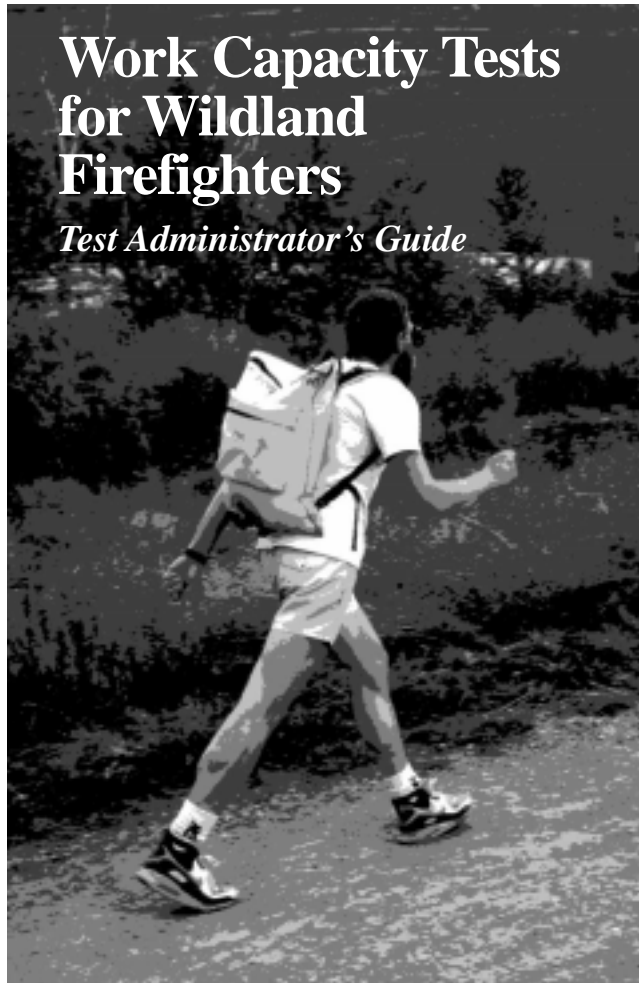


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**Technology &
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4E42P30–Firefighter Work Capacity

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Contents

Introduction	3
Test Administration	6
Safety	14
References	17
Appendix A—<i>Test Administrator’s Script</i>	18
Appendix B—<i>Informed Consent Form</i>	21
Appendix C—<i>Training for the Pack Test</i>	23
Appendix D—<i>Sample Data Sheet</i>	25

Introduction

Studies of wildland firefighting clearly show the link between fitness and work performance. Fit workers can do more work with less fatigue, and still have a reserve to meet unforeseen emergencies. They perform better in a hot environment, and recover faster from adverse firefighting conditions like long shifts and reduced rest. In short, fitness is the most important factor in work capacity.

Since 1975 Federal agencies have used a 5-minute Step Test and an alternative 1.5-mile run to screen candidates for wildland firefighting. In 1994 the Missoula Technology and Development Center (MTDC) began a review of alternative ways of testing work capacity. MTDC conducted a comprehensive job task analysis and extensive laboratory and field studies of proposed tests. The result is a family of job-related Field Tests to determine a worker's capacity to meet NWCG (National Wildfire Coordinating Group) 310-1 standards for wildland firefighters (Wildland Fire Qualification Subsystem Guide 310-1, NWCG, 1993). Tests were developed for workers with arduous, moderate, and light duties.

Work Category	Test	Distance	Pack	Time
Arduous	Pack Test	3 miles	45 lb	45 min
Moderate	Field Test	2 miles	25 lb	30 min
Light	Walk Test	1 mile	none	16 min

Arduous

“Duties involve field work requiring physical performance calling for above-average endurance and superior conditioning. These duties may include an occasional demand for extraordinarily strenuous activities in emergencies under adverse environmental conditions and over extended periods of time. Requirements include running, walking, climbing,

Introduction

jumping, twisting, bending, and lifting more than 50 pounds; the pace of work typically is set by the emergency condition” (NWCG 310-1).

The Pack Test is a valid, job-related test of the capacity for arduous work. It consists of a 3-mile hike with a 45-pound pack (typically a fire-suppression water bag) over level terrain. A time of 45 minutes, the passing score for the test, approximates a Step Test score of 45 (ml/kg•min), the established standard for wildland firefighters. The energy cost of the test is similar to that demanded on the job. The test is correlated to measures of performance in field tasks such as working with handtools, or carrying loads over rough terrain, as well as with measures of aerobic and muscular fitness. The duration of the test ensures the capacity to perform prolonged arduous work under adverse conditions, with a reserve to meet emergencies.

Moderate

“Duties involve field work requiring complete control of all physical faculties and may include considerable walking over irregular ground, standing for long periods of time, lifting 25 to 50 pounds, climbing, bending, stooping, squatting, twisting, and reaching. Occasional demands may be required for moderately strenuous activities in emergencies over long periods of time. Individuals usually set their own work pace” (NWCG 310-1).

A job-related test of work capacity designed for those with moderately strenuous duties, the Field Test is a 2-mile hike with a 25-pound pack in 30 minutes. The score approximates a Step Test (max VO₂) score of 40.

Light

“Duties mainly involve office-type work with occasional field activity characterized by light physical exertion requiring basic good health.

Introduction

Activities may include climbing stairs, standing, operating a vehicle, and long hours of work, as well as some bending, stooping, or light lifting. Individuals almost always can govern the extent and pace of their physical activity” (NWCG 310-1).

A test to determine the ability to carry out light duties, the Walk Test is a 1-mile test (with no load) that approximates a Step Test score of 35. The test ensures the ability to meet emergencies and evacuate to a safety zone.

The instructions for the Pack Test also apply to the Field and Walk Tests.



Test Administration

The Pack Test is a 3-mile hike with a 45-lb pack over level terrain. Field studies show that performance on the Pack Test is significantly related to performance of firefighting tasks, including line construction with hand tools. Studies at the University of Montana's Human Performance Laboratory indicate that the energy cost of the test is similar to that of firefighting tasks. A score of 45 minutes on the Pack Test approximates a Step Test score of 45 (ml/kg•min). Because of its length, the Pack Test is an excellent indicator of sustained work capacity. Scores on a flat course are highly related to performance on a hilly course. And performance on the Pack Test is significantly related to muscular fitness, including measures of upper and lower body strength. The Pack Test is job-related, safe, inexpensive, and easy to administer. It is a valid, reliable, and objective measure of work capacity that does not adversely impact workers on the basis of gender, ethnicity, age, height, or weight.

For valid, reliable, objective, and safe test administration, the test administrator must become familiar with these instructions. These instructions apply to the Pack, Field, and Walk Tests.

Instructions

Personnel

The number of individuals needed to administer the test will depend on the course layout, testing conditions, and the number of candidates to be tested. In some cases one person will fill multiple roles (administrator, timer, first aid specialist, course monitor). All persons involved in the testing must understand the instructions and safety considerations, as well as their individual roles and responsibilities. A briefing for test administration personnel is recommended before the test. The following personnel may be needed to administer the test:

Test Administration

Test Administrator–The person in charge of administration at the test site must understand test procedures, the Job Hazard Analysis (JHA), and the local medical and evacuation plan.

First Aid Specialist–A person currently qualified for first aid and CPR will be onsite to assist if needed, and to observe candidates during the test.

Course Monitor–The test administrator will determine the number of persons needed to monitor candidates during the test.

Lap Counter(s)–Someone who records the laps completed by each candidate (if needed).

Timer–Someone who keeps the time during the test.

Two people may be able to administer the test for small groups. For larger groups, or when course monitoring is difficult, three or more persons will be needed.

The Course

The course must be essentially level and have a firm, relatively smooth walking surface. The course length (3 miles) must be accurate: double-check measurements. Use a measuring wheel or a calibrated bicycle computer. Vehicle odometers are not sufficiently accurate.

Loop or out-and-back courses are preferable. Try to avoid one-way courses. A moderate grade (2 to 3%) is acceptable if the course starts and finishes at the same place. Have lap counters available for courses that will require more than one lap. Use course monitors when needed.

Candidates must be informed of the course layout (use a map or sketch of the course). Use distance markers (at 1 or 1.5 miles) to help candidates pace themselves. Use hazard and traffic markers as needed.

Equipment

Packs: The 5-gallon backpack pump water bag (NSN8465-01-321-1678) is recommended. One will be needed for each candidate in a test group. The trombone pump is not used with the water bag. If other packs are used, the test administrator must ensure the correct weight (45 lb).

Pack Liners: (NSN8465-01-321-1679): Have at least one extra liner for each pack.

Canteens: (NSN8465-00-102-6381): Use up to two in the pack pocket to obtain the proper weight (44.5 to 45.5 lb).

Safety Vests/Route Markers: As needed.

Distance Markers: Use mile and midpoint markers so candidates can maintain the proper pace.

Stop Watches: Have two watches to provide backup timing.

Vehicle: Bicycle or other vehicle to monitor candidates on the course.

Radios: As needed for monitoring and safety.

Scale: An accurate, hanging-style spring scale is recommended for weighing packs.

Test Administration

Forms:

- **PAR-Q** health screening questionnaire (see centerfold) and an informed consent form (Appendix B).
- A data collection form (Appendix D).

Before the Test

Notify candidates 6 to 8 weeks before the test. Send them the *Fit to Work* brochure (see References) that explains the test and provides suggestions for training, clothing, and health screening.

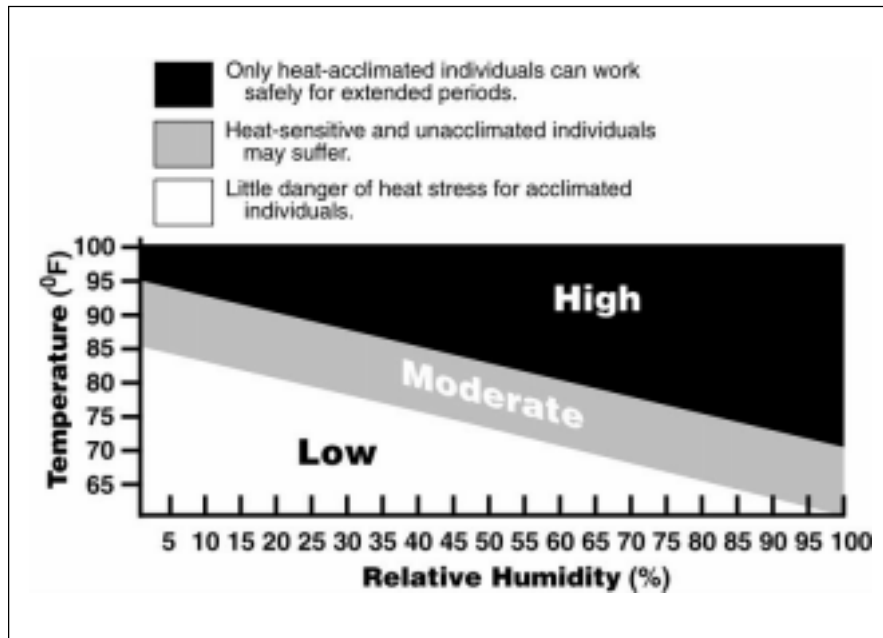
On the test day, read the instruction script (Appendix A) to the candidates to ensure that all candidates are informed about the test, the course, safety, and other site-specific information.

Testing Tips

- Fill packs the night before to check for leaks (use plumber's Teflon tape to stop leaks in threaded fittings).
- Weigh bags before the test. Check the weight after the test, if necessary. The trombone pump is not used.
- Group or staggered starts can be used. Some candidates will benefit from the support provided by a group start.

Environmental Conditions

Administer the test in moderate environmental conditions; do not test **new recruits** when the temperature is high or when the temperature and humidity combine to create high heat stress conditions. If necessary, test early in the day to avoid combinations of high temperature and high humidity. Avoid high winds that may affect performance.



Heat stress. Unacclimated or unfit workers will suffer at lower levels of heat or work (chart is based on shaded air temperature, moderate radiant heat, light breeze, standard firefighter clothing, and moderate work rate).

Hydration: If the weather is hot, encourage candidates to drink fluids before the test, and provide fluid replacement at the midpoint in the course. Candidates may carry a water bottle.

Test Administration

Altitude: Use this chart to adjust for tests administered above 4,000 ft:

Table 1—Altitude corrections for work capacity tests.*

Altitude (Feet)	Pack Test (Seconds)	Field Test (Seconds)	Walk Test (Seconds)
4,000 to 5,000	30	20	10
5,000 to 6,000	45	30	15
6,000 to 7,000	60	40	20
7,000 to 8,000	75	50	25
8,000 to 9,000	90	60	30

* Add the correction to the required test time. For the Pack Test at 6,000 to 7,000 ft, add 60 seconds to the test standard (45 min) for an altitude-adjusted standard of 46 min.

The altitude adjustment assumes that the candidate has had an opportunity to acclimate to the altitude of the test site. If a candidate doesn't meet the required standard even with the adjustment, he or she should be encouraged to train at the altitude and retake the test.

Providing Instructions for Candidates

Distribute the *Fit to Work* pamphlet and the confidential **PAR Q** physical activity readiness questionnaire 6 to 8 weeks before the test so candidates can prepare for the test and decide whether they should seek medical advice before taking it. Have candidates initial a form indicating that they have read and completed the **PAR Q** questionnaire. Some agencies may ask candidates to sign an informed consent form before taking the test (Appendix B).

Clothing: Candidates may select the clothing worn during the test. T-shirts and shorts are acceptable. Footwear that provides ankle-height support, such as hiking boots or ankle-height sport shoes, is required for the Pack and Field Tests, and recommended for the Walk Test.

Safety: Brief candidates on the test, the course, and safety considerations. Tell candidates they are free to stop at any time for any reason, and that they should seek help if they experience major physical problems (Appendix A).

Warm-up: Encourage candidates to stretch (calves, hamstrings, lower back) and to warm up before the test.

Pace: Show candidates how they should hike (power walk) the course as fast as possible without jogging. The heel of one foot must make contact before the opposite toe leaves the ground. Jogging or running will invalidate results and require a retest.

Accommodations: Candidates may use padding to make the pack more comfortable. Candidates who wish to use their own walking staff may do so.

Hydration: If the weather is hot, tell candidates to drink one to two cups of water before the test. Candidates may elect to carry a water bottle, but the extra weight will not be counted as part of the pack weight.

Essentials of Good Testing

- An accurately measured flat course with a good surface.
- Packs of the proper weight. Use the specified water bags and verify pack weight with a calibrated scale. If alternative packs are used, candidates are responsible for adjusting them.

Test Administration

- Accurate timing that is verified by backup timing. Give split times along the course (at 1-mile and/or the midpoint, 1.5 miles for the Pack Test).
- Candidates should be rested and well informed about the course and the need to maintain a fast pace.
- Favorable environmental conditions. Avoid adverse conditions.
- A completed **PAR Q** physical activity readiness questionnaire and a signed informed consent form (if applicable).

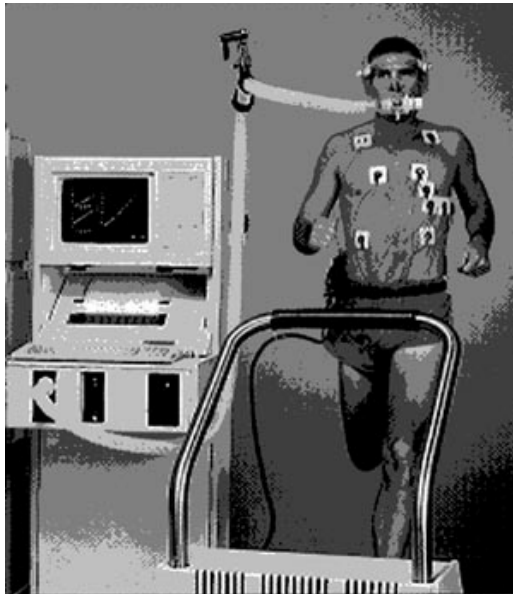
Safety

- A locally developed job hazard analysis and safety/medical evacuation plan must be prepared for the course.
- Test administrators must be familiar with the safety plan.
- A trained and qualified First Responder (or the equivalent) who knows the symptoms of physical distress and appropriate CPR and first-aid procedures must be onsite during the test.
- Avoid conducting the test on roads and intersections where traffic is a concern. When testing on roads, use traffic control devices and traffic controllers wearing high-visibility vests as needed.
- Require candidates to read and sign the **PAR Q** health screening questionnaire and an informed consent form (if applicable).
- Check to see that candidates are wearing proper footwear. The Pack and Field Tests require footwear with support above the ankle.
- Encourage candidates to stretch and warm up before the test.
- Do not test anyone who is tired or has been injured, or conduct tests during conditions that could compromise health or safety.
- Monitor candidates to identify those having difficulties and encourage them to terminate the test if necessary.
- Encourage fluid intake and replacement. Provide fluids along the route when conditions contribute to heat stress.
- At the midpoint, consider terminating candidates who are substantially behind the required pace (22.5 minutes for 1.5 miles), and those who are

Safety

having difficulty maintaining the pace. Candidates cannot jog or run to make up time.

- Encourage cooling down with an easy walk after the test. Monitor the recovery of candidates, especially those who appear distressed.
- Recommend several weeks of training before candidates retake the test.



Over 40?

If candidates are over 40 years of age, have one or more heart disease risk factors (smoking, high blood pressure, elevated cholesterol), and have been inactive, they should talk to their physician about an ECG-monitored exercise test. A progressive treadmill test (stress test) determines functional capacity and cardiovascular health.

PAR - Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO	
<input type="checkbox"/>	<input type="checkbox"/>	1. Has your doctor ever said that you have a heart condition <u>and</u> that you should only do physical activity recommended by a doctor?
<input type="checkbox"/>	<input type="checkbox"/>	2. Do you feel pain in your chest when you do physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	3. In the past month, have you had chest pain when you were not doing physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	4. Do you lose your balance because of dizziness or do you ever lose consciousness?
<input type="checkbox"/>	<input type="checkbox"/>	5. Do you have a bone or joint problem that could be made worse by a change in your physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
<input type="checkbox"/>	<input type="checkbox"/>	7. Do you know of <u>any other reason</u> why you should not do physical activity?

YES to one or more questions

If
you
answered

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active — begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal — this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever — wait until you feel better; or
- if you are or may be pregnant — talk to your doctor before you start becoming more active.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

You are encouraged to copy the PAR-Q but only if you use the entire form

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction.

NAME _____

SIGNATURE _____

SIGNATURE OF PARENT _____
or GUARDIAN (for participants under the age of majority)

DATE _____

WITNESS _____



References



Appendix A—Test Administrator’s Script

(To be read to candidates before they take the Pack, Field, or Walk Tests).

Welcome. You are about to take a job-related work capacity test to determine your fitness for duty. The test you are taking has been determined by the requirements of the job. You will be taking the _____ test, intended for _____ duties (read the description for the appropriate test).

*The **Pack Test** is intended for those involved in arduous duties, defined as requiring an aerobic fitness score of 45, lifting more than 50 pounds, and an occasional demand for extraordinarily strenuous activities. The 3-mile test with a 45-pound pack in 45 minutes is strenuous, but no more so than the duties of wildland firefighting.*

*The **Field Test** is intended for those with moderately strenuous duties, defined as requiring an aerobic fitness score of 40, lifting 25 to 50 pounds, and an occasional demand for moderately strenuous activity. The 2-mile test with a 25-pound pack in 30 minutes is fairly strenuous, but no more so than field duties.*

*The **Walk Test** is intended for those whose duties involves light work with occasional field activity, defined as requiring an aerobic fitness score of 35. The 1-mile walk in 16 minutes is moderately strenuous, but no more so than the duties assigned.*

You may read more about the tests in the brochure *Fit to Work*.

You should complete the **PAR Q** health screening questionnaire before taking the test. Some agencies may require that you sign an informed consent form. It is your responsibility to discuss any concerns with your physician before taking the test. The test and the work of wildland firefighting require individuals who are healthy and physically fit. If you

Appendix A—*Test Administrator’s Script*

have doubts about your health you should talk to your physician; if you are not in good physical condition, you should undertake a training program before you take the test.

You are free to wear clothing that suits the activity and environmental conditions. Your footwear must provide support to the feet and ankles. Ankle-high hiking boots or athletic shoes are required for the Pack and Field Tests, and recommended for the Walk Test.

The course is _____ (describe local course and any safety issues, such as traffic, and heat). [If heat stress conditions exist, encourage candidates who are not acclimatized to the heat to delay testing until conditions are more favorable, or until they have become acclimatized after working for about 1 week in the heat.]

You should stretch and warm up before the test, and cool down after the test. [If heat stress conditions exist—explain that water will be available at the _____ point on the course.]

The test begins when I say go and finishes when you complete the required distance. We will announce the elapsed time when you pass the _____ (1- or 1.5-mile point) of the course. You are free to stop the test at any time, for any reason. Simply notify the course monitor that you have decided to stop.

The course monitor may recommend that you stop the test if you are having difficulties or if you are substantially behind the pace required to pass the test.

The test requires a fast walking pace. Jogging or running is not allowed and will lead to disqualification.

Appendix A—Test Administrator’s Script

When you finish the course, remove your pack and keep moving until you cool down. Pack weight may be checked after the test.

Your test score is the time required to complete the course. At this elevation, _____ ft, you will receive an altitude correction of _____ min: sec, so you must complete the course within _____ min: sec to receive a passing score. If you do not pass, you are encouraged to train before you retake the test. Retests will be possible _____ (indicate when).

Before we begin, do you have any questions about the test, the course, or related matters? (answer questions)

Complete your warmup. The test will begin in 5 minutes.

Informed Consent: Work Capacity Tests

Pack Test—Intended for those involved in arduous duties (defined in NWCG 310-1 as requiring an aerobic fitness level [max VO₂] of 45, lifting more than 50 pounds, and occasional demand for extraordinarily strenuous activities). The 3-mile test with a 45-pound pack in 45 minutes is strenuous, but no more so than the duties of wildland firefighting.

Field Test—Intended for those with moderately strenuous duties (requires a max VO₂ of 40, lifting 25 to 50 pounds, and occasional demand for moderately strenuous activity). The 2-mile test with a 25-pound pack in 30 minutes is fairly strenuous, but no more so than field duties.

Walk Test—Intended for those whose duties involve light work with occasional field activity (required max VO₂ of 35). The 1-mile walk in 16 minutes is moderately strenuous, but no more so than the duties assigned.

Risks

- There is a slight risk of injury (blisters, sore legs, sprained ankles) especially for those who have not practiced the test. If you have been inactive and have not practiced or trained for the test, you should engage in several weeks of specific training before you take the test. Be certain to warm up and stretch before taking the test, and to cool down after the test. The risk of more serious consequences (such as respiratory or heart problems) is diminished by completing the **PAR Q** physical activity readiness questionnaire.

- If you cannot answer NO to all the questions in the **PAR Q** health screening questionnaire, or if you are over 40 years of age and unaccustomed to vigorous exercise, you should contact your physician, by phone or in person, before you take the test. Your physician may want to see **PAR Q** and information about the test or job demands.

1. I have read the information on this form and understand the purpose, instructions, and risks of the job-related work capacity test.
2. I have read, understood, and truthfully answered the **PAR Q** physical activity readiness questionnaire.
3. I believe I have the ability to complete the test and carry out the assigned duties of the position (e.g., wildland firefighter).
4. I assume responsibility and release the United States Government from liability for injuries sustained in testing that result from any physical or mental disorders. (EEOC #915.002, 5/19/94)

Circle test to be taken:

Pack

Field

Walk

Signature _____ Date _____

Print Name _____

Witness _____ Location _____

Appendix C—*Training for the Pack Test*

Begin at least 4 to 6 weeks before you report for duty. Train by hiking or power walking, using the ankle-height footwear you will use in the test. Hike a 3-mile flat course without a pack. When you can cover the course in less than 45 minutes, add a pack with about 25 pounds to your training hikes. Increase the pack weight until you can hike 3 miles in 45 minutes with a 45-pound pack. Also:

- Hike hills (with a pack) to build leg strength and endurance
- Jog the flat course (without a pack) to build aerobic fitness
- Hike or jog longer distances for stamina
- Engage in cross-training (mountain biking, weight lifting).



Appendix C—Training for the Pack Test

Finally, do job-specific tasks and training to become work hardened for the coming season. Wear work boots on extended hikes. Work with hand tools to prepare trunk and upper body muscles for prolonged work. Work hardening ensures that the hands, feet, muscles, tendons, and ligaments used on the job are tough and ready to go. For more information see Sharkey, Brian, *Fitness and Work Capacity*, (NFES 1596), 1997.





About the Author

Brian Sharkey completed a Ph.D. degree in exercise physiology at the University of Maryland before coming west to join the faculty of the University of Montana and begin a long association with MTDC. His work for the Forest Service has included research and development on fitness tests and programs, heat stress, hydration, nutrition, protective clothing, tools, work/rest cycles, employee health (wellness), and more.

A researcher, author of several books, and past president of the American College of Sports Medicine, Dr. Sharkey practices what he preaches, participating regularly in running, mountain biking, cross-country skiing, backpacking, canoeing, and other pursuits. His work has recently been honored with a USDA Distinguished Service Award, and a Forest Service Technology Transfer Award.

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