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THESIS

**ELITE SELECTION AND A CULTURE
OF TRADITION IN FDNY SPECIAL OPERATIONS**

by

Jonathan E. Moritz

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Thesis Advisor:
Second Reader:

Carolyn C. Halladay
Shannon A. Brown

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**ELITE SELECTION AND A CULTURE OF TRADITION IN FDNY SPECIAL
OPERATIONS**

Jonathan E. Moritz
Lieutenant, FDNY
BPS, State University of New York Empire State College, 2019

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March 2023**

Approved by: Carolyn C. Halladay
Advisor

Shannon A. Brown
Second Reader

Erik J. Dahl
Associate Professor, Department of National Security Affairs

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ABSTRACT

The New York City Fire Department (FDNY) is a brand name in public safety. Like many high-reliability organizations, its specialized units carry out advanced and technical work. Expanded mission tasking, compensation, and training have made these assignments a career ladder, but the antiquated selection and assignment policy threaten the integrity of the selection and recruitment process. FDNY may improve its selection for special operations based on what similar organizations do. By reviewing them, specifically the armed services and commercial diving, two high-reliability organizations, this study compares selection methods to identify validated testing, determine criteria, and develop a selection construct that can maintain or improve current selection policies. Findings reveal that cognitive ability testing, physical ability assessments, and in-depth character evaluations used to make personnel selections could enhance FDNY. This thesis recommends that further development of selection models would be beneficial for the organization and defend the FDNY against claims of bias, favoritism, and discrimination. Lack of validation has already cost New York City and the FDNY legal fines. Validation studies identify areas of selection that need improvement so the FDNY could reinforce traditional selection criteria and establish new and validated ways of identifying and cultivating talent with the fire service.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACDE	Association of Commercial Diving Educators
ACFT	Army Combat Fitness Test
ADCI	Association of Diving Contractors International
AO	assembling objects
ASVAB	Armed Services Vocational Aptitude Battery
CPAT	Candidate Physical Ability Test
CTT	classical testing theory
DOD	Department of Defense
EMS	emergency medical service(s)
FDNY	New York City Fire Department
FEMA	Federal Emergency Management Agency
GT	generalization theory
HRO	high-reliability organization
I/O	industrial/occupational
NAUI	National Association of Underwater Instructors
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
PFT	physical fitness test
SEAL	Sea, Air, and Land (member/team)
SOC	Special Operations Command
SOF	special operations forces
US&R	urban search and rescue
USAR	urban search and rescue
WK	word knowledge

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EXECUTIVE SUMMARY

The FDNY pioneered advanced units for complex and technical rescues in the early 20th century. These newly formed units comprised the first “special operations” elements in the fire service, responding to complex fires and emergencies. Appointments to these units required selection criteria, but traditional criteria included seniority, experience, and prior trade experience.¹ At the inception of special operations units, validating selection parameters did not matter. Although technology and mission tasking changed, the criteria for selection remained the same.²

Special operations in the FDNY has grown considerably over the past 100 years. FDNY special operations now encompass all technical rescue incidents and hazardous materials responses. However, the training, compensation, and demand for this specialized response have grown considerably.³ This thesis identifies how the FDNY can best validate selection criteria and improve personnel selection models based on those of other organizations with similar goals and responsibilities.

This thesis addresses the question of how the FDNY can adapt U.S. armed forces and private organizational selection methods to its benefit. This thesis uses a comparative case study analysis that compared the armed services selection methods and commercial diving selection methods to those of the FDNY, revealing possible improvements for special operations selection. This thesis compared content validation, criterion validation, and construct validation to identify similarities and differences between the three organization’s selection processes.

¹ Ray Downey, *The Rescue Company* (Saddle Brook, NJ: Fire Engineering Books, 1992), 9.

² New York City Fire Department, *Application Procedure for Rescue Operations Command—Rescue and Squad Companies*, AUC 297, Addendum 3 (Brooklyn: New York City Fire Department, 2019), 1.

³ New York City Fire Department, “SOC Unit Response Policy,” Addendum 1 in *Communications Manual* (Brooklyn: New York City Fire Department, 2019).

Content, criteria, and construct validation establish whether tests in organizations correctly assess job-relevant skills.⁴ The accurate identification of knowledge, skills, and abilities and the validation of selection models allow agencies to identify talent and ensure fairness in their hiring. This thesis identified weaknesses in criterion validity, a lack of content validity, and questionable construct validity within the FDNY special operations' selection models. Traditional means of selection for the FDNY rely heavily on criterion validation of seniority and experience. The FDNY has little to no content validation and seems to rely solely on members meeting an arbitrary and outdated criterion.⁵ This criterion may still produce viable firefighters for special operations; however, the lack of validation makes the FDNY vulnerable to penalties and claims of discriminatory hiring practices.

Other organizations, for example, the armed services, use content validation to select recruits for specific occupations and missions based on performance in content-validated assessments and testing.⁶ These examinations have been validated to match recruits with jobs in the armed services so that applicants will have the best chances of success. Tests and assessments whose content has been validated for specific jobs or mission requirements successfully match skills and talent for mission success.⁷ All selection requirements are transparent and linked to job/mission analysis, along with content validity, so the selection and recruitment model continues to produce successful candidates.

Commercial diving successfully selects and certifies people in an endeavor that must be zero failure. Theories of high-reliability organizations demand that complex and

⁴ James L. Farr and Nancy T. Tippins, eds., *Handbook of Employee Selection* (New York: Routledge, 2010), 34.

⁵ New York City Fire Department, *Application Procedure for Rescue Operations*, 1.

⁶ Janet E. Wall and Robert G. Gard, *Armed Services Vocational Aptitude Battery*, 5th ed. (New York: McGraw-Hill Education, 2022), 19.

⁷ Janet D. Held et al., *Technical Guidance for Conducting ASVAB Validation/Standards Studies in the U.S. Navy*, NPRST-TR-15-2 (Millington, TN: Navy Personnel Research, Studies, and Technology, 2015), iii, <https://apps.dtic.mil/sti/citations/ADA612759>.

high-risk occupations strive for safety and limit risk as much as possible.⁸ Candidates for commercial diving first undergo extensive training before employment and prove a level of physical ability unlike that of other trade professions. This demand differs from other organizations that allow apprenticeships or on-the-job training before hiring. Construct validation aims to assess theoretical attributes that cannot be measured by other means.⁹ Construct validation compares the selection methods to the outcome or performance, often requiring validation of criteria and content.¹⁰ Commercial diving's construct validity demonstrates that a proper training regimen, along with proper physical screening, yields a competent and certified employee.

All three organizations examined in this thesis have traditions and varying levels of validation for their selection decisions. Each organization uses criteria, content, and construct validation in choosing candidates. The FDNY would benefit from improved job/mission analysis and better appointment validation of special operations firefighters and officers. Updating the currently used criteria and content could better reflect the change in responsibilities and mission tasking for special operations firefighters.

A review of the listed criteria could also benefit the FDNY and help defend against claims of bias or ambiguity. Further research is needed to determine the benchmarks or cut scores desired for special operations. Additional consultation costs incurred by the FDNY could become a challenge to move forward in the validation of a new or updated selection model. However, these incurred costs would be minimal compared to court penalties or legal fees.

Better-defined organizational goals and performance standards merit further examination. The FDNY should perform a job and mission analysis of special operations and advance a structured selection pipeline that is diverse and transparent. Determining

⁸ Daved van Stralen, Spencer L. Byrum, and Bahadır Inozu, *High Reliability for a Highly Unreliable World: Preparing for Code Blue through Daily Operations in Healthcare* (North Charleston, SC: CreateSpace, 2017), 1.

⁹ Pritha Bhandari, "Construct Validity: Definition, Types, & Examples," Scribbr, February 17, 2022, <https://www.scribbr.com/methodology/construct-validity/>.

¹⁰ Uniform Guidelines on Employee Selection Procedures, 29 C.F.R. 1607 (1978), <https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XIV/part-1607>.

criteria requires a job/mission analysis that asks what the goals and outcomes are and what behavior or performance the FDNY is trying to elicit. The answers to these questions will outline the desired criteria.

The next phase would involve building content-rich assessments of skill in this criterion. The FDNY can incorporate content validation into its current practices to provide better information for decision-makers. If a position requires mechanical aptitude, then the FDNY should develop a test measuring the degree of aptitude. Having a content-rich assessment and selection measurement would help to match the skill/talent to the occupation/assignment.

Last, the FDNY should implement a defined selection model that combines criteria and content along with committee oversight and input. The FDNY would benefit from validating the construct and identifying criteria and content that identify special operations talent. The formation of a selection committee could further advance the validity of special operations selection. Currently, company commanders make selection decisions in consultation with the chief and company officers. Establishing a committee like those of the armed services could help identify talent and incorporate more input from senior firefighters and officers both within and outside of special operations.¹¹

Promoting collaborative contribution in selection decisions would provide greater transparency and a better understanding of successful outcomes. If the services of special operations units develop problems or if behaviors and performances fall short of goals, this committee would have a mechanism to make necessary course corrections. The training regimen is a formality, not a prerequisite for the appointment in special operations. Currently, the training occurs after selection to special operations, so incorporating the training performance into the selection of special operations firefighters could further validate the selection and appointment to specialized units.

¹¹ Robert M. Burrell, "Tactics, Methods and Techniques to Improve Special Forces In-Service Enlisted Recruiting" (master's thesis, Naval Postgraduate School, 2002), 12, <https://calhoun.nps.edu/handle/10945/5953>.

Ensuring that the legal and ethical considerations in workforce selection are bulletproof requires much more research. The FDNY is an inclusive agency with exclusive units—as in the armed services, not every servicemember is a Navy SEAL or Green Beret. Updating and validating criteria, content, and construct selection would improve selection decisions and uphold behavior and performance standards that have been cultivated over 100 years of service.

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I. INTRODUCTION

Members of the Special Operations Command (SOC) carry out many homeland security initiatives for the New York City Fire Department (FDNY), including technical rescues, post-building collapses, hazardous materials response, as with the anthrax incident in late 2001, or chemical/radiological/biological preparedness.¹ Hand-selected from the ranks of the FDNY, the members of SOC have performed consistently for more than a century. Many of the men and women lost on September 11, 2001, from the FDNY were members of special operations units.² Of the 343 members of the FDNY lost, 93 were from SOC.³ The effects of this loss are still felt today.

Yet some top-quality candidates seeking to advance within special operations may be overlooked or discouraged from applying because the current process and selection methods are, in many ways, unsystematic and erratic.⁴ The application for SOC, which measures only the ability to fill out forms and answer selected questions, aptly illustrates the nature of the problem.⁵ The application is a blunt instrument asking simple yes or no questions that fail to capture relevant experience or qualifications needed for the position. The questions include the following:

- Are you comfortable in water environment?
- Do you have issues working at heights?
- Are you willing to work additional overtime hours?⁶

¹ John Norman, *Fire Department Special Operations* (Tulsa, OK: Fire Engineering Books, 2009).

² National Commission on Terrorist Attacks upon the United States, *The 9/11 Commission Report* (New York: Norton, 2004).

³ Norman, *Fire Department Special Operations*, 10.

⁴ New York City Fire Department, *Application Procedure for Rescue Operations Command—Rescue and Squad Companies*, AUC 297, Addendum 3 (Brooklyn: New York City Fire Department, 2019).

⁵ New York City Fire Department.

⁶ New York City Fire Department, 7–8.

The department asks these simple questions without any follow-up measurements. No subsequent examinations validate the integrity of the applicants' answers, for example, the degree to which the candidate is comfortable in the water or at which heights the firefighter can operate. Furthermore, no guidelines set an accepted standard. Despite an interview component, the nature of any such conversation depends on which company commander or chief officer assigned to SOC conducts it; the criteria are highly personal to the interviewing/hiring officer.⁷

The process neglects some crucial measurements and data. The applicant may or may not demonstrate ability and problem-solving skills or teamwork. Accepted, reliable, and validated physical ability testing is available to all members of the FDNY. Adapting this testing to the application process would provide data on an applicant's ability to join SOC. Moreover, character and measurements of perseverance could provide personality information, which might also determine the likelihood of success.⁸

The FDNY is a unique organization with specific qualities and cultures. Structured as a paramilitary organization, the FDNY maintains many methods for selection and performance. Also, as a civil service agency with a public safety mission, the FDNY must attempt to balance these selection methods with equal employment opportunity, fairness of standards, and transparency of process guidelines. Thus, the FDNY may benefit from exploring new approaches to enhance and expand current selection and recruitment models for members applying to SOC.

Other organizations, including the U.S. armed forces, and such private-sector activities as commercial diving have developed workforce development standards to identify and select the best applicants for successfully carrying out special operations objectives.⁹ The U.S. armed forces have a volume of data that pertains to selection,

⁷ New York City Fire Department, 2.

⁸ Angela L. Duckworth et al., "Grit: Perseverance and Passion for Long-Term Goals," *Journal of Personality and Social Psychology* 92, no. 6 (June 2007): 1088, <https://doi.org/10.1037/0022-3514.92.6.1087>.

⁹ James L. Farr and Nancy T. Tippins, eds., *Handbook of Employee Selection* (New York: Routledge, 2010), 697.

identifying the physical and mental characteristics of applicants with the greatest likelihood of success. The process is both qualitative and quantitative. Assisted by these metrics, the armed forces can withstand scrutiny and promote advancement goals without compromising the quality.¹⁰ What can the FDNY learn from the many years of armed forces assessment and selection methods that underpin the staffing of special operations units?

Beyond this question, this thesis explores how for-profit firms develop talent and select individuals for high-stress and highly sensitive positions. The U.S. private sector uses organizational psychology to motivate and optimize workforce development for high-risk and high-performance working environments. Understanding the psychological factors that allow people to become more successful will aid organizations in selecting people with the requisite ability for specific assignments within the organization.¹¹

A. RESEARCH QUESTION

How can the FDNY adapt U.S. armed forces and private-sector organizational selection methods to its benefit?

B. LITERATURE REVIEW

This section reviews the literature on organizational development about measuring individuals' cognitive ability, examining personality and character, and conducting physical ability testing of employees within specific organizations. This review examines many aspects of hiring, selection, and recruitment methods from public, private, and government organizations. One meta-analysis, a study summarizing many findings, shows that many organizations can adapt application methods to identify more competent candidates.¹² The reading also suggests that identifying more suitable candidates will increase and improve performance within organizations. This literature broadly concurs

¹⁰ Anthony D. Smith, "Predicting Ranger Assessment and Selection Program 1 Success and Optimizing Class Composition" (master's thesis, Naval Postgraduate School, 2017), <https://calhoun.nps.edu/handle/10945/55538>.

¹¹ Farr and Tippins, *Handbook of Employee Selection*, 226.

¹² Farr and Tippins, 134.

that the proper measurement of cognitive ability, character analysis, and physical capability contributes to improved efficiency and optimal performance depending on job criteria.¹³

1. Testing, Validity, and Reliability Theories

Beginning with the testing and examination of candidates, research in industrial/occupational (I/O) psychology provides the basis of qualitative data on prospective applicants.¹⁴ James Farr and Nancy Tippins have collaborated with I/O psychologists to compile a reference that scrutinizes selection and hiring practices.¹⁵ Specifically, “reliability and validity are concepts that provide the scientific foundation upon which we construct and evaluate predictor and criterion measures of interest in personnel selection.”¹⁶ Given that theories have evolved over decades, the validity and reliability of examinations used to measure the human aspects of job performance merit rigorous evaluation.¹⁷

Sackett, Putka, and McCloy expand on the concept of validity as central to hiring and selection to ensure that performance and selection criteria are met.¹⁸ The validity studies of testing and criteria verify that the tests administered measure the attribute targeted.¹⁹ Cognitive ability tests measure intelligence and critical thinking, and physical performance tests measure strength and stamina for job functions.²⁰ Examinations of validity evaluate the wording, format, and administrative guidelines to ensure the test

¹³ John C. Scott and Douglas H. Reynolds, eds., *Handbook of Workplace Assessment: Evidence-Based Practices for Selecting and Developing Organizational Talent* (San Francisco: Jossey-Bass, 2010), 30.

¹⁴ Farr and Tippins, *Handbook of Employee Selection*, 182.

¹⁵ Farr and Tippins, xi.

¹⁶ Farr and Tippins, 3.

¹⁷ Paul R. Sackett, Dan J. Putka, and Rodney A. McCloy “The Concept of Validity and the Process of Validation,” in *The Oxford Handbook of Personnel Assessment and Selection*, ed. Neal Schmitt (Oxford: Oxford University Press, 2014), 91.

¹⁸ Sackett, Putka, and McCloy, 91.

¹⁹ Farr and Tippins, *Handbook of Employee Selection*, 34.

²⁰ Todd A. Baker and Deborah L. Gebhardt, “The Assessment of Physical Capabilities in the Workplace,” in *The Oxford Handbook of Personnel Assessment and Selection*, ed. Neal Schmitt (Oxford: Oxford University Press, 2014), 277.

construct applies to the content of the job.²¹ The American Educational Research Association, American Psychological Association, and National Council on Measurement in Education define validity as “the degree to which evidence and theory support the interpretation of test scores for proposed uses of the test.”²² According to the research on validity, if the test is not valid and reliable, its results could be questionable and make organizations susceptible to vulnerabilities.²³

In Farr and Tippins’s investigation, reliability is complementary to validity and jointly determines an examination’s accuracy and utility. Reliability refers to the measurement of error and the consistency of that error across all variables.²⁴ Did the same person make the same error when taking the same test? Is this error repeatable and consistent among test takers at other times or locations? These questions help organizations understand the results of tests, select employees who have displayed competency, and reject those who may show too high a degree of error for the given job description.²⁵ Like validity, reliability is defined as “the degree to which test scores for a group of test takers are consistent over repeated applications of a measurement procedure and hence are inferred to be dependable, and repeatable for an individual test taker [or] the degree to which scores are free of errors of measurement for a given group.”²⁶

The validity and reliability of examinations are corresponding functions. One assures the strength of the test, the other its consistency. Validity and reliability ensure fair, accurate, and job-specific testing practices.²⁷ More importantly, validity and reliability help organizations set performance criteria and defend against legal and fairness

²¹ Farr and Tippins, *Handbook of Employee Selection*, 96.

²² American Educational Research Association, American Psychological Association, and National Council on Measurement in Education, *Standards for Educational and Psychological Testing* (Washington, DC: American Educational Research Association, 2014), 9.

²³ Farr and Tippins, *Handbook of Employee Selection*, 56.

²⁴ Farr and Tippins, 5.

²⁵ Farr and Tippins, 3.

²⁶ American Educational Research Association, American Psychological Association, and National Council on Measurement in Education, *Standards for Educational and Psychological Testing*, 180.

²⁷ Scott and Reynolds, *Handbook of Workplace Assessment*, 223.

challenges.²⁸ Without reliability and validity, organizations could not establish performance criteria, and tests used to make hiring decisions would be ineffective.²⁹ Test results lacking validity and reliability would be indefensible in legal challenges.

2. Classical Testing Theory

One of the first concepts discussed for identifying a measure of competency is the classical testing theory (CTT). Farr and Tippins list CTT in the selection and human resource field as follows: “The observed score (X) for a given person (P) that is produced by replicate (r) of a measurement procedure is assumed to be a simple additive function of two parts: the person’s true score (T) and an error score (E).”³⁰ In short, measuring the score derived from this function can identify the degree of understanding and the error made on an examination (e.g., 95/100).³¹ Farr and Tippins further state that CTT extends to all aspects of tests, whether written, physical, or psychometric. The measurement of error is the determining factor that separates one individual from another.³² A reliable and valid testing score provides the basis for decisions in many organizations—public, private, and government.³³ Without this test score, the selection process cannot determine who is eligible and competent to advance in the selection process.

CTT has value because it identifies candidates who possess the necessary cognitive ability to pass exams and measures that ability against the errors made. CTT and cognitive ability assessments are popular measures within the I/O psychology field.³⁴ However, such authorities as Kevin Murphy and Richard Deshon claim that the only outcome of traditional

²⁸ Scott and Reynolds, 15.

²⁹ Farr and Tippins, *Handbook of Employee Selection*, 56.

³⁰ Farr and Tippins, 8.

³¹ Farr and Tippins, 8.

³² Farr and Tippins, 9.

³³ Farr and Tippins, 56.

³⁴ Farr and Tippins, 253.

tests is a measurement with no correlation to job performance.³⁵ In CTT, a value comes from a single test score, but test scores alone provide a questionable basis for hiring decisions because other subjective variables affect the true score.

This true value score obtained through CTT has become one of the only means to base hiring and selection decisions. Some researchers critical of CTT claim that obtaining a more valid and reliable measurement of a person's ability requires assessing more factors and information.

3. Generalization Theory

Far and Tippins go on to describe generalization theory (GT), which runs parallel to CTT. GT assumes that the true value score within CTT cannot be the basis for measurement without considering contextual factors of the testing method.³⁶ Test scores alone do not reveal the whole picture. As Murphy and Deshon assert, GT accommodates more variables for consideration, and evaluating more information yields a more accurate result.³⁷ Examples include comparing test scores among individual test takers or against a set performance standard or benchmark criteria.³⁸ In this way, GT accounts for differences in performance between individuals and distinguishes between tests and meeting the requirements of the given job.³⁹

Whereas CTT claims that test scores provide a measurement of error and facilitates the measurement of cognitive ability, GT accounts for more factors and generalizations when making decisions based on test scores.⁴⁰ Specifically, CTT scores applicants on a scale of 0–100 out of 100 questions; GT examines variables that account for discrepancies

³⁵ Kevin R. Murphy and Richard Deshon, "Interrater Correlations Do Not Estimate the Reliability of Job Performance Ratings," *Personnel Psychology* 53, no. 4 (Winter 2000): 873–900, <https://doi.org/10.1111/j.1744-6570.2000.tb02421.x>.

³⁶ Farr and Tippins, *Handbook of Employee Selection*, 10.

³⁷ Walter P. Vispoel, Carrie A. Morris, and Murat Kilinc, "Applications of Generalizability Theory and Their Relations to Classical Test Theory and Structural Equation Modeling," *Psychological Methods* 23, no. 1 (March 2018): 1–26, <https://doi.org/10.1037/met0000107>.

³⁸ Farr and Tippins, *Handbook of Employee Selection*, 10.

³⁹ Vispoel, Morris, and Kilinc, "Applications of Generalizability Theory."

⁴⁰ Farr and Tippins, *Handbook of Employee Selection*, 12.

in error, changes in variables, and test results.⁴¹ Some of these factors include variations in the items examined, raters, occasions, and tasks tested.⁴²

Authors Murphy and Deshon have researched the use of GT as it relates to performance evaluations.⁴³ In their research on interrater correlations to measurements of reliability, they claim that GT allows for more accurate adjustments from one rater to another. Murphy and Deshon have identified that similarities and differences in performance evaluations may have dramatic effects on final performance ratings.⁴⁴ Under GT, according to Murphy and Deshon, “one of the key insights...is that there is no single number that can adequately describe the reliability of most measures and that there are likely to be different ‘reliabilities’ (specifically, generalizability coefficients) that correspond to different purposes or goals of measurement.”⁴⁵ Explained another way, different evaluators will award scores differently from one another. These differences or similarities in rating have numerical measurements assigned to them. Depending on how these differences or similarities are weighed by the organization, the outcome could be vastly different and challenge the reliability of the evaluation as a measurement of performance or competency.⁴⁶ GT addresses this score and accounts for variances in scores from one rater to another, attempting to find the most reliable result.

The similarities and differences described by Murphy and Deshon can be attributed to “different raters observ [ing] different behaviors, and hav [ing] different responsibilities when completing performance ratings....Indeed, one explanation for disagreements between raters is that they are not equally knowledgeable..., but rather observe fundamentally different aspects of a ratee’s behavior.”⁴⁷ GT offers fine adjustments to differences in knowledge and observations between different raters.

⁴¹ Farr and Tippins, 10.

⁴² Farr and Tippins, 10.

⁴³ Murphy and Deshon, “Interrater Correlations Do Not Estimate the Reliability,” 873.

⁴⁴ Murphy and Deshon, 874.

⁴⁵ Murphy and Deshon, 886.

⁴⁶ Murphy and Deshon, 874.

⁴⁷ Murphy and Deshon, 875.

CTT and GT support the evolution of performance measurement rather than standing as theories to test. Robert Brennan frames the two theories as tools for understanding true score measurement. Each tool has its own defined use and, in conjunction with other methods, illustrates the true value of the person or object of examination.⁴⁸ For instance, when many evaluators and panel examinations participate in the selection and multiple factors are assessed, GT may be the preferred choice.⁴⁹ In other tests that examine single-aspect measurements like multiple choice examinations, CTT may be the preferred method.⁵⁰ The literature seems to subscribe to multiple evolving ways to better understand the individual value, ability, or evaluation. The more tools an organization employs to vet applicants, the more data it has to defend hiring and selection decisions.

4. Psychological and Character Examinations

Psychological motivations for job selection and performance are another disputed area. Investigations into long-term goals and success have refined instruments—for example, personality inventory exams, psychological exams, self-evaluation tests, and panel interviews—for identifying candidates who persevere more often and attain goals more regularly.⁵¹

Grit or perseverance is another emerging measurable quality.⁵² Angela Duckworth et al. describe grit as “perseverance and passion for long-term goals. Grit entails working strenuously toward challenges, maintaining effort and interest over the years despite failure, adversity, and plateaus in progress.”⁵³ Duckworth et al. have created an equation

⁴⁸ Robert L. Brennan, “Generalizability Theory and Classical Test Theory,” *Applied Measurement in Education* 24, no. 1 (December 2011): 1–21, <https://doi.org/10.1080/08957347.2011.532417>.

⁴⁹ Brennan, 4.

⁵⁰ Brennan, 8.

⁵¹ Duckworth et al., “Grit.”

⁵² Kevin R. Murphy, “Individual Differences,” in *The Oxford Handbook of Personnel Assessment and Selection*, ed. Neal Schmitt (Oxford: Oxford University Press, 2014), 31.

⁵³ Duckworth et al., “Grit,” 1087.

to measure grit: passion plus the level of perseverance equals the grit score.⁵⁴ These scholars have tried to determine success rates and compare successful outcomes with personality, age, and gender, among other characteristics, over various goals and careers.⁵⁵ Their finding seems to support grit as a measurable factor in predicting success and equivalent to talent and intelligence when determining success rates.⁵⁶ The concept of grit and perseverance as factors in success rates, as promoted by Duckworth et al., has been widely accepted, even by the Department of Education.⁵⁷

However, some scholars challenge the claims of Duckworth et al. that grit and perseverance are predictors of individual measurement and success. Marcus Credé contends that the grit equation (grit = passion + perseverance) is flawed.⁵⁸ Credé argues that a person with high passion and low perseverance scores, according to such a measurement, would score equal to a person with high perseverance and low passion.⁵⁹ According to Credé, the distinction of either passion or perseverance as more valuable to determining success outcomes calls grit into question as a measurable trait. Credé has examined the claims that grit alone is a better predictor of successful outcomes in education settings than intelligence and test scores.⁶⁰ His findings suggest that while perseverance and passion play a significant role in achievement, other factors including study habits, study skills, and class attendance have a greater impact than grit alone.

The results of Credé's research favor effort regulation and meta-cognition as predictors of successful outcomes.⁶¹ The gritty individual, according to Credé, may not possess the necessary intelligence or work ethic required for the achievement, and

⁵⁴ Duckworth et al., 1089.

⁵⁵ Duckworth et al., 1092.

⁵⁶ Duckworth et al., 1089.

⁵⁷ Marcus Credé, "What Shall We Do about Grit? A Critical Review of What We Know and What We Don't Know," *Educational Researcher* 47, no. 9 (December 2018): 606–11, <https://doi.org/10.3102/0013189X18801322>.

⁵⁸ Credé, 606.

⁵⁹ Credé, 607.

⁶⁰ Credé.

⁶¹ Credé, 607.

conscientiousness as a character trait is a better gauge of work ethic.⁶² Duckworth et al. seem to agree: “Grit overlaps with achievement aspects of conscientiousness but differs in its emphasis on long term stamina rather than short term intensity...[The] gritty individual not only finishes tasks at hand but pursues a given aim over years.”⁶³ In contrast, Credé argues that grit and perseverance merely rename conscientiousness; grit measures the same concepts that personality exams and, more specifically, conscientiousness evaluations already have.⁶⁴

Examinations of the “big five” personality categories—openness, conscientiousness, extroversion, agreeableness, and neuroticism—reveal additional agreed-upon psychological traits that affect job performance.⁶⁵ Adding these traits allows organizations to gain a broader view of a potential candidate’s character and ability.⁶⁶ This big five model is significant because it measures traits unaffected or separate from cognitive ability testing.⁶⁷ In using such predictors as conscientiousness, extroversion, and grit, organizations can now administer tests that search for these qualities to cultivate desired traits.⁶⁸ Organizations can gain broader insight into the personality and intellect of potential employees.⁶⁹ Examples of personality and job performance correlations include people working in sales experiencing greater success when they are more social, open, extroverted, and engaging with customers or public safety personnel displaying more competency if they are agreeable, careful, considerate, and attentive to detail.⁷⁰ Thus, using

⁶² Credé.

⁶³ Duckworth et al., “Grit,” 1089.

⁶⁴ Credé, “What Shall We Do about Grit?,” 607.

⁶⁵ Scott E. Seibert and Maria L. Kraimer, “The Five-Factor Model of Personality and Career Success,” *Journal of Vocational Behavior* 58, no. 1 (2001): 1, <https://doi.org/10.1006/jvbe.2000.1757>.

⁶⁶ Murray R. Barrick and Michael K. Mount, “The Big Five Personality Dimensions and Job Performance: A Meta-Analysis,” *Personnel Psychology* 44, no. 1 (Spring 1991): 1–26, <https://doi.org/10.1111/j.1744-6570.1991.tb00688.x>.

⁶⁷ Barrick and Mount, 3.

⁶⁸ Barrick and Mount, 5.

⁶⁹ Barrick and Mount, 11.

⁷⁰ Barrick and Mount, 20.

character and personality measures ensures a better job fit and improves the likelihood of organizational and individual success.

According to Barrick and Mount, conscientiousness and extroversion are two of the most measured and reliable factors when comparing personality with job performance.⁷¹ Such factors as openness to experience, agreeableness, and neuroticism contribute to selection and personality–job matches.⁷² However, the measurement across different categories is too subjective for these markers to have a significant determining result.⁷³ Additionally, too many job criteria and personality variations interfere with establishing a correlation between performance and successful outcomes from these factors.⁷⁴

5. Physical Performance Measurements

Many organizations require a physical ability examination to select applicants who can physically perform the tasks. The U.S. Bureau of Labor reports that nearly 30 percent of jobs in the United States require physically demanding work.⁷⁵ Screening employees for physical fitness and ability standards has an associated cost–benefit return. Indeed, selecting individuals for physical ability reduces injuries, decreases job turnover, and accurately identifies individuals capable of the work.⁷⁶ Identifying individuals who are most likely to succeed or display proficiency at a given job has a systemic effect on the organization’s overall mission.⁷⁷ Therefore, physical exams have strong economic, legal, and performance justifications for the employer.

However, sometimes the physical assessment of employees harms the organization, resulting in legal proceedings. The primary legal precedents cited to challenge the validity

⁷¹ Barrick and Mount, 21.

⁷² Barrick and Mount.

⁷³ Barrick and Mount, 21.

⁷⁴ Barrick and Mount, 21.

⁷⁵ Farr and Tippins, *Handbook of Employee Selection*, 277.

⁷⁶ Baker and Gebhardt, “The Assessment of Physical Capabilities in the Workplace,” 275.

⁷⁷ Sue Cox, Bethan Jones, and David Collinson, “Trust Relations in High-Reliability Organizations,” *Risk Analysis* 26, no. 5 (October 2006): 1123–38, <https://doi.org/10.1111/j.1539-6924.2006.00820.x>.

of physical performance testing are the Civil Rights Act of 1964 and the Americans with Disabilities Act of 1990.⁷⁸ Furthermore, the case of *Berkman v. City of New York* alleged discrimination based on gender. The case involved a female applicant denied an appointment to the FDNY for not passing the physical ability test, yet this test and the written exam had not been properly validated as job/mission specific. The validation of these exams had fallen victim to budget cutbacks in the 1970s.⁷⁹ The events administered in this physical ability test included such assessments as the dummy carry, hand grip test, free-style broad jump, flexed arm hang, agility test, ledge walk, and mile run. Every event administered in this exam had been weighted differently based on criteria of stamina or agility and scored on individual ratings of importance. It was found that none of these events had been validated as job-specific or necessary to firefighting. This is not to say that these tasks were not applicable, but they had not been validated as mission specific.⁸⁰

The court determined that the city had discriminated against female applicants, even though several women had been some of the first to apply for careers with the department. Moving forward, the City of New York, along with the FDNY, began to analyze and validate written and physical performance tests.⁸¹ The court accepted the fact that the city had failed to validate its own administered tests and, as a result, ruled in favor of the plaintiff. This landmark case allowed for the first woman to be admitted into the FDNY.

Akin to cognitive entrance exams, physical ability assessments must meet equivalent validity and reliability standards. Such sources as the Department of Labor and I/O professionals Todd A. Baker and Deborah L. Gebhardt reveal that different jobs have different levels of physical performance criteria.⁸² Organizations must establish physical

⁷⁸ Farr and Tippins, *Handbook of Employee Selection*, 290.

⁷⁹ *Berkman v. City of New York*, 536 F. Supp. 177 (E.D.N.Y. 1982), <https://law.justia.com/cases/federal/district-courts/FSupp/536/177/2009820/>

⁸⁰ *Berkman*, 536 F. Supp. at 177.

⁸¹ *Berkman*, 536 F. Supp. at 177; *Berkman v. City of New York*, 812 F.2d 52 (1987), <https://www.leagle.com/decision/1987864812f2d521853>.

⁸² Baker and Gebhardt, "The Assessment of Physical Capabilities in the Workplace," 289.

ability measures that match select job criteria to survive legal challenges.⁸³ Organizations have paid high costs to identify optimal applicants and avoid legal action. Understanding already established, valid, reliable, and transparent standards of performance allows organizations not only to select capable employees but also to save money on legal and medical expenses.

C. RESEARCH DESIGN

Challenges remain in determining valid tests and examinations specific to different organizations and in which selection criteria apply. This thesis examines other organizations with specialized selection and recruitment models. A multiple comparative case study approach to solving recruitment and selection allows the FDNY to learn from other organizations facing similar challenges. For example, a case study with similar goals conducted by the Army's Special Forces Recruitment Command examined civilian organizations.⁸⁴

The objective of this comparison is to explore content validity, criterion validity, and construct validity to identify areas in which the FDNY may benefit. This thesis explores the differences and similarities of recruitment and selection models across multiple organizations and determines applicable changes and feasible goals. The cases include the FDNY's SOC model for criteria, the U.S. armed services selection models for content, and the current examinations and selection parameters of commercial diving for the construct. These three organizations have specific demands on the individual selected to carry out the mission. However, the literature suggests alternative means for identifying and selecting candidates more effectively. Each case has its culture and climate within which hiring or selection decisions happen. The FDNY and the armed services share many values and similar cultures and climates on mission-specific hiring and selection. Government and non-government hiring and selection practices may exhibit similarities

⁸³ Baker and Gebhardt, 274.

⁸⁴ Robert M. Burrell, "Tactics, Methods and Techniques to Improve Special Forces In-Service Enlisted Recruiting" (master's thesis, Naval Postgraduate School, 2002), 12, <https://calhoun.nps.edu/handle/10945/5953>.

and differences. Through each case, the FDNY can compare discrepancies to reveal better options for selection or substantiate and reinforce methods in use.

This analysis of the selected organizations focuses on how different concepts are used in testing, selection, and recruitment. The concepts within the literature—for example, cognitive ability, physical performance, and character/personality traits—form the primary qualitative analysis and determine the appropriateness of implementing any changes. The legality and ethical examinations within the private sector reveal transparent and equally applicable selection standards and legal precedents. The three case studies represent organizations with similar goals, missions, and challenges, along with improved diversity and inclusion efforts from broader demographics. A comparison of testing methods can also examine the validity and reliability of tests administered and recommend improving or confirming current practices.

D. OVERVIEW OF CHAPTERS

This thesis examines organizational development and, specifically, validation of employee selection methods. Three high-reliability organizations—FDNY special operations, the armed services, and commercial diving—are examined as case studies of specific validation methods. Chapter II explores the use of content validation within the armed services in making job–applicant matches. The content of such selection tools such testing and physical ability measurement highlights the need for proper criteria and the suitable assessment of competency and skill. Next, Chapter III explores the use of construct validation in commercial diving, meeting high-reliability theory goals. Construct validation is used to measure theoretical concepts that cannot be measured directly, like job behavior.⁸⁵ Chapter IV analyzes each case study through the framework of criteria, content, and construct validation methods to identify areas where the FDNY can adapt or improve its selection model for special operations firefighters. Last, this thesis offers

⁸⁵ Pritha Bhandari, “Construct Validity: Definition, Types, & Examples,” Scribbr, February 17, 2022, <https://www.scribbr.com/methodology/construct-validity/>; Farr and Tippins, *Handbook of Employee Selection*, 34.

recommendations based on the analysis of results and suggests how the FDNY can incorporate best practices in validated selection moving forward.

II. CASE STUDY: FDNY SPECIAL OPERATIONS' CRITERION VALIDATION

The firefighters who work in a rescue company must be multi-talented, highly experienced, and tremendously motivated. Their attitude must be “never give up.”

—Ray Downey⁸⁶

For the FDNY to improve on currently held practices of selection and recruitment, the tradition, culture, and evolution of the process must be examined. The FDNY has a long and storied history of innovation and service. The evolution of these units allowed the FDNY to identify talent and establish criteria for future employment in special operations. This chapter explores the background of special operations and follows the formation of selection criteria that guides appointments into elite units of the FDNY today. This chapter concludes that the FDNY lacks sufficient criterion validation because of outdated job analysis vis-à-vis selection criteria. This chapter examines the criteria of special operations, how they were formed, and how they have changed or stayed the same.

A. BACKGROUND

This section provides a timeline from inception to present-day use of FDNY's special operations units. This timeline is important for understanding the criteria used in selection and recruitment, the mission's evolution, and potential improvements in selecting special operations firefighters. Mission tasking, performance standards, and selection criteria were introduced based on the experience and technology available at the time.⁸⁷ According to Kassiani Nikolopoulou, *criterion validation* defines “how accurately a test measures the outcome it was designed to measure.”⁸⁸ The outcome in the case of FDNY special operations has been performing above and beyond normal fire department operations by applying technical proficiency with advanced tools in ultra-hazardous

⁸⁶ Ray Downey, *The Rescue Company* (Saddle Brook, NJ: Fire Engineering Books, 1992), 12.

⁸⁷ Norman, *Fire Department Special Operations*, 10.

⁸⁸ Kassiani Nikolopoulou, “What Is Criterion Validity?: Definition & Examples,” Scribbr, September 2, 2022, <https://www.scribbr.com/methodology/criterion-validity/>.

environments.⁸⁹ The criteria of seniority and experience have largely remained unchanged. However, technology and mission tasking have changed dramatically. Understanding the origins of special operations, compared to contemporary special operations, identifies areas where the criteria could be validated or improved. The following subsections organize the command evolution of FDNY special operations into three periods: 1915–1980, 1980–2001, and 2001 to the present.

1. History of Command, 1915–1980

One of the first special operations units, developed in 1915, was the rescue company unit. After several fires and emergencies that were mitigated using skilled technical proficiency and firefighting expertise combined, the FDNY realized the potential of staffing a fully trained unit to handle complicated and technical emergencies.⁹⁰ The scope of the mission for rescue companies primarily involved fire suppression and civilian and firefighter rescue.⁹¹ Other emergencies were considered additional work and resulted in a special status where specific skill sets would be beneficial.

During the initial organization of these units, particular attention was paid to staffing. Desirable skills included experience in a trade union skill (e.g., carpenters, riggers, masons, ironworkers, and sandhogs).⁹² These trades lent themselves to the physical demand and required expertise in advanced construction tools and techniques of the time.⁹³ Firefighters who possessed these skills were instructed to apply their previous work ethic and experience during fires and emergencies.⁹⁴ As described by the first captain of a rescue unit, “Rescue firemen began where the ordinary firemen left off.”⁹⁵ As shown in Figure 1,

⁸⁹ Norman, *Fire Department Special Operations*, 10.

⁹⁰ Norman, 9.

⁹¹ Downey, *The Rescue Company*, 19.

⁹² Downey, 19.

⁹³ Norman, *Fire Department Special Operations*, 21.

⁹⁴ Norman, 10.

⁹⁵ Paul Hashagen, *A Distant Fire: A History of FDNY Heroes* (Dover, NH: DMC Associates, 2010), 218.

FDNY rescue units had at their disposal the most rudimentary of fire apparatus and equipment.



Figure 1. Original Fire Equipment and Apparatus.⁹⁶

The experience of firefighters was intended to make up for the shortfalls in technology.⁹⁷ Eventually, each borough of New York City received a fully staffed and equipped rescue unit. This strategic deployment of rescue companies allowed for centralized technical rescue resources throughout the city. The geography and population densities of New York City lent themselves to unique hazards associated with the neighborhoods.⁹⁸ As each borough presented different inherent hazards, each rescue company began to define its own sought-after criteria with limited overlap. As a case in point, each rescue company required firefighting experience, but there were differences between fighting high-rise fires in Manhattan and suppressing private dwelling fires in the outer boroughs. Being familiar with the terrain and understanding the structures that made

⁹⁶ Source: Paul Hashagen and Janet Kimmerly, *Fire Department City of New York* (Paducah, KY: Turner Publishing, 2000), 56.

⁹⁷ Donald Van Holt, "Recue 1 Manhattan," *Unofficial website of FDNY* (blog), accessed January 19, 2023, https://nyfd.com/rescue/rescue_1.html.

⁹⁸ Mike Wallace and Edwin G. Burrows, *Greater Gotham: A History of New York City from 1898 to 1919* (New York: Oxford University Press, 2017), 251.

neighborhoods and boroughs distinctive were imperative for the firefighters working in these specialized rescue companies. Members of rescue companies acquired vast emergency and fire service experience, thus making special service positions desirable and prestigious.⁹⁹ There were no additional benefits to working in rescue companies, so the added workload, experience, training, and tools were the only incentives.¹⁰⁰

During the initial organization of rescue companies, no special screening or application processes were formalized. Firefighters and officers could be assigned to rescue units through standard transfer applications and with the endorsements of commanding officers.¹⁰¹ Rescue units followed the standard chain of command, and support, logistical, and operational issues were not a consideration.¹⁰² The only specialization was the type of task assigned by the chief officer when specially called to fires or emergencies.¹⁰³ Company commanders made staffing selections based on special skills, experiences, and peer references.¹⁰⁴ Given the mission of the rescue companies, these listed traits were the basis for success in a specialized unit. Company commanders had very little to assess about their applicants before recruitment.¹⁰⁵ Therefore, the demands of rescue companies during this time limited the commander's scope of desirable skills and abilities.

2. 1980–2001

After the initial concept of rescue services proved successful, very little changed regarding operations at fire scenes until the 1980s. Fires and arson-for-hire during the 1960s and 1970s further cemented the need for special services for firefighting.¹⁰⁶

⁹⁹ Downey, *The Rescue Company*, 19.

¹⁰⁰ Downey, 19.

¹⁰¹ "History of Rescue Company 1," *History of Rescue Company 1* (blog), accessed January 31, 2023, <https://www.angelfire.com/ny2/fdnyrescue/oldsite/history.html>.

¹⁰² Hashagen and Kimmerly, *Fire Department City of New York*, 57.

¹⁰³ Downey, *The Rescue Company*, 9.

¹⁰⁴ Downey, 19.

¹⁰⁵ Downey, 19.

¹⁰⁶ Joe Flood, *The Fires: How a Computer Formula Burned Down New York City—and Determined the Future of American Cities* (New York: Riverhead Books, 2010), 174.

However, the mission of special operations was expanding, and technology was improving special operations tactics.¹⁰⁷ Furthermore, additional responsibilities were being added to special operations units, including formalized structural collapse response, hazardous materials mitigation, high-angle rope rescue, and confined space rescue.¹⁰⁸ As technology and tactics improved, the demand for special operations increased to keep pace with call volume and mission tasking. As shown in Figure 2, the current apparatus model is outfitted with state-of-the-art equipment and tools to handle any type of emergency incident—a vast difference from the earliest firefighting equipment (see also Figure 1).



Figure 2. Rescue Company 1's Fire Apparatus.¹⁰⁹

During times of high call volume and high fire activity in the 1960s and 1970s, tactical units known as squad companies responded as additional resources and staffing for overwhelmed areas of the city.¹¹⁰ These squad units were nothing special in the

¹⁰⁷ Hashagen and Kimmerly, *Fire Department City of New York*, 177.

¹⁰⁸ Hashagen and Kimmerly, 226.

¹⁰⁹ Source: Michael Martinelli, 2019 *Ferrara*, 2022, photograph. This author obtained permission from the photographer to reproduce his work in this thesis.

¹¹⁰ John Calderone, *Squad Company Apparatus of the New York City Fire Department* (Summit, NJ: Fire Apparatus Journal, 2008), 5.

organization as they were trained solely for firefighting.¹¹¹ Special skills and previous experience were not initial considerations in assignments to these squad units. During times of financial crisis, these units were the first to be disbanded or reorganized to save money.¹¹² Nevertheless, squad companies presented an ideal opportunity to expand special operations and further develop technical assets throughout New York City.

The FDNY developed squad units to provide additional staffing resources for the overwhelming number of fires from the 1960s to the 1980s. Given the increasing need for tiered technical response, newly designated squad companies were organized formally as firefighting or special operations resources in the late 1990s.¹¹³ These squad units were tasked with typical first-due engine assignments as well as specially requested—with their additional training and tools—for technical emergencies.¹¹⁴ Eventually, squad units developed into senior and experienced fire service units. With humble origins in engine operations, some technical training, and hazmat mitigation, these modern-day squad units quickly rose to elite status, and work in special operations has drawn similar personalities and desires to the rescue companies of old.

Today, there is little discernable difference between the education, training, skills, or abilities of squad companies and those of rescue companies. The SOC has grown significantly since 1915. Special operations comprise five rescue companies, eight squad companies, one dedicated hazardous materials unit, four satellite hazardous materials engine companies, and many more support and logistics units.¹¹⁵ All these units are now more technically enhanced through training, equipment, and mission tasking than were the original units over the past 100 years (see Figure 3). Special operations have expanded in both incident response and staffing. This expansion of mission has allowed the FDNY to respond to modern emergencies and have the training, equipment, and ability to mitigate

¹¹¹ Calderone, 5.

¹¹² Calderone, 5.

¹¹³ Hashagen and Kimmerly, *Fire Department City of New York*, 207.

¹¹⁴ Calderone, *Squad Company Apparatus*, 6.

¹¹⁵ Hashagen and Kimmerly, *Fire Department City of New York*, 226.

almost any given scenario. See Appendix A for the FDNY's Special Operations Response Matrix.



Figure 3. Fire Apparatus circa 1970 vs. 2018.¹¹⁶

With the expansion of special operations to such varied specialties as rescue, squad, and hazardous material units, a dedicated chain of command was created. SOC oversees all the administrative issues and organizes the operational and logistics concerns of special operations units.¹¹⁷ Staffed with several chief officers and several supporting officers, this dedicated command is responsible solely for special operations.¹¹⁸ Members selected to work in this command usually have previous experience working in special operations as either a firefighter or an officer.

With the formalization of SOC, administrative, managerial, support, and logistical issues were streamlined.¹¹⁹ This process allowed for a dedicated command staff and chain of command for issues affecting administration and operations.¹²⁰ The same tradition of company commanders' screening applicants continued, and work experience, seniority, and character traits were used to recruit firefighters and officers for special operations units,

¹¹⁶ Source: Calderone, *Squad Company Apparatus*; Michael Martinelli, 2013 *Seagrave 1000/500*, 2018, photograph.

¹¹⁷ Hashagen and Kimmerly, *Fire Department City of New York*, 226.

¹¹⁸ Hashagen and Kimmerly, 226.

¹¹⁹ Hashagen and Kimmerly, 226.

¹²⁰ Hashagen and Kimmerly, 226.

particularly squad and rescue companies.¹²¹ Company commanders still maintained firm control over staffing and the expectations of special operations units, with little need to change the status quo.

Company commanders maintained their selection criteria based on experience, capability, and reputation. Some attempts were made to formalize the transfer to special operations companies, but the captain of the unit had the most influence over the process.¹²² This recruitment and selection process was a cultural norm within the FDNY.¹²³ The tradition of the captain's prerogative over the selection of members to units was not unique to rescue companies. Many of the line units within the fire department relied on the captain to admit and remove members of the unit to maintain operational efficiency.¹²⁴

3. 2001 to the Present

Special operations have expanded into an all-hazards response group. The mission of special operations encompasses every considerable situation—from building collapse, confined space entry, and high-angle rope rescue to dive, swift water, and severe storm response.¹²⁵ Technician positions involve advanced training in technical rescue disciplines and hazardous material chemistry. There are hundreds of hours of training and years of service required to achieve these technician ratings within the FDNY.¹²⁶ Much of this advanced training was never a thought when these units were originally developed. The rescue specialist rating includes state certifications in the various fields of technical rescue.¹²⁷ In accordance with National Fire Protection Association (NFPA) 1670,

¹²¹ Norman, *Fire Department Special Operations*, 23.

¹²² New York City Fire Department, *Application Procedure for Rescue Operations*, 2.

¹²³ New York City Fire Department, *Policy Regarding Assignment and Transfer of Firefighter*, AUC 297 (Brooklyn: New York City Fire Department, 1995), 3.

¹²⁴ New York City Fire Department, 2.

¹²⁵ Norman, *Fire Department Special Operations*, xi.

¹²⁶ New York City Fire Department, Bureau of Training, *FDNY Higher Education & Training Course Catalog* (Brooklyn: FDNY Foundation 2022).

¹²⁷ New York City Fire Department, Bureau of Training, 148.

Standards on Operations and Training for Technical Search and Rescue Incidents, to be considered a technician in any one discipline—for example, building collapse or rope rescue—one would need to attend at least 40 hours of instruction.¹²⁸ Each firefighter and officer must complete courses in various disciplines of technical rescue. The FDNY considers the successful completion of all required technician courses worthy of distinction.¹²⁹ Collapse technician training requires some aptitude in construction skills and carpentry along with the appropriate math and reasoning skills.¹³⁰ Other certifications are an amalgamation of other critical-thinking skills. For example, a trench/cave-in rescue technician requires knowledge of collapse operations, rope rescue, and technical rigging and possibly hazardous materials mitigation.¹³¹ To receive a technician certification, a member of special operations need to certify in the following fields:

1. Basic structural collapse
2. Medium collapse related to building failure
3. Emergency rescue shoring
4. Basic trench rescue
5. Intermediate rope rescue
6. Rescue operations I
7. Rescue operations confined space¹³²

Additionally, members also receive more training in first aid than members of special operations did in times past. As the FDNY plays an increasingly important role in medical emergencies, new certification has been added to the criteria for selection into special operations.¹³³ All the listed training has been formalized and certified by the state of New

¹²⁸ National Fire Protection Association, *Standards on Operations and Training for Technical Search and Rescue Incidents*, NFPA 1670 (Quincy, MA: National Fire Protection Association, 2017), 12.

¹²⁹ New York City Fire Department, *Chest Insignia*, PA/ID 2–75, Addendum 2 (Brooklyn: New York City Fire Department, 2004), 2.

¹³⁰ John P. O’Connell, *Emergency Rescue Shoring Techniques* (Tulsa, OK: PennWell Corporation, 2005), 39.

¹³¹ New York City Fire Department, Bureau of Training, *FDNY Higher Education & Training*, 161.

¹³² Fire Department - City of New York, *Chest Insignia 2–75*, PA/ID Add 2 (Fire Department, City of New York, 2004), 3.

¹³³ New York City Fire Department, *FDNY Strategic Plan 2015–2017* (Brooklyn: New York City Fire Department, 2015), 39; New York City Fire Department, *Application Procedure for Rescue Operations*, 1.

York, requiring minimum passing scores.¹³⁴ Also required are out-of-state training courses in weapons of mass destruction and advanced chemical and biological warfare agents. The current criteria do little to determine whether an applicant intends to meet the new training requirements.¹³⁵

Some members possess ulterior motives for joining special operations. None of the earlier eras in special operations required as much from the applicants as does the special operations mission of today. Along with the added training and proficiency that special operations demand, there are financial incentives in belonging to rescue, squad, and hazardous materials units. An additional 12 percent salary differential has been negotiated for members working in these units.¹³⁶ Moreover, the four-member minimum to start the tour of duty incentivizes minimum staffing and possible overtime.¹³⁷

Company commanders must now assess the ability of applicants to pass the listed training requirements and determine whether they are committed to the training regimen and applying for the right reasons—and not just for the additional pay. While there is nothing wrong with earning more money for doing more work, using validated selection methods would help ensure there are no adverse impacts on any one demographic of the department related to compensation or, more importantly, on the operational standards that have been validated over several decades of service. Added compensation might motivate applicants to keep perform to a bare minimum.¹³⁸ This added compensation, along with the added education, training, and experience, will have an impact on the careers of anyone successful in joining special operations. More opportunities will be afforded these members than those assigned to regular line units. While the current application attempts to standardize the evaluation of company commanders and provide a measure of ability

¹³⁴ New York City Fire Department, Bureau of Training, *FDNY Higher Education & Training*, 142.

¹³⁵ New York City Fire Department, *Application Procedure for Rescue Operations*, 6.

¹³⁶ “About Page,” Uniformed Firefighters Association, accessed January 28, 2023, <https://ufanyc.org/about/>.

¹³⁷ New York City Fire Department, *Rescue Company Policy*, AUC 275 (Brooklyn: New York City Fire Department, 1990).

¹³⁸ Robert C. Barr and John M. Eversole, eds., *The Fire Chief's Handbook*, 6th ed. (Tulsa, OK: PennWell Corporation, 2003).

and character, the questions included are open-ended and ambiguous, and none assess the ability of a member to any degree of proficiency.¹³⁹

SOC assignments are rare and prestigious; combined, there are only 377 members assigned to rescue operations, and these firefighters and officers account for only 3.5 percent of the operating force (see Figure 4).¹⁴⁰

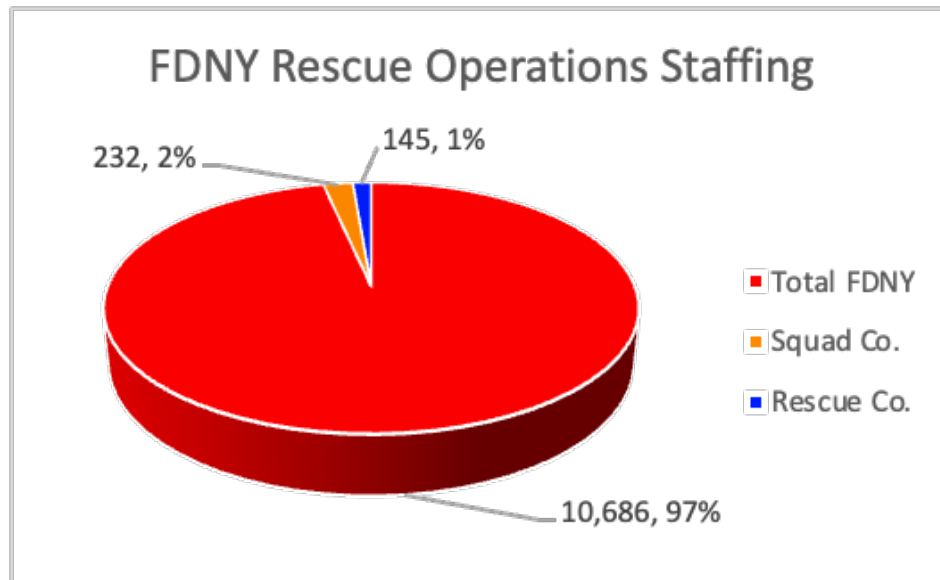


Figure 4. Elite Status of Rescue/Squad Company.¹⁴¹

a. Federal Emergency Management Agency's Urban Search and Rescue Task Force 1

This subsection examines national repercussions from special operations unit development. As a result of advanced technical training and successful operations at the local level, the general fire service has staffed federal response teams known as urban search and rescue (USAR) task forces (TFs).¹⁴² New York City's TF-1 is staffed by

¹³⁹ New York City Fire Department, *Application Procedure for Rescue Operations*, 6.

¹⁴⁰ New York City Fire Department, *FDNY Strategic Plan*, 39.

¹⁴¹ Adapted from New York City Fire Department, 39.

¹⁴² "Urban Search & Rescue," Federal Emergency Management Agency, accessed October 6, 2022, <https://www.fema.gov/emergency-managers/national-preparedness/frameworks/urban-search-rescue>.

members of FDNY special operations units. As technical response capabilities have grown, so has the FDNY's special operations jurisdiction. This mission tasking of special operations firefighters and officers has expanded the criteria used in selecting these operators for roles at the national and state level.

The selection model and criteria have consequences that might affect jurisdictions nationally. As resources for technical capabilities have increased across public safety agencies, federal and state resources have seized the opportunity to make use of these expanded capacities. The federal government formalized the concept of USAR TFs in the early 1990s.¹⁴³ These TFs saw deployments at severe weather incidents and terrorist attacks, including Hurricane Katrina and the Oklahoma City bombing. Staffing for these USAR TFs was drawn from local public safety agencies. New York TF-1 comprises FDNY special operations firefighters, emergency medical service (EMS) paramedics, and hazardous materials technicians.¹⁴⁴

The consequences of selecting elite rescue and hazmat operation personnel are critical given the responsibilities. The selection of members applying for these positions—unless they are otherwise trained in specialties, for example, as certified engineers—falls to the ranking TF leader, usually an FDNY special operations officer. As firefighters or officers in special operations, the candidates already possess the requisite training. Selection is based on the needs of the USAR TF and the experience of the ranking officer making the decision. As with the application for special operations, no in-depth examinations currently measure the skills listed in the rescue specialist position. All decisions are based on the FDNY application and the recommendation of the Federal Emergency Management Agency (FEMA)'s USAR officer recruiting the applicant.

Figure 5 depicts the command structure of the USAR TF. Each TF across the nation is staffed with 100 personnel, and each branch has a specialist rating. As training often aligns with the jurisdictional authority, New York TF-1 holds training at the state fire training center.

¹⁴³ Federal Emergency Management Agency.

¹⁴⁴ Hashagen and Kimmerly, *Fire Department City of New York*, 182.

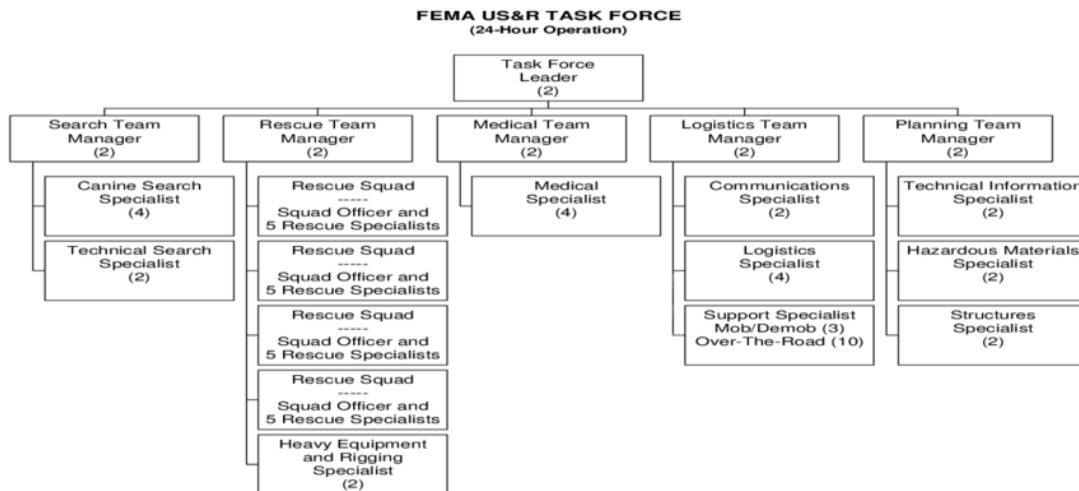


Figure 5. FEMA’s USAR Task Force Hierarchy.¹⁴⁵

The tactical and technical capability of these USAR TF allows for rapid deployment in any city or state where a declaration of an emergency has been made. Deployment times can last up to two weeks of self-sustained operations, the idea being that most local agencies are overwhelmed by the disaster and unable to host mutual aid resources. The following paragraphs detail the rescue specialist position, as described by New York TF-1.

Position Specific Requirements:

The Rescue Specialist is responsible for performing the rescue function of the Task Force incident operation. The Rescue Specialist reports directly to a Rescue Squad Officer.

Description of Duties:

The Rescue Specialist is responsible for:

- Implementing technical skills and operating equipment necessary for completing the rescue portion of the action plan
- Performing rescue operations under the direct supervision of a Rescue Squad Officer and providing periodic progress reports as needed
- The operation and routine field maintenance of rescue tools and equipment
- Ensuring accountability and maintenance for all issued equipment

¹⁴⁵ Source: Mikko Karvonen, “Applying the Lessons of Quality Management to International Urban Search and Rescue” (master’s diss., University of Leicester, 2013), ResearchGate.

- Evaluating and modifying rescue tactics as needed
- Performing additional tasks or duties as assigned

Position Requirements and Criteria:

Individuals who meet the following requirements and criteria will be eligible to become Rescue Specialists in the DHS/FEMA US&R [National Urban Search and Rescue] Response System. The intent of these requirements is to select personnel fully capable of providing the rescue tactics and techniques required in a disaster environment.

Required Training:

The Rescue Specialist shall:

- Complete all Administrative and General Training requirements
- Complete DHS/FEMA National US&R Response System GPS Awareness Level Course
- Meet requirements of NFPA 1670 (2004) Structural Collapse Technician Level
- Meet all requirements of NFPA 1670 (2004 Edition) Chapter 9 Section 9.3.5. Operations levels for the specific disciplines defined in Sections 9.3.6–9.3.9 are excluded from this requirement.
- Complete the DHS/FEMA National US&R Response System Structural Collapse Technician course.¹⁴⁶

There are no additional criteria for responsibilities under current selection models. The applicant fills out more paperwork and applies for an appointment to the USAR TF-1 with the team leader's endorsement.

b. FDNY SOC-TF

For state-declared emergencies, the FDNY has developed a local USAR TF mirroring the federal USAR concept. This local asset is modeled from the larger federal team concept and responds at the direction of local city and state leaders rather than federal authorities. The staffing and equipment cache is similar, and operational capabilities are also identical. The SOC-TF has responded to such catastrophes as storm flooding and

¹⁴⁶ “FEMA National US&R Response System Task Force Position Description: Rescue Specialist,” New York Task Force 1, accessed October 6, 2022, <https://www.nytf1.org/fema-positions-menu/rescue-specialist-menu>. In this excerpt from New York TF-1, the text emphasized in bold is original to the source.

severe weather and can be activated for mutual aid if any jurisdiction requires the response of a technical search and rescue asset.

The selection of members for this unit again is drawn from rescue and hazmat operations. The process is more in-house, as other agencies, including the NYPD, are excluded from the process. This one-agency model has proven effective as there are no cultural or operational differences to correct before deployment. Everyone comes from the same school of training and operational expectations. In this sense, the SOC-TF may prove to be more efficient than the federal USAR TF. Selection is again predicated on the TF's ranking officer, and the training and experience are provided by elite units. The need to ensure the selection of the most proficient and capable people is of utmost importance for operational performance.

B. ASSESSMENT: CRITERION VALIDITY

Criterion validity assesses the test's ability to measure accurately the intended outcome, for example, a behavior or performance.¹⁴⁷ The FDNY has relied on criterion validity as a foundation of special operations selection and recruitment—evident in the reliance on prior performance and experiences in line fire units.¹⁴⁸ The traditional method of recruitment into special operations currently depends on performance in regular fire service duties.¹⁴⁹ It is assumed that if an applicant is a good firefighter in busy fire units, then he or she should be an asset as a special operations firefighter or officer. Following the criterion validation model, if the applicant has been successful in meeting the performance and behavioral goals in a regular fire unit, that validation is then applied to special operations companies as a predictor of success.

Moving validation evidence from one agency or organization to another is an acceptable practice so long as certain benchmarks are met. As defined by Industrial/Organizational Solutions,

¹⁴⁷ Nikolopoulou, "What Is Criterion Validity?"

¹⁴⁸ New York City Fire Department, *Application Procedure for Rescue Operations*, 1.

¹⁴⁹ New York City Fire Department, 1.

Transportability is a process sanctioned by the Uniform Guidelines, Section 7B, that allows validity evidence gathered in one setting to be borrowed or “transported” to another setting. Transporting validity evidence is a formal process by which criterion-related validity evidence gathered for a particular job in a particular setting is empirically extended to a similar job in a different setting where no empirical validation has been conducted. Therefore, the purpose of a study of this nature is to provide evidence (for a location that lacks such evidence) that the inference drawn about test scores predicting work outcomes or behaviors is valid.¹⁵⁰

Transporting validity across similar jobs—for instance, from firefighting to special operations—is an acceptable method for predicting success or validating testing and selection practices, according to the Uniform Guidelines in the *Code of Federal Regulations*, so long as the criteria have been proven effective and job-related.¹⁵¹ Specifically, four factors are also required for transporting validation:

1. The incumbents of the “new job” must perform the same or similar work as the incumbents of the original job,
2. Criterion-related evidence demonstrates test validity,
3. The test is fair to protected groups, and
4. Other variables (e.g., work methods) have been explored to determine their effect on validity.¹⁵²

The FDNY’s listed criteria for special operations have two main themes: seniority and experience. Seniority deals with time served in the department operating as a firefighter, and experience addresses other skills and abilities independent of seniority, for example, prior training and certifications.¹⁵³ Neither of these criteria has corresponding

¹⁵⁰ “Transport Validity Evidence,” Industrial/Organizational Solutions, accessed December 31, 2022, <https://iosolutions.com/transportability-test-validation/>.

¹⁵¹ Uniform Guidelines on Employee Selection Procedures, 29 C.F.R. 1607, 1607.14 (1978), <https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XIV/part-1607>; Farr and Tippins, *Handbook of Employee Selection*, 611.

¹⁵² Michael T. Brannick, Adrienne Cadle, and Edward L. Levine, “Job Analysis for Knowledge, Skills, Abilities, and Other Characteristics, Predictor Measures, and Performance Outcomes,” in *The Oxford Handbook of Personnel Assessment and Selection*, ed. Neal Schmitt (Oxford: Oxford University Press, 2014), 138.

¹⁵³ New York City Fire Department, *Application Procedure for Rescue Operations*, 1.

qualitative measurements of technical or advanced skills and abilities of modern-day special operations.¹⁵⁴

1. Seniority

Seniority in the FDNY addresses both experience and compensation for firefighters and officers. Experience, as listed in the application for special operations, is set at five years of service. This time allows firefighters to pass their probationary period from being appointed and become tenured civil servants in the FDNY. Once tenured, the firefighter will be a permanent employee with the City of New York and have full union protections. Employee evaluations of skills and abilities are performed annually in accordance with department policy.

Presumably, the five-year seniority criterion has been established to allow firefighters the ability to apply to special operations and for the FDNY to gain a return on investment in training and staffing. If the threshold for firefighters and officers were longer periods of service, then firefighters might only be retained in special operations for five to 10 years more before retiring at 20 years of service. In that case, training and experience would be in a constant state of turnover. Nevertheless, special operations firefighters require some time in rank before applying for additional work and training.

2. Experience

Experiences are another founding criterion of special operations. The first firefighters selected for service had prior experience and training that made them assets to the newly formed units. As it is now, experience is also examined in the application for special operations firefighters.¹⁵⁵ Company commanders assess the applicants' work history to gauge whether they need more experience before applying to special operations. Further consideration is given to the applicants' type of firefighting experience. Firefighters assigned to engine companies often work in close teams and under constant officer supervision while firefighters working in team-based ladder companies operate

¹⁵⁴ New York City Fire Department, 6.

¹⁵⁵ New York City Fire Department, 6.

unsupervised and remotely from officers. An argument could be made that firefighters in engine companies are more team-oriented than firefighters in ladder companies, who may prefer individual operations. Each has its advantages and drawbacks, so the company commander must assess individuals on a case-by-case basis to select the firefighters most capable of filling the needs of special operations.

C. CONCLUSION

The FDNY's SOC has evolved from humble beginnings. While initially only responding to fires and complex emergencies, special operations units now respond to all hazards and, if selected for additional service, respond statewide and possibly nationally. Special operations units were developed out of necessity to maintain a tactical advantage in emergency services. The selection and staffing of special operations units within the FDNY have attempted to keep pace with the changing demands of special operations firefighters. Such criteria as seniority, experience, and prior fire service employment skills have been the overall guide for selection into special operations. These criteria were once job and mission specific. However, the mission tasking and service of special operations have grown extensively. The criteria may still be valid, but without an updated job analysis and a more in-depth examination of applicants' competencies, the FDNY might not be validating its selection choices. More importantly, the FDNY might be missing talented firefighters with greater abilities and additional skill sets. The next chapter explores additional validation strategies dealing with testing and selection.

III. CASE STUDY: THE U.S. ARMED SERVICES' CONTENT VALIDATION

People—not equipment—make the critical difference. The right people, highly trained and working as a team, will accomplish the mission with the equipment available. On the other hand, the best equipment in the world cannot compensate for a lack of the right people.

—U.S. Army Special Operations Command Pacific¹⁵⁶

This chapter focuses on content validation within the armed services' testing and selection methods. As defined by Kassiani Nikolopoulou, "Content validity evaluates how well an instrument (like a test) covers all relevant parts of the construct it aims to measure."¹⁵⁷ The U.S. armed services leverage the talent of their personnel to achieve operational goals. Content validation is "the degree to which a test or assessment instrument evaluates all aspects of the topic, construct, or behavior that it is designed to measure."¹⁵⁸ The armed services, like the fire service, have special units to expand missions. Both organizations share a commitment to service, long-standing traditions, and culture and undertake missions with a high risk of death if unsuccessful.

This chapter seeks to examine selection models of the U.S. armed services that require technical knowledge, competency, and physical capability for specific occupations. Armed service units, especially units that perform special operations missions in different operating environments, must select members with uncommon traits and skill sets to be successful. The armed services screen on average one million applicants each year.¹⁵⁹ The FDNY, too, could implement content validity models including a wide-ranging test of

¹⁵⁶ "SOF Truths," U.S. Army Special Operations Command Pacific, accessed March 17, 2023, <https://www.socom.mil/socpac/Pages/SOF-Truths.aspx#:~:text=People%20%E2%80%93%20not%20equipment%20%E2%80%93%20make%20the,Quality%20is%20better%20than%20quantity>.

¹⁵⁷ Kassiani Nikolopoulou, "What Is Content Validity?: Definition & Examples," Scribbr, August 26, 2022, <https://www.scribbr.com/methodology/content-validity/>.

¹⁵⁸ Jim Frost, "Content Validity: Definition, Examples & Measuring," *Statistics by Jim* (blog), accessed February 13, 2023, <https://statisticsbyjim.com/basics/content-validity/>.

¹⁵⁹ Janet E. Wall and Robert G. Gard, *Armed Services Vocational Aptitude Battery*, 5th ed. (New York: McGraw-Hill Education, 2022), 20.

knowledge, cognitive abilities, and mechanical aptitudes linked to job criteria and occupational specialties.

A. BACKGROUND

The armed services utilize testing in myriad ways as a predictor of successful outcomes. Some of the most common tests used in the armed services are the Armed Services Vocational Aptitude Battery (ASVAB) and the physical fitness test (PFT). The physical test may be named something different from one branch to another, but the content and goal are the same based on the job criteria. The mission of this testing is to identify knowledge, skills, and abilities and match recruits to the appropriate job classification. The armed services seek to achieve a return on investment for each recruit in both costs of training and performance.

1. ASVAB

The Department of Defense (DOD) screens hundreds of thousands of people annually for enlistment into the armed services.¹⁶⁰ Most of the applicants to the military are young adults who have not had previous job histories.¹⁶¹ The ASVAB is the single exam used to determine competency in the U.S. armed forces. Scores of subtests are divided into the following fields:

1. General science (GS)
2. Arithmetic reasoning (AR)
3. Word knowledge (WK)
4. Paragraph comprehension (PC)
5. Mathematics knowledge (MK)
6. Electronics information (EI)
7. Auto and shop information (AS)
8. Mechanical comprehension (MC)
9. Assembling objects (AO).¹⁶²

¹⁶⁰ Farr and Tippins, *Handbook of Employee Selection*, 697.

¹⁶¹ Farr and Tippins, 697.

¹⁶² “What Your ASVAB Scores Mean,” Military.com, August 21, 2020, <https://www.military.com/join-armed-forces/asvab/what-your-asvab-scores-mean.html>.

Each of the domains relates directly to proficiency at given jobs within the armed services and is used as a predictor of job success (see Table 1).¹⁶³

Table 1. ASVAB Subtests.¹⁶⁴

Verbal	Math	Science/Technology	P&P ASVAB # of test items	CEP iCAT # of test items
General Science	Measures knowledge of life science, physical science, and earth and space science		25	16
Arithmetic Reasoning	Measures ability to solve basic arithmetic word problems		30	16
Word Knowledge	Measures ability to understand the meaning of words through synonyms		35	16
Paragraph Comprehension	Measures ability to obtain information from written material		15	11
Mathematics Knowledge	Measures knowledge of mathematical concepts and applications		25	16
Electronics Information	Measures knowledge of electrical current, circuits, devices and electronic systems		20	16
Mechanical Comprehension	Measures knowledge of the principles of mechanical devices, structural support, and properties of materials		25	16
Auto Information	Measures knowledge of automotive maintenance repair		25	11
Shop Information	Measures knowledge of the principles of wood and metal shop practices			11

Each component of this exam is designed to identify applicants who possess specific skills and knowledge in areas of both cognitive ability and mental aptitude. To match applicants with jobs, scores from several subtests are combined to determine applicants' compatibility with various job criteria. For example, a combat position correlates with the combined scores of AR, CS, AS, and MC.¹⁶⁵ The stronger an applicant performs on the ASVAB, the better one's chances of success in the given occupation.¹⁶⁶

¹⁶³ Wall and Gard, *Armed Services Vocational Aptitude Battery*, 19.

¹⁶⁴ Source: "Understanding Your ASVAB Result," ASVAB Career Exploration Program, accessed February 8, 2023, <https://www.asvabprogram.com/media-center-article/46>.

¹⁶⁵ Zach B., "ASVAB Scores for All 150+ Army Jobs," Operation Military Kids, November 19, 2021, <https://www.operationmilitarykids.org/asvab-scores-for-army-jobs/>.

¹⁶⁶ Farr and Tippins, *Handbook of Employee Selection*, 706.

Special or technical services come with their own eligibility requirements. The Army Ranger Assessment and Selection Program lists the following criteria to attend its courses:

- U.S. citizenship
- ASVAB placement test TECH score of 105 or above
- Army fitness test completion and clearing the height and weight standards, including the Ranger Fitness Test and the Water Survival Assessment
- Qualification for Airborne School
- A specific Military Occupational Specialty...authorized to be hired by the 75th Ranger Regiment, including infantryman (11B), combat engineer (12B), and many more
- Re-class into a Military Occupational Specialty...found in the 75th Ranger Regiment
- Eligibility for a secret security clearance.¹⁶⁷

Many units within the different branches have prerequisites and utilize test scores along with physical performance and character assessments to make selection decisions.¹⁶⁸ Performance on the ASVAB seems to have a direct impact on a career path in the armed services. Other examples include minimum test scores as a predetermined career path, as with Navy SEAL qualifications:

- Meet specific eyesight requirements: 20/40 best eye; 20/70 worst eye; correctable to 20/25 with no color blindness
- Meet the minimum...[ASVAB] score: GS+MC+EI=170 or VE+MK+MC+CS=220 or VE+AR=110 MC=50
- Be 28 years of age or younger
- Pass a physical examination required for divers
- Be a U.S. citizen and eligible for security clearance.¹⁶⁹

The validation of the ASVAB has recently fallen to the U.S. Navy as the last branch of service to conduct studies.¹⁷⁰ The validation process is not performed in a vacuum in

¹⁶⁷ “Army Rangers,” U.S. Army, accessed October 8, 2022, <https://www.goarmy.com/careers-and-jobs/specialty-careers/special-ops/army-rangers.html>.

¹⁶⁸ Wall and Gard, *Armed Services Vocational Aptitude Battery*, 3.

¹⁶⁹ “Navy SEAL,” U.S. Navy Recruiting Command, accessed January 24, 2023, <https://www.navy.com/seals>.

¹⁷⁰ Janet D. Held et al., *Technical Guidance for Conducting ASVAB Validation/Standards Studies in the U.S. Navy*, NPRST-TR-15-2 (Millington, TN: Navy Personnel Research, Studies, and Technology, 2015), 5, <https://apps.dtic.mil/sti/citations/ADA612759>.

the armed services, as validation involves other organizations providing input about the content validity of the exam. However, the U.S. Navy has led the validation efforts of the ASVAB:

The Navy led the development of the two manuals because it is the only Service currently supporting a continuing “ASVAB Validation/Standards Program.” All of the Services support ASVAB validation/standards efforts to some degree, but generally (a) on an as-needed basis for specific occupations or occupational groups, (b) periodically when new predictors are considered for occupational classification, or (c) when the validity of the ASVAB is questioned at a highly visible level. The Navy takes the proactive position of conducting ASVAB validation/standards studies on a routine basis because the need is not always apparent. In doing so, the Navy continually monitors potential red flags such as high academically related failure rates or setback rates in training, major changes in the curriculum or training platforms, reductions in training time, recruiting stressors, and the emergence of new occupations (Ratings) or the consolidation of existing Ratings.¹⁷¹

Each service is responsible for developing its own ASVAB job classification composites and cut scores, referred to as ASVAB standards.¹⁷²

The general knowledge assessed in the ASVAB is further broken into different knowledge, described as either fluid or crystalized.¹⁷³ Crystalized intelligence “is based upon facts and rooted in experiences.”¹⁷⁴ The ability to bake a cake from a memorized recipe is one practical example.¹⁷⁵ Fluid intelligence measures are not as common on the ASVAB but are still part of the test.¹⁷⁶ Fluid intelligence would involve devising problem-solving strategies, interpreting statistics, reasoning philosophically, or solving puzzles.¹⁷⁷ The ASVAB has been designed to encompass as many skills and abilities as possible to

¹⁷¹ Held et al., vii.

¹⁷² Held et al., vii.

¹⁷³ Farr and Tippins, *Handbook of Employee Selection*, 714.

¹⁷⁴ Kendra Cherry, “Fluid vs. Crystallized Intelligence,” Verywell Mind, November 11, 2022, <https://www.verywellmind.com/fluid-intelligence-vs-crystallized-intelligence-2795004>.

¹⁷⁵ Cherry.

¹⁷⁶ Farr and Tippins, *Handbook of Employee Selection*, 714.

¹⁷⁷ Cherry, “Fluid vs. Crystallized Intelligence.”

predict performance outcomes. The validation of the ASVAB has been thorough and diverse, allowing for a holistic view of an applicant's abilities.

Recent revisions of the ASVAB have attempted to include more fluid assessments of intelligence and abilities. Some of the proffered recommendations were as follows:

Reconsidering Coding Speed (CS)

- In recent validation studies by the Navy, CS provided small increments in validity over [the Armed Forces Qualification Test] for predicting performance in Navy jobs, reduced adverse impact compared to other measures, and improved classification.
- The DOD is evaluating the Mental Counters test (MCt), a [working memory capacity] test that was a part of the Enhanced Computer Administered Test...battery....[whereby] research showed that MCt (a) loaded strongly on (g).
- Adding a matrix-type test. Matrix-type tests are well-established measures of fluid intelligence.

Making better use of AO

- Factor-analytic research suggests that AO, which has spatial content, is a measure of visual perception and nonverbal reasoning.

Identifying cyber talent

- A Cyber Test was developed and validated as a special supplement to ASVAB for selection into cybersecurity occupations.¹⁷⁸

Overall, the ASVAB has been designed to measure the skills and knowledge that are relevant to military careers, and its content is reviewed and updated by experts in the field.¹⁷⁹ Its reliability and validity have been established through long-term use and research over several decades. Content validity is defined as “how well an instrument (like a test) covers all relevant parts of the construct it aims to measure.”¹⁸⁰ Therefore, arguably, the ASVAB has a high level of content validity for each category of the exam.

¹⁷⁸ Farr and Tippins, *Handbook of Employee Selection*, 714.

¹⁷⁹ Held et al., *Technical Guidance for Conducting ASVAB Validation*, vi.

¹⁸⁰ Nikolopoulou, “What Is Content Validity?”

2. Physical Fitness Examinations

Physical fitness is assessed to identify competency in military service. As such, different branches of the armed services have identified their unique standards for assessing physical performance.¹⁸¹ Each of these standards is directly related to whether an applicant can apply or be selected for a specific job or branch of the service.¹⁸² Usually, there are overlapping examinations that test for the same desired traits. The common traits that are assessed include strength and stamina to meet the given criteria. Timed runs, push-ups per minute, and sit-ups are the general tools used to measure the strength and stamina of soldiers.¹⁸³ For more branch-specific occupations, the added component of swimming may be used or substituted to identify stamina for water-related combat duties.¹⁸⁴

In each of the armed services, there are annual assessments of physical ability.¹⁸⁵ The results of these PFTs often have an impact on job assignments and promotional opportunities. In 2019, the U.S. Army updated its PFT and rebranded the test as the Army Combat Fitness Test (ACFT).¹⁸⁶ It included more exercises that account for differences in ability, gender, and age (see Table 2). Changes to the physical assessment of soldiers, from the PFT to ACFT, are still being evaluated, and the results are forthcoming as of this writing.

¹⁸¹ Stew Smith, “What You Should Know about Any Military Physical Fitness Test,” Military.com, accessed January 21, 2023, <https://www.military.com/military-fitness/fitness-test-prep/physical-fitness-test-standards>.

¹⁸² “Understanding the Army Combat Fitness Test,” U.S. Army, accessed January 21, 2023, <https://www.goarmy.com/how-to-join/requirements/fitness.html>.

¹⁸³ U.S. Army.

¹⁸⁴ Stew Smith, “How Tough Is the Navy SEAL Fitness Test?,” Military.com, accessed January 21, 2023, <https://www.military.com/military-fitness/navy-special-operations/navy-seal-fitness-test>.

¹⁸⁵ “The Army Combat Fitness Test (ACFT) and Impact on Promotion Points,” Army Cutoff Scores, accessed January 21, 2023, <https://cutoffscores.com/promotion-points/the-army-combat-fitness-test-acft-and-impact-on-promotion-points.html>.

¹⁸⁶ Source: Chaitra M. Hardison et al., *Independent Review of the Army Combat Fitness Test: Summary of Key Findings and Recommendations* (Santa Monica, CA: RAND Corporation, 2022), <https://doi.org/10.7249/RR1825-1>.

Table 2. ACFT Grading Scales.¹⁸⁷

		POINTS	17-21	22-26	27-31	32-36	37-41	42-46	47-51	52-56	57-61	62+
 MDL (lbs)	Female	100	210	230	230	230	210	210	190	190	170	170
	Male	100	340	340	340	340	340	340	330	290	250	230
 SPT (meters)	Female	60	8.4	8.5	8.7	8.6	8.2	8.1	7.8	7.4	6.6	6.6
	Male	60	12.6	13.0	13.1	12.9	12.8	12.3	11.6	10.6	9.9	9.0
 HRP (reps)	Female	100	53	50	48	47	41	36	35	30	24	24
	Male	100	57	61	62	60	59	56	55	51	46	43
 SDC (m:ss)	Female	100	1:55	1:55	1:55	1:59	2:02	2:09	2:11	2:18	2:26	2:26
	Male	100	1:29	1:30	1:30	1:33	1:36	1:40	1:45	1:52	1:58	2:09
 PLK (m:ss)	Female	100	3:40	3:35	3:30	3:25	3:20	3:20	3:20	3:20	3:20	3:20
	Male	100	3:40	3:35	3:30	3:25	3:20	3:20	3:20	3:20	3:20	3:20
 2MR (mm:ss)	Female	100	15:29	15:00	15:00	15:18	15:30	15:49	15:58	16:29	17:18	17:18
	Male	100	13:22	13:27	13:31	13:42	13:58	14:05	14:30	15:09	15:28	15:28

*The full ACFT grading scales are available at <https://www.army.mil/acft/>

To address the impact of physical fitness on different abilities, genders, and ages, many branches of the armed services have different scoring for these traits. The goal is not to lower the standard or exclude anyone but to acknowledge the difference ability, age, and gender have on performance and include as many applicants as possible for advancement or placement.¹⁸⁸ An example of this score norming includes the standing deadlift event. To achieve perfect scores, men between the ages of 17 and 21 must lift 340 pounds three times, but women in the same age range must lift 210 lbs.¹⁸⁹ The differences account for body mass and stamina unique to the differences in age and

¹⁸⁷ Source: Davis Winkie, "Army Combat Fitness Test Debuts with Major Changes to Scoring April 1," *Army Times*, March 23, 2022, <https://www.armytimes.com/news/your-army/2022/03/23/army-combat-fitness-test-debuts-with-major-changes-to-scoring-april-1/>.

¹⁸⁸ Winkie.

¹⁸⁹ "ACFT Scoring Scales," U.S. Army, March 23, 2022, https://www.army.mil/e2/downloads/rv7/acft/ACFT_scoring_scales_220323.pdf.

gender. These scores change as age increases. See Appendix B for the U.S. Army's complete ACFT scoring scales.

The ACFT and ASVAB exams are tests used in the armed services to measure physical fitness and assess the readiness of soldiers for military operations. Multiple studies have determined these tests possess a high level of content validity.¹⁹⁰ These studies have shown that the PFT is designed to measure the physical abilities that are most important for success in combat and is regularly updated to reflect changes in military operations and advancements in training. Additionally, these studies have found that the ACFT and ASVAB are reliable and valid predictors of physical fitness and readiness for military operations. They have been developed and reviewed by experts in the field of military fitness and training.¹⁹¹ The evidence from these studies supports the argument that the ACFT and ASVAB are valid measures of physical fitness and readiness for military operations.¹⁹²

B. ASSESSMENT: CONTENT VALIDITY

The armed services have been thorough in assessments of ability and performance for their applicants. The DOD is listed as one of the largest employers in the United States.¹⁹³ The time and money invested in training a recruit cannot be wasted on an applicant that is not up to standard.¹⁹⁴ The content of these examinations, both cognitive and physical, is designed to measure specific attributes and abilities related to jobs within the services. The focus of this section is on the assessment of applicants and the correlation of the assessment's content to job assignments. The FDNY could benefit from following the ASVAB and physical ability measurements used within the armed services to select special operations firefighters.

¹⁹⁰ Hardison et al., *Independent Review of the Army Combat Fitness Test*.

¹⁹¹ Hardison et al., iii.

¹⁹² Wall and Gard, *Armed Services Vocational Aptitude Battery*, 39.

¹⁹³ Farr and Tippins, *Handbook of Employee Selection*, 697.

¹⁹⁴ Farr and Tippins, 698.

1. Testing/Assessment

The ASVAB is a multi-faceted examination that measures a recruit's various skills and abilities.¹⁹⁵ The content of each part of the exam is specific to the desired trait being measured.¹⁹⁶ The ASVAB's content is heavy with not only measures of intelligence but also competency in abilities.¹⁹⁷ Along with the specific trait being examined, the ASVAB assesses different types of intelligence. Differences between fluid and crystallized intelligence have been incorporated into the exam not only to discern between knowledge and critical thinking but to gauge how different applicants use this intelligence—either recalling general intelligence for solving math and reading problems or drawing conclusions and inferences from given situations.¹⁹⁸ The ASVAB distinguishes between applicants' intelligence and ability.

Some of the topics listed are quantifiable by such other methods as IQ tests; however, the ASVAB accurately measures both intelligence and theoretical knowledge that applies to given job functions.¹⁹⁹ For example, a written test on auto and shop information poses questions on the process and assembly of automotive parts and the proper use of tools. For this part of the exam, there is high content validity in the questions that assess a recruit's understanding of this challenge and how to solve specific problems. Each section of the ASVAB has its validated content, and as such, the ASVAB is a tool for assessing ability and a validated predictor of successful outcomes.²⁰⁰ Differences in ability and intelligence predict job–applicant matches for critical roles in the armed services. Validating the testing used to identify these differences ensures correct applicant placement.

¹⁹⁵ Wall and Gard, *Armed Services Vocational Aptitude Battery*, 19.

¹⁹⁶ Wall and Gard, 31.

¹⁹⁷ Wall and Gard, 39.

¹⁹⁸ Farr and Tippins, *Handbook of Employee Selection*, 714.

¹⁹⁹ Held et al., *Technical Guidance for Conducting ASVAB Validation*, 22.

²⁰⁰ Held et al., 23.

2. Performance Measures

The armed services have various careers for myriad functions. Not every soldier, sailor, or airman can perform every task with perfect execution. Furthermore, there are combat functions and non-combat functions that need to be filled by qualified personnel.²⁰¹ Misallocating these personnel could be costly and tragic. Physical assessments pervade a servicemember's career. The armed services understand this disconnect, and attempt, through testing and evaluation of ability, to allocate human resources where they can excel. Different skills and abilities are measured in this physical assessment. Also, age and gender are considered to make the most appropriate assessment given the differences in performance.²⁰² The RAND Corporation has conducted an independent review of the new ACFT, and further studies are ongoing.

The content of the physical ability measurement directly correlates with the tasks performed as an enlisted member. Some physical conditions like obesity are the leading cause of disqualification from service.²⁰³ The goals of the Army's ACFT are to "improve soldier and unit readiness, transform the army's fitness culture, reduce preventable injuries and attrition, and enhance mental toughness and stamina."²⁰⁴ Adjusting exercises to include differences in gender and age allows the Army, in this case, to identify soldiers with the correct degree of physical performance to pursue occupations with varying degrees of difficulty.

C. CONCLUSION

This chapter has demonstrated the utility of content validation of performance examinations. Both cognitive and physical ability are considered in the selection process for armed service jobs. The armed services, specifically the U.S. Navy, along with private independent corporations, have invested heavily in validating selection testing. The

²⁰¹ "Jobs in the Military That Don't Involve Combat," Indeed, March 10, 2023, <https://www.indeed.com/career-advice/finding-a-job/jobs-in-the-military-that-don%27t-involve-combat>.

²⁰² Hardison et al., *Independent Review of the Army Combat Fitness Test*, 19.

²⁰³ Wall and Gard, *Armed Services Vocational Aptitude Battery*, 39.

²⁰⁴ "Army Combat Fitness Test," U.S. Army, accessed January 24, 2023, <https://www.army.mil/acft>.

recruitment for the armed services seeks to identify intelligence and ability that will provide a return on investment in training. Applicants who score higher on aptitude tests are deemed more trainable and have higher levels of job performance. Each branch of the armed services has validated and developed its own set of examinations to identify the ablest for the best fit into specific occupations.

The U.S. Army has developed an in-depth selection and recruitment model for its Ranger battalions. The Navy has defined content to examine SEAL applicants. These selection and recruitment models have been based on the extensive research of aptitude tests as a predictor of successful outcomes. The result is that the mission is a success or failure based largely on the success or failure of optimizing the performance of the soldier. When soldiers are identified and trained effectively, then the return on that investment becomes enhanced performance and optimal competency of the soldiers. The FDNY is lacking content validation of selection into special operations. Using the armed services selection methods as an example would benefit the FDNY in validating selection and training decisions.

IV. CASE STUDY: HIGH-RELIABILITY/COMMERCIAL DIVING'S CONSTRUCT VALIDATION

High Reliability developed in organizations as a necessary response to the vulnerability of operating in hazardous environments. What distinguishes [a high-reliability organization] is how the organization considers any lapse in performance a serious consequence; there are no small failures.

—van Stralen, Byrum, and Inozu, *High Reliability for a Highly Unreliable World*²⁰⁵

Commercial diving and high-reliability organizations (HROs) may seem like unrelated concepts, but they are closely intertwined. Commercial diving refers to the practice of diving for industrial or commercial purposes, including underwater construction, inspection, or maintenance of underwater structures.²⁰⁶ HROs, on the other hand, are organizations that operate in complex and high-risk environments, where small errors can have catastrophic consequences.²⁰⁷ Such organizations as nuclear power plants or air traffic control towers must maintain a high level of safety and reliability, and their practices and principles can be applied to the field of commercial diving to improve safety and prevent accidents. In this context, commercial diving serves as an example of a high-risk activity that can benefit from the lessons of HROs.

This chapter aims to identify construct validity in the methods of testing applicants for commercial diving. A *construct* is defined as “a theoretical entity, a working hypothesis or concept, or a product of ideology, history, or social circumstances.”²⁰⁸ Construct validation addresses theoretical concepts that cannot be measured by other means. In essence, it forms the bridge between the theory of constructs (e.g., work ethic) and the

²⁰⁵ Daved van Stralen, Spencer L. Byrum, and Bahadır Inozu, *High Reliability for a Highly Unreliable World: Preparing for Code Blue through Daily Operations in Healthcare* (North Charleston, SC: CreateSpace, 2017), 22.

²⁰⁶ Department of Labor, Employment and Training Administration, “Commercial Divers 49–9092.00,” O*NET OnLine, accessed October 25, 2022, <https://www.onetonline.org/link/summary/49-9092.00>.

²⁰⁷ van Stralen, Byrum, and Inozu, *High Reliability for a Highly Unreliable World*, 1.

²⁰⁸ *Merriam-Webster*, s.v. “construct,” accessed January 31, 2023, <https://www.merriam-webster.com/dictionary/construct>.

operationalization of the construct (see Figure 6). As an HRO with specific selection and training methods, commercial diving combines physical ability and training academies in its selection process to qualify applicants for employment. Thus, evaluating the construct of commercial diving involves determining whether dive training identifies and develops in applicants the desired traits of determination, physical and mental fitness, and acuity. Furthermore, when operationalized, HRO theory is manifest in commercial diving’s training, experience, and expertise. This chapter explores the relationship between commercial diving and HROs, the ways in which commercial diving strives to meet the principles of high reliability, and the construct validity of the commercial diving selection process.

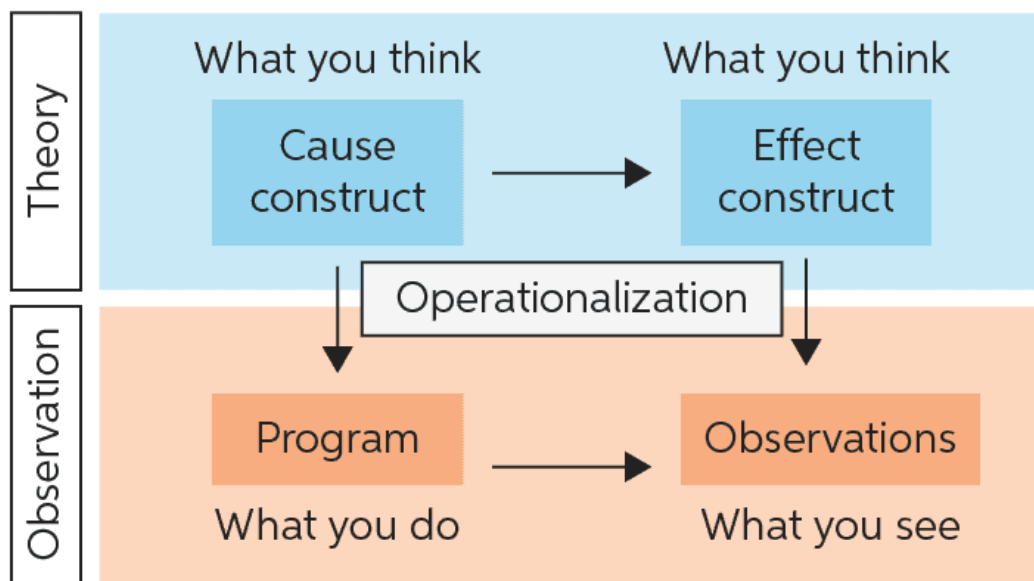


Figure 6. Construct Validation.²⁰⁹

²⁰⁹ Source: “Construct Validity,” Chegg, accessed February 13, 2023, <https://www.chegg.com/writing/guides/research/construct-validity/>.

A. BACKGROUND

Organizations of all calibers use selection and screening tools to identify and cultivate talent. The private sector uses testing and selection methods that might help such other organizations as the FDNY meet their organizational goals. Like HROs, commercial diving sets benchmarks of performance, but their outcomes do not meet such catastrophic consequences as nuclear fallout from nuclear power plants or large-scale power outages from major utility networks.²¹⁰ As explained by Michael Blumenberg, “While diving is certainly technologically complex and potentially hazardous, errors would rarely be considered catastrophic to the public or environment. Errors committed underwater, however, can lead to fatal consequences for the individual diver.”²¹¹ Thus, commercial diving has relied on HRO research to improve training and performance. The constructs included in this selection model compare HROs’ tenets to the training and performance criteria used to qualify applicants for employment as commercial divers. The successful completion of the training allows graduates the ability to work in the commercial diving field. Commercial diving has already identified the value of high-reliability organizational theory in improving performance.²¹² How commercial diving trains and operationalizes its workforce has helped it progress toward meeting HRO tenets.

1. HROs

HROs are described as “organizations which operate in hazardous conditions but have fewer than their fair share of adverse events. HROs are committed to safety at the highest level and adopt a special approach to its pursuit.”²¹³ HROs have adopted several characteristics, including preoccupation with failure, reluctance to simplify, sensitivity to operations, deference to expertise, and commitment to resilience.²¹⁴ Given these

²¹⁰ Michael Blumenberg, *Human Factors in Diving* (Berkeley: University of California, Berkeley, 1996), 25.

²¹¹ Blumenberg, 24.

²¹² Blumenberg, 24.

²¹³ Kathleen M. Sutcliffe, “High Reliability Organizations (HROs),” *Best Practice & Research Clinical Anaesthesiology* 25, no. 2 (June 2011): 133–44, <https://doi.org/10.1016/j.bpa.2011.03.001>.

²¹⁴ “High Reliability,” PSNet, September 7, 2019, <https://psnet.ahrq.gov/primer/high-reliability>.

characteristics and the corresponding theoretical framework, many types of organizations qualify as HROs. Notably, how HROs select and train talent is as critical as the missions they pursue. HROs are theory-based, high-consequence, high-performing, and high-stress organizations, and when failures occur, they are catastrophic.²¹⁵ HROs take numerous forms—from air traffic controllers, nuclear power plants, and major utility (power and water) providers to fire services and armed service special operations.²¹⁶ The following subsection examines how the commercial diving industry has adapted training and criteria to meet the construct of HROs for its benefit.

2. Commercial Diving

Commercial diving is a growing industry combining such trades as welding, carpentry, and engineering with an ultra-hazardous environment.²¹⁷ It has many parallels to the FDNY. Both diving and the fire service are cognitive occupations, both are physically demanding, most missions require some precertification before hiring, and both operate in dangerous environments. The FDNY, commercial diving, and the armed services share the principles of HRO theory.

According to the Department of Labor on its job search and abilities website, commercial diving is a “bright outlook occupation,” defined as “expected to grow rapidly in the next several years, will have large numbers of job openings, or...[is] new and emerging.”²¹⁸ Similarly, as detailed by the Department of Labor, nearly three-quarters of commercial diving occupations require precertification through an accredited institution to gain employment.²¹⁹ The benefits of commercial diving include a salary of more than \$60,000 annually and health insurance.²²⁰ Commercial diving is a trade that not only

²¹⁵ van Stralen, Byrum, and Inozu, *High Reliability for a Highly Unreliable World*, 1.

²¹⁶ van Stralen, Byrum, and Inozu, 1.

²¹⁷ “Occupational Employment and Wages, May 2021: 49–9092 Commercial Divers,” Bureau of Labor Statistics, May 2021, <https://www.bls.gov/oes/current/oes499092.htm>.

²¹⁸ Department of Labor, Employment and Training Administration, “Bright Outlook: Commercial Divers.”

²¹⁹ Department of Labor, Employment and Training Administration, “Commercial Divers 49–9092.00.”

²²⁰ Bureau of Labor Statistics, “Commercial Divers.”

requires talent, competency, and ability but also demands structures for certification and employment applications.²²¹ Chiefly, divers must navigate tests and processes and be mentally proficient and physically capable to perform the work. Given the consequences of failure, the commercial diving industry strives to be an HRO worthy of examination of selection and testing methods.

a. Training

Commercial diving has numerous listed abilities members of the profession must possess to be employed—many of them similar those that firefighters require.²²² The following mission-specific abilities are required for success as a commercial diver:

- Oral Expression—The ability to communicate information and ideas in speaking so others will understand.
- Problem Sensitivity—The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing that there is a problem.
- Control Precision—The ability to adjust the controls of a machine or a vehicle quickly and repeatedly to exact positions.
- Multilimb Coordination—The ability to coordinate two or more limbs (for example, two arms, two legs, or one leg and one arm) while sitting, standing, or lying down. It does not involve performing the activities while the whole body is in motion. . . .
- Deductive Reasoning—The ability to apply general rules to specific problems to produce answers that make sense.
- Information Ordering—The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).²²³

²²¹ Department of Labor, Employment and Training Administration, “Commercial Divers 49–9092.00”; Diver Institute of Technology, *Live Your Adventure: Become a Skilled Commercial Diver* (Seattle: Diver Institute of Technology, 2020), 7, <https://www.diversinstitute.edu/wp-content/uploads/2014/10/DIT-Digital-Viewbook.pdf>.

²²² Department of Labor, Employment and Training Administration, “Commercial Divers 49–9092.00.”

²²³ Department of Labor, Employment and Training Administration.

For most if not all of these attributes, an examination—written standardized testing or a physical ability battery—gauges a diver’s proficiency.²²⁴ The Association of Diving Contractors International (ADCI) requires the following of its divers:

All personnel entering the profession of commercial diving shall be a high school graduate or equivalent. The entry-level minimum skill designation on the diving crew is a tender/diver. The entry-level tender/diver satisfies the minimum entry-level qualifications of diving proficiency, technical proficiency and experience by successfully completing a formal course of study.²²⁵

With such criteria and specific job functions, private schools have been developed to meet training needs and conditioning requirements and certify commercial divers for their future employment. The testing and assessment of students for each commercial diving academy must be certified by other regulating or government organizations.²²⁶ Furthermore, the Occupational Safety and Health Administration (OSHA) has outlined standards for maintaining a safe work environment for commercial divers, dive tenders, and diving supervisors.²²⁷ Having validated content and criteria for commercial diver training and employment ensures the safety and successful operations of commercial diving.

As with training academies in public safety and military basic training, the ADCI and other diving authorities determine the construct for those in training: “Each person engaged in diving and underwater operations shall possess the necessary qualifications for the job assignment. Designation of skill levels in these standards incorporates three primary elements: technical training, field experience, and demonstrated proficiency.”²²⁸ Establishing the objectives of this training beforehand is necessary for safety and

²²⁴ Farr and Tippins, *Handbook of Employee Selection*, 285.

²²⁵ Association of Diving Contractors International, “Diving Personnel Medical and Training Requirements,” Section 2.0 in *International Consensus Standards for Commercial Diving and Underwater Operations*, Revision 6.2 (Houston: Association of Diving Contractors International, 2016), 4, https://www.adc-int.org/files/C11634_ADC%20Consensus%20Standard.pdf.

²²⁶ Diver Institute of Technology, *Live Your Adventure*, 8.

²²⁷ Commercial Diving Operations, 29 C.F.R. 1910 T, <https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1910/subpart-T>.

²²⁸ Association of Diving Contractors International, “Diving Personnel Medical and Training Requirements,” 4.

competency in commercial diving. Given the work environment of commercial diving, combining training, experience, and competency reduces the chances of catastrophic failures or fatalities. Notably, the industry's preoccupation with failure focuses on the system, not the individual.²²⁹ By training individuals to be proficient and certified to industry standards, the system remains operational and competent.

These trade schools have been accredited through such agencies as the Association of Commercial Diving Educators (ACDE). The process of becoming a commercial diver requires certification and physical conditioning before employment, and the ACDE, as one of the largest certifying agencies in the commercial diving field, has written the book on performance standards in commercial diving and related training academies. As described by the ADCI, the ACDE, "in its endeavor to foster better vocational training and education,...encouraged the development of standards-based qualifications that focused on essential competence at the workplace and that were assessable, as well as understood, by employers, trainees and trainers."²³⁰ The ACDE has been successful at creating a 625-hour curriculum for minimum qualifications to become a certified commercial diver.²³¹

In this month's long training regimen, applicants complete coursework on dive physics, train for dive fitness, and experience real-world conditions to hone such commercial diver skill sets as welding underwater or salvage operations.²³² This training course is vastly different from the recreational scuba courses civilians attend. The work that commercial divers perform requires high-level cognitive ability to understand construction trades as well as diving physics. For example, high-voltage welding underwater is a complex skill in a hazardous atmosphere. If applicants do not grasp the risks and hazards, the consequences could be fatal.

²²⁹ van Stralen, Byrum, and Inozu, *High Reliability for a Highly Unreliable World*, 21.

²³⁰ Association of Diving Contractors International, "ANSI/ACDE-01-2009 Standards," Section 11.9 in *International Consensus Standards for Commercial Diving and Underwater Operations*, Revision 6.2 (Houston: Association of Diving Contractors International, 2016), 279, https://www.adc-int.org/files/C11634_ADC%20Consensus%20Standard.pdf.

²³¹ Association of Diving Contractors International, 279.

²³² Diver Institute of Technology, *Live Your Adventure*.

b. Physical Screening

For commercial divers, the ability to perform the work relates directly to the ability to survive in the water. Most recreational dive programs assess swimming ability and PFT for the given course, though many examinations are scalable to the prospective diver.²³³ For example, the Dive Institute of Technology in the Seattle area requires applicants to perform a 400-meter swim unassisted.²³⁴ All of the training academies examined, along with the recreational dive certification curriculum, measure the prospective diver's ability to pass a physical swim examination.²³⁵

For physical examinations accredited by the ADCI, a range of physical abilities and psychosocial traits either qualify or preclude an applicant from becoming a commercial diver. This extensive form allows physicians to examine an applicant for any adverse physical or fit-for-duty determinations (see Appendix C). The goal of keeping divers and the people working alongside them safe requires an annual physical specific to the work they perform. The ADCI also identifies “red flag” conditions, including mental illness:

The nature of diving duties requires a careful appraisal of the individual's emotional and temperamental fitness. Personality disorders, bipolar disorders, psychosis, instability, and anti-social traits shall be disqualifying. Any psychiatric condition requiring medication may be disqualifying. Temporary situational depression may be approved on low-dose antidepressants that do not affect seizure thresholds or have any side effects of [central nervous system] depression. Any past or present evidence of psychiatric illness shall be cause for rejection unless the examining doctor can be confident that it is of a minor nature and unlikely to occur.²³⁶

According to the ADCI's standards, physicians and divers must adhere to strict medical requirements for continued work and employment.

²³³ “Open Water Diver,” PADI, accessed January 25, 2023, <https://www.padi.com/courses/open-water-diver>.

²³⁴ Diver Institute of Technology, *Live Your Adventure*, 16.

²³⁵ Francis P. Matuszak and Jeffrey S. Cooper, *Cardiovascular Fitness to Dive* (Treasure Island, FL: StatPearls Publishing, 2022), <http://www.ncbi.nlm.nih.gov/books/NBK532949/>.

²³⁶ Association of Diving Contractors International, “Diving Personnel Medical and Training Requirements,” 19.

Commercial diving is a high-hazard, high-performance occupation. Specific diving schools are accredited and certified to select and train applicants to perform within industry standards. The evaluation of cognitive and physical traits is a key element in the selection process. Commercial diving requires a commitment to months-long training that encompasses not only the nature of diving but also trade skills and hazardous environments. Without this precise selection and training regimen, fatal and costly mistakes could compromise the efficiency and performance of private industry and civilian construction trades. This complex and structured measurement of competency allows commercial divers to limit failure and ensure performance simultaneously.

B. ASSESSMENT: CONSTRUCT VALIDITY

The HRO constructs of reluctance to simplify and preoccupation with failure are predominant themes in commercial diving selection models. Training requires a mental or cognitive ability measure in the form of preparing for and passing selected certifications.²³⁷ Physical screening tools assess whether a commercial diver can perform the work. Both equally important halves make up the content and criteria to be employed as a commercial diver. The Uniform Guidelines on Employee Selection Procedures discuss the “appropriateness of construct validity studies” as follows:

Construct validity is a more complex strategy than either criterion-related or content validity....The user should be aware that the effort to obtain sufficient empirical support for construct validity is both an extensive and arduous effort involving a series of research studies, which include criterion related validity studies and which may include content validity studies.²³⁸

Thus, the need for an in-depth content validation study along with a criterion-related validation study makes determining construct validity far more complex.²³⁹ Nevertheless, the act of accredited institutions’ training commercial divers and government agencies’ certifying them makes manifest the content and criterion validation process.

²³⁷ Diver Institute of Technology, *Live Your Adventure*, 1.

²³⁸ Uniform Guidelines on Employee Selection Procedures, § 1607.14 D.

²³⁹ Uniform Guidelines on Employee Selection Procedures, § 1607.14 D.

1. Reluctance to Simplify

The reluctance to simplify is described in HRO literature as deliberate steps to create more comprehensive pictures of what an organization faces.²⁴⁰ Within commercial diving, deliberate measures are taken to assess the competency of the divers performing the work. Also, deliberate career progression is in place to ensure that the standards of performance meet the criteria of the work.²⁴¹ Examinations are case specific for applicants certifying for a career in commercial diving, for example, welding and rigging in commercial and construction settings.²⁴² Each of the skill sets requires its content and testing to determine competency, and each dive training institution certifies its students in various trade skills. The following list details select trade skills for commercial divers:

- Unrestricted surface-supplied air diver,
- Qualified rigger,
- Hazardous waste and emergency response operator,
- Equipment maintenance and repair,
- Open water scuba, and
- Nitrox diving for no-decompression limits.²⁴³

Depending on the specialty of the commercial diver, training and certification may involve salvage operations, hazardous materials operations, and blackwater diving in commercial settings.

²⁴⁰ van Stralen, Byrum, and Inozu, *High Reliability for a Highly Unreliable World*, 22.

²⁴¹ Association of Diving Contractors International, “Diving Personnel Responsibilities, Qualifications and Certifications,” Section 3.0 in *International Consensus Standards for Commercial Diving and Underwater Operations*, Revision 6.2 (Houston: Association of Diving Contractors International, 2016), 25, https://www.adc-int.org/files/C11634_ADC%20Consensus%20Standard.pdf.

²⁴² Diver Institute of Technology, *Live Your Adventure*, 8.

²⁴³ Diver Institute of Technology, 8.

Their complex training allows commercial divers to perform their jobs successfully and competently in hazardous environments.²⁴⁴ The content of each of these certifications has been validated by such independent authorities as the National Association of Underwater Instructors (NAUI) or OSHA.²⁴⁵ The training matrix depicted in Table 3 walks divers through the steps from entry-level to more advanced diving and dive operations supervisors. Each stage of the process has been developed to scale the required performance based on mission objectives.

Table 3. Certification and Training Matrix for the Commercial Diver Certification Program.²⁴⁶

CERTIFICATION AND TRAINING MATRIX										
REQUIREMENT	ENTRY-LEVEL TENDER/ DIVER	AIR DIVER	AIR-DIVING SUPERVISOR	MIXED-GAS DIVER	MIXED-GAS DIVING SUPERVISOR	BELL/SAT DIVER	BELL/SAT DIVING SUPERVISOR	NITROX SUPERVISOR	LIFE-SUPPORT TECHNICIAN	SATURATION TECHNICIAN
Formal Training	625 hours									
Field Days		100	200	100 Air 50 Mixed Gas	350 Air or Mixed Gas	200 Air or Mixed Gas	100 days as Mixed Gas and/ or Air Diving Supervisor		100 Days as an Assistant LST	180 Days as an Assistant Saturation Technician
Working Dives		30	50	50 – Air 10 – Mixed Gas	150 Air or Mixed Gas	100 Air or Mixed Gas and 10 Bell Runs				
Operations on System						30 Working Days				
Assistant Supervisor Training Field			30 Working Days		30 Working Days		60 Working Days			
EXAM			EXAM REQUIRED		EXAM REQUIRED		EXAM REQUIRED	EXAM REQUIRED	EXAM REQUIRED	EXAM REQUIRED

²⁴⁴ Association of Diving Contractors International, “General Provisions,” Section 1.0 in *International Consensus Standards for Commercial Diving and Underwater Operations*, Revision 6.2 (Houston: Association of Diving Contractors International, 2016), 2, https://www.adc-int.org/files/C11634_ADC%20Consensus%20Standard.pdf.

²⁴⁵ Diver Institute of Technology, *Live Your Adventure*, 7.

²⁴⁶ Source: Association of Diving Contractors International, “Diving Personnel Responsibilities, Qualifications and Certifications,” 26.

The training and positions within commercial dive teams address the HRO tenet of reluctance to simplify operations. When commercial dive teams operate, their objectives are rarely simple. Commercial divers, like HROs, “should be suspicious of simplicity, reluctant to simplify, and reluctant to keep simple.”²⁴⁷ This principle of reluctance to simplify builds in safety and adaptability for commercial divers operating in ultra-hazardous environments with the possibility of fatal or catastrophic consequences.

2. Preoccupation with Failure

According to HRO theory, “Failure has context, industry, and time specificity. We create several objectives when engaging uncertainty; we act to increase our chances of success and to decrease chances of failure.”²⁴⁸ The standards set forth by the ADCI are designed to train divers to competency and ensure successful and safe operations.²⁴⁹ A complete list of diving-related material and general requirements appear under the ANSI/ACDE-01-2009 Standards.²⁵⁰ Fatal consequences would ensue if these were not included in the process of commercial diving. Regulations by OSHA, the ADCI, and the ACDE have been written to limit failure and ensure safe operating standards for commercial diving. Standards for commercial dive operations are explicit in their staffing, equipment, and safe operating guidelines.

Diving schools, like many colleges, have predetermined criteria for admittance. These criteria are physical and cognitive, based on the job function and the tasks a diver must perform (see Table 4). Selection criteria have been set by industry demand to limit failure and increase the chances of success. Some applicants may be more inclined to perform salvage and recovery than to work in construction or fabrication. Commercial diving is only one type of HRO. The selection and training are not universal, however, so they might not support transportability into other facets of selection and recruitment, as was discussed in the previous cases.

²⁴⁷ van Stralen, Byrum, and Inozu, *High Reliability for a Highly Unreliable World*, 24.

²⁴⁸ van Stralen, Byrum, and Inozu, 22.

²⁴⁹ Association of Diving Contractors International, “General Provisions,” 2.

²⁵⁰ Association of Diving Contractors International, “ANSI/ACDE-01-2009 Standards.”

Table 4. Medical Test for Diving.²⁵¹

Test	Initial	Annual	Comments
History & Physical	X	X	Include predisposition to unconsciousness, vomiting, cardiac arrest, impairment of oxygen transport, serious blood loss or anything that, in the opinion of the examining physician, will interfere with effective underwater work.
Chest X-ray	X	X	PA and lateral (Projection: 14" x 17" minimum) every three years unless medical conditions dictate otherwise.
Bone and Joint X-ray Survey	X		Optional and as medically indicated.
EKG: Standard (12 Leads)	X		Optional initially to establish baseline; annually after age 35; and as medically indicated.
EKG: Stress Test			Required as medically indicated if the Framingham Risk Score indicates risk of >10%.
Spirometry	X	X	Required including FVC, FEV1 and FEF25-75. Tests should be compared with NHANESIII reference values for determining percent of predicted
Audiogram	X	X	Threshold audiogram by pure tone audiometry; bone conduction audiogram as medically indicated.
EEG			Required only as medically indicated.
Visual Acuity	X	X	Required initially and annually.
Color Blindness	X		Required.
Complete Blood Count	X	X	
Routine Urinalysis	X	X	
Pregnancy Test	X	X	Recommended prior to saturation diving.
Sickle Cell Screen	X		Optional.
TB screening	X	X	Optional.
Comprehensive Metabolic Profile	X	X	Optional, including cholesterol and triglycerides required for divers over 40.
Framingham Risk Score	X	X	Required annually after the age of 35

An in-depth evaluation of the fitness level of commercial divers, along with their proper training and certification, are combined to limit failure and optimize performance. Any compromise in either training or fitness is not allowed under the standards that have been adopted in commercial diving. However, adhering to such strict standards does not mean that fatalities do not occur or that failure has been eliminated from the selection process. On the contrary, the preoccupation with failure and attempts to prevent it have become embedded in the selection and training process of commercial divers. These standards, both in education and performance, highlight the need for validated methods of selection and limited chances of failure or fatalities.

C. CONCLUSION

In conclusion, commercial diving is a high-risk activity that requires concentration on safety and risk management. By applying the principles of HROs, commercial diving

²⁵¹ Source: Association of Diving Contractors International, "Diving Personnel Medical and Training Requirements," 6.

operations can reduce the likelihood of accidents and ensure the safety of divers and other personnel involved. These HRO principles include preoccupation with failure, sensitivity to operations, reluctance to simplify, commitment to resilience, and deference to expertise. By embracing these principles, commercial diving operations can minimize the risk of accidents, improve the safety culture of their organizations, and promote the well-being of their workers. Ultimately, the application of HRO principles can help ensure that commercial diving remains a safe and viable activity, both now and in the future.

The construct validity of HRO principles was identified in commercial diving. While such additional concepts as deference of expertise and commitment to resilience could have been addressed, the examination of preoccupation with failure and reluctance to simplify focused specifically on content-related and criterion-related assessments of commercial divers. The criteria and content of the selection process have been determined by a diverse group of commercial diving professionals ranging from training schools to government regulatory agencies to dive practitioners. The FDNY could use the model identified to incorporate reluctance to simplify and preoccupation with failure, along with other HRO frameworks, to integrate construct validity into the selection of firefighters for special operations. Thorough and specific criteria, along with proper testing and certification, may help reinforce traditional selection methods and identify ways to improve and diversify applicant pools within the FDNY.

V. ANALYSIS, RECOMMENDATIONS, AND CONCLUSIONS

This thesis has examined three different organizations and three types of validation used to select members for various occupations. Each type of validity presents its unique measurement of competency. For some organizations, a test or instrument is used to measure ability. For others, defined criteria are established to elicit the desired performance or behavior. Yet others operationalize the desired theoretical construct, for example, the attitude or determination that an organization desires. If any part of the validation method fails to produce the desired results, then one or more parts of the selection model must be repaired or replaced. Organizations of all calibers have subjective and objective means of selection, and their respected cultures and traditions have guided them to their operational efficiency.

The analysis of validity in this chapter explores the question of whether the FDNY can benefit from other organizations and the models they use to select employees. This comparison identifies similarities and differences across the FDNY, the armed services, and commercial diving, evaluating the content validity, the criterion validity, and the construct validity to identify opportunities and vulnerabilities or validate the current methods and preserve the status quo. Through this careful examination of outcomes and competency, not only can the FDNY improve its organizational and professional development, but other fire and homeland security agencies across the national may benefit as well.

A. FDNY SPECIAL OPERATIONS

This section identifies what has worked for the FDNY, what is lacking compared to other organizations, and how the FDNY could adapt or include more validation methods into its selection models for special operations firefighters and officers. By examining more people with different validated instruments for measuring competency, the FDNY could identify more potential applicants with greater chances of success.

1. Content

Content validity is the weakest validation in the FDNY's selection process for special operations. It offers no tests to gauge the knowledge, skills, and abilities of special operations applicants. All testing occurs before hiring or during initial training for the FDNY, including a civil service examination, the Candidate Physical Ability Test (CPAT), medical and psychological screening, and fire academy training and testing.²⁵² No tests or instruments examine the content of special operations criteria, particularly because criteria are outdated, as discussed in the next subsection. The FDNY could benefit from either reformatting currently used tests from the fire academy or creating assessment instruments defined to measure ability. With the added certifications issued by the state fire academy, there are ample resources to draw from to establish assessment tools.

The armed services' detailed testing for applicant job placement has been studied and compared to the cost of training, retraining, and academic deficiencies to evaluate its effectiveness.²⁵³ Furthermore, newly revised and validated physical fitness standards have been incorporated into selection and advancement opportunities for the armed services.²⁵⁴ In contrast, the FDNY's lacking content is a vulnerability the department can no longer ignore. Similar content-rich examinations may be found in commercial diving schools and certified by other government regulatory agencies. Each of the case studies listed in this thesis has far superior content-validated examinations of ability and competence. Furthermore, previous legal actions have identified a lack of validation as a key issue in physical and written examinations for selection.²⁵⁵ The FDNY's SOC must include content-validated selection assessments for firefighters and officers wishing to work in elite units.

²⁵² "Notice of Examination: Firefighter," New York City Police Department, May 31, 2017, <https://www.nyc.gov/assets/dcas/downloads/pdf/noes/201707001000.pdf>; International Association of Fire Fighters, *Candidate Physical Ability Test*, 2nd ed. (Washington, DC: International Association of Fire Fighters, 2019), <https://www.iaff.org/wp-content/uploads/2019/04/CPAT-2nd-Edition.pdf>.

²⁵³ Held et al., *Technical Guidance for Conducting ASVAB Validation*, 16.

²⁵⁴ U.S. Army, "ACFT Scoring Scales."

²⁵⁵ *Berkman*, 536 F. Supp.

2. Criteria

The FDNY's selection process for special operations is based on applicant criteria, chiefly seniority, experience, and prior job skills, trade skills or EMS training.²⁵⁶ The transportability of criteria has proven successful in other organizations and the FDNY in identifying firefighters and predicting success in special operations units. The application to join the ranks of special operations has attempted to keep pace with changing missions, new technology, and increased demand for special services. Application criteria for either rescue or squad companies are as follows:

1. Members must have at least five years of service with the FDNY.
2. They must be in good standing with no disciplinary charges.
3. They must not be on the supervised medical leave program.
4. Those applying for rescuer squad companies must be certified first responders, emergency medical technicians, or paramedics.
5. SOC applications are accepted only in January or July.
6. Members may apply to only one unit, either rescue or squad company, at any given time.²⁵⁷

These criteria prioritize seniority and experience and mention thresholds for discipline and absenteeism. Company commanders are tasked with identifying talent and ensuring that these requirements are met before one earns a special operations detail. Along with the listed criteria, the application poses several vague and open-ended questions to applicants.

- Do you feel you are currently able to perform rescue operations and train in a water environment with or without a personal flotation device (PFD)?...
- Do you feel you are currently able to perform rescue operations and train in an extreme height situation?...

²⁵⁶ New York City Fire Department, *Application Procedure for Rescue Operations*, 1.

²⁵⁷ New York City Fire Department, 1.

- Will you be available to work overtime?²⁵⁸

These special operations criteria have been derived from previous work experience in line fire units or additional skills from previous employment.²⁵⁹ Along with the follow-up questions, there is no measure of the degree of competency for the applicant. To what heights are they comfortable? How comfortable are they in a water environment? An effective criterion validation demands a job analysis.²⁶⁰ Operating from outdated criteria gives a false sense of validation, especially given the advancement in training, compensation, and mission tasking that FDNY special operations units currently face. Compared to the criteria of the armed services or commercial diving, the FDNY's criteria are outdated and borderline ineffective at selecting for ability. In contrast, the criteria of the armed services and commercial diving are both physical and cognitive in design. Each of these domains represents the required skills to complete the objective. Within each of the domains, there are content-rich assessments of skill and ability—the ASVAB, the ACFT, or the minimum swim test. The FDNY must include more criteria to better reflect the growing mission tasking of special operations units.

3. Construct

The current construct that the FDNY uses to select members of special operations has produced competent members for several decades. This construct has examined such traits as determination, work ethic, and demeanor.²⁶¹ Using the transported validation of older criteria has produced firefighters who meet this construct. However, due to a lack of current job analysis and the nonexistent assessment of content-specific ability, there are serious vulnerabilities in the validity of this selection method. HRO tenets should be embedded into the selection model for FDNY special operations. These tenets personify the desired traits special operations claims to attract. As the mission for special operations has changed, so should the construct that identifies talent and selects high-performance

²⁵⁸ New York City Fire Department, 8.

²⁵⁹ New York City Fire Department, 6.

²⁶⁰ Uniform Guidelines on Employee Selection Procedures.

²⁶¹ Norman, *Fire Department Special Operations*, 16.

individuals for service in special operations. See Table 5 for an analysis of the FDNY’s content, criterion, and construct validity.

Table 5. Validation Analysis of the FDNY’s Special Operations Selection Model

Type of Validity	Degree/Measure	Example	Note
Content validity (valid test/instrument of assessment)	Poor/nonexistent	No assessment of the degree of competency or a test of ability before an appointment. ²⁶²	Physical ability; cognitive ability; character assessment.
Criterion validity (valid performance or behavior)	Moderate	Assessment of seniority or experience/ examination of medical leave and absenteeism. ²⁶³	Traditional to FDNY and many trade union occupations.
Construct validity (valid selection procedure/job performance)	Moderate	Selection has produced desired results.	No recycling rate of training; no attrition rate.

B. ARMED SERVICES

The armed services utilize more formal and defined testing and selection models than the FDNY does, starting with such validated testing as the ASVAB and PFTs. These tests are given to assess recruits’ knowledge, skills, and abilities before they enter service to match recruits and jobs with the greatest chances of success.²⁶⁴ Cut scores and minimum performance metrics have been established for different contents of knowledge, skills, or abilities.²⁶⁵ The armed services’ content- and criterion-heavy selection model yields a

²⁶² New York City Fire Department, *Application Procedure for Rescue Operations*.

²⁶³ New York City Fire Department.

²⁶⁴ Held et al., *Technical Guidance for Conducting ASVAB Validation*, 1.

²⁶⁵ Held et al., 1.

defined construct of selection. Of all the validation methods, the armed services have succeeded in defining its content with the greatest success.

1. Content

The armed services' assessments are strong in content and have been validated for over six decades.²⁶⁶ They assess numerous factors to gauge critical thinking and mechanical ability as well as crystalized and fluid knowledge. The combination of the ASVAB and PFTs has provided an acceptable model of job placement for recruits. Each branch of the service has different performance metrics and interpretations of the ASVAB, which is constantly updated to maintain its relevance.²⁶⁷ The ASVAB covers a broad range of topics to assess skills and abilities, identifies the potential of recruits based on their abilities, and indicates areas needing improvement. Moreover, different service branches have defined cut scores for their job postings, which might create discontinuity from one branch to another.²⁶⁸ Nevertheless, claims of bias and unfair testing practices affect all forms of validation, and no testing or examination produces 100 percent valid results.

2. Criteria

An examination of criterion validation reviews the performance and behavior of applicants to determine successful outcomes. The armed services use several tests, including a physical ability exam, background checks, medical fitness reports, and psychological screening, for applicants. Poor performance on one exam may not necessarily disqualify a recruit from service but will factor into which jobs the recruit is best suited for or allowed to do, thus limiting the misappropriation of funds and training resources on applicants who cannot perform the job. More specifically, high-performance jobs are reserved for recruits who score high on the ASVAB and perform exceptionally well on physical ability measures, ensuring that recruits will complete the training and limiting the cost of injuries or retraining.

²⁶⁶ Held et al., 48.

²⁶⁷ Held et al., v.

²⁶⁸ "ASVAB Scores and Army Jobs," Military.com, accessed October 8, 2022, <https://www.military.com/join-armed-forces/asvab/asvab-and-army-jobs.html>.

The criterion validation effort has also made strides in accounting for differences in age and gender. Such accommodations further diversify the applicant pool and defend the criteria and selection methods. Proper job analyses and appropriate strength and stamina assessments support standards of performance. Along with the support of standards, identifying areas of deficiency allows organizations to build in corrective measures and permits retesting and improvement in professional development.

3. Construct

The armed services' selection construct, which combines criterion and content validation, has successfully identified applicant and job matches over a long timeline. There are ample data to compare and assess the success rates of selection based on the construct: a large sample size of applicants, hundreds of thousands of test and retest scores that identify talent, and claims of bias and unfair testing practices that affect all forms of validation.

Table 6. Validation Analysis of the Armed Services' Selection Model

Type of Validity	Degree/Measure	Example	Note
Content validity (valid test/instrument of assessment)	High	Degree of knowledge includes crystalized and fluid intelligence.	Physical ability; cognitive ability; character assessment
Criterion validity (valid performance or behavior)	High		Physical and medical screenings, along with character evaluations.
Construct validity (valid selection procedure/job performance)	High	Degree of construct validation supported by test/retest data, along with attrition and failure rates.	Defined cut scores and attrition rates identify areas of improvement.

C. COMMERCIAL DIVING

Commercial diving is a high-risk occupation with many similarities to the FDNY. The process by which one becomes a commercial diver is both content and criterion related.

It shares constructs of preoccupation with failure and reluctance to simplify with the FDNY. The FDNY fire academy is comparable to the process, as all new firefighters must pass the academy and excel in academics and physical performance to remain employed. The diving industry has constructed a model of selection that accurately combines content testing and criterion measurement to produce a commercial diver capable of performing the work. This validated construct of selection could prove beneficial to the FDNY for the internal selection of firefighters into special operations roles. The following subsections analyze each part of the process—content, criteria, and construct.

1. Content

There is a high degree of content validation, as the assessment for each specific trade is examined along with diving and working underwater. Each private school for certifying applicants as commercial divers has its own testing and assessment methods. According to the Department of Labor, successfully completing training with one of these commercial diving training institutions is a must in this industry.²⁶⁹ The content is standardized, including dive physics and construction trade skills, but the delivery methods vary. The testing structure and content are evaluated by regulating agencies, for example, the ADCI. For each certification in the diving academy, there are individual exams to measure competency. According to the ACDE, the minimum entry-level diver/tender training requires 625 hours of coursework.

With testing in each of the mission-specific areas, deficiencies are identified and remedied or removed before investing further in the applicant. Usually, there are comprehensive training regimens for all required certifications overseen by OSHA, including the technical rigging and welding certifications.²⁷⁰ Due to the high-risk nature of commercial diving, strong content validation of certifying examinations is a prerequisite.

²⁶⁹ Department of Labor, Employment and Training Administration, “Commercial Divers 49–9092.00.”

²⁷⁰ “Subpart CC—Cranes and Derricks in Construction: Qualified Rigger,” Occupational Safety and Health Administration, October 2010, <https://www.osha.gov/sites/default/files/publications/cranes-qualified-rigger-factsheet.pdf>.

2. Criteria

The ACDE has established unique and defined criteria for commercial diving. Listed in its standards are not only the minimum training qualifications in hours but also extensive medical and physical requirements. The physical requirements of demanding occupations must encompass all aspects of the job to be performed, the environment where the work will be conducted, and the equipment that must be used to accomplish the goal.²⁷¹ To avoid fatalities and to incur minimal loss from injuries, commercial divers must be capable in their abilities.

Physically performing in the water is essential to diving. Swim tests and basic water competencies are laid out in the NAUI's training curriculum.²⁷² Commercial dive training centers go further—beyond the applicant's ability to swim 400 meters unassisted—to the character traits and aptitudes of divers: "Prior dive experience is not required. Applicants should be experienced swimmers and be comfortable in the water. Ideal candidates have a positive attitude, a high mechanical aptitude, and the ability to work safely and effectively in a team environment."²⁷³ Those who do not meet these criteria are not allowed to graduate from the program or become certified commercial divers.

Medical criteria are also important in certifying commercial divers. With the demands placed on the employee, along with physical conditioning, there can be no question of ill health. The ACDE has a comprehensive screening for medical conditions that can be fatal to commercial divers.²⁷⁴ Strict adherence to these listed requirements prevents divers from endangering themselves and those around them. As the medical screening is an annual requirement, and a necessity upon return from injury or sick leave, the industry prevents accidents and saves time and money.

²⁷¹ Farr and Tippins, *Handbook of Employee Selection*, 277.

²⁷² PADI, "Open Water Diver."

²⁷³ Diver Institute of Technology, *Live Your Adventure*, 16.

²⁷⁴ Association of Diving Contractors International, "Diving Personnel Medical and Training Requirements," 4.

3. Construct

Commercial diving is strong in construct validation. As defined by the Uniform Guidelines on Employee Selection Procedures, “A construct is the intermediary between the selection procedure on the one hand and job performance on the other.”²⁷⁵ The phases of selection that commercial divers are subject to before employment are each validated by such other organizations as OSHA, the NAUI, or the ACDE, and continually assessed to address staffing and training concerns. For construct validation to be reliable, the content and criteria must be validated beforehand, and a detailed job analysis is required.²⁷⁶ A problem in any one area of this selection construct would compromise productivity, health, and safety. Thus, the selection construct works well for commercial diving as an HRO and the rapidly growing industry.²⁷⁷

Table 7. Validation Analysis of the Commercial Diving/HRO Selection Model

Type of Validity	Degree/Measure	Example	Note
Content validity (valid test/instrument of assessment)	High	Certification in multi-discipline areas of construction and diving.	Reluctance to simplify.
Criterion validity (valid performance or behavior)	High	Defined physical and medical qualifications and disqualifications.	Preoccupation with failure.
Construct Validity (valid selection procedure/job performance)	High	Criteria + content = Certified commercial diver.	Commensurate with HRO principles.

²⁷⁵ Uniform Guidelines on Employee Selection Procedures, § 1607.14 D.

²⁷⁶ Uniform Guidelines on Employee Selection Procedures; Farr and Tippins, *Handbook of Employee Selection*, 620.

²⁷⁷ Department of Labor, Employment and Training Administration, “Commercial Divers 49–9092.00.”

D. RECOMMENDATIONS

This thesis has identified areas within the FDNY special operations that could benefit from updating or adapting selection models. This is not to say that what the FDNY is doing is wrong or ineffective. Special operations began in early 1915 with the establishment of the first designated rescue company, which was created to solve a specific need in the fire service—to respond to fires and emergencies and provide a technical rescue asset for chief officers. As training, technology, and the response mission progressed, the application method did not adapt to the current climate with the same tempo. Today, while still producing viable candidates, special operations could use an array of valid tools to help defend the selection parameters of company captains. The goal of this thesis was not to destroy the traditional selection method used today but to improve it.

Currently, 18 specialized units employ additional training, compensation, and additional demand for technical skill sets. The criteria have always included prior experience from busy firefighting units before admission into special operations. Courses offered in technical rescue by the FDNY have accreditation through the state training academy. This additional training has college-level course value and certifies firefighters to perform advanced rescue procedures. Updating and validating the selection method might identify more and perhaps better applicants. This thesis has identified other methods of validation from the selection models of other organizations to improve the FDNY's special operations selection.

The following pages offer recommendations to address the three types of validation strategies examined in this thesis: content, criterion, and construct. Based on the findings of this thesis, these recommended policy changes, if correctly implemented, could validate special operations selection in all three domains.

1. Job Analysis and Criterion Determination

In the research of all validation studies, there is a recurring theme of job analysis. This analysis is the first step in determining criteria. This analysis would ask, What are we doing? Why are we doing it? And, most importantly, what is required to accomplish the goal or mission? Many tests in the FDNY, both written and physical, have been scrutinized

and challenged for claims of bias and discriminatory practices. Examinations that have been found discriminatory often had little to no validation of the content or the criteria of the test.

Special operations units are tasked with missions that go above and beyond the normal response scope of line units in the FDNY. That is why they are called special operations. The training and performance criteria should be better reflected in the application and selection process for special operations units. Applicants for special operations units should have defined responsibilities and, along with them, defined behavior and performance metrics. The mission tasking for additional response assignments includes firefighter rescue, building collapse, hazardous materials, rope rescue, technical rigging/trench cave-in, and dive/water rescue, among others. These certifications correspond with specific criteria involving detailed competency measurements. By better defining the criteria and having an application that properly measures the ability of the applicant, the FDNY could reduce and eliminate ambiguous selection parameters and streamline decision-making.

At the inception of new units within the FDNY, there have been physical ability measurements. The newest unit went online in 2020. During this initial startup, applicants had to demonstrate a specified proficiency. The events or scoring of this new endeavor have not been made public. However, if these tests of knowledge and ability were performed in the past, the FDNY could implement them again in future selection decisions. Eliminating the ambiguous nature of selection surrounding the FDNY will serve to empower company commanders in supporting decisions and simultaneously holding company commanders accountable for poor selection.

The aforementioned changes should eliminate differences between squad unit operations and rescue unit operations. There should only be a special operation standard of performance. Personnel are currently interchangeable between squad and rescue units, so a criterion could easily be established to reflect this transferability. However, missions might have different areas of operations and structured tiers of performance, as demonstrated in the armed services. Notably, while not every Navy SEAL is responsible for the same mission, the screening for SEAL team placement is standardized and

unyielding. Establishing one standard, defined criterion will reduce ad hoc selection decisions.

The current criteria have strategic ambiguity built into them to allow company commanders the most leeway in staffing decisions. Seniority and experience are vital to the operational performance of special operations units; however, seniority should be examined as it pertains to engine and ladder company operations. Members of these similar yet distinct mission sets are often considered for appointments to special operations. If there are underlying differences, the criteria should reflect them. If experiences both on the job and from prior work are considerations, then the selection process should incorporate a detailed list of preferred work experience. Some examples could include serious or significant fires, perhaps with firefighter fatalities, where the unit had an impact on operations. Prior work in such trades as welding, rigging, or framing could affect how well firefighters build shoring, understand building construction, and assist in technical rigging at emergency scenes. This short list should be included in the criteria, and applicants should be considered based on current and prior work experience and knowledge.

2. Structured Assessment and Measurement of Ability

Establishing a valid method of testing for content would complement criterion validation. Currently, the FDNY administers tests to new firefighters before they graduate from the fire academy, complete probation, and are promoted to officer. The validated and accepted physical ability test, CPAT, is also an academy graduation requirement. Creating or adapting any current assessment of knowledge and physical ability could reinforce content validation for special operations firefighters.

The model for firefighter professional development—notably probationary firefighter exam modules—could be formatted to assess firefighters’ mastery of basic firefighting skills. A benefit of remote access and advances in technology is the ability of firefighters to log in to study, prepare, and test themselves on competency. These modules are already in use for probationary members to reinforce lessons from the fire academy. Methods are already used by the FDNY today that could be applied to special operations

selection. With the added benefits of remote learning tools, access to these study aids and tests is ubiquitous.

The FDNY has a designated physical fitness unit whose members are experts in physical health and conditioning. Many of these members are professional trainers. Given the extra demands on special operations, this unit could create a training and preparation course for members aspiring to join special operations. Having such physical ability measurements available might keep members motivated to stay healthy and reduce sickness and injuries in the department. Physical fitness and a healthy lifestyle have benefits beyond special operations and could improve the culture of safety at the FDNY.

The FDNY could measure one more domain besides cognitive and physical ability—mental performance. The FDNY has spent time and effort understanding the effects of stress on firefighters and ways to reduce those effects on operations. The mental performance initiative combines psychological assessments and stress inoculation scenarios to allow anyone operating in high-risk environments to improve decision-making and tactical operations. Incorporating this aspect into the selection criteria might provide company commanders with a glimpse into how applicants would perform under stressful scenarios faced by special operations units. If an applicant has difficulty with this assessment, there are built-in exercises to improve, equip, and develop skill sets the firefighter can use to overcome the effects of stress on performance.

Cognitive, physical, and psychological domains are often assessed for many occupations. The criteria of FDNY special operations, the content of the examinations, and the construct of selection could better incorporate these traits into the selection process and possibly identify applicants without running the risk of adversely impacting the mission of special operations. Such content measures as testing and assessment of ability and competency allow for a holistic view of an applicant to special operations. These assessments should not be the determining factor—the company commander must assess what is needed for the unit. However, providing the company commander with more information enables better decision-making and ultimately proves performance within special operations.

The FDNY should also consider establishing public–private partnerships for professional development. Before special operations emerged, many selection criteria focused on trade skills. The FDNY could attempt to partner with adult learning institutions and provide learning opportunities in these specific skills. This educational opportunity would have lasting effects on firefighters wishing to advance into special operations or allow secondary employment outside the fire service. Such professional development initiatives could improve firefighter performance. Currently, opportunities exist for secondary education and tuition assistance and reimbursement, but expanded educational opportunities could be incorporated into the special operations selection model.

The FDNY’s Technical Rescue School is of vital importance in moving forward with better validation strategies. It could be implemented into the selection process as a screening tool rather than as an afterthought. Currently, the rescue school is not a requirement for the selection process. Including recycling and attrition rates in the process might better identify strengths and weaknesses in applicants and highlight areas where professional development is needed. There are thousands of hours of training, and some of the courses are technical. Thus, including training institutions in the final selection and appointment process would allow for metrics of improvement and measurement of applicants’ ability to perform.

3. Stakeholder Analysis/Special Operations Recruitment Committee

Many groups within the FDNY have a vested interest in the selection method for special operations. Some obvious benefits and privileges come with being part of elite groups. Within the FDNY, fraternal organizations represent nearly all firefighter demographics. Given the many stakeholders, the FDNY could consolidate stakeholders into the following categories yet maintain a diverse and inclusive group from which to draw: civilians, non-SOC firefighters, current SOC firefighters and officers, and chief officers and administration (see Table 8). Other organizations—for example, the U.S. armed services—have selection and recruitment committees comprising recruitment specialists and members of the special forces communities. Such collaborative efforts aim to realize recruitment quotas along with elite selection standards and metrics. Including

members of both the FDNY's fraternal organizations and stakeholders from within special operations might provide an avenue to gain buy-in from rank-and-file members of the department.

Table 8. Proposed Members of Special Operations Recruitment Committee

Stakeholders	Involvement in issues	Investment in issues	Influence/ power	Position	Impact of the issue on actor
Civilians	Rely on FDNY for life-saving services	Low/ medium	Low	Indifferent	Low
Firefighters (non-SOC)	Career path and advancement	Medium/ high	Medium	Supportive/ mobilized	Medium
Current SOC firefighters/ officers	Maintain common standards of performance	High	Medium	Supportive/ mobilized/ active	High
Chief officers and admin.	Maintain high performance and limited liability of inequity	High	High	Supportive/ mobilized	High

The armed services, specifically special forces groups, are competing for talent under pressure to make recruitment quotas and identify quality candidates. Several branches have developed recruitment commands that help meet those challenges. The FDNY would be wise to develop a special operations recruitment committee to help meet similar challenges. With defined criteria that meet job analysis and a mechanism to assess applicants for talent, there needs to be a committee of firefighters and officers of both special operations and non-special operations communities to help steer applicants who show proficiency or promise in firefighting and meet operational needs toward successful appointments in special operations. This well-rounded committee could dispel any issues

of transparency and communicate the needs and standards to firefighters and officers wishing to join special operations.

This committee of firefighters and officers should comprises senior and active firefighters from busy neighborhoods in New York City. Traditionally, these units send more applicants to special operations units—a tradition built into the selection criteria from rescue services’ inception in 1915. This committee would also have a role in succession planning. Members of the committee could be trained on evaluations, interview skills, and character assessments to uphold the desired characteristics that special operations cultivates. The FDNY is currently under the supervision of a federal court monitor to oversee personnel decisions. Proactively including this court monitor in this process could help avoid legal challenges to criteria and selection testing and evaluation.

4. Policy Evaluation and Revision

As with any policy implementation, these program changes will need to make room for further revisions as needed. The presence of errors is not an indication of failures of policy but of a need to be flexible and adaptable. Collaborative meetings among the stakeholders and the selection and recruitment committees identified in the previous subsection could help to identify areas of deficiency and solutions to these problems. Selection and recruitment campaigns could become vulnerable to nepotism, favoritism, and cronyism, for example. Again, committee members could have an impact by clarifying the process and evaluating feedback from both up and down the chain of command. The revision and adaptation of newer and more validated selection constructs must have flexibility and input to course-correct any adverse and unforeseen impacts on either applicants or performance.

Creating a timeline of scheduled revisions would also aid the FDNY in a proactive approach to criteria and ability measurement. The FDNY has been slow to evaluate criteria and abilities for special operations vis-à-vis the rapidly growing mission of special operations. Built-in revisions, evaluations of selection criteria, and job analyses could allow for phased changes to selections without revamping the entire system. Once revisions and corrections are identified, they can then be developed and implemented. The act of

creating revisions will not derail the entire selection and recruitment model as the abilities and criteria will have already been formalized and validated. Tailoring the selection process should be mission and outcome driven. If the mission or performance is impacted, then the selection committee can take the necessary steps to identify the problem and implement the solution. If disparate impacts of demographics are the issue, again, the selection committee can identify areas of professional development, training, and education required to include more people in the selection pipeline.

E. CONCLUSIONS

The FDNY pioneered the concept of the special operations unit. The FDNY's Chief Raymond Downey, who lost his life on 9/11, and Chief John Norman (ret.) have been referenced extensively in this thesis. These two practitioners wrote extensively on the tactics, mission, and tools of special operations but provided only limited information on selection and staffing—mostly because the capabilities and demands of each fire service are not one-size-fits-all. Understanding the contributions of these leaders coupled with the models of the armed services and HROs might provide solutions for other organizations to follow.

Special forces (SOF) in the armed services have identified five truths in their mission. While the FDNY is already an HRO, its special operations should incorporate these truths into its culture as a standout among the regular line units.

1. **Humans are more important than hardware.** People—not equipment—make the critical difference. The right people, highly trained and working as a team, will accomplish the mission with the equipment available. On the other hand, the best equipment in the world cannot compensate for a lack of the right people...

Quality is better than quantity. A small number of people, carefully selected, well trained, and well led, are preferable to larger numbers of troops, some of whom may not be up to the task....

2. **Special Operations Forces cannot be mass produced.** It takes years to train operational units to the level of proficiency needed to accomplish difficult and specialized

SOF missions. Intense training—both in SOF schools and units—is required to integrate competent individuals into fully capable units. This process cannot be hastened without degrading ultimate capability....

3. **Competent Special Operations Forces cannot be created after emergencies occur.** Creation of competent, fully mission capable units take time. Employment of fully capable special operations capability on short notice requires highly trained and constantly available SOF units in peacetime....
4. **Most special operations require non-SOF support.** The operational effectiveness of our deployed forces cannot be, and never has been, achieved without being enabled by our joint service partners. The support Air Force, Army, Marine and Navy engineers, technicians, intelligence analysts, and the numerous other professions that contribute to SOF, have substantially increased our capabilities and effectiveness throughout the world.²⁷⁸

The FDNY would benefit from adopting this mindset in its selection of special operations firefighters and officers. The criteria and content already exist—the FDNY just needs to validate and formalize the ethos of these tenets. Adding this construct of character into selection decisions not only allows for growth of special operations firefighters but also cultivates talent in the future. Likewise, the HRO mindset in high-stress/high-consequence occupations offers replicable principles for other organizations to emulate: preoccupation with failure, reluctance to simplify, sensitivity to operations, deference to expertise, and commitment to resilience.²⁷⁹

By channeling the five SOF truths and the five HRO principles, the FDNY can validate the current method of selection for special operations and have a lasting impact on the performance and culture of the department. In updating its criteria, developing content, and building a new selection construct, the FDNY’s special operations unit can honor its traditions while validating a model that is worthy of sharing with its partners in the fire service and homeland security.

²⁷⁸ U.S. Army Special Operations Command Pacific, “SOF Truths.”

²⁷⁹ PSNet, “High Reliability.”

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APPENDIX A. SPECIAL OPERATIONS RESPONSE MATRIX

Table 9. SOC Unit Response Policy.²⁸⁰



CHAPTER 7 ADDENDUM 1
SOC UNIT RESPONSE POLICY
(Reference Material)

COMMUNICATIONS MANUAL
CHAPTER 7 ADDENDUM 1
June 20, 2019

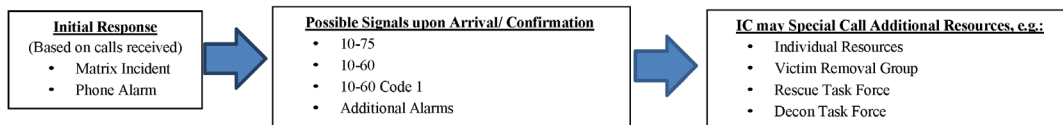
CALL TYPES	DESCRIPTION	RESPONSE	NOTES
Auto Extrication		1E + 1L + Rescue + BC (Normally assigned Rescue)	Confirmed Pin Assign: 1E + 1L + Squad (Rescue if not assigned)
Ceiling Down/Fell-Residential		1E + 1L + BC	
Water-Ice Rescue	Water Rescue	2E; 1L; BC; Nearest Water/Ice Rescue Unit; Rescue; Tactical Support Unit; Squad; Rescue BC; 1 Marine CO; Safety BC; Marine BC	Confirmed Boat In Distress/Water-Ice Rescue Assign 2 nd Marine CO FD Divers in Water Assign: Add'l Rescue; 1E (ENG to assist the 2 nd Rescue)
Boat in Distress		1E; 1L; BC; 2 Marine CO; Marine BC	
Building Collapse - Minor [Loose facade; bricks/cornice falling, etc.]	MINOR Technical Rescue	1E; 1L; BC; Squad; Rescue; Tactical Support Unit; Rescue BC; Safety BC	All Transit Incidents Assign 2 Ladder companies to ensure communications relay
Entrapment (Non-Vehicle related) [Person in machine, elevator accident, etc.]			
Transit Incident - Minor [Person under train/pinned by train]			All Transit Incidents If TLO not already at RCC, TLO will be assigned.
Construction Accident [Crane incident; impalements, etc.]			
Hi-Angle Incident [Persons on scaffolds; bridges, etc.]			
SOC SUPPORT LADDERS: MN: L-1, 7, 14, 25, 45 BX: L-27, 42, 46, 47, 50 BK: L-131, 132, 146, 169, 170, 175 SE: L-77, 79 QN: L-117, 121, 126, 136, 144, 150, 152		USE SQUAD AS HMTU EXCEPT IN THE FOLLOWING BATTALIONS: E-44: BC 7, 8, 9, 10, 11, 12, 16 E-165: BC 21, 22, 23 E-250: BC 33, 40, 41, 42, 43 E-274: BC 46, 50, 52, 53, 54	
		TECHNICAL RESCUE TASK FORCE: (1) Rescue Company; (1) Collapse Rescue; (1) Squad Company w/2 nd Piece EMD assigns: 1 Haz/Tac Officer & 1 Rescue Paramedic Unit.	

²⁸⁰ Source: New York City Fire Department, "SOC Unit Response Policy," 1–2.

Transit Incident - Major [Train Derailment; crash; etc.]	MAJOR Technical Rescue	3E; 2L; BC; Tactical Support Unit; Rescue BC; Safety BC; Field Communications Unit 1 Technical Rescue Task Force, 1 Additional Rescue, SOC Compressor; SOC Logistics HazMat 1; HazMat BC; HazMat Tech Engine Note: When the 2 nd Rescue Task Force is assigned, it will not include a Rescue Co. The additional Rescue previously assigned on the 10-60 fulfills this requirement.	Transit Incident Major Rebreather Unit + SOC Electric Rail Cart assigned on initial phone call.
Plane Down - Off Airport			
Trench Rescue			Trench Rescue Con Ed Vacuum Truck assigned on initial phone call.
Building Collapse - Major [Floors, Walls, Structures, etc.]			
Explosion [Injuries and/or Structural Damage]			
Confined Space			
HAZMAT Incident		2E; 2L; BC; Haz-Mat 1; HazMat BC; HazMat Tech Unit	

10-60 RESPONSE POLICY
Transmission of a 10-60 Signal following the dispatch of a matrix incident will result in the balance of the appropriate 10-60 units being assigned.

The escalation of assignment should proceed as follows:



APPENDIX B. ARMY COMBAT FITNESS GRADING SCALES

Table 10. Max Deadlift, Three Repetitions.²⁸¹

		Max Deadlift (MDL) - Three-Repetitions (LBS)																				
		17-21		22-26		27-31		32-36		37-41		42-46		47-51		52-56		57-61		Over 62		
Points		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Points
100		340	210	340	230	340	230	340	230	340	210	340	210	330	190	290	190	250	170	230	170	100
99		330	---	330	220	330	220	330	220	330	200	330	200	320	180	280	180	240	160	220	160	99
98		---	200	---	210	---	210	---	210	---	---	---	190	310	---	270	170	230	---	210	---	98
97		---	190	---	---	---	---	---	---	---	190	320	---	300	170	260	160	220	---	---	---	97
96		320	---	---	200	---	---	---	200	---	---	310	180	290	---	250	---	210	---	---	---	96
95		310	---	---	---	---	200	---	190	320	180	300	170	280	---	240	---	---	---	200	---	95
94		---	180	---	190	---	190	---	---	310	---	290	---	270	---	230	---	200	---	190	---	94
93		300	---	---	---	---	---	320	180	300	170	280	---	260	---	220	---	190	---	180	---	93
92		---	---	320	---	---	---	---	---	290	---	270	---	250	---	---	---	---	---	170	---	92
91		290	170	---	180	320	180	310	170	280	---	260	---	240	---	---	---	180	---	---	---	91
90		280	---	310	---	310	---	300	---	270	160	---	160	230	160	210	150	---	150	---	150	90
89		---	---	290	170	300	170	290	---	---	---	250	---	220	---	---	---	170	---	---	---	89
88		---	---	280	---	290	---	280	160	260	---	---	---	---	---	200	---	---	---	---	---	88
87		270	160	---	160	280	---	270	---	---	---	240	---	210	---	---	---	---	---	---	---	87
86		---	---	270	---	---	160	---	---	250	---	---	---	---	---	190	---	---	---	---	---	86
85		---	---	---	---	270	---	260	---	---	---	230	---	200	---	180	---	---	---	---	---	85
84		260	---	260	---	260	---	---	---	240	---	220	---	---	---	170	---	---	---	---	---	84
83		250	---	---	---	---	---	250	---	---	---	---	---	190	---	---	---	---	---	---	---	83
82		240	---	---	---	---	---	---	---	230	---	---	---	---	---	---	---	---	---	160	---	82
81		---	---	250	---	250	---	240	---	220	---	210	---	180	---	---	---	---	---	---	---	81
80		---	---	---	---	---	---	---	---	---	---	---	---	170	---	---	140	---	140	---	140	80
79		230	---	240	---	240	150	230	150	---	150	200	150	---	150	160	---	160	---	---	---	79
78		---	150	---	150	---	---	---	---	210	---	---	---	160	---	---	---	---	---	---	---	78
77		220	---	230	---	230	---	220	---	---	---	190	---	---	---	---	---	---	---	---	---	77
76		---	---	---	---	---	---	---	---	200	---	180	---	---	---	---	---	---	---	---	---	76
75		---	---	220	---	220	---	210	---	---	---	170	---	---	---	---	---	---	---	---	---	75
74		210	---	---	---	---	---	---	---	190	---	---	---	---	---	---	---	---	---	---	---	74
73		---	---	210	---	210	---	200	---	---	---	160	---	---	140	---	---	---	---	---	---	73
72		200	---	---	---	---	---	---	---	180	---	---	140	---	---	---	---	---	---	150	130	72
71		---	140	200	140	200	140	190	140	170	140	---	---	---	---	---	---	150	130	---	---	71
70		---	---	190	---	190	---	180	---	160	---	---	---	150	---	150	130	---	---	---	---	70
69		190	---	180	---	180	---	170	---	---	---	150	---	---	---	---	---	---	---	---	---	69
68		180	---	---	---	170	---	160	---	150	---	---	---	---	---	---	---	---	---	---	---	68
67		170	---	170	---	---	---	---	---	---	---	---	---	---	130	---	---	---	---	---	---	67
66		---	---	---	---	---	---	150	---	---	---	---	---	---	---	---	---	---	---	---	---	66
65		---	---	160	---	160	---	---	---	---	130	---	130	---	---	---	---	---	---	---	---	65
64		160	130	---	130	---	130	---	130	---	---	---	---	---	---	---	---	---	---	---	---	64
63		---	---	---	---	150	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	63
62		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	62
61		150	---	150	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	61
60		140	120	140	120	140	120	140	120	140	120	140	120	140	120	140	120	140	120	140	120	60
50		130	110	130	110	130	110	130	110	130	110	130	110	130	110	130	110	130	110	130	110	50
40		120	100	120	100	120	100	120	100	120	100	120	100	120	100	120	100	120	100	120	100	40
30		110	90	110	90	110	90	110	90	110	90	110	90	110	90	110	90	110	90	110	90	30
20		100	80	100	80	100	80	100	80	100	80	100	80	100	80	100	80	100	80	100	80	20
10		90	70	90	70	90	70	90	70	90	70	90	70	90	70	90	70	90	70	90	70	10
0		80	60	80	60	80	60	80	60	80	60	80	60	80	60	80	60	80	60	80	60	0

²⁸¹ Source: U.S. Army, “ACFT Scoring Scales,” 1.

Table 11. Standing Power Throw.²⁸²

		Standing Power Throw (SPT) (Distance - meters and centimeters)																				
		17-21		22-26		27-31		32-36		37-41		42-46		47-51		52-56		57-61		Over 62		
Points		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Points
100		12.6	8.4	13.0	8.5	13.1	8.7	12.9	8.6	12.8	8.2	12.3	8.1	11.6	7.8	10.6	7.4	9.9	6.6	9.0	6.6	100
99		12.4	8.2	12.9	8.4	12.9	8.5	12.6	8.4	12.6	8.0	12.1	7.9	11.4	7.6	10.4	7.1	9.7	6.4	8.8	6.4	99
98		12.0	7.7	12.5	7.9	12.6	8.2	12.4	8.0	12.2	7.5	11.7	7.4	11.0	7.1	10.2	6.6	9.5	6.3	---	6.3	98
97		11.7	7.5	12.2	7.7	12.4	8.0	12.2	7.8	12.0	7.3	11.4	7.2	10.7	6.8	10.0	6.5	9.4	6.2	8.7	6.2	97
96		11.5	7.3	12.0	7.5	12.2	7.7	12.0	7.6	11.8	7.2	11.3	7.1	10.6	6.5	9.8	6.3	9.3	6.1	---	6.1	96
95		11.3	7.2	11.8	7.4	12.0	7.5	11.8	7.4	11.6	7.0	11.1	6.9	10.4	6.4	9.6	6.2	9.1	6.0	8.6	6.0	95
94		11.0	7.0	11.5	7.2	11.7	7.3	11.6	7.3	11.4	6.8	10.8	6.8	10.2	6.2	9.5	6.1	9.0	5.9	8.5	5.9	94
93		10.9	6.9	11.4	7.1	11.6	7.2	11.4	7.1	11.2	6.7	10.7	6.7	10.1	---	9.3	6.0	8.9	5.8	8.3	5.8	93
92		10.7	6.8	11.3	7.0	11.4	7.1	11.3	7.0	11.1	---	10.6	6.6	10.0	---	9.2	5.9	8.8	5.7	8.2	5.7	92
91		10.6	6.6	11.1	6.9	11.3	7.0	11.2	6.9	10.9	6.6	10.5	6.5	9.9	6.1	9.1	5.8	8.7	5.6	8.1	5.6	91
90		10.5	6.5	11.0	6.8	11.1	6.9	11.0	6.8	10.7	6.4	10.4	6.4	9.7	6.0	9.0	5.7	8.5	5.5	8.0	5.5	90
89		10.4	---	10.7	6.7	11.0	6.8	10.8	6.7	10.6	---	10.3	6.3	9.6	5.9	8.9	5.6	---	5.4	---	---	89
88		10.3	6.4	10.6	6.6	10.9	6.7	10.7	6.5	10.5	6.3	10.1	6.2	9.5	---	8.8	---	8.4	---	7.9	5.4	88
87		10.0	6.3	10.4	6.5	10.7	6.6	10.5	6.4	10.4	6.2	9.9	6.1	9.4	5.8	8.7	5.5	8.3	5.3	---	---	87
86		9.9	6.2	10.3	6.4	10.6	6.5	10.4	---	10.3	6.1	9.8	6.0	9.3	5.7	8.6	---	8.2	---	7.8	5.3	86
85		9.8	6.1	10.2	6.3	10.5	---	10.3	6.3	10.2	---	9.7	---	9.2	5.6	---	5.4	8.1	---	---	---	85
84		9.7	---	10.1	6.2	10.4	6.4	10.2	---	10.1	6.0	9.6	5.9	9.1	---	8.5	---	---	5.2	7.7	---	84
83		9.6	6.0	10.0	6.1	10.2	6.3	10.1	6.2	9.9	5.9	9.5	5.8	9.0	5.5	8.4	5.3	8.0	---	7.6	5.2	83
82		9.5	---	9.9	---	10.1	---	10.0	6.1	9.8	5.8	9.4	---	8.9	---	8.3	5.2	7.9	---	---	---	82
81		9.4	5.9	9.8	6.0	10.0	6.2	9.9	6.0	9.7	---	9.3	---	8.8	5.4	8.2	---	7.8	---	7.5	---	81
80		9.3	5.8	9.7	5.9	9.8	6.1	9.8	5.9	9.6	5.7	9.2	5.7	8.7	5.3	8.1	---	7.7	5.1	---	5.1	80
79		9.2	---	9.6	5.8	---	5.9	9.7	---	9.5	---	9.1	5.6	---	---	---	5.1	7.6	---	7.4	---	79
78		9.1	5.7	9.5	---	9.7	---	9.6	5.8	9.4	5.6	9.0	---	8.6	5.2	8.0	---	7.5	---	---	---	78
77		9.0	---	9.4	---	9.6	5.8	9.5	---	9.3	---	8.9	5.5	8.5	---	7.9	5.0	---	5.0	7.3	5.0	77
76		8.9	5.6	9.3	5.7	9.4	5.7	9.4	5.7	9.2	5.5	8.8	5.4	8.4	---	7.8	---	7.4	---	7.2	---	76
75		8.8	5.5	9.2	5.6	9.3	---	9.3	---	9.1	5.4	8.7	---	8.3	5.1	---	4.9	7.3	4.9	---	4.9	75
74		8.6	5.4	9.1	5.5	---	5.6	9.2	5.6	9.0	---	---	5.3	8.2	---	7.7	---	7.2	---	7.1	---	74
73		8.5	---	9.0	---	9.2	---	9.1	5.5	8.9	5.3	8.6	---	---	5.0	7.6	4.8	7.1	---	7.0	4.8	73
72		8.4	5.3	8.9	5.4	9.0	5.5	8.9	---	8.8	5.2	8.4	5.2	8.1	---	7.5	4.7	7.0	4.8	6.8	4.7	72
71		8.3	5.2	8.8	5.3	8.9	5.4	8.8	5.4	8.7	---	8.3	---	8.0	4.9	7.4	---	---	4.6	6.7	4.6	71
70		8.2	---	8.6	---	8.8	5.3	8.7	5.3	8.6	---	8.2	5.1	7.9	---	7.3	4.6	6.9	---	6.6	---	70
69		8.1	5.1	8.5	5.2	8.6	---	8.6	---	8.5	5.1	8.1	5.1	7.7	4.8	7.1	---	6.8	4.5	6.4	4.5	69
68		8.0	5.0	8.3	---	8.5	5.2	8.5	5.2	8.3	5.0	8.0	5.0	7.6	4.7	7.0	4.5	6.7	4.4	6.2	4.4	68
67		7.9	---	8.2	5.1	8.4	---	8.3	---	8.2	4.9	7.9	4.9	7.5	4.6	---	4.4	6.6	4.3	---	4.3	67
66		7.7	4.9	8.1	5.0	8.3	5.1	8.2	5.1	8.1	---	7.8	4.8	7.4	---	6.9	---	6.5	4.2	6.1	4.2	66
65		7.5	4.8	7.8	4.9	8.1	5.0	8.1	5.0	7.8	4.8	7.6	4.7	7.2	---	6.7	4.3	6.3	4.1	---	4.1	65
64		7.4	---	7.7	4.8	7.9	4.9	7.9	4.9	7.7	4.7	7.4	---	7.1	4.5	6.6	4.2	6.2	4.0	5.9	---	64
63		7.2	4.7	7.5	4.7	7.7	4.8	7.6	4.8	7.5	4.6	7.3	4.6	6.9	4.4	6.4	---	6.1	3.9	5.7	4.0	63
62		6.9	4.6	7.3	4.6	7.5	4.7	7.4	4.7	7.3	4.5	7.1	4.5	6.7	4.2	6.2	4.1	6.0	3.8	5.4	3.9	62
61		6.6	4.4	6.9	4.4	7.1	4.6	7.1	4.5	7.0	4.4	6.7	4.2	6.4	4.1	6.0	3.9	5.7	3.6	5.1	3.6	61
60		6.0	3.9	6.3	4.0	6.5	4.2	6.5	4.1	6.4	4.1	6.2	3.9	6.0	3.7	5.7	3.5	5.3	3.4	4.9	3.4	60

TABLE CONTINUES NEXT PAGE

²⁸² Source: U.S. Army, 2.

		Standing Power Throw (SPT) (Distance - meters and centimeters)																			
		17-21		22-26		27-31		32-36		37-41		42-46		47-51		52-56		57-61			Over 62
Points	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Points
60	6.0	3.9	6.3	4.0	6.5	4.2	6.5	4.1	6.4	4.1	6.2	3.9	6.0	3.7	5.7	3.5	5.3	3.4	4.9	3.4	60
59	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	59
58	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	58
57	5.9	---	6.2	---	6.4	4.1	6.4	---	6.3	---	6.1	---	5.9	---	5.6	---	---	---	---	---	57
56	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	56
55	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	55
54	---	3.8	---	3.9	---	---	---	4.0	---	4.0	---	3.8	---	3.6	---	3.4	5.2	---	4.8	---	54
53	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	53
52	5.8	---	6.1	---	6.3	4.0	6.3	---	6.2	---	6.0	---	5.8	---	5.5	---	---	---	---	---	52
51	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	51
50	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	50
49	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	49
48	---	---	---	---	6.2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	48
47	5.7	---	---	---	---	---	6.2	---	6.1	---	---	3.7	5.7	---	5.4	---	5.1	---	---	---	47
46	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	46
45	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	45
44	---	3.7	6.0	3.8	6.1	3.9	---	3.9	---	3.9	5.9	---	---	3.5	---	3.3	---	3.3	4.7	3.3	44
43	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	43
42	5.6	---	---	---	---	---	6.1	---	6.0	---	---	3.6	5.6	---	5.3	---	5.0	---	---	---	42
41	---	---	---	---	6.0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	41
40	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	40
39	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	39
38	5.5	---	5.9	---	---	---	---	---	---	---	5.8	---	---	---	5.2	---	---	---	---	---	38
37	---	3.6	---	---	5.9	---	6.0	---	5.9	3.8	---	---	5.5	---	---	3.2	---	---	4.6	---	37
36	---	---	5.8	---	---	---	---	---	---	---	5.7	---	---	---	---	---	---	---	---	---	36
35	---	---	---	3.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	35
34	5.4	---	---	---	---	3.8	---	3.8	---	---	---	3.5	---	3.4	5.1	---	---	3.2	---	3.2	34
33	---	---	5.7	---	---	---	---	---	---	---	5.6	---	---	---	---	---	---	---	---	---	33
32	---	3.5	---	---	5.8	---	5.9	---	5.8	3.7	---	---	5.4	---	---	3.1	---	---	4.5	---	32
31	5.3	---	5.6	---	---	---	---	---	---	---	5.5	---	---	---	5.0	---	---	---	---	---	31
30	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	30
29	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	29
28	5.2	---	5.5	---	5.7	---	5.8	---	5.7	---	5.4	---	5.3	3.3	---	---	---	---	---	---	28
27	---	---	---	3.6	---	3.7	---	3.7	---	---	---	3.4	---	---	---	---	---	---	---	---	27
26	---	---	5.4	---	5.6	---	5.7	---	5.6	---	5.3	---	5.2	---	---	---	---	---	---	---	26
25	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	25
24	5.1	3.4	---	---	---	---	5.6	---	---	3.6	---	---	---	3.2	4.9	3.0	4.9	3.1	4.4	3.1	24
23	---	---	5.3	---	5.5	---	---	---	5.5	---	5.2	---	5.1	---	---	---	---	---	---	---	23
22	---	---	---	3.5	---	3.6	5.5	3.6	---	---	---	3.3	---	---	---	---	---	---	---	---	22
21	5.0	---	5.2	---	5.4	---	---	---	5.4	---	5.1	---	5.0	3.1	---	---	---	---	---	---	21
20	---	---	---	---	---	---	5.4	---	---	---	---	---	---	---	---	---	---	---	---	---	20
19	---	---	---	---	5.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	19
18	4.9	3.3	5.1	3.4	---	3.5	5.3	3.5	5.3	3.5	5.0	3.2	4.9	3.0	4.8	---	4.8	3.0	---	3.0	18
17	---	---	---	---	5.2	---	---	---	---	---	---	---	---	---	---	2.9	---	---	4.3	---	17
16	4.8	---	5.0	---	---	---	5.2	---	5.2	---	---	---	4.8	---	4.7	---	4.7	---	---	---	16
15	---	---	---	---	5.1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	15
14	4.7	3.2	4.9	3.3	5.0	3.4	5.1	3.4	5.1	3.4	4.9	3.1	---	2.9	---	---	---	2.9	---	2.9	14
13	---	---	---	---	---	---	---	---	---	---	---	---	4.7	---	4.6	---	4.6	---	---	---	13
12	4.6	---	4.8	---	4.9	---	5.0	---	5.0	---	---	---	---	---	---	2.8	---	---	4.2	---	12
11	---	3.1	---	3.2	---	3.3	---	3.3	---	3.3	4.8	3.0	4.6	2.8	4.5	---	4.5	2.8	---	2.8	11
10	4.5	---	4.7	---	4.8	---	4.9	---	4.9	---	---	---	---	---	---	---	---	---	---	---	10
9	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9
8	4.4	3.0	4.6	3.1	4.7	3.2	4.8	3.2	4.8	3.2	4.7	2.9	4.5	2.7	4.4	2.7	4.4	2.7	4.1	2.7	8
7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	7
6	4.3	2.9	4.5	3.0	4.6	3.1	4.7	3.1	4.7	3.1	4.6	2.8	4.4	2.6	4.3	2.6	4.3	2.6	4.0	2.6	6
5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	5
4	4.2	2.8	4.4	2.9	4.5	3.0	4.6	3.0	4.6	3.0	4.5	2.7	4.3	2.5	4.2	2.5	4.2	2.5	3.9	2.5	4
3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3
2	4.1	2.7	4.3	2.8	4.4	2.9	4.5	2.9	4.5	2.9	4.4	2.6	4.2	2.4	4.1	2.4	4.1	2.4	3.8	2.4	2
1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1
0	4.0	2.6	4.2	2.7	4.3	2.8	4.4	2.8	4.4	2.8	4.3	2.5	4.1	2.3	4.0	2.3	4.0	2.3	3.7	2.3	0

Table 12. Hand-Release Push-up.²⁸³

		Hand-release Push-up (HRP) (number of correctly performed repetitions in 2 minutes)																			
		17-21		22-26		27-31		32-36		37-41		42-46		47-51		52-56		57-61			Over 62
Points	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Points
100	57	53	61	50	62	48	60	47	59	41	56	36	55	35	51	30	46	24	43	24	100
99	56	50	60	49	59	45	59	46	57	39	55	34	53	34	48	28	43	23	41	23	99
98	54	47	57	46	56	42	56	43	54	36	53	31	50	31	45	26	40	22	39	22	98
97	53	45	54	43	55	39	54	40	53	34	50	30	47	30	43	25	38	21	37	21	97
96	51	43	53	42	53	38	53	37	51	33	48	28	44	27	40	24	37	20	35	20	96
95	50	42	52	39	52	36	52	36	48	31	46	26	42	25	38	23	35	19	34	19	95
94	49	39	50	37	51	35	50	35	46	28	44	24	41	24	35	22	34	18	33	18	94
93	48	---	49	36	49	34	48	34	45	27	43	23	39	23	34	20	33	---	31	---	93
92	47	38	48	35	48	33	47	32	44	26	42	22	38	22	33	19	31	17	30	17	92
91	46	37	47	34	47	32	45	31	43	23	41	21	36	21	32	18	30	16	29	16	91
90	45	36	46	33	46	30	44	30	42	22	38	20	34	20	31	17	29	15	26	15	90
89	44	35	45	32	45	28	43	28	41	---	37	---	33	19	30	---	26	14	24	14	89
88	43	34	44	31	44	27	42	26	39	21	36	19	---	18	28	16	25	---	---	---	88
87	42	33	43	30	43	26	41	25	38	---	34	18	32	---	27	15	24	---	23	---	87
86	41	32	42	28	42	25	40	---	37	20	33	17	31	17	26	---	23	---	---	13	86
85	---	31	41	27	41	---	39	24	34	---	32	16	30	16	25	14	---	---	22	---	85
84	40	30	40	26	40	24	38	---	33	19	---	---	29	15	24	---	22	13	21	---	84
83	39	29	38	25	38	23	36	23	32	18	31	15	28	14	23	---	21	---	20	---	83
82	38	28	37	24	37	22	34	---	---	17	30	---	27	---	---	13	20	---	19	---	82
81	---	---	---	---	36	---	33	22	31	---	29	14	25	13	22	---	19	---	18	---	81
80	37	27	35	---	35	21	---	19	30	16	28	---	23	---	21	---	18	---	17	---	80
79	36	26	34	23	34	20	32	---	29	15	27	13	22	---	20	---	---	---	16	12	79
78	35	25	33	22	33	19	---	18	28	14	26	---	---	---	19	---	17	---	---	---	78
77	34	24	32	21	32	18	31	---	27	---	25	---	21	---	18	---	---	12	15	---	77
76	33	23	31	19	---	17	30	---	26	13	23	---	---	---	17	---	16	---	14	---	76
75	32	22	---	---	31	---	29	17	25	---	22	---	20	---	---	---	15	---	---	---	75
74	---	21	---	18	30	16	28	16	24	---	21	---	19	12	16	12	---	---	13	---	74
73	31	---	30	---	29	---	26	15	23	---	20	12	18	---	---	---	14	---	---	---	73
72	30	20	27	17	27	15	24	14	22	12	---	---	17	---	15	---	---	---	---	---	72
71	29	19	26	16	26	---	23	---	21	---	19	---	16	---	14	---	13	---	12	---	71
70	28	18	25	15	23	14	22	13	20	---	18	---	15	---	---	---	---	---	---	---	70
69	27	17	22	14	21	---	21	---	19	---	17	---	14	---	13	---	---	---	---	11	69
68	25	16	21	13	---	13	20	---	17	---	16	---	13	---	---	---	12	---	11	---	68
67	24	---	---	---	---	---	19	---	16	11	15	11	---	11	12	11	---	11	---	---	67
66	23	15	20	---	20	---	17	12	15	---	14	---	12	---	---	---	---	---	---	---	66
65	22	14	17	12	18	12	16	---	14	---	13	---	---	---	---	---	11	---	---	---	65
64	20	13	16	---	16	---	14	11	13	---	12	---	---	---	11	---	---	---	---	---	64
63	17	---	14	---	14	11	13	---	12	---	---	---	11	---	---	---	---	---	---	---	63
62	16	12	13	11	12	---	12	---	---	---	11	---	---	---	---	---	---	---	---	---	62
61	13	11	12	---	11	---	11	---	11	---	---	---	---	---	---	---	---	---	---	---	61
60	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	60
50	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	50
40	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	40
30	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	30
20	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	20
10	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	10
0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0

²⁸³ Source: U.S. Army, 4.

Table 13. Sprint/Drag/Carry.²⁸⁴

	Sprint / Drag / Carry (SDC) (Overall Time: minutes and seconds)																				
	17-21		22-26		27-31		32-36		37-41		42-46		47-51		52-56		57-61		Over 62		
Points	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Points
100	01:29	01:55	01:30	01:55	01:30	01:55	01:33	01:59	01:36	02:02	01:40	02:09	01:45	02:11	01:52	02:18	01:58	02:26	02:09	02:26	100
99	01:31	01:59	01:32	01:56	01:31	01:57	01:34	02:01	01:37	02:04	01:42	02:10	01:46	02:13	01:55	02:21	02:02	02:28	02:12	02:28	99
98	01:34	02:02	01:33	02:00	01:34	02:01	01:37	02:05	01:40	02:10	01:44	02:15	01:50	02:22	01:57	02:28	02:03	02:34	---	02:34	98
97	01:35	02:05	01:34	02:02	01:35	02:04	01:38	02:08	01:42	02:11	01:46	02:17	01:52	02:24	02:00	02:30	02:06	02:39	02:13	02:39	97
96	01:36	02:06	01:36	02:05	01:37	02:06	01:40	02:10	01:43	02:14	01:48	02:18	01:54	02:26	02:01	02:32	02:08	02:41	---	02:41	96
95	01:37	02:08	01:37	02:06	01:38	02:08	01:41	02:11	01:45	02:15	01:49	02:20	01:55	02:28	02:03	02:35	02:09	02:44	02:14	02:44	95
94	01:39	02:10	01:39	02:09	01:40	02:10	01:43	02:14	01:47	02:18	01:51	02:23	01:57	02:30	02:05	02:38	02:11	02:45	02:15	02:45	94
93	01:40	02:12	01:40	02:10	01:41	02:12	01:44	02:15	01:48	02:20	01:52	02:25	01:59	02:31	02:06	02:40	02:13	02:46	02:16	02:46	93
92	01:41	02:13	01:41	02:12	01:42	02:13	01:45	02:17	01:49	02:21	01:53	02:27	02:00	02:33	02:07	02:41	02:15	02:48	---	02:48	92
91	01:42	02:14	01:42	02:13	01:43	02:15	01:46	02:18	01:50	02:23	01:54	02:28	02:01	02:35	02:09	02:42	02:16	02:52	---	02:52	91
90	01:43	02:16	01:43	02:15	01:45	02:16	01:48	02:20	01:52	02:25	01:56	02:30	02:02	02:37	02:10	02:44	02:17	02:54	---	02:54	90
89	01:44	02:17	01:44	02:16	01:46	02:18	01:49	02:21	01:53	02:26	01:57	02:31	02:03	02:38	02:11	02:45	02:19	02:55	02:17	02:55	89
88	01:45	02:18	01:45	02:18	01:47	02:19	01:50	02:23	01:54	02:27	01:58	02:33	02:05	02:40	02:13	02:46	02:20	02:57	02:18	02:57	88
87	01:46	02:20	01:46	02:20	01:48	02:20	01:51	02:24	01:55	02:29	01:59	02:35	02:06	02:41	02:14	02:48	02:21	02:58	02:19	02:58	87
86	01:47	02:21	01:47	02:21	01:49	02:22	01:52	02:26	01:56	02:30	02:00	02:36	02:07	02:42	02:15	02:50	02:22	02:59	02:20	02:59	86
85	01:48	02:22	01:48	02:22	01:50	02:23	01:53	02:27	01:57	02:31	02:01	02:37	02:08	02:44	02:16	02:51	02:23	03:00	02:21	03:00	85
84	01:49	02:23	01:49	02:23	01:51	02:24	01:54	02:28	01:58	02:32	02:02	02:38	02:09	02:45	02:17	02:52	02:24	03:01	02:22	03:01	84
83	01:50	02:24	01:50	02:25	01:52	02:26	01:55	02:30	01:59	02:34	02:04	02:40	02:10	02:46	02:19	02:54	02:26	03:02	02:23	03:02	83
82	01:51	02:25	01:51	02:26	01:53	02:27	01:56	02:31	02:00	02:35	02:05	02:41	02:12	02:47	02:20	02:55	02:27	03:03	02:24	03:03	82
81	01:52	02:26	01:52	02:27	01:54	02:28	01:57	02:32	02:01	02:36	02:06	02:42	02:13	02:48	02:21	02:57	02:28	03:04	02:27	03:04	81
80	01:53	02:28	01:53	02:29	01:55	02:29	01:58	02:34	02:02	02:38	02:07	02:44	02:14	02:50	02:23	02:58	02:29	03:07	02:32	03:07	80
79	01:54	02:29	01:54	02:30	01:56	02:30	01:59	02:35	02:03	02:39	02:08	02:45	02:15	02:51	02:23	02:59	02:30	03:08	02:33	03:08	79
78	01:55	02:30	01:55	02:31	01:57	02:31	02:00	02:36	02:04	02:40	02:09	02:46	02:16	02:52	02:25	03:00	02:31	03:09	02:35	03:09	78
77	01:56	02:31	01:56	02:32	01:58	02:32	02:01	02:37	02:05	02:42	02:10	02:47	02:17	02:54	02:26	03:02	02:33	03:11	02:36	03:11	77
76	01:57	02:33	01:58	02:34	01:59	02:34	02:02	02:39	02:07	02:43	02:12	02:49	02:19	02:56	02:28	03:05	02:35	03:17	02:38	03:17	76
75	01:58	02:34	01:59	02:35	02:00	02:36	02:03	02:40	02:08	02:45	02:13	02:50	02:20	02:57	02:29	03:07	02:36	03:21	02:41	03:21	75
74	01:59	02:35	02:00	02:37	02:01	02:37	02:04	02:41	02:09	02:46	02:14	02:52	02:21	02:58	02:30	03:09	02:37	03:25	02:43	03:25	74
73	02:00	02:37	02:01	02:38	02:02	02:38	02:05	02:43	02:10	02:47	02:15	02:53	02:23	02:59	02:31	03:10	02:38	03:32	02:44	03:32	73
72	02:01	02:39	02:02	02:40	02:04	02:40	02:07	02:45	02:12	02:49	02:17	02:55	02:25	03:00	02:32	03:13	02:40	03:34	02:46	03:34	72
71	02:02	02:40	02:03	02:42	02:05	02:41	02:08	02:46	02:13	02:50	02:18	02:56	02:26	03:02	02:34	03:16	02:42	03:35	02:47	03:35	71
70	02:03	02:41	02:05	02:43	02:06	02:43	02:10	02:47	02:14	02:52	02:20	02:58	02:27	03:05	02:35	03:19	02:43	03:36	02:49	03:36	70
69	02:04	02:44	02:07	02:45	02:08	02:45	02:11	02:50	02:16	02:55	02:22	03:00	02:29	03:08	02:37	03:25	02:45	03:40	02:52	03:40	69
68	02:06	02:45	02:08	02:47	02:10	02:47	02:13	02:51	02:18	02:56	02:23	03:01	02:30	03:10	02:38	03:27	02:47	03:41	02:56	03:41	68
67	02:07	02:47	02:10	02:49	02:11	02:49	02:15	02:53	02:20	02:58	02:25	03:02	02:32	03:14	02:40	03:29	02:48	03:43	02:57	03:43	67
66	02:08	02:49	02:11	02:51	02:13	02:51	02:16	02:55	02:21	03:00	02:26	03:06	02:34	03:16	02:41	03:33	02:50	03:46	03:00	03:46	66
65	02:11	02:53	02:14	02:54	02:15	02:54	02:19	02:58	02:24	03:02	02:29	03:10	02:37	03:21	02:44	03:38	02:53	03:54	03:03	03:54	65
64	02:13	02:55	02:16	02:57	02:17	02:56	02:21	03:00	02:26	03:05	02:31	03:12	02:39	03:24	02:46	03:42	02:55	04:00	03:09	04:00	64
63	02:15	02:58	02:18	02:59	02:20	02:59	02:24	03:02	02:28	03:09	02:33	03:17	02:41	03:29	02:48	03:45	02:57	04:08	03:11	04:08	63
62	02:17	03:00	02:21	03:01	02:22	03:00	02:26	03:06	02:31	03:13	02:36	03:21	02:44	03:32	02:50	03:50	02:59	04:16	03:12	04:16	62
61	02:22	03:08	02:26	03:09	02:28	03:07	02:31	03:15	02:36	03:21	02:41	03:31	02:48	03:42	02:57	03:58	03:04	04:21	03:14	04:21	61
60	02:28	03:15	02:31	03:15	02:32	03:15	02:36	03:22	02:41	03:27	02:45	03:42	02:53	03:51	03:00	04:03	03:12	04:48	03:16	04:48	60

TABLE CONTINUES NEXT PAGE

²⁸⁴ Source: U.S. Army, 5–6.

Sprint / Drag / Carry (SDC) (Overall Time: minutes and seconds)													Points								
17-21		22-26		27-31		32-36		37-41		42-46											
Points	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Points				
60	02:28	03:15	02:31	03:15	02:32	03:15	02:36	03:22	02:41	03:27	02:45	03:42	02:53	03:51	03:00	04:03	03:12	04:48	03:16	04:48	60
59	02:29	03:16	02:32	03:16	02:33	03:16	02:37	03:23	02:42	03:28	02:46	03:43	02:54	03:52	03:01	04:04	03:13	04:49	03:17	04:49	59
58	02:30	03:17	02:33	03:17	02:34	03:17	02:38	03:24	02:43	03:29	02:47	03:44	02:55	03:53	03:02	04:05	03:14	04:50	03:18	04:50	58
57	02:31	03:18	02:34	03:18	02:35	03:18	02:39	03:25	02:44	03:30	02:48	03:45	02:56	03:54	03:03	04:06	03:15	04:51	03:19	04:51	57
56	02:32	03:19	02:35	03:19	02:36	03:19	02:40	03:26	02:45	03:31	02:49	03:46	02:57	03:55	03:04	04:07	03:16	04:52	03:20	04:52	56
55	02:33	03:20	02:36	03:20	02:37	03:20	02:41	03:27	02:46	03:32	02:50	03:47	02:58	03:56	03:05	04:08	03:17	04:53	03:21	04:53	55
54	02:34	03:21	02:37	03:21	02:38	03:21	02:42	03:28	02:47	03:33	02:51	03:48	02:59	03:57	03:06	04:09	03:18	04:54	03:22	04:54	54
53	02:35	03:22	02:38	03:22	02:39	03:22	02:43	03:29	02:48	03:34	02:52	03:49	03:00	03:58	03:07	04:10	03:19	04:55	03:23	04:55	53
52	02:36	03:23	02:39	03:23	02:40	03:23	02:44	03:30	02:49	03:35	02:53	03:50	03:01	03:59	03:08	04:11	03:20	04:56	03:24	04:56	52
51	02:37	03:24	02:40	03:24	02:41	03:24	02:45	03:31	02:50	03:36	02:54	03:51	03:02	04:00	03:09	04:12	03:21	04:57	03:25	04:57	51
50	02:38	03:25	02:41	03:25	02:42	03:25	02:46	03:32	02:51	03:37	02:55	03:52	03:03	04:01	03:10	04:13	03:22	04:58	03:26	04:58	50
49	02:39	03:26	02:42	03:26	02:43	03:26	02:47	03:33	02:52	03:38	02:56	03:53	03:04	04:02	03:11	04:14	03:23	04:59	03:27	04:59	49
48	02:40	03:27	02:43	03:27	02:44	03:27	02:48	03:34	02:53	03:39	02:57	03:54	03:05	04:03	03:12	04:15	03:24	05:00	03:28	05:00	48
47	02:41	03:28	02:44	03:28	02:45	03:28	02:49	03:35	02:54	03:40	02:58	03:55	03:06	04:04	03:13	04:16	03:25	05:01	03:29	05:01	47
46	02:42	03:29	02:45	03:29	02:46	03:29	02:50	03:36	02:55	03:41	02:59	03:56	03:07	04:05	03:14	04:17	03:26	05:02	03:30	05:02	46
45	02:43	03:30	02:46	03:30	02:47	03:30	02:51	03:37	02:56	03:42	03:00	03:57	03:08	04:06	03:15	04:18	03:27	05:03	03:31	05:03	45
44	02:44	03:31	02:47	03:31	02:48	03:31	02:52	03:38	02:57	03:43	03:01	03:58	03:09	04:07	03:16	04:19	03:28	05:04	03:32	05:04	44
43	02:45	03:32	02:48	03:32	02:49	03:32	02:53	03:39	02:58	03:44	03:02	03:59	03:10	04:08	03:17	04:20	03:29	05:05	03:33	05:05	43
42	02:46	03:33	02:49	03:33	02:50	03:33	02:54	03:40	02:59	03:45	03:03	04:00	03:11	04:09	03:18	04:21	03:30	05:06	03:34	05:06	42
41	02:47	03:34	02:50	03:34	02:51	03:34	02:55	03:41	03:00	03:46	03:04	04:01	03:12	04:10	03:19	04:22	03:31	05:07	03:35	05:07	41
40	02:48	03:35	02:51	03:35	02:52	03:35	02:56	03:42	03:01	03:47	03:05	04:02	03:13	04:11	03:20	04:23	03:32	05:08	03:36	05:08	40
39	02:49	03:36	02:52	03:36	02:53	03:36	02:57	03:43	03:02	03:48	03:06	04:03	03:14	04:12	03:21	04:24	03:33	05:09	03:37	05:09	39
38	02:50	03:37	02:53	03:37	02:54	03:37	02:58	03:44	03:03	03:49	03:07	04:04	03:15	04:13	03:22	04:25	03:34	05:10	03:38	05:10	38
37	02:51	03:38	02:54	03:38	02:55	03:38	02:59	03:45	03:04	03:50	03:08	04:05	03:16	04:14	03:23	04:26	03:35	05:11	03:39	05:11	37
36	02:52	03:39	02:55	03:39	02:56	03:39	03:00	03:46	03:05	03:51	03:09	04:06	03:17	04:15	03:24	04:27	03:36	05:12	03:40	05:12	36
35	02:53	03:40	02:56	03:40	02:57	03:40	03:01	03:47	03:06	03:52	03:10	04:07	03:18	04:16	03:25	04:28	03:37	05:13	03:41	05:13	35
34	02:54	03:41	02:57	03:41	02:58	03:41	03:02	03:48	03:07	03:53	03:11	04:08	03:19	04:17	03:26	04:29	03:38	05:14	03:42	05:14	34
33	02:55	03:42	02:58	03:42	02:59	03:42	03:03	03:49	03:08	03:54	03:12	04:09	03:20	04:18	03:27	04:30	03:39	05:15	03:43	05:15	33
32	02:56	03:43	02:59	03:43	03:00	03:43	03:04	03:50	03:09	03:55	03:13	04:10	03:21	04:19	03:28	04:31	03:40	05:16	03:44	05:16	32
31	02:57	03:44	03:00	03:44	03:01	03:44	03:05	03:51	03:10	03:56	03:14	04:11	03:22	04:20	03:29	04:32	03:41	05:17	03:45	05:17	31
30	02:58	03:45	03:01	03:45	03:02	03:45	03:06	03:52	03:11	03:57	03:15	04:12	03:23	04:21	03:30	04:33	03:42	05:18	03:46	05:18	30
29	02:59	03:46	03:02	03:46	03:03	03:46	03:07	03:53	03:12	03:58	03:16	04:13	03:24	04:22	03:31	04:34	03:43	05:19	03:47	05:19	29
28	03:00	03:47	03:03	03:47	03:04	03:47	03:08	03:54	03:13	03:59	03:17	04:14	03:25	04:23	03:32	04:35	03:44	05:20	03:48	05:20	28
27	03:01	03:48	03:04	03:48	03:05	03:48	03:09	03:55	03:14	04:00	03:18	04:15	03:26	04:24	03:33	04:36	03:45	05:21	03:49	05:21	27
26	03:02	03:49	03:05	03:49	03:06	03:49	03:10	03:56	03:15	04:01	03:19	04:16	03:27	04:25	03:34	04:37	03:46	05:22	03:50	05:22	26
25	03:03	03:50	03:06	03:50	03:07	03:50	03:11	03:57	03:16	04:02	03:20	04:17	03:28	04:26	03:35	04:38	03:47	05:23	03:51	05:23	25
24	03:04	03:51	03:07	03:51	03:08	03:51	03:12	03:58	03:17	04:03	03:21	04:18	03:29	04:27	03:36	04:39	03:48	05:24	03:52	05:24	24
23	03:05	03:52	03:08	03:52	03:09	03:52	03:13	03:59	03:18	04:04	03:22	04:19	03:30	04:28	03:37	04:40	03:49	05:25	03:53	05:25	23
22	03:06	03:53	03:09	03:53	03:10	03:53	03:14	04:00	03:19	04:05	03:23	04:20	03:31	04:29	03:38	04:41	03:50	05:26	03:54	05:26	22
21	03:07	03:54	03:10	03:54	03:11	03:54	03:15	04:01	03:20	04:06	03:24	04:21	03:32	04:30	03:39	04:42	03:51	05:27	03:55	05:27	21
20	03:08	03:55	03:11	03:55	03:12	03:55	03:16	04:02	03:21	04:07	03:25	04:22	03:33	04:31	03:40	04:43	03:52	05:28	03:56	05:28	20
19	03:09	03:56	03:12	03:56	03:13	03:56	03:17	04:03	03:22	04:08	03:26	04:23	03:34	04:32	03:41	04:44	03:53	05:29	03:57	05:29	19
18	03:10	03:57	03:13	03:57	03:14	03:57	03:18	04:04	03:23	04:09	03:27	04:24	03:35	04:33	03:42	04:45	03:54	05:30	03:58	05:30	18
17	03:11	03:58	03:14	03:58	03:15	03:58	03:19	04:05	03:24	04:10	03:28	04:25	03:36	04:34	03:43	04:46	03:55	05:31	03:59	05:31	17
16	03:12	03:59	03:15	03:59	03:16	03:59	03:20	04:06	03:25	04:11	03:29	04:26	03:37	04:35	03:44	04:47	03:56	05:32	04:00	05:32	16
15	03:13	04:00	03:16	04:00	03:17	04:00	03:21	04:07	03:26	04:12	03:30	04:27	03:38	04:36	03:45	04:48	03:57	05:33	04:01	05:33	15
14	03:14	04:01	03:17	04:01	03:18	04:01	03:22	04:08	03:27	04:13	03:31	04:28	03:39	04:37	03:46	04:49	03:58	05:34	04:02	05:34	14
13	03:15	04:02	03:18	04:02	03:19	04:02	03:23	04:09	03:28	04:14	03:32	04:29	03:40	04:38	03:47	04:50	03:59	05:35	04:03	05:35	13
12	03:16	04:03	03:19	04:03	03:20	04:03	03:24	04:10	03:29	04:15	03:33	04:30	03:41	04:39	03:48	04:51	04:00	05:36	04:04	05:36	12
11	03:17	04:04	03:20	04:04	03:21	04:04	03:25	04:11	03:30	04:16	03:34	04:31	03:42	04:40	03:49	04:52	04:01	05:37	04:05	05:37	11
10	03:18	04:05	03:21	04:05	03:22	04:05	03:26	04:12	03:31	04:17	03:35	04:32	03:43	04:41	03:50	04:53	04:02	05:38	04:06	05:38	10
9	03:19	04:06	03:22	04:06	03:23	04:06	03:27	04:13	03:32	04:18	03:36	04:33	03:44	04:42	03:51	04:54	04:03	05:39	04:07	05:39	9
8	03:20	04:07	03:23	04:07	03:24	04:07	03:28	04:14	03:33	04:19	03:37	04:34	03:45	04:43	03:52	04:55	04:04	05:40	04:08	05:40	8
7	03:21	04:08	03:24	04:08	03:25	04:08	03:29	04:15	03:34	04:20	03:38	04:35	03:46	04:44	03:53	04:56	04:05	05:41	04:09	05:41	7
6	03:22	04:09	03:25	04:09	03:26	04:09	03:30	04:16	03:35</												

Table 14. Plank.²⁸⁵

		Plank (PLK) (maintain proper straightline position (Time: minutes and seconds))																					
		17-21		22-26		27-31		32-36		37-41		42-46		47-51		52-56		57-61		Over 62			
Points		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Points	
100	03:40	03:40	03:35	03:35	03:30	03:30	03:25	03:25	03:20	03:20	03:20	03:20	03:20	03:20	03:20	03:20	03:20	03:20	03:20	03:20	03:20	100	
99	03:37	03:37	03:32	03:32	03:27	03:27	03:22	03:22	03:17	03:17	03:17	03:17	03:17	03:17	03:17	03:17	03:17	03:17	03:17	03:17	03:17	99	
98	03:34	03:34	03:29	03:29	03:24	03:24	03:19	03:19	03:14	03:14	03:14	03:14	03:14	03:14	03:14	03:14	03:14	03:14	03:14	03:14	03:14	98	
97	03:30	03:30	03:25	03:25	03:20	03:20	03:15	03:15	03:10	03:10	03:10	03:10	03:10	03:10	03:10	03:10	03:10	03:10	03:10	03:10	03:10	97	
96	03:27	03:27	03:22	03:22	03:17	03:17	03:12	03:12	03:07	03:07	03:07	03:07	03:07	03:07	03:07	03:07	03:07	03:07	03:07	03:07	03:07	96	
95	03:24	03:24	03:19	03:19	03:14	03:14	03:09	03:09	03:04	03:04	03:04	03:04	03:04	03:04	03:04	03:04	03:04	03:04	03:04	03:04	03:04	95	
94	03:21	03:21	03:16	03:16	03:11	03:11	03:06	03:06	03:01	03:01	03:01	03:01	03:01	03:01	03:01	03:01	03:01	03:01	03:01	03:01	03:01	94	
93	03:17	03:17	03:12	03:12	03:07	03:07	03:02	03:02	02:57	02:57	02:57	02:57	02:57	02:57	02:57	02:57	02:57	02:57	02:57	02:57	02:57	93	
92	03:14	03:14	03:09	03:09	03:04	03:04	02:59	02:59	02:54	02:54	02:54	02:54	02:54	02:54	02:54	02:54	02:54	02:54	02:54	02:54	02:54	92	
91	03:11	03:11	03:06	03:06	03:01	03:01	02:56	02:56	02:51	02:51	02:51	02:51	02:51	02:51	02:51	02:51	02:51	02:51	02:51	02:51	02:51	91	
90	03:08	03:08	03:03	03:03	02:58	02:58	02:53	02:53	02:47	02:47	02:47	02:47	02:47	02:47	02:47	02:47	02:47	02:47	02:47	02:47	02:47	90	
89	03:04	03:04	02:59	02:59	02:54	02:54	02:49	02:49	02:44	02:44	02:44	02:44	02:44	02:44	02:44	02:44	02:44	02:44	02:44	02:44	02:44	89	
88	03:01	03:01	02:56	02:56	02:51	02:51	02:46	02:46	02:41	02:41	02:41	02:41	02:41	02:41	02:41	02:41	02:41	02:41	02:41	02:41	02:41	88	
87	02:58	02:58	02:53	02:53	02:48	02:48	02:43	02:43	02:38	02:38	02:38	02:38	02:38	02:38	02:38	02:38	02:38	02:38	02:38	02:38	02:38	87	
86	02:55	02:55	02:50	02:50	02:45	02:45	02:40	02:40	02:35	02:35	02:35	02:35	02:35	02:35	02:35	02:35	02:35	02:35	02:35	02:35	02:35	86	
85	02:51	02:51	02:46	02:46	02:41	02:41	02:36	02:36	02:31	02:31	02:31	02:31	02:31	02:31	02:31	02:31	02:31	02:31	02:31	02:31	02:31	85	
84	02:48	02:48	02:43	02:43	02:38	02:38	02:33	02:33	02:28	02:28	02:28	02:28	02:28	02:28	02:28	02:28	02:28	02:28	02:28	02:28	02:28	84	
83	02:45	02:45	02:40	02:40	02:35	02:35	02:30	02:30	02:25	02:25	02:25	02:25	02:25	02:25	02:25	02:25	02:25	02:25	02:25	02:25	02:25	83	
82	02:41	02:41	02:37	02:37	02:31	02:31	02:27	02:27	02:22	02:22	02:22	02:22	02:22	02:22	02:22	02:22	02:22	02:22	02:22	02:22	02:22	82	
81	02:38	02:38	02:33	02:33	02:28	02:28	02:23	02:23	02:18	02:18	02:18	02:18	02:18	02:18	02:18	02:18	02:18	02:18	02:18	02:18	02:18	81	
80	02:35	02:35	02:30	02:30	02:25	02:25	02:20	02:20	02:15	02:15	02:15	02:15	02:15	02:15	02:15	02:15	02:15	02:15	02:15	02:15	02:15	80	
79	02:32	02:32	02:27	02:27	02:22	02:22	02:17	02:17	02:12	02:12	02:12	02:12	02:12	02:12	02:12	02:12	02:12	02:12	02:12	02:12	02:12	79	
78	02:29	02:29	02:23	02:23	02:18	02:18	02:13	02:13	02:08	02:08	02:08	02:08	02:08	02:08	02:08	02:08	02:08	02:08	02:08	02:08	02:08	78	
77	02:25	02:25	02:20	02:20	02:15	02:15	02:10	02:10	02:05	02:05	02:05	02:05	02:05	02:05	02:05	02:05	02:05	02:05	02:05	02:05	02:05	77	
76	02:22	02:22	02:17	02:17	02:12	02:12	02:07	02:07	02:02	02:02	02:02	02:02	02:02	02:02	02:02	02:02	02:02	02:02	02:02	02:02	02:02	76	
75	02:19	02:19	02:14	02:14	02:09	02:09	02:04	02:04	01:59	01:59	01:59	01:59	01:59	01:59	01:59	01:59	01:59	01:59	01:59	01:59	01:59	75	
74	02:15	02:15	02:10	02:10	02:06	02:06	02:00	02:00	01:56	01:56	01:56	01:56	01:56	01:56	01:56	01:56	01:56	01:56	01:56	01:56	01:56	74	
73	02:12	02:12	02:07	02:07	02:02	02:02	01:57	01:57	01:52	01:52	01:52	01:52	01:52	01:52	01:52	01:52	01:52	01:52	01:52	01:52	01:52	73	
72	02:09	02:09	02:04	02:04	01:59	01:59	01:54	01:54	01:49	01:49	01:49	01:49	01:49	01:49	01:49	01:49	01:49	01:49	01:49	01:49	01:49	72	
71	02:06	02:06	02:01	02:01	01:56	01:56	01:51	01:51	01:46	01:46	01:46	01:46	01:46	01:46	01:46	01:46	01:46	01:46	01:46	01:46	01:46	71	
70	02:02	02:02	01:58	01:58	01:52	01:52	01:47	01:47	01:42	01:42	01:42	01:42	01:42	01:42	01:42	01:42	01:42	01:42	01:42	01:42	01:42	70	
69	01:59	01:59	01:54	01:54	01:49	01:49	01:44	01:44	01:39	01:39	01:39	01:39	01:39	01:39	01:39	01:39	01:39	01:39	01:39	01:39	01:39	69	
68	01:56	01:56	01:51	01:51	01:46	01:46	01:41	01:41	01:36	01:36	01:36	01:36	01:36	01:36	01:36	01:36	01:36	01:36	01:36	01:36	01:36	68	
67	01:53	01:53	01:48	01:48	01:43	01:43	01:38	01:38	01:33	01:33	01:33	01:33	01:33	01:33	01:33	01:33	01:33	01:33	01:33	01:33	01:33	67	
66	01:49	01:49	01:45	01:45	01:39	01:39	01:35	01:35	01:30	01:30	01:30	01:30	01:30	01:30	01:30	01:30	01:30	01:30	01:30	01:30	01:30	66	
65	01:46	01:46	01:41	01:41	01:36	01:36	01:31	01:31	01:26	01:26	01:26	01:26	01:26	01:26	01:26	01:26	01:26	01:26	01:26	01:26	01:26	65	
64	01:43	01:43	01:38	01:38	01:33	01:33	01:28	01:28	01:23	01:23	01:23	01:23	01:23	01:23	01:23	01:23	01:23	01:23	01:23	01:23	01:23	64	
63	01:40	01:40	01:35	01:35	01:30	01:30	01:25	01:25	01:20	01:20	01:20	01:20	01:20	01:20	01:20	01:20	01:20	01:20	01:20	01:20	01:20	63	
62	01:37	01:37	01:32	01:32	01:26	01:26	01:22	01:22	01:16	01:16	01:16	01:16	01:16	01:16	01:16	01:16	01:16	01:16	01:16	01:16	01:16	62	
61	01:33	01:33	01:28	01:28	01:23	01:23	01:18	01:18	01:13	01:13	01:13	01:13	01:13	01:13	01:13	01:13	01:13	01:13	01:13	01:13	01:13	61	
60	01:30	01:30	01:25	01:25	01:20	01:20	01:15	01:15	01:10	01:10	01:10	01:10	01:10	01:10	01:10	01:10	01:10	01:10	01:10	01:10	01:10	60	

TABLE CONTINUES NEXT PAGE

²⁸⁵ Source: U.S. Army, 7–8.

	Plank(PLK) (maintain proper straightline position (Time: minutes and seconds))																				
	17-21		22-26		27-31		32-36		37-41		42-46		47-51		52-56		57-61		Over 62		
Points	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Points
60	01:30	01:30	01:25	01:25	01:20	01:20	01:15	01:15	01:10	01:10	01:10	01:10	01:10	01:10	01:10	01:10	01:10	01:10	01:10	01:10	60
59	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	59
58	01:29	01:29	01:24	01:24	01:19	01:19	01:14	01:14	01:09	01:09	01:09	01:09	01:09	01:09	01:09	01:09	01:09	01:09	01:09	01:09	58
57	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	57
56	01:28	01:28	01:23	01:23	01:18	01:18	01:13	01:13	01:08	01:08	01:08	01:08	01:08	01:08	01:08	01:08	01:08	01:08	01:08	01:08	56
55	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	55
54	01:27	01:27	01:22	01:22	01:17	01:17	01:12	01:12	01:07	01:07	01:07	01:07	01:07	01:07	01:07	01:07	01:07	01:07	01:07	01:07	54
53	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	53
52	01:26	01:26	01:21	01:21	01:16	01:16	01:11	01:11	01:06	01:06	01:06	01:06	01:06	01:06	01:06	01:06	01:06	01:06	01:06	01:06	52
51	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	51
50	01:25	01:25	01:20	01:20	01:15	01:15	01:10	01:10	01:05	01:05	01:05	01:05	01:05	01:05	01:05	01:05	01:05	01:05	01:05	01:05	60
49	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	49
48	01:24	01:24	01:19	01:19	01:14	01:14	01:09	01:09	01:04	01:04	01:04	01:04	01:04	01:04	01:04	01:04	01:04	01:04	01:04	01:04	48
47	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	47
46	01:23	01:23	01:18	01:18	01:13	01:13	01:08	01:08	01:03	01:03	01:03	01:03	01:03	01:03	01:03	01:03	01:03	01:03	01:03	01:03	46
45	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	45
44	01:22	01:22	01:17	01:17	01:12	01:12	01:07	01:07	01:02	01:02	01:02	01:02	01:02	01:02	01:02	01:02	01:02	01:02	01:02	01:02	44
43	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	43
42	01:21	01:21	01:16	01:16	01:11	01:11	01:06	01:06	01:01	01:01	01:01	01:01	01:01	01:01	01:01	01:01	01:01	01:01	01:01	01:01	42
41	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	41
40	01:20	01:20	01:15	01:15	01:10	01:10	01:05	01:05	01:00	01:00	01:00	01:00	01:00	01:00	01:00	01:00	01:00	01:00	01:00	01:00	40
39	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	39
38	01:19	01:19	01:14	01:14	01:09	01:09	01:04	01:04	00:59	00:59	00:59	00:59	00:59	00:59	00:59	00:59	00:59	00:59	00:59	00:59	38
37	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	37
36	01:18	01:18	01:13	01:13	01:08	01:08	01:03	01:03	00:58	00:58	00:58	00:58	00:58	00:58	00:58	00:58	00:58	00:58	00:58	00:58	36
35	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	35
34	01:17	01:17	01:12	01:12	01:07	01:07	01:02	01:02	00:57	00:57	00:57	00:57	00:57	00:57	00:57	00:57	00:57	00:57	00:57	00:57	34
33	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	33
32	01:16	01:16	01:11	01:11	01:06	01:06	01:01	01:01	00:56	00:56	00:56	00:56	00:56	00:56	00:56	00:56	00:56	00:56	00:56	00:56	32
31	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	31
30	01:15	01:15	01:10	01:10	01:05	01:05	01:00	01:00	00:55	00:55	00:55	00:55	00:55	00:55	00:55	00:55	00:55	00:55	00:55	00:55	30
29	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	29
28	01:14	01:14	01:09	01:09	01:04	01:04	00:59	00:59	00:54	00:54	00:54	00:54	00:54	00:54	00:54	00:54	00:54	00:54	00:54	00:54	28
27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	27
26	01:13	01:13	01:08	01:08	01:03	01:03	00:58	00:58	00:53	00:53	00:53	00:53	00:53	00:53	00:53	00:53	00:53	00:53	00:53	00:53	26
25	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	25
24	01:12	01:12	01:07	01:07	01:02	01:02	00:57	00:57	00:52	00:52	00:52	00:52	00:52	00:52	00:52	00:52	00:52	00:52	00:52	00:52	24
23	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	23
22	01:11	01:11	01:06	01:06	01:01	01:01	00:56	00:56	00:51	00:51	00:51	00:51	00:51	00:51	00:51	00:51	00:51	00:51	00:51	00:51	22
21	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	21
20	01:10	01:10	01:05	01:05	01:00	01:00	00:55	00:55	00:50	00:50	00:50	00:50	00:50	00:50	00:50	00:50	00:50	00:50	00:50	00:50	20
19	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	19
18	01:09	01:09	01:04	01:04	00:59	00:59	00:54	00:54	00:49	00:49	00:49	00:49	00:49	00:49	00:49	00:49	00:49	00:49	00:49	00:49	18
17	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	17
16	01:08	01:08	01:03	01:03	00:58	00:58	00:53	00:53	00:48	00:48	00:48	00:48	00:48	00:48	00:48	00:48	00:48	00:48	00:48	00:48	16
15	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	15
14	01:07	01:07	01:02	01:02	00:57	00:57	00:52	00:52	00:47	00:47	00:47	00:47	00:47	00:47	00:47	00:47	00:47	00:47	00:47	00:47	14
13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	13
12	01:06	01:06	01:01	01:01	00:56	00:56	00:51	00:51	00:46	00:46	00:46	00:46	00:46	00:46	00:46	00:46	00:46	00:46	00:46	00:46	12
11	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	11
10	01:05	01:05	01:00	01:00	00:55	00:55	00:50	00:50	00:45	00:45	00:45	00:45	00:45	00:45	00:45	00:45	00:45	00:45	00:45	00:45	10
9	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9
8	01:04	01:04	00:59	00:59	00:54	00:54	00:49	00:49	00:44	00:44	00:44	00:44	00:44	00:44	00:44	00:44	00:44	00:44	00:44	00:44	8
7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	7
6	01:03	01:03	00:58	00:58	00:53	00:53	00:48	00:48	00:43	00:43	00:43	00:43	00:43	00:43	00:43	00:43	00:43	00:43	00:43	00:43	6
5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	5
4	01:02	01:02	00:57	00:57	00:52	00:52	00:47	00:47	00:42	00:42	00:42	00:42	00:42	00:42	00:42	00:42	00:42	00:42	00:42	00:42	4
3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3
2	01:01	01:01	00:56	00:56	00:51	00:51	00:46	00:46	00:41	00:41	00:41	00:41	00:41	00:41	00:41	00:41	00:41	00:41	00:41	00:41	2
1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1
0	01:00	01:00	00:55	00:55	00:50	00:50	00:45	00:45	00:40	00:40	00:40	00:40	00:40	00:40	00:40	00:40	00:40	00:40	00:40	00:40	0

Table 15. Two-Mile Run.²⁸⁶

	Two-Mile Run (2MR) (Overall time - minutes and seconds)																				
	17-21		22-26		27-31		32-36		37-41		42-46		47-51		52-56		57-61		Over 62		
Points	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Points
100	13:22	15:29	13:27	15:00	13:31	15:00	13:42	15:18	13:58	15:30	14:05	15:49	14:30	15:58	15:09	16:29	15:28	17:18	15:28	17:18	100
99	13:42	15:55	13:50	15:30	13:58	15:30	14:06	15:46	14:20	15:56	14:29	16:12	14:54	16:14	15:34	17:01	15:55	17:47	15:55	17:47	99
98	14:00	16:16	14:08	15:51	14:15	15:53	14:25	16:07	14:37	16:18	14:48	16:35	15:14	16:36	15:55	17:22	16:22	17:56	16:22	17:56	98
97	14:15	16:34	14:25	16:09	14:31	16:10	14:40	16:28	14:53	16:36	15:04	16:50	15:32	16:56	16:14	17:38	16:44	18:00	16:44	18:00	97
96	14:28	16:48	14:38	16:26	14:45	16:26	14:54	16:43	15:06	16:51	15:20	17:07	15:48	17:15	16:28	17:50	16:58	18:25	16:58	18:25	96
95	14:40	17:01	14:50	16:39	14:57	16:40	15:06	16:57	15:19	17:04	15:33	17:24	16:02	17:28	16:42	18:00	17:14	18:31	17:14	18:31	95
94	14:51	17:14	15:01	16:52	15:07	16:54	15:18	17:08	15:30	17:18	15:45	17:35	16:15	17:39	16:55	18:13	17:27	18:36	17:27	18:36	94
93	15:00	17:27	15:13	17:04	15:19	17:05	15:30	17:20	15:41	17:30	15:56	17:47	16:27	17:53	17:06	18:20	17:45	18:46	17:45	18:46	93
92	15:11	17:37	15:23	17:16	15:30	17:17	15:39	17:30	15:51	17:41	16:06	17:56	16:36	18:00	17:16	18:30	17:57	18:48	17:57	18:48	92
91	15:20	17:47	15:32	17:28	15:39	17:27	15:49	17:41	16:00	17:52	16:18	18:06	16:46	18:12	17:26	18:40	18:07	18:56	18:07	18:56	91
90	15:30	17:56	15:43	17:37	15:48	17:35	15:58	17:50	16:10	18:00	16:28	18:16	16:57	18:24	17:36	18:53	18:17	18:59	18:17	18:59	90
89	15:39	18:04	15:53	17:47	15:58	17:46	16:07	18:00	16:20	18:10	16:38	18:26	17:07	18:34	17:48	19:02	18:25	19:04	18:25	19:04	89
88	15:48	18:13	16:01	17:57	16:05	17:55	16:16	18:09	16:30	18:20	16:47	18:35	17:16	18:44	17:57	19:14	18:36	19:14	18:36	19:14	88
87	15:57	18:22	16:10	18:04	16:15	18:02	16:25	18:18	16:38	18:30	16:55	18:44	17:26	18:55	18:04	19:29	18:45	19:29	18:45	19:29	87
86	16:05	18:30	16:20	18:13	16:24	18:12	16:32	18:27	16:46	18:36	17:04	18:53	17:34	19:04	18:15	19:36	18:53	19:41	18:53	19:41	86
85	16:14	18:39	16:29	18:23	16:32	18:21	16:41	18:36	16:55	18:45	17:12	19:01	17:43	19:13	18:24	19:45	19:00	19:45	19:00	19:45	85
84	16:22	18:46	16:37	18:30	16:41	18:30	16:49	18:45	17:03	18:52	17:21	19:10	17:51	19:22	18:32	19:58	19:07	19:58	19:07	19:58	84
83	16:30	18:54	16:46	18:39	16:49	18:37	16:58	18:52	17:13	19:00	17:30	19:19	18:00	19:30	18:40	20:02	19:17	20:02	19:17	20:02	83
82	16:39	19:00	16:55	18:48	16:58	18:46	17:05	19:00	17:21	19:05	17:38	19:27	18:06	19:40	18:49	20:07	19:27	20:07	19:27	20:07	82
81	16:48	19:09	17:04	18:56	17:05	18:54	17:15	19:07	17:30	19:14	17:47	19:36	18:16	19:45	18:56	20:17	19:36	20:17	19:36	20:17	81
80	16:57	19:17	17:13	19:03	17:14	19:00	17:23	19:15	17:38	19:22	17:55	19:45	18:26	19:52	19:03	20:22	19:45	20:22	19:45	20:22	80
79	17:05	19:24	17:22	19:12	17:23	19:08	17:31	19:23	17:45	19:30	18:00	19:51	18:33	19:59	19:13	20:31	19:51	20:31	19:51	20:31	79
78	17:15	19:32	17:30	19:21	17:31	19:16	17:40	19:31	17:54	19:37	18:10	19:58	18:42	20:06	19:21	20:38	19:59	20:38	19:59	20:38	78
77	17:24	19:40	17:40	19:30	17:41	19:25	17:48	19:40	18:00	19:48	18:20	20:02	18:51	20:14	19:30	20:43	20:07	20:43	20:07	20:43	77
76	17:33	19:48	17:49	19:39	17:50	19:33	17:56	19:47	18:10	19:56	18:29	20:12	19:00	20:20	19:36	20:44	20:14	20:44	20:14	20:44	76
75	17:43	19:56	17:59	19:47	17:58	19:42	18:03	19:55	18:18	20:02	18:37	20:21	19:07	20:29	19:45	20:44	20:22	20:44	20:22	20:44	75
74	17:52	20:03	18:07	19:56	18:05	19:50	18:12	20:01	18:28	20:12	18:46	20:32	19:17	20:36	19:53	20:50	20:31	20:50	20:31	20:50	74
73	18:01	20:12	18:17	20:04	18:15	19:59	18:23	20:10	18:37	20:20	18:56	20:38	19:27	20:43	20:00	21:03	20:41	21:03	20:41	21:03	73
72	18:12	20:21	18:28	20:14	18:25	20:07	18:33	20:18	18:47	20:30	19:04	20:47	19:36	20:44	20:08	21:15	20:46	21:15	20:46	21:15	72
71	18:23	20:30	18:38	20:23	18:35	20:16	18:43	20:27	18:57	20:38	19:16	20:57	19:47	20:52	20:18	21:32	20:54	21:32	20:54	21:32	71
70	18:35	20:40	18:50	20:32	18:46	20:25	18:53	20:35	19:06	20:46	19:26	21:00	19:57	21:09	20:27	21:40	21:00	21:40	21:00	21:40	70
69	18:47	20:49	19:00	20:43	18:58	20:36	19:03	20:44	19:19	20:55	19:38	21:08	20:06	21:24	20:39	21:43	21:01	21:43	21:01	21:43	69
68	19:00	20:58	19:13	20:53	19:09	20:45	19:16	20:54	19:30	21:00	19:50	21:20	20:17	21:36	20:49	21:59	21:19	21:59	21:19	22:02	68
67	19:12	21:03	19:26	21:00	19:22	20:56	19:28	21:00	19:42	21:04	20:00	21:35	20:28	21:49	20:59	22:09	21:35	22:09	21:35	22:15	67
66	19:27	21:20	19:40	21:06	19:36	21:00	19:41	21:05	19:55	21:20	20:10	21:51	20:40	22:01	21:00	22:23	21:47	22:23	21:47	22:31	66
65	19:43	21:37	19:56	21:24	19:51	21:15	19:56	21:27	20:07	21:36	20:25	22:05	20:53	22:13	21:16	22:33	22:03	22:33	22:03	22:44	65
64	20:00	21:54	20:12	21:44	20:06	21:34	20:11	21:48	20:22	21:56	20:40	22:20	21:00	22:28	21:39	22:43	22:21	22:43	22:21	22:50	64
63	20:19	22:11	20:30	22:03	20:25	21:56	20:29	22:06	20:41	22:11	20:58	22:36	21:13	22:35	22:00	22:52	22:39	23:01	22:39	23:04	63
62	20:42	22:35	20:52	22:24	20:46	22:18	20:49	22:30	21:00	22:34	21:00	22:53	21:43	22:50	22:24	23:04	22:58	23:22	22:58	23:22	62
61	21:03	22:58	21:14	22:50	21:00	22:46	21:01	22:55	21:17	23:00	21:44	23:10	22:17	23:25	22:53	23:44	23:12	24:05	23:12	24:11	61
60	22:00	23:22	22:00	23:15	22:00	23:13	22:00	23:19	22:11	23:23	22:32	23:42	22:55	24:00	23:20	24:24	23:36	24:48	23:36	25:00	60

TABLE CONTINUES NEXT PAGE

²⁸⁶ Source: U.S. Army, 9–10.

Two-Mile Run (2MR) (Overall time - minutes and seconds)													Points								
17-21		22-26		27-31		32-36		37-41		42-46											
M	F	M	F	M	F	M	F	M	F	M	F										
60	22:00	23:22	22:00	23:15	22:00	23:13	22:00	23:19	22:11	23:23	22:32	23:42	22:55	24:00	23:20	24:24	23:36	24:48	23:36	25:00	60
59	22:01	23:23	22:01	23:16	22:01	23:14	22:01	23:20	22:12	23:24	22:33	23:43	22:56	24:01	23:21	24:25	23:37	24:49	23:37	25:01	59
58	22:03	23:25	22:03	23:18	22:03	23:16	22:03	23:22	22:14	23:26	22:35	23:45	22:58	24:03	23:23	24:27	23:39	24:51	23:39	25:03	58
57	22:05	23:27	22:05	23:20	22:05	23:18	22:05	23:24	22:16	23:28	22:37	23:47	23:00	24:05	23:25	24:29	23:41	24:53	23:41	25:05	57
56	22:07	23:29	22:07	23:22	22:07	23:20	22:07	23:26	22:18	23:30	22:39	23:49	23:02	24:07	23:27	24:31	23:43	24:55	23:43	25:07	56
55	22:09	23:31	22:09	23:24	22:09	23:22	22:09	23:28	22:20	23:32	22:41	23:51	23:04	24:09	23:29	24:33	23:45	24:57	23:45	25:09	55
54	22:11	23:33	22:11	23:26	22:11	23:24	22:11	23:30	22:22	23:34	22:43	23:53	23:06	24:11	23:31	24:35	23:47	24:59	23:47	25:11	54
53	22:13	23:35	22:13	23:28	22:13	23:26	22:13	23:32	22:24	23:36	22:45	23:55	23:08	24:13	23:33	24:37	23:49	25:01	23:49	25:13	53
52	22:15	23:37	22:15	23:30	22:15	23:28	22:15	23:34	22:26	23:38	22:47	23:57	23:10	24:15	23:35	24:39	23:51	25:03	23:51	25:15	52
51	22:17	23:39	22:17	23:32	22:17	23:30	22:17	23:36	22:28	23:40	22:49	23:59	23:12	24:17	23:37	24:41	23:53	25:05	23:53	25:17	51
50	22:19	23:41	22:19	23:34	22:19	23:32	22:19	23:38	22:30	23:42	22:51	24:01	23:14	24:19	23:39	24:43	23:55	25:07	23:55	25:19	50
49	22:21	23:43	22:21	23:36	22:21	23:34	22:21	23:40	22:32	23:44	22:53	24:03	23:16	24:21	23:41	24:45	23:57	25:09	23:57	25:21	49
48	22:23	23:45	22:23	23:38	22:23	23:36	22:23	23:42	22:34	23:46	22:55	24:05	23:18	24:23	23:43	24:47	23:59	25:11	23:59	25:23	48
47	22:25	23:47	22:25	23:40	22:25	23:38	22:25	23:44	22:36	23:48	22:57	24:07	23:20	24:25	23:45	24:49	24:01	25:13	24:01	25:25	47
46	22:27	23:49	22:27	23:42	22:27	23:40	22:27	23:46	22:38	23:50	22:59	24:09	23:22	24:27	23:47	24:51	24:03	25:15	24:03	25:27	46
45	22:29	23:51	22:29	23:44	22:29	23:42	22:29	23:48	22:40	23:52	23:01	24:11	23:24	24:29	23:49	24:53	24:05	25:17	24:05	25:29	45
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43	22:33	23:55	22:33	23:48	22:33	23:46	22:33	23:52	22:44	23:56	23:05	24:15	23:28	24:33	23:53	24:57	24:09	25:21	24:09	25:33	43
42	22:35	23:57	22:35	23:50	22:35	23:48	22:35	23:54	22:46	23:58	23:07	24:17	23:30	24:35	23:55	24:59	24:11	25:23	24:11	25:35	42
41	22:37	23:59	22:37	23:52	22:37	23:50	22:37	23:56	22:48	24:00	23:09	24:19	23:32	24:37	23:57	25:01	24:13	25:25	24:13	25:37	41
40	22:39	24:01	22:39	23:54	22:39	23:52	22:39	23:58	22:50	24:02	23:11	24:21	23:34	24:39	23:59	25:03	24:15	25:27	24:15	25:39	40
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38	22:43	24:05	22:43	23:58	22:43	23:56	22:43	24:02	22:54	24:06	23:15	24:25	23:38	24:43	24:03	25:07	24:19	25:31	24:19	25:43	38
37	22:45	24:07	22:45	24:00	22:45	23:58	22:45	24:04	22:56	24:08	23:17	24:27	23:40	24:45	24:05	25:09	24:21	25:33	24:21	25:45	37
36	22:47	24:09	22:47	24:02	22:47	24:00	22:47	24:06	22:58	24:10	23:19	24:29	23:42	24:47	24:07	25:11	24:23	25:35	24:23	25:47	36
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33	22:53	24:15	22:53	24:08	22:53	24:06	22:53	24:12	23:04	24:16	23:25	24:35	23:48	24:53	24:13	25:17	24:29	25:41	24:29	25:53	33
32	22:55	24:17	22:55	24:10	22:55	24:08	22:55	24:14	23:06	24:18	23:27	24:37	23:50	24:55	24:15	25:19	24:31	25:43	24:31	25:55	32
31	22:57	24:19	22:57	24:12	22:57	24:10	22:57	24:16	23:08	24:20	23:29	24:39	23:52	24:57	24:17	25:21	24:33	25:45	24:33	25:57	31
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29	23:02	24:24	23:02	24:17	23:02	24:15	23:02	24:21	23:13	24:25	23:34	24:44	23:57	25:02	24:22	25:26	24:38	25:50	24:38	26:02	29
28	23:04	24:26	23:04	24:19	23:04	24:17	23:04	24:23	23:15	24:27	23:36	24:46	23:59	25:04	24:24	25:28	24:40	25:52	24:40	26:04	28
27	23:06	24:28	23:06	24:21	23:06	24:19	23:06	24:25	23:17	24:29	23:38	24:48	24:01	25:06	24:26	25:30	24:42	25:54	24:42	26:06	27
26	23:08	24:30	23:08	24:23	23:08	24:21	23:08	24:27	23:19	24:31	23:40	24:50	24:03	25:08	24:28	25:32	24:44	25:56	24:44	26:08	26
25	23:10	24:32	23:10	24:25	23:10	24:23	23:10	24:29	23:21	24:33	23:42	24:52	24:05	25:10	24:30	25:34	24:46	25:58	24:46	26:10	25
24	23:12	24:34	23:12	24:27	23:12	24:25	23:12	24:31	23:23	24:35	23:44	24:54	24:07	25:12	24:32	25:36	24:48	26:00	24:48	26:12	24
23	23:14	24:36	23:14	24:29	23:14	24:27	23:14	24:33	23:25	24:37	23:46	24:56	24:09	25:14	24:34	25:38	24:50	26:02	24:50	26:14	23
22	23:16	24:38	23:16	24:31	23:16	24:29	23:16	24:35	23:27	24:39	23:48	24:58	24:11	25:16	24:36	25:40	24:52	26:04	24:52	26:16	22
21	23:18	24:40	23:18	24:33	23:18	24:31	23:18	24:37	23:29	24:41	23:50	25:00	24:13	25:18	24:38	25:42	24:54	26:06	24:54	26:18	21
20	23:20	24:42	23:20	24:35	23:20	24:33	23:20	24:39	23:31	24:43	23:52	25:02	24:15	25:20	24:40	25:44	24:56	26:08	24:56	26:20	20
19	23:22	24:44	23:22	24:37	23:22	24:35	23:22	24:41	23:33	24:45	23:54	25:04	24:17	25:22	24:42	25:46	24:58	26:10	24:58	26:22	19
18	23:24	24:46	23:24	24:39	23:24	24:37	23:24	24:43	23:35	24:47	23:56	25:06	24:19	25:24	24:44	25:48	25:00	26:12	25:00	26:24	18
17	23:26	24:48	23:26	24:41	23:26	24:39	23:26	24:45	23:37	24:49	23:58	25:08	24:21	25:26	24:46	25:50	25:02	26:14	25:02	26:26	17
16	23:28	24:50	23:28	24:43	23:28	24:41	23:28	24:47	23:39	24:51	24:00	25:10	24:23	25:28	24:48	25:52	25:04	26:16	25:04	26:28	16
15	23:30	24:52	23:30	24:45	23:30	24:43	23:30	24:49	23:41	24:53	24:02	25:12	24:25	25:30	24:50	25:54	25:06	26:18	25:06	26:30	15
14	23:32	24:54	23:32	24:47	23:32	24:45	23:32	24:51	23:43	24:55	24:04	25:14	24:27	25:32	24:52	25:56	25:08	26:20	25:08	26:32	14
13	23:34	24:56	23:34	24:49	23:34	24:47	23:34	24:53	23:45	24:57	24:06	25:16	24:29	25:34	24:54	25:58	25:10	26:22	25:10	26:34	13
12	23:36	24:58	23:36	24:51	23:36	24:49	23:36	24:55	23:47	24:59	24:08	25:18	24:31	25:36	24:56	26:00	25:12	26:24	25:12	26:36	12
11	23:38	25:00	23:38	24:53	23:38	24:51	23:38	24:57	23:49	25:01	24:10	25:20	24:33	25:38	24:58	26:02	25:14	26:26	25:14	26:38	11
10	23:40	25:02	23:40	24:55	23:40	24:53	23:40	24:59	23:51	25:03	24:12	25:22	24:35	25:40	25:00	26:04	25:16	26:28	25:16	26:40	10
9	23:42	25:04	23:42	24:57	23:42	24:55	23:42	25:01	23:53	25:05	24:14	25:24	24:37	25:42	25:02	26:06	25:18	26:30	25:18	26:42	9
8	23:44	25:06	23:44	24:59	23:44	24:57	23:44	25:03	23:55	25:07	24:16	25:26	24:39	25:44	25:04	26:08	25:20	26:32	25:20	26:44	8
7	23:46	25:08	23:46	25:01	23:46	24:59	23:46	25:05	23:57	25:09	24:18	25:28	24:41	25:46	25:06	26:10	25:22	26:34	25:22	26:46	7
6	23:48	25:10	23:48	25:03	23:48	25:01	23:48	25:07	23:59	25:11	24:2										

Table 16. Alternate Events (Go/No-Go).²⁸⁷

		Alternate Events (Go/No-Go) (Overall time for required distance - minutes and seconds)																		
		17-21		22-26		27-31		32-36		37-41		42-46		47-51		52-56		57-61		Over 62
Event	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
2.5-mile Walk	31:00	34:00	30:45	33:30	30:30	33:00	30:45	33:30	31:00	34:00	31:00	34:00	32:00	35:00	32:00	35:00	33:00	36:00	33:00	36:00
12 km Bike	26:25	28:58	26:12	28:31	26:00	28:07	26:12	28:31	26:25	28:58	26:25	28:58	27:16	29:50	27:16	29:50	28:07	30:41	28:07	30:41
1 km Swim	30:48	33:48	30:30	33:18	30:20	32:48	30:30	33:18	30:48	33:48	30:48	33:48	31:48	34:48	31:48	34:48	32:50	35:48	32:50	35:48
5 km Row	30:48	33:48	30:30	33:18	30:20	32:48	30:30	33:18	30:48	33:48	30:48	33:48	31:48	34:48	31:48	34:48	32:50	35:48	32:50	35:48

²⁸⁷ Source: U.S. Army, 11.

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APPENDIX C. COMMERCIAL DIVING MEDICAL AND FITNESS REPORT

Table 17. ADCI Physical Examination Standards.²⁸⁸

1	Name	Record.
2	Social Security Number or Passport Number	Record.
3	Height	No set limits.
4	Weight	The weight limits listed in the maximum allowable weight chart (2.4.9) should apply. If a diver exceeds these limits and the cognizant physician feels the increase is due to muscular build and physical fitness, a variance may be appropriate. A variance may be appropriate for divers who do not meet the weight limits but are at 23% body fat or less as measured by impedance or hydrostatic fat testing. Furthermore, individuals who fall within these weight limits but who present an excess of fatty tissue should be disqualified.
5	Body Fat	Optional. According to US Navy, 23% for males, 34% for females.
6	Body Mass Index (BMI)	Optional. Calculation for BMI = $(\text{weight in pounds} \times 703) / \text{height in inches}^2$. The maximum BMI allowable according to the U.S. Navy height and weight table is 28.
7	Temperature	The diver should be free of any infection/disease that would cause an abnormal temperature.
8	Blood Pressure	The resting blood pressure should not exceed 140/90 mm Hg. In cases of apparent hypertension, repeated daily blood pressure determinations should be made before a final decision is made. The blood pressure should be controlled without target organ damage. Beta blockers are not acceptable. Low-dose diuretics are acceptable. Medications required to control blood pressure should be noted on the physical exam form.
9	Pulse/Rhythm	Persistent tachycardia, arrhythmia except of the sinus type, or other significant disturbance of the heart or vascular system should be evaluated and may be disqualifying.
10	General Appearance/Hygiene	Should be good.
11	Distant Vision	Vision must be tested with and without correction when applicable. Should have vision corrected to 20/40, in both eyes. Monocular vision is not necessarily disqualifying for commercial diving. Divers who have had vision corrective surgery should be restricted from diving until cleared by a qualified diving physician and ophthalmologist.
12	Near Vision	Correctable to 20/40.
13	Color Vision	Record. Color blindness does not disqualify for diving, but diver must have color vision specific for duties.
14	Field of Vision	Should be normal, with any discrepancies documented. A minimum of 85 degrees field of vision is required.
15	Contact Lenses	Record if used. Appropriate lenses for diving may be used (gas permeable/fenestrated hard lens). Vision must be recorded with and without contact lenses.
16	Head, Face and Scalp	Some causes for rejection may include: a) Deformities of the skull in the nature of depressions, exostosis, etc., of a degree that would prevent the individual from wearing required equipment. b) Deformities of the skull of any degree associated with evidence of disease of the brain, spinal cord or peripheral nerves. c) Loss or congenital absence of the bony substance of the skull.

²⁸⁸ Source: Association of Diving Contractors International, "Diving Personnel Medical and Training Requirements," 9–12.

17	Neck	Conditions affecting the neck must not impair the diver to cause insufficient range of motion. The causes for rejection may include: a) Cervical ribs if symptomatic. b) Congenital cysts of bronchial cleft origin or those developing from the remnants of the thyroglossal duct, with or without fistulous tracts. c) Fistula, chronic draining, of any type. d) Spastic contraction of the muscles of the neck of a persistent and chronic nature. e) Neural impingement.
18	Eyes	Active pathology or previous eye surgery may be cause for restriction or rejection. Divers who have had vision corrective surgery should be restricted from diving until cleared by a qualified diving physician and ophthalmologist. History of cataract surgery with intraocular lens implant is not disqualifying.
19	Fundus	Optional. No pathology.
20	Through # 24	The following conditions are disqualifying: a) Acute disease including vestibular disease. b) Chronic serious otitis. c) Active otitis media. d) Current perforation of the tympanic membrane. e) PE tubes in place. f) Any significant nasal or pharyngeal respiratory obstruction. g) Chronic sinusitis if not readily controlled. h) Speech impediments due to organic defects. i) Inability to equalize pressure due to any cause. j) Recurrent or persistent vertigo. k) Recent piercings are disqualifying until healed. If Eustachian tube dysfunction is suspected, then referral or testing should be done. Adequately repaired round window ruptures that have no significant residual deficits may be approved for diving.
25	Mouth and Throat	a) Candidate should have a high degree of dental fitness; any abnormalities of dentition or malformation of the mandible likely to impair the diver's ability to securely and easily retain any standard equipment mouthpiece should disqualify. b) Removable dentures should not be worn while diving. c) Severe dental caries is disqualifying until repaired.
26	Chest (include breasts)	Note any chest deformities, breast abnormalities or masses.
27	Lungs	Pulmonary: Congenital and acquired defects that may restrict pulmonary function, cause air entrapment, or affect the ventilation-perfusion or balance shall be disqualifying for both initial training and continuation. Obstructive or restrictive pulmonary functions require further evaluation. Pulmonary disease requiring medication use may be disqualifying. History of recurrent or spontaneous pneumothorax is disqualifying.
28	Heart (thrust, size, rhythm, sounds)	Any evidence of heart disease or arrhythmias other than sinus arrhythmias must be fully investigated. For evaluation purposes, Bruce protocol functional stress testing through stage III must be to at least 10 METS without evidence of ischemia. Pacemakers and implantable cardiac defibrillators are disqualifying. PFO repairs are not disqualifying. Routine PFO testing is not recommended. Coumadin or any anticoagulants, antiplatelet medications and aspirin (except low dose aspirin) are considered disqualifying. Ejection fractions must be at least 40% if measured.
29	Pulse	Record. Peripheral pulses should be regular, full and symmetric.

30	Vascular System (varicosities, etc.)	Cardiovascular system: The cardiovascular system shall be without significant abnormality in all respects as determined by physical examination and tests as may be indicated. Evidence of symptomatic arteriosclerosis, severe varicose veins and marked symptomatic hemorrhoids may be disqualifying.
31	Abdomen and Viscera	a) Active peptic ulceration should be disqualifying until treated and healing has been documented. History of gastrointestinal bleeding may be disqualifying from diving and is disqualifying from saturation diving. b) Any other chronic gastrointestinal disease (e.g., ulcerative colitis, cholelithiasis) may be cause for rejection. c) Crohn's disease may be disqualifying. d) Hepatitis may be disqualifying. e) Colostomies should be disqualified for saturation diving.
32	Hernia (all types)	All inguinal or femoral hernias are disqualifying until repaired. Ventral hernias more than one cm must be repaired prior to diving.
33	Endocrine System	Diabetics controlled only with diet and exercise and with Hgb A1C < 7.0 are acceptable. History of thyroid disease adequately controlled with medication is acceptable to dive. Any other endocrine disorders requiring medication may be disqualifying.
34	G-U System (genital-urinary)	a) Gonococcal disease, syphilis, chlamydia and genital herpes will disqualify until adequately treated. b) Evidence or history of nephrolithiasis must be fully investigated and treated and may be disqualifying. c) Any renal insufficiency or chronic renal disease may be disqualifying. d) History of kidney stones may be disqualifying for surface and saturation diving. Divers with a history of kidney stones should have periodic evaluation by a urologist to determine the presence of stones. e) Evidence or history of urinary dysfunction or retention must be fully investigated and treated.
35	Upper Extremities (strength, ROM)	Any impairment of musculoskeletal function should be carefully assessed against the general requirements that would interfere with the individual's performance as a diver. Amputations may be disqualifying. Orthopedic internal fixation hardware is not disqualifying if the fracture site is healed.
36	Lower Extremities, Except Feet	Any impairment of musculoskeletal function should be carefully assessed against the general requirements that would interfere with the individual's performance as a diver. Amputations may be disqualifying. Orthopedic internal fixation hardware is not disqualifying if the fracture site is healed.
37	Feet	Any impairment of musculoskeletal function should be carefully assessed against the general requirements that would interfere with the individual's performance as a diver.
38	Spine	Any impairment of musculoskeletal function should be carefully assessed against the general requirements that would interfere with the individual's performance as a diver. Neural impingement or nerve root displacement is considered disqualifying even if asymptomatic.
39	Skin and Lymphatic System	Active, acute or chronic disease of the skin or lymphatic system may be disqualifying. Tattoos must be fully healed prior to diving.
40	Anus and Rectum	Any conditions that interfere with normal function (e.g., stricture, prolapse, severe hemorrhoids) may be disqualifying.
41	Sphincter Tone	Note and record.
	Neurological Exam (42-49)	A full examination of the central and peripheral nervous system should show normal function, but localized minor abnormalities, such as patches of anesthesia, are allowable provided generalized nervous system disease can be excluded. Any history of seizure (apart from childhood febrile convulsions, oxygen toxicity or withdrawal seizures) is disqualifying. Intracranial surgery, loss of consciousness, and severe head injury involving more than momentary unconsciousness or concussion, may be disqualifying. If the severity of head injury is in doubt, special consultation and studies should be considered. All neurodegenerative conditions are disqualifying.

42	Cranial Nerves	Examine, evaluate and record.
43	Reflexes	Should be symmetrical and free from pathology. Document any abnormalities. Pathological reflexes should be evaluated. Asymmetrical reflexes should be documented.
44	Cerebellar Function	Test and record.
45	Strength and Tone of Muscles	Examine and record. Note any atrophy or loss of tone.
46	Proprioception/ Stereognosis	Examine and record.
47	Nystagmus	Do and record. Congenital nystagmus is not necessarily disqualifying. End point lateral gaze nystagmus is considered normal.
48	Sensations and Vibration	Test and record. Vibration should be tested using a 128 Hz tuning fork. Two point discrimination should be tested at the thumb (C6), middle finger (C7) and the little finger (C8) and should be discernable at 5 mm.
49	Romberg	Do and record. May perform romberg for up to two minutes.
50	Miscellaneous Remarks and Dermatome Diagram	Record findings and comments.
51	Urinalysis	Includes color pH, specific gravity, glucose, albumin and micro, and all results should be within normal limits.
52	Blood Tests	Hematology: Any significant anemia or history of hemolytic disease must be evaluated. When due to a variant hemoglobin state, it shall be disqualifying.
53	Spirometry	All divers must have periodic spirometry to establish Forced Expiratory Volume at one (1) second (FEV1), Forced Vital Capacity (FVC) , and FEF 25-75 recording best of three measurements using American Thoracic Society standards. FEV1 and FVC should both be 75% or over using NHANES reference values. If either or both are below 75%, then the diver should be referred for functional stress testing under Bruce protocol to at least 10 METS.
54	X-ray/Imaging	a) 14 x 17 chest: PA and lateral every three years. No pathology within normal limits. b) Lumbar/sacral spine (optional on new hire). c) Long bones (optional): Any lesions, especially juxta-articular, should be evaluated to determine patient's fitness to dive. d) MRI (optional): Neural impingement or nerve root displacement on MRI examinations are disqualifying.
55	Electrocardiogram	ECG examinations: Resting standard 12 lead ECG are optional on new hire examinations and required annually after the age of 35. Exercise stress tests should be considered and may be indicated after the age of 40.
56	Audiogram Pure Tone	A hearing loss in either ear of 40 dB in the range of 500, 1000 and 2000 Hz may be an indication for referral of the candidate to a specialist for further opinion, unless the examining doctor is convinced that such a hearing loss is unlikely to be significantly increased by continued diving activities. Doubts about function of labyrinths require specialized examination. Monaural hearing is not disqualifying. Hearing ability must be adequate to perform job duties.
57	Comprehensive Metabolic Panel	Optional.
58	Hemoglobin A1C	Required for any history of diabetes.
59	Lipid Panel	Required for Framingham Risk Calculation. Must be done on divers 35 years and older.
60	Drug Screen	Recommended.

Table 18. Medical History Form.²⁸⁹


Association of Diving Contractors International
MEDICAL HISTORY FORM

Employer			Job Title		Date	
1. Last Name	First Name	Middle Name	2. Email Address	3. Date of Birth	4. Gender	5. Last 4 No. of SSN
6. Address (Number, Street)			7. City	8. State	9. Zip Code	10. Area Code - Phone Number ()
11. Emergency Contact Person - Relationship - Address - Telephone Number						12. Cell Phone Number ()

13. MEDICAL HISTORY: Have you ever had or been treated for (positive answers must be explained below):

Yes	No		Yes	No		Yes	No	
☐	☐	Convulsions or Seizures	☐	☐		☐	☐	Shoulder Injury
☐	☐	Epilepsy	☐	☐		☐	☐	Elbow Injury
☐	☐	Concussion or Head Injury	☐	☐		☐	☐	Arm/wrist/hand Injury
☐	☐	Disabling Headaches	☐	☐		☐	☐	Hip/Leg/Ankle Injury
☐	☐	Loss of Balance/Dizziness	☐	☐		☐	☐	Knee Injury or "Trick Knee"
☐	☐	Severe Motion Sickness	☐	☐		☐	☐	Foot Trouble or Injuries
☐	☐	Unconsciousness	☐	☐		☐	☐	Dislocations
☐	☐	Fainting Spells	☐	☐		☐	☐	Swollen Joints
☐	☐	Wear Contacts/Glasses	☐	☐		☐	☐	Broken Bones or Fractures
☐	☐	Color Vision Defect	☐	☐		☐	☐	Varicose Veins
☐	☐	Eye Disease or Injury	☐	☐		☐	☐	Muscle Disease or Weakness
☐	☐	Eye Surgery	☐	☐		☐	☐	Numbness or Paralysis
☐	☐	Hearing Loss	☐	☐		☐	☐	Sleep Disorders
☐	☐	Ear Disease or Injury	☐	☐		☐	☐	Diabetes
☐	☐	Ear Surgery	☐	☐		☐	☐	Goiter or Thyroid Disease
☐	☐	Perforated Eardrum	☐	☐		☐	☐	Blood Disease
☐	☐	Difficulty Clearing	☐	☐		☐	☐	Anemia: Sickle Cell or Other
☐	☐	Nose Bleed	☐	☐		☐	☐	Skin Rash or Disease
☐	☐	Airway Obstruction	☐	☐		☐	☐	Staph Infections
☐	☐	Hay Fever or Allergies	☐	☐		☐	☐	Tumor or Cancer
☐	☐	Chest Pain	☐	☐		☐	☐	Claustrophobia
☐	☐	Heart Murmur	☐	☐		☐	☐	Mental Illness/Depression/Anxiety
☐	☐	Rheumatic Fever	☐	☐		☐	☐	Nervous Breakdown
☐	☐	Heart Attack	☐	☐		☐	☐	Any Sexually Transmitted Disease
☐	☐	Abnormal Heart Rhythm	☐	☐		☐	☐	Contagious Disease
☐	☐	Heart Disease	☐	☐		☐	☐	Prior Military Service
☐	☐	Cardiac Stent or Angioplasty	☐	☐		☐	☐	Other Illness or Injury or Any Other Medical Condition

For Females ONLY	☐	☐	☐	☐	
☐ Irregular Menses	☐	☐	☐	☐	Last Menstrual Period

PLEASE EXPLAIN THE DETAILS OF EACH ITEM CHECKED YES

14. LIST ALL SURGERIES **YEAR**

15. LIST ALL HOSPITALIZATIONS **YEAR**

16. LIST ALL INJURIES **YEAR**

17. LIST ALL MEDICATIONS, PRESCRIPTION OR OVER THE COUNTER

18. ANSWER THE FOLLOWING QUESTIONS:

Every Item Checked Yes Must Be Fully Explained Below		YES	NO			YES	NO
Do you have any physical defects or any partial disabilities?				Have you ever resigned, been terminated, or changed jobs for medical reasons?			
Have you ever been rejected or rated for insurance, employment, license, or armed forces for health reasons?				Have you ever been dismissed from employment because of excess use of drugs or alcohol?			
Have you ever had illnesses, injuries, or lost time accidents from any work that you have done?				Do you have any allergies or reactions to food, chemicals, drugs, insect stings, or marine life?			
Have you been advised to have a surgical operation or medical treatment that has not been done?				Are you presently under the care of a physician? Give physician's name and address on the next page.			

COMMENTS:

²⁸⁹ Source: Association of Diving Contractors International, 13-14.

19. My Personal Physician is: Name _____
 Address _____
 City, State _____
 Phone Number _____

20. DIVING HISTORY How long have you been commercial diving? _____

Surface Air Diving History		Saturation Diving History	
Maximum Depth Surface Air _____		Heliox Yes ☐ No ☐	Maximum Depth _____
Maximum Depth Surface Mixed Gas _____		Trimix Yes ☐ No ☐	Maximum Duration (Days) _____
Longest Bottom Time Air _____		Nitrox Yes ☐ No ☐	
Longest Bottom Time Mixed Gas _____			

21. DIVING EXPERIENCE (Number of years experience):	22. INDICATE THE NUMBER OF DECOMPRESSION INCIDENTS If None put 0 (Zero) List any residuals
Name of Diving School _____	
Air _____	Bends, pain only _____
Mixed Gases _____	Bends, neurological _____
Saturation _____	Chokes _____
	Inner ear _____

23. IN DIVING HAVE YOU HAD A HISTORY OF: (Provide details of dates and severity)

Yes	No	Details	Yes	No	Details
☐	☐	Gas Embolism _____	☐	☐	Lung Squeeze _____
☐	☐	Oxygen Toxicity _____	☐	☐	Near Drowning _____
☐	☐	CO ₂ Toxicity _____	☐	☐	Asphyxiation _____
☐	☐	CO Toxicity _____	☐	☐	Vertigo (Dizziness) _____
☐	☐	Ear/Sinus Squeeze _____	☐	☐	Pneumothorax _____
☐	☐	Ear Drum Rupture _____	☐	☐	Nitrogen Narcosis _____
☐	☐	Deafness _____	☐	☐	Loss of Consciousness _____

24. Have you been involved in a diving accident (decompression sickness or others) since your last physical examination? ☐ Yes ☐ No

25. Date of last physical examination: _____ Name of Physician who performed your last exam _____
 For what company or organization were you last examined? _____ Address of Physician _____
 _____ City, State _____

26. Have you ever had any of the following? If so, give approximate date:

Yes	No	Give Date	Yes	No	Give Date
☐	☐	Chest X-Ray _____	☐	☐	Pulmonary Function Studies _____
☐	☐	Longbone Series _____	☐	☐	Audiogram _____
☐	☐	Back (Spine) X-Ray _____	☐	☐	EKG _____
☐	☐	MRI _____	☐	☐	Exercise (Stress) EKG _____

27. Physician Remarks: _____

I CERTIFY THAT I HAVE REVIEWED THE FOREGOING INFORMATION SUPPLIED BY ME AND THAT IT IS TRUE AND COMPLETE TO THE BEST OF MY KNOWLEDGE. I UNDERSTAND THAT LEAVING OUT OR MISREPRESENTING FACTS CALLED FOR ABOVE MAY BE CAUSE FOR REFUSAL OF EMPLOYMENT OR SEPARATION FROM THE COMPANY. I AUTHORIZE ANY OF THE DOCTORS, HOSPITALS, OR CLINICS MENTIONED ABOVE TO FURNISH THE COMPANY MEDICAL EXAMINER WITH A COMPLETE TRANSCRIPT OF MY MEDICAL RECORD FOR PURPOSES OF PROCESSING MY PHYSICAL EXAM.

Date _____ Signature _____

Table 19. Physical Examination Form.²⁹⁰

Association of Diving Contractors International

PHYSICAL EXAMINATION FORM

Employer		Date		Date of Birth		Age	
1. Last Name		First Name		Middle Name		2. Last 4 No. of SSN or PASSPORT No.	
3. Height (inches)		4. Weight (pounds)		5. Body Fat (%) (Optional)		6. BMI (Optional)	
7. Temperature		8. Blood Pressure		9. Pulse/Rhythm		10. General Appearance/Hygiene	
11. Build							
12. Distant Vision:		13. Near Vision: Jaeger		Near Vision Corrected		14. Color Vision (Test Performed and Results)	
R. 20/		R. 20/		R. 20/			
L. 20/		L. 20/		L. 20/			
15. Field of Vision (Degrees)		R. L. *		16. Contact Lenses		☐ Yes ☐ No	
NORMAL ABNORMAL		Check each item in appropriate column (enter NE for Not Evaluated)		REMARKS			
		17. Head, Face, Scalp					
		18. Neck					
		19. Eyes					
		20. Ears - General (internal and external canal)					
		21. Eustachian Tube Function					
		22. Tympanic Membrane					
		23. Nose (Septal Alignment)					
		24. Sinuses					
		25. Mouth and Throat					
		26. Chest					
		27. Lungs					
		28. Heart (Thrust, Size, Rhythm, Sounds)					
		29. Pulses (Equality, etc.)					
		30. Vascular System (Varicosities, etc.)					
		31. Abdomen and Viscers					
		32. Hernia (All Types)					
		33. Endocrine System					
		34. G-U System					
		35. Upper Extremities (Strength, ROM)					
		36. Lower Extremities (Except Feet)					
		37. Feet					
		38. Spine					
		39. Skin, Lymphatics					
		40. Anus and Rectum					
		41. Sphincter Tone					

NEUROLOGICAL EXAMINATION

42. CRANIAL NERVES

	NORMAL	ABNORMAL	NE
I Olfactory			
II Optic			
III Oculomotor			
IV Trochlear			
V Trigeminal			
VI Abducens			

	NORMAL	ABNORMAL	NE
VII Facial			
VIII Auditory			
IX Glossopharyngeal			
X Vagus			
XI Spinal Accessory			
XII Hypoglossal			

43. REFLEXES

	Left					Right				
	0	1	2	3	4	0	1	2	3	4
Triceps										
Biceps										
Patella										
Achilles										

	Pathological				Superficial			
	Present	Absent	Present	Absent	Present	Absent	NE	
Babinski Hoffman								
Ankle Clonus								
Upper Abdomen								
Lower Abdomen								
Cremasteric								

44. CEREBELLAR FUNCTION

	0	1	2	3	4
Ataxia					
Tremor (intention)					
Finger to Nose					
Heel to Shin (Sliding)					
Rapidly Alternating Movements					

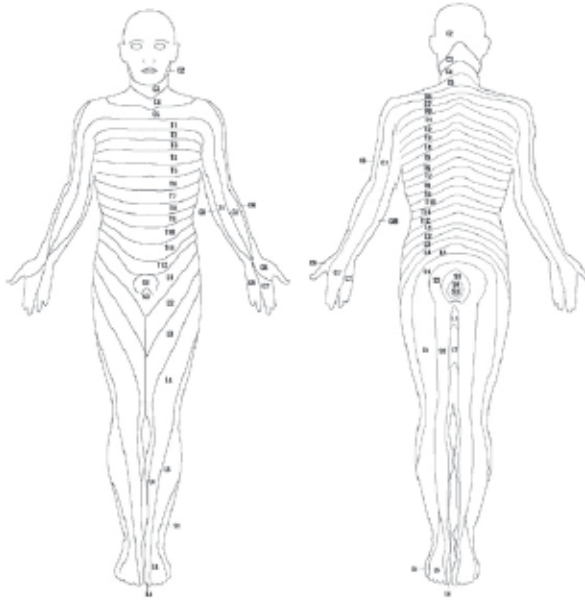
45. MUSCLE

	STRENGTH					TONE	
	1	2	3	4	5	Normal	Abnormal
Right Upper Extremity							
Left Upper Extremity							
Right Lower Extremity							
Left Lower Extremity							

46. PROPIOCEPTION

	Left		Right	
--	------	--	-------	--

²⁹⁰ Source: Association of Diving Contractors International, 15–16.

[illegible]

51. Urinalysis Color _____ Appearance _____ Sp. Gravity _____ Ph _____ Microscopic _____ Normal ☐ Abnormal ☐ (See report)		<table border="1"> <tr> <th></th> <th>0</th> <th>1+</th> <th>2+</th> <th>3+</th> <th>4+</th> </tr> <tr> <td>Sugar</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Blood</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Ketones</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Bilirubin</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Protein</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>			0	1+	2+	3+	4+	Sugar						Blood						Ketones						Bilirubin						Protein						52. Blood Tests CBC _____ Normal ☐ Abnormal ☐ Sickle Cell ☐ Pos ☐ Neg		Attach Reports RPR ☐ Pos ☐ Neg 53. Cardiac Risk Score No. of Points _____ 10 year risk _____	
	0	1+	2+	3+	4+																																						
Sugar																																											
Blood																																											
Ketones																																											
Bilirubin																																											
Protein																																											
54. Pulmonary Function FVC _____ FEV1 _____ FEV1/FVC _____		55. X-ray/MRI Chest ☐ Normal ☐ Abnormal Lumbar Spine ☐ _____ Long Bones ☐ _____ MRI ☐ _____		(Describe) _____ _____ _____																																							
56. Electrocardiogram Static _____ Exercise Stress _____		57. Audiogram <table border="1"> <tr> <th></th> <th>Hz</th> <th>500</th> <th>1000</th> <th>2000</th> <th>3000</th> <th>4000</th> <th>6000</th> <th>8000</th> </tr> <tr> <td>Left</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Right</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>			Hz	500	1000	2000	3000	4000	6000	8000	Left									Right																					
	Hz	500	1000	2000	3000	4000	6000	8000																																			
Left																																											
Right																																											
58. Comprehensive Metabolic Panel Attach Report ☐ Normal ☐ Abnormal ☐		Lipid Panel (if done) Attach Report ☐ Normal ☐ Abnormal ☐		Comments: _____ _____		59. Drug Screen ☐ Not collected ☐ Collected, results sent to employer																																					

☐ Fit for diving
☐ Cleared for supervisor
☐ Cleared for topside work only
☐ Cleared with restrictions: _____
☐ Further evaluation needed: _____
☐ Unfit for diving : _____
☐ Unfit _____
Comments: _____

Examinee Name _____

Physician Signature _____

Physician Name _____

Address _____

Phone Number _____

Date of Examination _____

Page 4 of 4

Table 20. Body Mass Index in Inches and Centimeters.²⁹¹

BMI Table										
Height (inches)	BMI									
	19	20	21	22	23	24	25	26	27	28
	Body Weight (pounds)									
58	91	96	100	105	110	115	119	124	129	134
59	94	99	104	109	114	119	124	128	133	138
60	97	102	107	112	118	123	128	133	138	143
61	100	106	111	116	122	127	132	137	143	148
62	104	109	115	120	126	131	136	142	147	153
63	107	113	118	124	130	135	141	146	152	158
64	110	116	122	128	134	140	145	151	157	163
65	114	120	126	132	138	144	150	156	162	168
66	118	124	130	136	142	148	155	161	167	173
67	121	127	134	140	146	153	159	166	172	178
68	125	131	138	144	151	158	164	171	177	184
69	128	135	142	149	155	162	169	176	182	189
70	132	139	146	153	160	167	174	181	188	195
71	136	143	150	157	165	172	179	186	193	200
72	140	147	154	162	169	177	184	191	199	206
73	144	151	159	166	174	182	189	197	204	212
74	148	155	163	171	179	186	194	202	210	218
75	152	160	168	176	184	192	200	208	216	224
76	156	164	172	180	189	197	205	213	221	230

BMI Table										
Height (Centimeters)	BMI									
	19	20	21	22	23	24	25	26	27	28
	Body Weight (kilograms)									
147.3	41.3	43.5	45.4	47.6	49.9	52.2	54.0	56.2	58.5	60.8
149.9	42.6	44.9	47.2	49.4	51.7	54.0	56.2	58.1	60.3	62.6
152.4	44.0	46.3	48.5	50.8	53.5	55.8	58.1	60.3	62.6	64.9
154.9	45.4	48.1	50.3	52.6	55.3	57.6	59.9	62.1	64.9	67.1
157.5	47.2	49.4	52.2	54.4	57.2	59.4	61.7	64.4	66.7	69.4
160.0	48.5	51.3	53.5	56.2	59.0	61.2	64.0	66.2	68.9	71.7
162.6	49.9	52.6	55.3	58.1	60.8	63.5	65.8	68.5	71.2	73.9
165.1	51.7	54.4	57.2	59.9	62.6	65.3	68.0	70.8	73.5	76.2
167.6	53.5	56.2	59.0	61.7	64.4	67.1	70.3	73.0	75.7	78.5
170.2	54.9	57.6	60.8	63.5	66.2	69.4	72.1	75.3	78.0	80.7
172.7	56.7	59.4	62.6	65.3	68.5	71.7	74.4	77.6	80.3	83.5
175.3	58.1	61.2	64.4	67.6	70.3	73.5	76.7	79.8	82.6	85.7
177.8	59.9	63.0	66.2	69.4	72.6	75.7	78.9	82.1	85.3	88.5
180.3	61.7	64.9	68.0	71.2	74.8	78.0	81.2	84.4	87.5	90.7
182.9	63.5	66.7	69.9	73.5	76.7	80.3	83.5	86.6	90.3	93.4
185.4	65.3	68.5	72.1	75.3	78.9	82.6	85.7	89.4	92.5	96.2
188.0	67.1	70.3	73.9	77.6	81.2	84.4	88.0	91.6	95.3	98.9
190.5	68.9	72.6	76.2	79.8	83.5	87.1	90.7	94.3	98.0	101.6
193.0	70.8	74.4	78.0	81.6	85.7	89.4	93.0	96.6	100.2	104.3

²⁹¹ Source: Association of Diving Contractors International, 18.

Table 21. Body Fat and Body Fat Percentages.²⁹²

Body Fat Percentages Comparison Table		
Fat Level	Men (%)	Women (%)
Very Low	7-10	14-17
Low	10-13	17-20
Average	13-17	20-27
High	17-25	27-31
Very High	above 25	above 31

Table 22. Maximum Allowable Weight Chart.²⁹³

Maximum Allowable Weight Chart		
Males Weight in Pounds	Height (inches)	Females Weight in Pounds
170	60	170
176	61	174
182	62	179
188	63	182
194	64	187
200	65	192
206	66	196
212	67	200
218	68	204
225	69	209
230	70	212
235	71	217
241	72	222
247	73	225
253	74	230
259	75	234
265	76	239
271	77	243
277	78	248
283	79	252
289	80	255

²⁹² Source: Association of Diving Contractors International, 19.

²⁹³ Source: Association of Diving Contractors International, 19.

Table 23. Return to Duty after Diving-Related Incidents.²⁹⁴

ADCI Recommendations on Return to Diving	
Diving Related Incident	Time to return to diving
Simple pain only with complete resolution after single treatment table	24 to 72 hours
Pain only needing more than one treatment table for complete resolution	7 days
Altered sensation in limbs resolvable by one treatment table	7 days
Motor or other neurological deficit resolvable by one treatment table	28 days
Neurological injury needing several treatment tables to resolve	4 to 6 months
Pulmonary barotrauma resolved	3 months
Pneumothorax resolved (other than spontaneous)	3 months
Vestibular decompression sickness	4 to 6 months
Round window rupture	6 months after repair
Central nervous system oxygen toxicity (after complete evaluation)	7 days
Perforated tympanic membrane	6 weeks after healed
Other ENT barotrauma	Determined by examiner

Table 24. Cardiac Risk Calculator for Men.²⁹⁵

Total Cholesterol	Age 20-39	Age 40-49	Age 50-59	Age 60-69	Age 70-79
<160	0	0	0	0	0
160-199	4	3	2	1	0
200-239	7	5	3	1	0
240-279	9	6	4	2	1
280+	11	8	5	3	1

²⁹⁴ Source: Association of Diving Contractors International, 20.

²⁹⁵ Source: Association of Diving Contractors International, 20–21.

Age	Points
20-34	-9
35-39	-4
40-44	0
45-49	3
50-54	6
55-59	8
60-64	10
65-69	11
70-74	12
75-79	13

HDL	Points
60+	-1
50-59	0
40-49	1
<40	2

Systolic BP	If Untreated	If Treated
<120	0	0
120-129	0	1
130-139	1	2
140-159	1	2
160+	2	3

Age	Smoker	Non-smoker
20-39	8	0
40-49	5	0
50-59	3	0
60-69	1	0
70-79	1	0

Enter No of Points	
Age	
Total Chol	
HDL Chol	
Sys B/P	
Smoking	
Total	

Point Total	10-Year Risk
<9	<1%
9	1%
10	1%
11	1%
12	1%
13	2%
14	2%
15	3%
16	4%
17	5%
18	6%
19	8%
20	11%
21	14%
22	17%
23	22%
24	27%
25 or more	≥30%

Determine Risk
From Chart

Table 25. Cardiac Risk Calculator for Women.²⁹⁶

Total Cholesterol	Age 20-39	Age 40-49	Age 50-59	Age 60-69	Age 70-79
<160	0	0	0	0	0
160-199	4	3	2	1	1
200-239	8	6	4	2	1
240-279	11	8	5	3	2
280+	13	10	7	4	2

Age	Points
20-34	-7
35-39	-3
40-44	0
45-49	3
50-54	6
55-59	8
60-64	10
65-69	12
70-74	14
75-79	16

HDL	Points
60+	-1
50-59	0
40-49	1
<40	2

²⁹⁶ Source: Association of Diving Contractors International, 22–23.

Systolic BP	If Untreated	If Treated
<120	0	0
120-129	1	3
130-139	2	4
140-159	3	5
160+	4	6

Age	Smoker	Non-smoker
20-39	9	0
40-49	7	0
50-59	4	0
60-69	2	0
70-79	1	0

Enter No of Points	
Age	
Total Chol	
HDL Chol	
Sys B/P	
Smoking	
Total	

Point Total	10-Year Risk
<9	<1%
9	1%
10	1%
11	1%
12	1%
13	2%
14	2%
15	3%
16	4%
17	5%
18	6%
19	8%
20	11%
21	14%
22	17%
23	22%
24	27%
25 or more	≥30%

Determine Risk
From Chart

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