israeli Litter

______ Data Collection Form

Manpower Requirements (4 personnel):

______ Proctor
______ Assistants (x3)

Purpose: To simulate extracting a casualty using various techniques throughout the course.

Procedure: This is a timed event.

1. Immediately following SUT-C, you will transition to SUT-D. You will be seated on an 18" plyo box and assistants will load the casualty onto your back. The Proctor will confirm you are ready. Time will start once you initiate rising from the box. Using the Fireman's carry position, you will carry the casualty up the stairs and, in a controlled manner, lower the casualty to the top landing ensuring all body parts are on the landing. You will immediately return down the stairs and the Proctor will direct you to sit on a plyo box for a two-minute equipment transition time.

2. After two minutes, you will proceed to the Skedco drag/Litter Carry portion of SUT-D. Here, you will:

    - Drag Skedco for 50 meters
    - Ambulate (Walk/Jog/Run) for 50 meters (around cone)
    - Drag sled for 50 meters
    - Ambulate (Walk/Jog/Run) for 50 meters (around cone)
    - Litter Carry (trap bar) for 50 meters

- Ambulate (Walk/Jog/Run) for 50 meters (around cone)
- Litter Carry (Trap Bar); proceed to marked course, around white flag and up the simulated C-17 ramp

3. You will proceed up the ramp and place trap bar down in the designated spot. After placing trap bar down, you will immediately proceed to the simulated litter and raise it up to your chest, take a lateral right step, and place your right wrist against the top of the wall and hold this position for five seconds. Timer will direct you when five seconds are complete. Time will stop and you will lower the litter in a controlled manner.

Post SUT-D Checklist:

______ Proctor secures Data Collection Form
______ Proctor secures Weather Data Form
______ Proctor secures BA Questionnaire
______ Return the following items to storage unit #1:
    ___ plyometric boxes
    ___ Larry (casualty)
    ___ Skedcos
    ___ L&M
    ___ Trap bars
______ Return trap bars to storage unit #3

APPENDIX D

Score Sheets and Feedback Forms

This appendix contains the forms used to record participant times for each completed segment of PTSs. Those forms were then used to elicit feedback from the participants. BA participants were asked how well they believed each PTS simulated the physical demands of CPTs, their perception of the difficulty of the task, and what minimal level of performance they would expect from a BA operator conducting the PTS. The score sheets and feedback forms are combined for the PTSs performed on a single day. There are five forms below corresponding to the five days of a testing week.

Test Day 1

We need to ask you a few questions about the simulation you just completed. Please keep in mind the simulations are designed for a standardized setting and do not include all the factors, e.g., terrain, that affect task difficulty in operational settings.

Date ________________ *List comments and scores below*:

Single Leg Vertical Rope Ascent (SLVA)

Rope Bridge

Airfield Operations (Lift and Move, Vehicle, Overall)

1. **Feedback:** Please provide verbal feedback:

   A. "How well does this simulation represent the **physical** demands of the tasks you would perform in a mission environment?"

   B. If negative feedback: "In what ways does the simulation *not* represent the physical demands of the tasks you perform on operational missions?"

2. **Representativeness:** "On a scale of 1–5, please rate how **representative** the simulation is of the **physical demands** of tasks performed on missions:

1 = not at all representative
2 = slightly representative
3 = somewhat representative
4 = very representative
5 = extremely representative

3. Your time to complete was [ZZ]. Please estimate how much time it would take for a **minimally effective performer (successful but just above borderline)** to complete **this simulation.**

Subject Name	#	SLVA	Rope Bridge	Afld Ops Lift & Move	Airfield Ops Vehicle	Airfield Ops Overall
______ Representative Score						
Subject Time						
Estimated Minimally Effective Time						
Comments						

Subject Name	#	SLVA	Rope Bridge	Afld Ops Lift & Move	Airfield Ops Vehicle	Airfield Ops Overall
______ Representative Score						
Subject Time						
Estimated Minimally Effective Time						
Comments						

Test Day 2

We need to ask you a few questions about the simulation you just completed. Please keep in mind the simulations are designed for a standardized setting and do not include all the factors, e.g., terrain, that affect task difficulty in operational settings.

Date ______________________ *List comments and scores below*:

Wall Climb (WC) and Haul (Ascent, Haul, Overall)

Remove Debris and Survivor from Confined Space (RDSCS)

Cross Load Personnel and Equipment (CLPE) (Ground, Vehicle, Overall)

1. **Feedback:** Please provide verbal feedback:
   A. "How well does this simulation represent the **physical** demands of the tasks you would perform in a mission environment?"

   B. If negative feedback: "In what ways does the simulation *not* represent the physical demands of the tasks you perform on operational missions?"

2. **Representativeness**: "On a scale of 1–5, please rate how **representative** the simulation is of the **physical demands** of tasks performed on missions:

• **1 = not at all representative**
• **2 = slightly representative**
• **3 = somewhat representative**
• **4 = very representative**
• **5 = extremely representative**

3. Your time to complete was [ZZ]. Please estimate how much time it would take for a **minimally effective performer (successful but just above borderline)** to complete **this simulation.**

Subject Name	#	WC Ascent	WC Haul	WC Overall	RDSCS	CLPE Ground	CLPE Vehicle	CLPE Overall
Representative Score								
Subject Time								
Estimated Minimally Effective Time								
Comments								

Subject Name	#	WC Ascent	WC Haul	WC Overall	RDSCS	CLPE Ground	CLPE Vehicle	CLPE Overall
Representative Score								
Subject Time								
Estimated Minimally Effective Time								
Comments								

Test Day 3

We need to ask you a few questions about the simulation you just completed. Please keep in mind the simulations are designed for a standardized setting and do not include all the factors, e.g., terrain, that affect task difficulty in operational settings.

Date ______________________ *List comments and scores below*:

Rope Ladder

Combat Rubber Raiding Craft (CRRC)

Casualty Movement (CM) (Fireman's Carry, Sled Drag, Overall)

1. **Feedback:** Please provide verbal feedback:
   A. "How well does this simulation represent the **physical** demands of the tasks you would perform in a mission environment?"

   B. If negative feedback: "In what ways does the simulation *not* represent the physical demands of the tasks you perform on operational missions?"

2. **Representativeness:** "On a scale of 1-5, please rate how **representative** the simulation is of the **physical demands** of tasks performed on missions:

• **1 = not at all representative**
• **2 = slightly representative**
• **3 = somewhat representative**
• **4 = very representative**
• **5 = extremely representative**

3. Your time to complete was [ZZ]. Please estimate how much time it would take for a **minimally effective performer (successful but just above borderline)** to complete **this simulation.**

Subject Name	#	Rope Ladder	CRRC	CM - Fireman's Carry	CM - Sled Drag	CM - Overall
________ Representative Score						
Subject Time						
Estimated Minimally Effective Time						
Comments						

Subject Name	#	Rope Ladder	CRRC	CM - Fireman's Carry	CM - Sled Drag	CM - Overall
________ Representative Score						
Subject Time						
Estimated Minimally Effective Time						
Comments						

Test Day 4

We need to ask you a few questions about the simulation you just completed. Please keep in mind the simulations are designed for a standardized setting and do not include all the factors, e.g., terrain, that affect task difficulty in operational settings.

Date ______________________ *List comments and scores below*:

Swim to Inflatable Craft (SwIC)(3 segments + total)

Surface Fin Swim (SFS)

1. **Feedback:** Please provide verbal feedback:

A. "How well does this simulation represent the **physical** demands of the tasks you would perform in a mission environment?"

B. If negative feedback: "In what ways does the simulation *not* represent the physical demands of the tasks you perform on operational missions?"

2. **Representativeness:** “On a scale of 1–5, please rate how **representative** the simulation is of the **physical demands** of tasks performed on missions:

• **1 = not at all representative**
• **2 = slightly representative**
• **3 = somewhat representative**
• **4 = very representative**
• **5 = extremely representative**

3. Your time to complete was [ZZ]. Please estimate how much time it would take for a **minimally effective performer (successful but just above borderline)** to complete **this simulation**.

Subject Name	#	SwIC 275m, 2 UW	SwIC Casualty	SwIC Craft Work	SwIC Overall	SFS
Representative Score						
Subject Time						
Estimated Minimally Effective Time						
Comments						

Subject Name	#	SwIC 275m, 2 UW	SwIC Casualty	SwIC Craft Work	SwIC Overall	SFS
Representative Score						
Subject Time						
Estimated Minimally Effective Time						
Comments						

Test Day 5

We need to ask you a few questions about the simulation you just completed. Please keep in mind the simulations are designed for a standardized setting and do not include all the factors, e.g., terrain, that affect task difficulty in operational settings.

Date ___________ *List comments and scores below*:

Small Unit Tactics A-B-C-D (9 segments + total)

Segments:

A. Ruck
B. Low Crawl / React to fire / Casualty (Buddy) Drag
C. Walls 2-4-3-5 ft /Agility Course / Wall 8 ft
D. Fireman's Carry / Sled Drag / Litter Carry
Total: SUT–Overall Simulation

1. **Feedback:** Please provide verbal feedback:

A. "How well does this simulation represent the **physical** demands of the tasks you would perform in a mission environment?"

B. If negative feedback: "In what ways does the simulation *not* represent the physical demands of the tasks you perform on operational missions?"

2. **Representativeness:** "On a scale of 1–5, please rate how **representative** the simulation is of the **physical demands** of tasks performed on missions:

• **1 = not at all representative**
• **2 = slightly representative**
• **3 = somewhat representative**
• **4 = very representative**
• **5 = extremely representative**

3. Your time to complete was [ZZ]. Please estimate how much time it would take for a **minimally effective performer (successful but just above borderline)** to complete **this simulation.**

Subject Name	#	Ruck	Low Crawl	Casualty Drag	Walls 2-4-3-5 ft	Agility Course	Wall 8 ft	Fireman's Carry	Sled Drag	Litter Carry	Total A-B-C-D
1. Representative Score											
Subject Time											
Estimated Minimally Effective Time											
Comments											
2. Representative Score											
Subject Time											
Estimated Minimally Effective Time											
Comments											

References

Aguinis, H., J. C. Beaty, R. J. Boik, and C. A. Pierce, "Effect Size and Power in Assessing Moderating Effects of Categorical Variables Using Multiple Regression: A 30-Year Review," *Journal of Applied Psychology*, Vol. 90, No. 1, 2005, pp. 94–107.

Anderson, A., and S. Robson, "A Meta-Analysis of the Criterion-Related Validity of Physical Ability Tests," Houston, Texas, poster presented at the annual conference for the Society for Industrial and Organizational Psychology, 2013.

Arvey, Richard D., Steven M. Nutting, and Timothy E. Landon, "Validation Strategies for Physical Ability Testing in Police and Fire Settings," *Public Personnel Management*, Vol. 1, No. 3, 1992, pp. 301–313.

Callinan, M., and I. T. Robertson, "Work Sample Testing," *International Journal of Selection and Assessment,* Vol. 8, No. 4, 2000, pp. 248–260.

Cascio, Wayne F., Ralph A. Alexander, and Gerald V. Barrett, "Setting Cutoff Scores: Legal, Psychometric, and Professional Issues and Guidelines," *Personnel Psychology*, Vol. 41, No. 1, pp. 1–24, 1988.

Cizek, G. J., ed.. *Setting Performance Standards: Foundations, Methods, and Innovations*, New York: Routledge, 2012.

Dempsey, Martin E., and Leon Panetta, "Elimination of the 1994 Direct Ground Combat Definition and Assignment Rule," memorandum for Secretaries of the Military Departments Acting Under Secretary of Defense for Personnel and Readiness Chiefs of the Military Service, January 24, 2013. As of February 22, 2017:
https://dod.defense.gov/Portals/1/Documents/WISRJointMemo.pdf

Farr, J. L., and N. T. Tippins, *Handbook of Employee Selection*, New York: Routledge, 2013.

Faul, F., E. Erdfelder, A. Buchner, and A. G. Lang, "Statistical Power Analyses Using G*Power 3.1: Tests for Correlation and Regression Analyses," *Behavior Research Methods*, Vol. 41, 2009, pp. 1149–1160.

Faul, F., E. Erdfelder, A. G. Lang, and A. Buchner, "G*Power 3: A Flexible Statistical Power Analysis Program for the Social, Behavioral, and Biomedical Sciences," *Behavior Research Methods*, Vol. 39, 2007, pp. 175–191.

Gebhardt, D. L., and T. A. Baker, "Physical Performance," in J. C. Scott and D. H. Reynolds, eds., *Handbook of Workplace Assessment: Evidence-Based Practices for Selecting and Developing Organizational Talent*, San Francisco: Jossey-Bass, Vol. 32, 2010, pp. 165–196.

Guion, R. M., *Assessment, Measurement, and Prediction for Personnel Selection*, Mahwah, N.J.: Lawrence Erlbaum, 1998.

Hausknecht, J. P., D. V. Day, and S. C. Thomas, "Applicant Reactions to Selection Procedures: An Updated Model and Meta-Analysis," *Personnel Psychology*, Vol. 57, No. 3, 2004, pp. 639–683.

Headquarters, U.S. Air Force, *Weather Officer*, Career Field Education and Training Plan AFSC 15WX, Washington, D.C., March 2012.

———, *Air Force Enlisted Classification Directory: The Official Guide to the Air Force Enlisted Classification Codes*, Washington, D.C., April 30, 2017.

Henderson, N. D., M. W. Berry, and T. Matic, "Field Measures of Strength and Fitness Predict Firefighter Performance on Physically Demanding Tasks," *Personnel Psychology*, Vol. 60, No. 2, 2007, pp. 431–473.

Hogan, J. C., "Physical Abilities," in M. D. Dunnette and L. M. Hough, eds., *Handbook of Industrial and Organizational Psychology*, Vol. 2, 2nd ed., Palo Alto, Calif.: Consulting Psychologists Press, 1991, pp. 753–831.

Hunter, J. E., and R. F. Hunter, "Validity and Utility of Alternative Predictors of Job Performance," *Psychological Bulletin*, Vol. 96, No. 1, 1984, pp. 72–98. As of February 22, 2017: https://www.uam.es/personal_pdi/psicologia/pei/diferencias/Hunter1984JobPerformance.pdf

Jackson, Andrew S., "Types of Physical Performance Tests," in Constable, Stefan, and Barbara Palmer, eds., *The Process of Physical Fitness Standards Development*, Wright-Patterson Air Force Base, Ohio: Human Systems Information Analysis Center, 2000, pp. 101–138.

Lievens, F., and B. De Soete, "Simulations," in N. Schmitt, ed., *The Oxford Handbook of Personnel Assessment and Selection*, New York: Oxford University Press, 2012, pp. 383–410.

Plake, B. S., and G. J. Cizek, "Variations on a Theme: The Modified Angoff, Extended Angoff, and Yes/No Standard Setting Methods," in Cizek, G.J., ed., *Setting Performance Standards*, 2nd ed., New York: Routledge, 2012.

Robson, Sean, Maria C. Lytell, Carra S. Sims, Stephanie Pezard, Thomas Manacapilli, Amanda Anderson, Therese Bohusch, and Abigail Haddad, *Fit For Duty? Evaluating the Physical Fitness Requirements of Battlefield Airmen*, Santa Monica, Calif.: RAND Corporation, RR-618-AF, 2017. As of October 17, 2018: https://www.rand.org/pubs/research_reports/RR618.html

Roth, P. L., P. Bobko, and L. A. McFarland, "A Meta-Analysis of Work Sample Test Validity: Updating and Integrating Some Classic Literature," *Personnel Psychology*, Vol. 58, No. 4, 2005, pp. 1009–1037.

Sothmann, M. S., D. L. Gebhardt, T. A. Baker, G. M. Kastello, and V. A. Sheppard, "Performance Requirements of Physically Strenuous Occupations: Validating Minimum Standards for Muscular Strength and Endurance," *Ergonomics*, Vol. 47, No. 8, 2004, pp. 864–875.

Terpstra, D. E., A. A. Mohamed, and R. B. Kethley, "An Analysis of Federal Court Cases Involving Nine Selection Devices," *International Journal of Selection and Assessment*, Vol. 7, No. 1, 1999, pp. 26–34. As of February 22, 2017:
http://onlinelibrary.wiley.com/doi/10.1111/1468-2389.00101/abstract

Thornton, G. C., and R. A. Mueller-Hanson, *Developing Organizational Simulations: A Guide for Practitioners and Students*, Mahwah, N.J.: Lawrence Erlbaum Associates, 2004.

U.S. Air Force, "Special Operations Weather Team," fact sheet, May 26, 2010a. As of October 28, 2014: http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104529/special-operations-weather-team.aspx

———, "Pararescue," fact sheet, June 17, 2010b. As of October 28, 2014: http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104515/pararescue.aspx

———, "Combat Controllers," fact sheet, August 18th, 2010c. As of October 28, 2014: http://www.af.mil/AboutUs/FactSheets/Display/tabid/224/Article/104592/combat-controllers.aspx

U.S. Department of Defense, "Physical Fitness Test and Standards for Battlefield Airmen Study: Executive Summary," *Women in Service Studies*, 2015.

Wigdor, A., and B. Green, Jr., eds., *Performance Assessment for the Workplace: Volume I*, Committee on the Performance of Military Personnel, Commission on Behavioral and Social Sciences and Education, and National Research Council, Washington, D.C.: National Academy Press, 1991.

In January 2013, the Chairman of the Joint Chiefs of Staff and the Secretary of Defense rescinded the 1994 Direct Ground Combat Definition and Assignment Rule and mandated that "[v]alidated gender-neutral occupational standards will be used to assess and assign Service members not later than September 2015." In support of this mandate, the U.S. Air Force asked RAND to assist its development and validation of gender-neutral tests and standards for six battlefield airmen (BA) specialties, which were the only occupational specialties that remained closed to women in the Air Force at the time of the study (now open to women). This report describes RAND's assistance to the Air Force on two fronts: (1) designing physical task simulations (PTSs) to measure the occupationally relevant physical requirements for BA specialties and (2) setting standards for BA physical performance on the PTSs. This research will provide the foundation for Air Force performance measures and tests that meet scientific, technical, and best practice standards.

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