Chapter 5

Test Administration and Test Items

This chapter presents test items in the BPFT in detail, along with specific recommendations for administering most test items. Although the BPFT includes 27 test items, testers generally administer only 4 to 6 items to a particular individual. The following list provides general recommendations for administering the BPFT.

• Practice administering test items and be confident of your mastery in administering them before taking formal measurements.

• Develop forms for selecting test items and recording scores, or use materials developed as part of the Brockport Physical Fitness Test.

• Describe the test to participants and explain what it is intended to assess.

• Ensure that individuals being tested dress appropriately; exercise clothing and sneakers (where appropriate) are recommended.

• Plan and provide general and specific warm-ups, as appropriate. This is particularly important for test items involving flexibility or range of motion and strenuous effort.

• Provide cool-down activities after testing. This is especially important after aerobic-functioning test items.

• Provide a positive testing atmosphere. Encourage individuals being tested to try their best and continually provide positive reinforcement for effort.

• Compare participants’ performances with criterion-referenced standards rather than with other individuals’ performances.

• Administer no more than half of the items on a particular day. If fatigue appears to be influencing performance, provide longer rest intervals between test items.

• Administer aerobic-functioning tests last.

• Administer running items on a surface that is flat and hard yet resilient.

• Give participants who are blind the opportunity to become clearly oriented to a test

The Brockport Physical Fitness Test (BPFT) for youngsters with disability was designed to correspond as closely as possible to health-related, criterion-referenced tests for youngsters without disability. The BPFT corresponds most closely to Fitnessgram (Cooper Institute, 2013). To enhance consistency, the procedures for the following test items, which are also included in Fitnessgram, were adapted, by permission, from The Cooper Institute, 2013, Fitnessgram/Activitygram test administration manual, updated 4th ed. (Champaign, IL: Human Kinetics): PACER, one-mile run/walk, percent body fat, skinfolds, body mass index, curl-up, flexed-arm hang, pull-up, modified pull-up, push-up, shoulder stretch, trunk lift, back-saver sit-and-reach, and aerobic-capacity test items. The procedures for other test items were developed by Project Target and the authors of this book.

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station or testing area. This is particularly important for tests that involve running.

- Provide careful demonstrations for participants with hearing impairment. Give instructions in writing or manually (e.g., signing, finger spelling). Use hand signals to start and stop activities.

- Administer the following test items individually to one participant at a time: target aerobic movement test (TAMT), percent body fat, skinfolds, extended-arm hang, flexed-arm hang, modified pull-up, pull-up, dominant grip strength, bench press, curl-up, modified curl-up, 40-meter push/walk, reverse curl, seated push-up, trunk lift, wheelchair ramp test, and most flexibility or range-of-motion test items (except shoulder stretch).

- The PACER, one-mile run/walk, and shoulder stretch may be administered to small groups of subjects at once. However, it may be necessary or most appropriate to provide partners for assistance.

- The following items can be administered to groups of two or three: dumbbell press, isometric push-up, and push-up. For the dumbbell press, provide spotters.

### Safety Guidelines and Precautions

Test items used in connection with the BPFT (including nontraditional ones) are typical of those used elsewhere in physical education or physical fitness programs. Some have appeared on disability-specific tests of physical fitness or tests classifying athletes with disability or are associated with activities of daily living. Although the BPFT is considered safe, one must recognize that accidents are possible. Use the following guidelines and precautions when administering test items. Also adhere to guidelines for specific test items presented later in this chapter and to other recommended professional practices.

- Personnel who administer the test should be qualified and knowledgeable about physical fitness testing and disability.

- Maximize the safety of all youngsters. Professionals using this test should follow the policies of their school or agency regarding medical information, medical records, and medical clearance for activity. Any others should administer this test only following approval by a physician who is aware of the health status of the individual taking the test. Consider information from manufacturers of any test equipment used in conjunction with the BPFT.

- Avoid administering tests under conditions of unusually high or low temperature or humidity or when windy. Youngsters with spinal cord injury may be especially prone to problems with thermoregulation, including overheating.

- Be sure that individuals being tested understand test instructions. Provide opportunities for students to practice test items.

- Terminate the test item if the individual being tested experiences dizziness, pain, or disorientation.

- Avoid comparing individuals’ performances with each other.

- Spot youngsters where necessary and appropriate.

- Incorporate warm-up and cool-down periods as appropriate for test items.

- Before testing, have youngsters with spinal cord injury above T6 empty their bowels and bladder and check them for tight clothing, straps, or pressure sores that might contribute to skin irritation. Individuals with spinal injury above T6 are subject to autonomic dysreflexia, a condition that can dangerously elevate the heart rate and blood pressure as a result of bowel or bladder distension or skin irritation.

- Be aware that some heart rate monitors may use latex in the strap, which can cause allergic reaction; therefore, wearing the strap may be contraindicated in certain instances.

### Age Considerations

For purposes of the BPFT, the age of the individual being tested is determined on the date when
the first test item is administered. Ages are not rounded to the nearest year. Thus, for example, an individual who is 10 years and 11 months old should be identified as being 10 years old.

**Index of Test Items**

Test items that have video clips in the accompanying web resource will be noted by the video icon placed next to the test title within the chapter. Use the pass code Brockport58743AR7 to access the web resource at www.HumanKinetics.com/BrockportPhysicalFitnessTestManual.

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In the PACER, participants run as long as possible back and forth across a distance of either 15 meters (16 yards, 15 inches) or 20 meters (21 yards, 32 inches) at a specified pace, which gets faster each minute. Designed to measure aerobic capacity, the test is conducted on a flat, nonslip surface. Participants run across the designated area to a line by the time a beep sounds from a recording. At the sound of the beep, they turn around and run back to the other end. If a participant reaches the line before the beep, he or she must wait for the next beep before running in the other direction. Participants continue in this manner until they can no longer reach the line before the beep sounds. Participants who do not reach the line before the beep sounds should be given two more beeps to regain the pace before being withdrawn. In attempting to catch up, the entire 15-meter or 20-meter lap must be completed. Upon completing the test, participants should walk from the testing area to a designated cool-down area, being careful not to interfere with others still running, and continue to walk and stretch in the cool-down area.

**Equipment**

Required equipment includes the PACER audio recording, an audio player with adequate volume, measuring tape, marker cones, a pencil, and score sheets. Participants should wear nonslip shoes. Plan for each participant to have a running space that is 40 to 60 inches (about 100 to 150 centimeters) wide. The PACER recording may include music or only the beeps.

**Scoring and Trials**

One test trial is given. The individual’s score is the number of completed laps. When 15-meter lap scores are used, they must be converted to 20-meter-lap equivalents (see appendix D). A run of at least 10 laps (in the 20-meter version) is required in order to calculate aerobic capacity.

**Test Modifications**

Runners who are blind may run with assistance from a partner, with guide wire or rope assistance (see figure 5.1, a and b), trailing along a wall, or using other tactual assistance. Runners with an assisting partner can use a short tether rope or grasp the partner’s elbow. In choosing a method of guidance, be sure that it does not inhibit running performance. For validity, give blind runners the opportunity to perform optimally. The runner should practice using the selected assistance until he or she is comfortable with it.

Be sure that youngsters with intellectual disability understand how to perform the test; take whatever time is necessary to ensure that participants learn the test. Because motivation is critical, at least one person should provide continual positive reinforcement to runners as they perform the test. Youngsters with intellectual disability often need to run with a tester or aide; however, assistants must not pull or push runners or give them any other physical advantage.

*Figure 5.1* PACER test: (a) touching a sighted guide and (b) with guide-rope assistance.
The PACER is preferred over the one-mile run particularly for youngsters with intellectual disability for shortest and slowest performances and when BMI is not to be incorporated in the calculation of VO2max. As participants exhibit increased mastery, the test may be modified so that they run laps in one direction only around a track or running surface to enhance preparation for long-distance running.

**Suggestions for Test Administration**

- Mark the PACER distance with marker cones and tape or chalk lines.
- Before test day, allow participants at least two practice sessions. Also allow participants to listen to several minutes of the audio recording before they perform the test so that they know what to expect.
- The test recording contains 21 levels (21 minutes). The 20-meter recording allows 9 seconds to run the distance during the first minute, and the pace increases by approximately half a second each following minute. The 15-meter recording allows 6.75 seconds to run the distance during the first minute, with lap time decreases of about half a second at each successive level.
- Single beeps indicate the end of a lap. Triple beeps at the end of each minute indicate an increase in speed. Participants should be alerted that the speed will increase. Caution participants not to begin too fast; the beginning speed is very slow.
- If a participant cannot reach the line before the beep sounds, he or she should be given two beeps to attempt to regain the pace before being withdrawn. If the participant regains the pace, continue to count laps. Give credit for a lap only if the entire PACER distance is completed.
- Volunteers can assist in recording scores.
- If participants are unable to hear beeps from the audio player, a whistle corresponding to the beeps can be used.

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**Target Aerobic Movement Test**

The target aerobic movement test (TAMT) is a modification of the aerobic movement test developed by Pat Good at the Howe School in Dearborn, Michigan. It measures the aerobic behavior of youngsters and their ability to exercise at or above a recommended target heart rate (THR) for 15 minutes. The test is recommended for youngsters with certain disabilities and with the PACER serves as an optional test for students who are unable to perform the one-mile run/walk in 13 minutes or less. Exercises that can be used in the test include, for example, running, dancing, swimming, and arm ergometry. The test’s basic level (level 1) estimates the ability to sustain a moderate intensity of physical activity (i.e., 70 percent of maximal predicted heart rate) without exceeding 85 percent of maximal predicted heart rate. Participants can engage in virtually any physical activity as long as it involves sufficient intensity to reach a minimal target heart rate and to sustain the heart rate in a target heart rate zone (THRZ). In preparation for the test, testers are encouraged to work with individuals to help them identify an appropriate physical activity.

For most participants—those who engage in whole-body forms of exercise (figure 5.2a)—the THRZ is defined as 70 percent to 85 percent of a maximal predicted heart rate (operationally, 140 to 180 beats per minute). Two exceptions exist. The first applies to participants with spinal cord injury resulting in low-level quadriplegia (LLQ, any spinal lesion between C6 and C8 inclusive). For these youngsters, THRZ may be defined in one of two ways. If an individual has a resting (sitting) heart rate of less than 65 beats per minute, the THRZ is defined as 85 to 100 beats per minute. If an individual’s resting heart rate is 65 beats per minute or more, the THRZ is defined as a range of 20 to 30 beats above the resting value. For example, if an individual has a resting heart rate of 75 beats per minute, the THRZ will be 95 to 105 beats per minute. The second exception applies to those who engage in strictly arm exercise (figure 5.2b). For those who use arm-only exercise, the THRZ is 130 to 170 beats per minute.

The tester checks the participant’s heart rate at least once every 60 seconds. If a participant is within his or her THRZ and no more than 10 beats above THR, the tester reinforces the behavior and
encourages the participant to continue at the present intensity of exercise (e.g., “Nice job! Just keep doing what you’ve been doing at the same speed”). If a participant is below his or her THRZ, the tester encourages the participant to increase the exercise intensity (e.g., “Okay, your heart rate is a little low right now, so try to exercise a little harder or a little faster”). Should a participant fall below the THRZ, he or she has 1 minute to regain the minimal value. If the participant does so, the test continues; if not, the test is terminated. If the participant is above the THRZ the tester should acknowledge the participant’s effort but also encourage the participant to decrease exercise intensity (e.g., “Wow, you’re really working hard—in fact, a little too hard! Try to exercise a little lighter or a little slower”). If a participant works above the THRZ but completes the 15-minute test, his or her results can be considered as meeting the criterion. If a participant is beyond the THRZ for 2 or more consecutive minutes and fails to reach the 15-minute criterion, he or she should be retested at a later time and encouraged to work at a lower intensity for the purposes of the test.

Figure 5.2  The target aerobic movement test: (a) whole-body form and (b) arm ergometry.

Equipment

This test item requires an exercise area large enough for adequate aerobic movement. It is also recommended that testers use an electronic heart rate monitor. If a monitor is not available, testers can choose an optional modified procedure using a stopwatch (or wristwatch that displays seconds). Music with a fast tempo is also recommended to provide motivation during the test and to encourage rhythmic, steady-state exercise.

Scoring and Trials

One test trial is given. This is a pass/fail test item; participants who can stay within or above the THRZ for 15 minutes pass the test. The 15-minute count begins when the participant enters the THRZ. For those unable to pass the test, it is recommended, for training purposes, that testers note how long the participant was able to exercise in the THRZ.

Test Modifications

If a heart rate monitor is unavailable, the test may be administered using the following procedures. The pulse rate at the wrist (i.e., radial pulse) is counted manually for 10-second intervals at a number of predetermined checkpoints. (The participant’s exercise must be briefly interrupted for each pulse rate check.) Specifically, the pulse rate is checked at the end of a 3-minute warm-up period and at the end of each of the following exercise intervals after warm-up: 2 minutes, 4 minutes, 6 minutes, 9 minutes, 12 minutes, and 15 minutes. If the participant is below the minimum THRZ value at any checkpoint,
he or she should be encouraged to increase the intensity of exercise and continue the test. If an individual is below the THRZ for two consecutive checkpoints, the test is terminated. Youngsters should be encouraged to maintain a steady exercise pace rather than fluctuate the exercise intensity. Minimal 10-second THRZ values and maximal THRZ values appear in Table 5.1. It is recommended that the test be terminated if youngsters attain the maximal values during a warm-up or test period.

**Table 5.1** Minimal and Maximal 10-Second Heart Rate (HR) Values

<table>
<thead>
<tr>
<th></th>
<th>Minimal</th>
<th>Maximal</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>23</td>
<td>30</td>
</tr>
<tr>
<td>Quadriplegic (C6–C8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resting HR &lt; 65</td>
<td>14</td>
<td>17</td>
</tr>
<tr>
<td>Resting HR ≥ 65</td>
<td>(Resting HR + 20) / 6</td>
<td>(Resting HR + 30) / 6</td>
</tr>
<tr>
<td>Arm-only exercise (paraplegic)</td>
<td>22</td>
<td>28</td>
</tr>
</tbody>
</table>

Participants who are able to exercise within these 10-second pulse rate values for 15 minutes (following a 3-minute warm-up) pass the test. If an individual cannot pass the test, the tester should note the approximate length of time for which the individual was in the THRZ based on the checkpoints. If a participant is below or above the THRZ at one checkpoint but regains the THRZ at the next checkpoint, the individual is credited for both checkpoints, and the test continues. If a participant works above his or her THRZ but completes the 15-minute test, his or her results can be considered as meeting the criteria as long as they do not go below the THRZ requirements. If a participant is below the THRZ for two consecutive checkpoints, however, the test ends, the participant is not credited for either checkpoint, and his or her score reverts to the last checkpoint within the THRZ.

The TAMT can also be used to measure the ability to sustain more vigorous physical activity. However, it is not recommended that higher-level intensities be used for people with quadriplegia. Table 5.2 summarizes THR and THRZ information by levels.

**Table 5.2** Minimum Target Heart Rates (THRs) and Target Heart Rate Zones (THRZs) for TAMT Levels

<table>
<thead>
<tr>
<th>Prescribed level of intensity</th>
<th>Minimum predicted heart rate intensity</th>
<th>Minimum THR and THRZ for whole-body activity</th>
<th>Minimum THR and THRZ for arm-only activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Moderate</td>
<td>70%</td>
<td>140 (minimum THR) 140–180 (THRZ)</td>
<td>130 (minimum THR) 130–170 (THRZ)</td>
</tr>
<tr>
<td>2. Low-level vigorous</td>
<td>75%</td>
<td>150 (minimum THR) 150–180 (THRZ)</td>
<td>140 (minimum THR) 140–170 (THRZ)</td>
</tr>
<tr>
<td>3. Vigorous</td>
<td>80%</td>
<td>160 (minimum THR) 160–180 (THRZ)</td>
<td>150 (minimum THR) 150–170 (THRZ)</td>
</tr>
</tbody>
</table>

**Suggestions for Test Administration**

- Provide a cool-down area and activities of decreasing intensity for participants at the conclusion of the test.
- In many cases, it will be necessary to lead up to the test by discussing the procedures with participants and providing training sessions of shorter duration than required by the test. One method is to start with a 5-minute training session and periodically increase the duration by 3-minute intervals until participants are ready for the full exercise period.
- Individuals with spinal injury above T6 are subject to autonomic dysreflexia, a condition that can elevate the heart rate and blood pressure as a result of bowel or bladder distension or skin irritation. As a precaution, therefore, it is recommended that youngsters with spinal cord injury above T6...
empty their bowels and bladder before testing and be checked for tight clothing, straps, or pressure sores that might contribute to skin irritation.

- Some participants require braces (e.g., thoracolumbosacral orthoses or TLSO braces) during testing. Medical personnel need to be consulted to determine whether participation in the specific physical activity is permitted and whether the brace needs to be worn. If a brace is worn, care must be taken to develop an acceptable method for securing a heart rate monitor. For example, in certain instances it may be possible to loosen the back brace, place the transmitter under the brace, and then tighten the brace to keep the transmitter in place. If it is not possible to use a transmitter, the test modification of manual pulse rate counting may be required.
In this test, participants run or walk one mile (1,760 yards or 1,609 meters) in the shortest time possible. The test is used to measure aerobic capacity. Participants should be instructed to run or walk one mile at the fastest pace possible. The one-mile run/walk can be conducted on a track or any other flat, measured area—for example, a rectangle measuring 35 by 75 yards (32 by 68.6 meters), for which eight laps total one mile. Thus fields, playground areas, other grassy areas, and indoor courts can all be measured and marked to serve as an appropriate testing area.

**Equipment**

Required equipment includes a stopwatch, scorecards, pencils, and a clipboard.

**Scoring and Trials**

The one-mile run/walk is scored in minutes and seconds. One test trial is given. Note: In order to calculate aerobic capacity using the one-mile run/walk, height and weight for each student must be collected in addition to performance time. Aerobic capacity is not calculated on the basis of the one-mile run/walk for times over 13 minutes. When a participant’s time is greater than 13 minutes, the tester should record and save the time as a measure of aerobic functioning and a baseline for comparison in future administrations of the test. Alternatively, testers may choose to give the PACER or TAMT to youngsters who are unable to run or walk a mile in less than 13 minutes.

**Test Modifications**

Runners who are blind may run with assistance from a partner. Assistance can involve using a short tether rope, touching or grasping the elbow of a sighted partner, or running alongside a sighted partner who gives verbal direction and encouragement (see figure 5.3). Once the method of ambulation is determined, ensure that it does not unduly inhibit running performance. For purposes of validity, a runner who is blind must be given the opportunity to perform optimally. The runner should practice using the selected method of assistance until he or she is comfortable with it.

**Figure 5.3** Running or walking the one-mile test.
Suggestions for Test Administration

- Before the day of testing, provide practice as necessary for the required distance.
- Participants should warm up properly before walking or running vigorously.
- Warm-up should include stretching exercises.
- It is recommended that youngsters not be tested in environments where temperature plus humidity is excessive.
- After test completion, give participants the opportunity to cool down by walking for several minutes.
Skinfold tests determine the thickness of skinfolds at selected sites and can be used to estimate the body fat of youngsters. Skinfold measurements can be taken at three sites: triceps, subscapular, and calf. The triceps skinfold is taken over the triceps muscle at a location midway between the tip of the shoulder and the elbow (figure 5.4a). The subscapular skinfold is taken at a site approximately 1 inch (2.5 centimeters) below the tip of the scapula (inferior angle) and 1 inch toward the midline of the body (figure 5.4b). The calf skinfold is taken on the inside of the leg at about the level of maximal calf girth (figure 5.4c). The foot should be placed flat on an elevated surface with the knee flexed at a 90-degree angle. These measures should be taken on the participant’s dominant or preferred side. Once the sites have been identified, the recommended testing procedure is as follows:

1. Grasp the skinfold firmly between the thumb and forefinger and pull slightly from the body, being careful to include only subcutaneous fat tissue, not muscle, in the fold. The triceps and calf skinfolds are vertical folds, while the subscapular skinfold is an oblique fold; see figure 5.4.
2. Place the tips of the caliper slightly (0.5 inch or 1.3 centimeters) above or below the fingers grasping the skinfold.
3. Slowly remove thumb pressure from the caliper, allowing it to exert full pressure on the fold.
4. Record the thickness of the fold to the nearest millimeter once the needle settles (1 to 2 seconds).
5. Open the caliper completely before removing it so as not to pinch the participant.

Figure 5.4  Skinfold measurements: (a) triceps, (b) subscapular, and (c) calf.
**Equipment**

A skinfold caliper of good quality should be used to obtain skinfold measurements (figure 5.5). The instrument should provide constant pressure on the skinfold of 10 grams per square millimeter.

**Figure 5.5** Lange skinfold caliper.
Photo courtesy of Matthew J. Yeoman.

**Scoring and Trials**

Three measurements should be taken at each selected skinfold site. The median (middle) score should be the criterion score. If a skinfold reading at the same site differs from other readings by 2 millimeters or more, an additional measurement should be taken, and the measurement that is substantially different should be ignored.

**Test Modifications**

Measurements should not be taken at sites with scar tissue, at sites where subdural or intramuscular injections have been received repeatedly, or on limbs that have muscular atrophy. In some instances, it may not be possible to attain skinfold measurements at a site.

**Suggestions for Test Administration**

- Testers should master administering the skinfold test before using it.
- Testers can help distinguish muscle and fat by having participants tense and relax the triceps muscle.
- The subscapular skinfold is an oblique fold, in line with the natural cleavage lines of the skin. Testers may be aided in finding the line by having subjects bend the elbow and place the arm on the back so that the back of the hand touches the spine while standing. The top of the fold should be medial to the bottom of the fold.
- It is recommended that females being tested wear a thin T-shirt or similar garment for measuring the subscapular skinfold. The shirt can be raised to allow access to the skinfold sites, or the measurement can be taken over the shirt. In such an instance, it would be necessary to subtract the fold of the T-shirt. For females wearing bras, the strap should be pushed upward only 2 to 3 inches (5 to 8 centimeters) to allow the measurement. If possible, female subjects should be measured by women.
- It is recommended that one measurement be taken at each site before taking second and third measurements at any site.
Body Mass Index

Whereas skinfolds estimate body fatness, body mass index reflects fat, muscle, and bone mass and indicates the appropriateness of an individual’s weight for his or her height. Therefore, in order to compute BMI, height and weight must be determined.

Equipment

A scale is required, and a stadiometer is preferred. If a stadiometer is unavailable, a marked wall or tape measure can be used to determine height (or body length). Participants may lie on a mat to determine body height if they are unable to support their weight in a standing position.

Scoring and Trials

Only one measurement each is necessary for height and weight. Participants should wear lightweight clothing and remove shoes when possible. Initially, height can be rounded to the nearest half inch (whole centimeter) and weight to the nearest pound (half kilogram). BMI can be determined by using the chart presented in appendix A or by using the following equations:

\[
\text{BMI} = \text{body weight (kilograms) / height}^2 (\text{meters})
\]
\[
\text{BMI} = \text{body weight (pounds) × 704.5 / height}^2 (\text{inches})
\]

To convert pounds to kilograms, divide by 2.2. To convert inches to meters, divide by 39.37. For example, consider a 170-pound person who is 5 feet 10 inches (70 inches) tall. The person’s metric weight is 77.3 kilograms (170 pounds divided by 2.2), and his or her metric height is 1.8 meters (70 inches divided by 39.37). The person’s BMI is calculated as 24 using either the metric or the English equation:

\[
\text{BMI} = 77.3 \text{ (kilograms) / 1.8}^2 \text{ (meters)} = 77.3 / 3.2 = 24
\]
\[
\text{BMI} = 170 \text{ (pounds) × 704.5 / 70}^2 \text{ (inches)} = 119,765 / 4,900 = 24
\]

Test Modifications

The height of an individual who wears prosthetic devices or braces should be taken while he or she wears the items. Subjects who are unable to support their body weight in a standing position can lie on a mat while body length is measured with a tape measure. If an individual with cerebral palsy cannot stand erect because of exaggerated flexor tone in the hips or knees, the tester can use a tape to measure body segments (i.e., floor to knee, knee to hip, hip to head) and add the segments to determine body length for the purpose of calculating BMI.

The weight of an individual who wears a prosthetic device or brace is taken with the items removed or by subtracting the weight of the item. The weight of an individual who uses a wheelchair can be determined either by taking the individual out of the wheelchair or by weighing the individual in the wheelchair and then subtracting the weight of the wheelchair. Individuals with amputation or congenital anomaly can be weighed, but care must be taken when making comparisons with other people or calculating BMI. When estimating the weight of a person with a leg amputation, add 1/18 of body weight for a below-knee amputation, 1/9 of body weight for an above-knee amputation, and 1/6 of body weight for a hip amputation.

Suggestions for Test Administration

This test may be waived if determination of either height or weight poses a safety problem to the subject or the tester; if anomaly, amputation, or contracture prohibits valid measurement; or if BMI will not be used for assessment or program planning.
Bioelectrical Impedance Analysis

Improvements in technology and cost have made it possible to provide portable bioelectrical impedance analysis (BIA) devices to accurately estimate body composition, specifically percent body fat. In this approach, body fat percentage is determined by measuring the body’s resistance to electrical flow. A body with a higher percentage of muscle has greater total body water and lower resistance to electrical flow; on the other hand, a body with a higher percentage of fat has less body water and greater resistance to electrical flow. Depending on the particular BIA instrument used, the tester can determine height, weight, body mass index, and percentage of body fat relative to overall body weight.

The basic principle underlying BIA involves the resistance between two conductors attached to a person’s body, and error can be caused by incorrect placement of the conductors. The test can also be affected by drinking and exercise, which affect hydration; for instance, an individual who consumes a large amount of water before the test may test out at a lowered body fat percentage.

Using BIA offers advantages, particularly when working with large numbers of school students. Results can be determined and recorded quickly—and much faster than is possible with skinfold measures. The procedure is also less invasive than taking skinfolds and thereby provides an excellent alternative to them. However, careful attention must be given to the methods of use described by BIA device manufacturers. Important before purchase is information regarding the psychometric qualities (reliability and validity) of the instrument. BIA is considered safe, but it should not be used without prior medical approval for persons with cardiac pacemakers, electrocardiographs, or other medical devices implanted in the body or used for life support.
This test item and its procedures were modified from Johnson and Lavay (1989). In it, participants perform as many bench presses as possible (to a maximum of 50 for males and 30 for females). The test is designed as a measure of upper-extremity (particularly elbow-extension) strength and endurance.

The participant lies supine on a bench with knees bent and feet on the floor or on rolled mats placed on either side of the bench. Individuals who are unable to assume this position should lie on the bench with knees flexed and lower extremities secured or supported. For safety, the tester acts as a spotter or assigns spotters (figure 5.6a). The participant grasps a 35-pound (15.9-kilogram) barbell with both hands directly above the shoulders and with elbows flexed; this is the ready position (figure 5.6b). Hands on the bar should be about shoulder-width apart with thumbs wrapped around the bar.

On command, the participant raises the barbell to a straight-arm position at a 90-degree angle to the body (figure 5.6c), then returns to the ready position. The participant repeats this action without rest until he or she can no longer raise the barbell or has successfully completed 50 repetitions for males or 30 repetitions for females. One repetition should be completed every 3 to 4 seconds at a steady pace. Spotters stand beside and adjacent to the rib cage, rather than behind the participant, so that the participant is encouraged to lift the barbell straight upward. Although a bilateral action with both arms is encouraged, the participant is credited with a successful repetition if the barbell touches the chest and both arms eventually end up in a straight-arm position without rest. The tester encourages the participant through praise and counting of repetitions.

**Equipment**

Required equipment includes barbells and weights that together weigh 35 pounds (15.9 kilograms). A sturdy bench is recommended; the bench may be placed on a mat (optional).
Scoring and Trials

One correct bench press involves bringing the barbell from the chest to the straight-arm position. Record the number of correct bench press repetitions performed. Participants stop when they can no longer lift the weight completely or when they complete the required number of correct repetitions (50 for males, 30 for females).

Test Modifications

Be certain that participants with intellectual disability and mild limitations in physical fitness understand how to perform the test. Take whatever time is necessary for the participant to learn the test. Subjects should have the upper-body ability to perform the test. Provide those who have lower-body disability with safe and stable support while they assume the supine position on the bench. Participants can be held or secured as necessary and appropriate for stability.

Suggestions for Test Administration

• Conduct practice sessions with participants to help them understand the proper method for performing the bench press. Stress safety in a positive manner through demonstrations.

• Demonstrate and let participants experiment with the proper method of performing the bench press—first with a broomstick, then the bar only, then the bar and lighter weights, and finally the 35-pound (15.9-kilogram) barbell. At the same time, demonstrate and let participants experience the proper position for lying on the bench, proper hand position on the bar, proper leg and foot position, and correct arm movement. Setting an upward target enhances proper upward movement of the bar (figure 5.6c). Give positive reinforcement for properly executed positions and movements. Do not test a participant who does not understand how to complete a properly performed repetition of the bench press.

Curl-Up

In this test, participants complete as many curl-ups as possible, up to a maximum of 75, at a cadence of one curl every 3 seconds. The test is designed to measure abdominal strength and endurance. The participant starts by lying in a supine position on a mat. The knees are bent at an angle of approximately 140 degrees, with the feet flat on the floor and the legs slightly apart. The arms are held straight, parallel to the trunk, with the palms facing down toward the mat and the fingers outstretched. The participant is positioned so that the closest edge of a flat measuring strip that is 4.5 inches (about 11.5 centimeters) wide can be touched with the outstretched fingers (figure 5.7a).

From the starting position, the participant curls up slowly, sliding the fingers across and to the opposite side of the measuring strip (figure 5.7b). The participant then returns to the starting position. The important factor is that participants move the fingertips 4.5 inches (11.5 centimeters) as part of the curl-up. The tester should call the cadence (about one curl every 3 seconds). The participant continues without pausing until he or she either cannot maintain the pace or has completed 75 repetitions.

Equipment

The test uses a gym mat and a measuring strip that is 30 inches by 4.5 inches (76 centimeters by 11.5 centimeters). The measuring strip can be held or secured to a supporting surface. Although measuring strips made from cardboard or sanded plywood are recommended, other systems are acceptable for measuring the 4.5 inches. For example, tape markers can be placed on a mat to indicate start and finish points.

Scoring and Trials

One trial is administered. An individual’s score is the number of curl-ups performed correctly. One curl-up is counted for every return to a supine position on the mat. Curl-ups should not be counted if
the feet completely leave the floor at any time during the movement or if the participant does not reach the required distance, does not return to the start position, or performs the curl-up in any other incorrect manner.

**Test Modifications**

It is acceptable to take whatever time is needed to ensure that youngsters know how to perform the test. Motivation is critical; therefore, continual positive reinforcement should be provided throughout testing.

**Suggestions for Test Administration**

- Encourage a slow curling of the upper spine during the curl-up.
- Encourage steady, controlled, and continuous movement.
- It may be necessary for an assistant to secure the measuring strip.
- Time can be saved by taping a measuring strip to a large mat and adjusting the participant’s starting position to the measuring strip.
- A testing assistant can judge whether the participant’s head touches the mat on each repetition with this judgment.

**Figure 5.7** Curl-up: (a) starting position and (b) up position.
The modified curl-up uses the procedure recommended for the curl-up with the following exceptions:

- The hands are placed on the front of the thighs rather than on the mat alongside the body.
- As the participant curls up, the hands slide along the thighs until the fingertips contact the patellae (figure 5.8a). The hands should slide approximately 4 inches (10 centimeters) to the patellae or, if necessary, beyond.
- If necessary, testers can place their hands on the individual’s kneecaps to provide a more tangible target for the individual’s reach (figure 5.8b).

Figure 5.8 Modified curl-up: (a) hands sliding to the patellae; (b) setting a target.
**Dumbbell Press**

In this test, the participant lifts a 15-pound (6.8-kilogram) dumbbell as many times as possible, up to 50 repetitions, in a specific cadence. The test is designed to measure arm and shoulder strength and endurance. The participant is seated in a wheelchair or other sturdy chair (figure 5.9). For safety, the tester serves as a spotter or assigns spotters. The participant grasps the dumbbell with the dominant hand, with the elbow flexed so that the weight is close to and slightly in front of the dominant shoulder (figure 5.9a). Once the participant has control of the weight, he or she should extend the elbow and flex the shoulder so that the weight is lifted straight up and above the shoulder (figure 5.9b). When the elbow is completely extended, the participant returns the weight to the starting position. The exercise is continued at a steady pace (3 to 4 seconds per repetition) until the participant either completes 50 repetitions or is no longer able to lift the weight above the shoulder with complete elbow extension.

**Equipment**

This test requires a 15-pound (6.8-kilogram) dumbbell, a stopwatch, and a wheelchair or other sturdy chair (preferably made of wood or metal).

**Scoring and Trials**

The participant receives one trial only. One successful lift is counted each time the dumbbell is raised above the shoulder with complete elbow extension. The scoring ends when the participant completes 50 repetitions, rests for more than 4 seconds between repetitions, or is unable to lift the weight with complete elbow extension.

**Test Modifications**

The test can be administered within the participant’s range of motion. If complete elbow extension is not possible due to impairment, the tester should record a successful lift each time the participant lifts the weight with his or her maximal elbow range of motion. During the test, a steady pace should be emphasized. If a participant requires more than 4 seconds to complete a repetition because of a disability, this should be permitted as long as the participant is working to lift the weight.

**Suggestions for Test Administration**

- Before testing, be sure the participant understands how to execute the movement.
- Provide continual encouragement throughout the test.
- Match counting with a cadence. For example, say “one and down, two and down . . .” to prompt about one repetition every 3 to 4 seconds.
Musculoskeletal Functioning: Muscular Strength and Endurance

Extended-Arm Hang

In this test, the participant hangs from a bar or similar apparatus for as long as possible, up to 40 seconds. The test is designed to measure hand, arm, and shoulder strength and endurance. The participant begins by grasping the bar using an overhand, or pronated, grip (knuckles toward the face; see figure 5.10). The thumbs should be wrapped around the bar. The participant may jump to this position, be lifted to it, or move to it from a chair. The participant must assume a fully extended position with feet clear of the floor throughout the test. Elbows and knees must not be bent. The participant can be steadied so that he or she does not sway.

Figure 5.10  Extended-arm hang.

Equipment

This test item requires an adjustable bar about 1.5 inches (3.8 centimeters) in diameter at a height enabling performance without touching the support surface. The surface should be no more than 2 feet (0.6 meter) below the feet while the participant is in the hanging position. A gym mat should be placed under the bar. A stopwatch is required.

Scoring and Trials

One trial is permitted for each participant. The score is the elapsed time in seconds (to the nearest second) from the start of a free hang to the time that the fingers leave the bar.

Test Modifications

Individuals with disability must be provided with an opportunity to learn and experience the test item before scores are recorded for testing purposes.

Suggestions for Test Administration

• Be sure that the bar and the participant’s hands are dry.
• Constant encouragement is extremely important throughout this test.
• For youngsters who are afraid of falling, keep them as close to the floor or ground as possible. Gently steady them, and assure them that they will be assisted if they lose their grip.
**Flexed-Arm Hang**

In this test, the participant maintains a flexed-arm position while hanging from a bar for as long as possible. The test is designed to measure hand, arm, and shoulder strength and endurance. The participant should grasp the bar with an overhand grip and be assisted to a position where the body is close to the bar and the chin is clearly over, but not touching, the bar (figure 5.11). The participant holds this position for as long as possible. The body must not swing, the knees must not be bent, and the legs must not kick during performance of the task. If a physical disability prohibits grasping, weight bearing, or reasonable execution, this item should not be administered.

![Figure 5.11 Flexed-arm hang.](image)

**Equipment**

This test item requires a pull-up bar about 1.5 inches (3.8 centimeters) in diameter at a height exceeding the height of the participant, preferably no more than 3 feet (0.9 meter) and no less than 1.5 feet (0.45 meter) above the participant’s standing height. A gym mat should be placed under the bar. A stopwatch is required.

**Scoring and Trials**

Each participant receives one trial. The tester records the length of time (to the nearest second) for which the participant maintains the flexed-arm position. Timing stops when the head tilts back or the chin contacts or drops below the bar.

**Test Modifications**

None.

**Suggestions for Test Administration**

- A spotter can place an arm across the participant’s thighs to restrict unwanted movement.
- Be sure that the participant understands how to perform the test before taking a score. Provide sufficient time for the participant to learn the activity.
In this test, participants squeeze a grip dynamometer with the stronger hand to generate as much force as possible. The test is designed to measure hand and arm strength. The participant should be seated on a straight-backed, armless chair with his or her feet flat on the floor. The tester must first adjust the handle of the dynamometer to fit the hand of the participant; when the dynamometer is squeezed, the second phalanx should rest on the adjustable handle. Once the dynamometer has been adjusted to the correct position, the participant should be instructed to squeeze the handle as hard as possible (figure 5.12). The hand grasping the dynamometer should be held away from the body and chair during the test.

**Figure 5.12** Dominant grip strength.

**Equipment**

Testers should use a good-quality grip dynamometer with an adjustable handle (figure 5.13). Data for this test presented in the tables found in chapter 4 were collected using a Jamar grip dynamometer.
Scoring and Trials

Three trials are administered using the participant’s preferred (stronger) hand. Allow at least 30 seconds between trials. After each trial, the needle should be reset to zero. The tester records each participant’s score to the nearest kilogram. The middle score of the three trials serves as the criterion score.

Test Modifications

The dominant grip strength test item should not be administered to individuals without sufficient functional strength or to those unable to grasp or release because of an impairment. Participants can be seated in a wheelchair or on another support surface as long as the test can be administered appropriately.

Suggestions for Test Administration

- All participants must be motivated to enhance maximal effort.
- Do not test subjects until they have learned to perform the test properly.
- Individuals with intellectual disability must be given an opportunity to practice using the equipment and be taught the concept of squeezing with as much force as possible.

Isometric Push-Up

This test item and its procedures were modified from Johnson and Lavay (1989). The participant attempts to hold a raised push-up position for as long as 40 seconds. The test is designed primarily to measure upper-body strength and endurance. The participant assumes a front-leaning rest position with the hands directly below the shoulders, the arms extended, the whole body in a straight line, and the toes touching the floor or mat; this is the correct up position for a push-up (figure 5.14). The test is terminated when any movement—such as bending, sagging, or swaying—occurs at the elbows, shoulders, trunk, or knees. In other words, scoring is terminated when the correct up position for the push-up is no longer held.

Figure 5.14  Isometric push-up.
Equipment
This test requires a stopwatch and a flat, solid surface. A firm mat is recommended.

Scoring and Trials
One test trial is given. The tester records the length of time, to the nearest second, for which the participant holds the proper position.

Test Modifications
It is permissible to provide tactual assistance to help place and keep the body in the proper position during the test. However, no assistance should be given in holding the body upright.

Suggestions for Test Administration
- Do not test a participant who does not understand how to properly execute the isometric push-up.
- Take whatever time is necessary to ensure that participants learn the test.
- Since motivation is critical, provide continual positive reinforcement to each participant.
- Demonstrate and let participants experiment with the proper method of performing an isometric push-up, including the proper positions for hands, arms, head, trunk, legs, and feet. Give visual, verbal, and physical support prompts to help participants learn the correct position. Physical supports during testing are not permitted.

Pull-Up
In this test, participants complete as many pull-ups as they can. The test is designed to measure upper-body strength and endurance. The participant begins in the position of a straight-arm hang from a bar using an overhand (pronated) grip (figure 5.15a). The participant then pulls the body up toward the bar until the chin is above the bar (figure 5.15b). Once this position is reached, the body is lowered to the full-hang starting position. The body must not swing, the knees must not be bent, and the legs must not kick during performance of the task.

Figure 5.15  Pull-up: (a) down position and (b) up position.
Photos courtesy of Matthew J. Yeoman.
**Equipment**

This test uses a sturdy horizontal bar about 1.5 inches (3.8 centimeters) in diameter that permits the participant to hang with arms fully extended and feet not touching the floor. A gym mat should be placed under the bar.

**Scoring and Trials**

Each participant is permitted one trial, and the score attained is the number of pull-ups performed. There is no time limit for the test, but participants should be encouraged to complete the test quickly in order to reduce the effects of fatigue.

**Test Modifications**

Testing assistants may need to spot participants in order to reduce the possibility of falling or losing balance after falling from bar.

**Suggestions for Test Administration**

- Be sure that the participant understands how to perform the test before taking a score. Provide sufficient time for the participant to learn to perform the test item with confidence.
- Spotters may place an arm across the participant's thighs to restrict swinging of the body, kicking, or other unwanted movement during the task.

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**Modified Pull-Up**

In this test, participants execute as many pull-ups as possible using a pull-up stand. The test is a measure of upper-body strength and endurance. It uses a modified pull-up apparatus (see appendix B and figure 5.16). The participant lies down under the crossbar so that the bar is directly over the shoulders. The participant's arms are extended up toward the bar, which should be set 1 to 2 inches (2.5 to 5 centimeters) above the participant's outstretched arms. An elastic band is placed on a peg 7 to 8 inches (18 to 20 centimeters) below the bar. This band marks the height to which the participant's chin must rise for completion of one repetition.

**Figure 5.16** Modified pull-up: (a) starting position and (b) raised position.
To get into the starting position, the participant raises the body high enough to grasp the bar using an overhand (pronated) grip with thumbs around the bar. The pull-up begins in the down position with arms, legs, and body straight; buttocks off the floor; and only the heels touching the floor. The pull-up action should raise the body to a height where the chin rises above the elastic band. Then the participant lowers to the starting position and repeats as many times as possible. Movement is performed using the arms only.

**Equipment**

A modified pull-up stand is preferred, but any adjustable bar arrangement can be used as long as the proper procedures are followed.

**Scoring and Trials**

The score is the number of correct pull-ups completed. There is no time limit, but the action should be continuous.

**Test Modifications**

Participants should be given sufficient practice to learn the test procedure.

**Suggestions for Test Administration**

- Give encouragement and positive feedback throughout the test.
- Stop the test if the participant experiences extreme discomfort.

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**Push-Up**

In this test, participants complete as many push-ups as possible at a rate of 1 push-up every 3 seconds. The test is designed primarily to measure upper-body strength and endurance. To begin, the participant assumes a prone position on a mat with the hands placed under the shoulders, the fingers outstretched, the legs straight and slightly apart, and the weight on the tucked toes. The participant pushes to the up position until the arms are straight (figure 5.17a). Next, the participant lowers the body by bending the elbows to a 90-degree angle (figure 5.17b). The participant then returns to the straight-arm position. The cadence should be approximately 1 push-up every 3 seconds.

**Figure 5.17** Push-up: (a) up position and (b) down position.
Equipment

Only a mat is required. However, in order to maintain good cadence, it is also recommended that test-
ers use a watch with a second hand (by which cadence can be called out), a metronome, or an audio
recording with the correct cadence.

Scoring and Trials

After learning the test, one trial is permitted. A participant’s score is the number of correctly executed
push-ups. The starting position for the push-up is the up position with the arms straight. One push-up
is counted each time the participant bends the arms and returns to the straight-arm position. The test
is terminated if the participant is unable to maintain correct cadence, stops to rest, or discontinues the
activity. Push-ups done incorrectly should not be counted. Push-ups are incorrect if the knees touch the
floor, the arms are not straight in the up position, the arms are not bent at 90 degrees on the downward
movement, movement is jerky or not coordinated bilaterally, or the back is not kept reasonably straight.

Test Modifications

• Extra time should be provided for participants with intellectual disability to learn the test.
• Some latitude is recommended in performing to a cadence, that is, approximately 20 push-ups
  in 1 minute.
• Considerable time is required to teach the test to individuals with visual disability if they have not
  already learned how to perform a push-up. Provide tactual or kinesthetic cues to help participants
  know correct arm positions and recognize a straight back during the push-up.

Suggestions for Test Administration

• Be sure that all participants have time to learn to perform the test correctly.
• Encourage participants to breathe as they perform the activity, preferably exhaling while rising to
  the up position.
• To help participants learn the push-up, have them watch themselves in a mirror. This is especially
  important for learning to bend the elbows to 90 degrees and keeping the back straight in the up
  position.
• Have participants practice with a cadence.
40-Meter Push/Walk

In this test, participants walk or push their wheelchairs a distance of 40 meters (43 yards, 27 inches), after moving through a start zone of 5 meters (5 yards, 17 inches) at a speed that is comfortable for them (figure 5.18). This test item is designed to measure whether participants have the strength and endurance to traverse a distance of 40 meters without reaching a moderate level of exertion. This is not a dash or race, and testers should not emphasize high speed as a component of the test. Participants should be encouraged to travel at the speed they usually use for mobility in the community. To pass the test, participants must be able to cover the 40-meter distance in 60 seconds or less while keeping the heart rate below the criterion for moderate exercise intensity.

Figure 5.18 Performing the 40-meter push/walk.

Equipment

This test requires a stopwatch or a watch with a second hand. The test should be conducted on a hard, flat, smooth surface. A starting line is placed 45 meters (49 yards, 8 inches) from a finish line, and a timing line is placed 5 meters (5 yards, 17 inches) from the starting line (figure 5.19). There should also be a safety zone of at least 5 meters beyond the finish line.

Scoring and Trials

Participants are timed to the nearest second over the 40-meter distance. The tester begins timing when the individual crosses the timing line and stops timing when the individual crosses the finish line. As soon as the participant crosses the finish line, the tester measures the participant’s radial pulse for 10 seconds. For the correct level of exercise intensity, participants who walk or push a wheelchair with their legs must have a posttest 10-second pulse rate of 20 beats or fewer. Those who push a wheelchair with their arms must have a posttest 10-second pulse rate of 19 beats or fewer. Two trials can be administered if necessary. If two trials are used, permit at least 1 minute of rest between trials. The participant's pulse must be at or near resting level before a trial is administered. The test is assessed on a pass/fail basis. Participants pass when they cover the distance within 60 seconds at the acceptable heart rate intensity.

Test Modifications

If testers experience difficulty with obtaining a radial pulse manually, it is recommended that they use a stethoscope to determine heart rate. Testers can also choose to use a heart rate monitor rather than take a manual radial pulse. If a monitor is used, it should be read within 5 seconds after the individual crosses the finish line. For youngsters who walk or push a wheelchair with their legs, the posttest heart rate on the monitor must be at or below 125 beats per minute. For participants who propel a chair with their arms, the rate must be at or below 115 beats per minute.
Suggestions for Test Administration

- If a participant covers the distance in fewer than 60 seconds but the heart rate is too high, provide a rest, instruct the individual to go slower, and retest.
- Testers should not use “on your mark, get set, go” or similar instructions to start the test. Instead, the participant should start from the starting line when he or she is ready, and the tester should begin timing as the participant crosses the timing line.
- Testers can use participants’ ratings of perceived exertion or tester observation of exertion to determine below-moderate effort in completing the test (though these procedures are not preferred because they are believed to be less accurate than heart rate measurements). For example, participants who are able to carry on a conversation comfortably or who indicate that the activity was at a “light” exertion level might be considered to have exercised below a moderate level of intensity.

**Figure 5.19** Acceptable courses for the 40-meter push/walk.
In the reverse curl, the participant attempts to pick up a 1-pound (0.5-kilogram) dumbbell with the preferred arm while seated in a chair or wheelchair. The test is designed as a measure of hand, wrist, and arm strength. During the movement, the fingers are flexed (i.e., wrapped around the weight), and the forearm is pronated both at the start and throughout the movement. The movement is executed primarily by extending the wrist and flexing the elbow. It starts with the weight resting on the midpoint of the ipsilateral thigh while the participant is in a normal seated position (figure 5.20a). From this starting position, the participant flexes the elbow and lifts the weight until the elbow is flexed to at least 45 degrees (figure 5.20b). The weight is held in this position for 2 seconds, then returned eccentrically to the starting position. The movement must be controlled, and the elbow extension on the downward movement must be slower than gravitational pull.

**Figure 5.20** Reverse curl: (a) starting position and (b) up position.

**Equipment**

The recommended equipment is a 1-pound (0.5-kilogram) soft-iron dumbbell.

**Scoring and Trials**

One trial is administered. One correct reverse curl involves bringing the dumbbell from the thigh to the flexed-arm position, holding it in the flexed position for 2 seconds, and returning it to the thigh in a controlled manner. The test item is passed if the participant can perform one correct reverse curl.

**Test Modifications**

- A table or other surface can be used for a starting support surface in place of the thigh. If an alternative support surface is used, it should be at the participant’s knee level while seated.
- Weights of 1 pound (0.5 kilogram) other than dumbbells can be used if the testing procedures can be essentially reproduced with them.

**Suggestions for Test Administration**

- Permit participants to practice the reverse curl before the formal test is administered.
- Provide a positive environment and positive reinforcement of good effort, proper execution, and successful completion of the task.
Musculoskeletal Functioning: Muscular Strength and Endurance

Seated Push-Up

In this test, participants attempt to perform a seated push-up and hold it for as long as 20 seconds. The test is designed to measure upper-body strength and endurance. Participants place their hands on the handles of push-up blocks (figure 5.21a), on the armrests of a standard wheelchair or armchair, or on the wheels of a sport wheelchair that does not have armrests (figure 5.21b), and then lift the body so that the buttocks are raised from the supporting surface by extension of the elbows. Once extension is obtained, participants maintain that position for as long as possible; the arms must be extended at the elbow.

Equipment

This test requires a stopwatch and a standard wheelchair with armrests, a sport wheelchair, a sturdy armchair, or a set of push-up blocks. The armrests (or wheels on a sport wheelchair) or push-up blocks should be slightly more than shoulder-width apart.

Scoring and Trials

The participant performs one trial only. The score is the length of time for which the participant holds the body off of the seat or supporting surface with elbow extension. Feet can come into contact with the floor but cannot be used to assist in performing the push-up. Timing begins when the participant raises the body and obtains elbow extension. Timing ends when the participant no longer holds the position or after a maximum of 20 seconds.

Test Modifications

The test can be administered within the participant’s range of motion as long as the buttocks are not in contact with the supporting surface. If the participant is unable to completely extend the elbows due to an impairment, timing should begin when the participant achieves his or her maximal extension and end when the maximal extension is no longer held.

Suggestions for Test Administration

- Take care that participants are in the correct position for testing.
- If using push-up blocks, the tester should stabilize the blocks before the test to prevent them from tipping during the test.
- Give participants an opportunity to practice.

Figure 5.21 Seated push-up performed (a) on a mat with push-up blocks and (b) on the wheels of a sport wheelchair.
**Trunk Lift**

In this test item, the participant attempts to lift the upper body as far as 12 inches (30 centimeters) off the floor using muscles of the back and to hold the position to allow for measurement. The test is designed to measure trunk extension, strength, and flexibility. The participant lies on a mat in a prone position (facedown). The toes are pointed, and the hands are placed under the thighs. A coin or other marker may be placed on the mat in line with the participant’s eyes. The participant lifts the upper body off the floor to a maximum height of 12 inches (30 centimeters); see figure 5.22. The movement should be performed in a very slow and controlled manner, and the participant should continue to look at the coin or marker throughout the test to enhance correct alignment of the head. The position is held long enough to allow the tester to measure the distance from the participant’s chin to the floor. For safety, the ruler should be placed on the floor at least 1 inch (2.5 centimeters) in front of the participant’s chin—not directly under the chin. After the tester makes the measurement, the participant returns to the starting position in a controlled manner.

![Figure 5.22 Trunk lift.](image)

**Equipment**

This test requires gym mats and a measuring stick.

**Scoring and Trials**

Allow two trials and record the better score to the nearest inch or centimeter. Stretches beyond 12 inches (30 centimeters) are discouraged; therefore, scores beyond that distance should be recorded as 12 inches (30 centimeters).

**Test Modifications**

For persons with intellectual disability, it is permissible to hold the legs in place on the mat during the test. Individuals with disability should be given sufficient time to practice the test and become thoroughly familiar with the testing procedure. When explaining the test item to participants who are blind, it may be helpful to have them feel an individual demonstrating the skill. If the participant cannot see the coin or marker, he or she should be taught to hold the head at a similar angle.

**Suggestions for Test Administration**

- Do not allow participants to do ballistic (bouncing) movements.
- Do not encourage participants to rise higher than 12 inches (30 centimeters). Excessive arching of the back can cause compression of the disks.
- Because motivation is an important factor, give positive reinforcement continually throughout the test.
- Pay particular attention to performance technique during this test.
Wheelchair Ramp Test

In this test, participants in wheelchairs attempt to push their chairs up a standard wheelchair ramp (figure 5.23). The test is designed to measure upper-body strength and endurance. Participants may use whatever wheelchair push technique they prefer to complete the test.

Figure 5.23  Wheelchair ramp test.

Equipment

A standard wheelchair ramp is required. A standard ramp is one that complies with American National Standards Institute (ANSI) guidelines, which specify that ramps should be at least 36 inches (91 centimeters) wide and constructed with 12 inches (30 centimeters) of run for every 1 inch (2.5 centimeters) of rise. For example, a ramp with an elevation of 14 inches (36 centimeters) should be 14 feet (4.3 meters) long. For this test, the ramp must be at least 8 feet (2.4 meters) long. On longer ramps, testers should place lines 8 feet (2.4 meters), 15 feet (4.6 meters), and 30 feet (9.1 meters) from the start of the incline. (Ramps longer than 30 feet generally have a level platform at the 30-foot mark.) It is anticipated that testers will use existing ramps in their schools or buildings to conduct this test, though a ramp with sufficient run is not difficult to construct (see appendix B).

Scoring and Trials

Participants start with their lead wheels off the ramp and attempt to get their rear wheels beyond the lines on the ramp. Going beyond the 8-foot (2.4-meter) line satisfies the minimal standard for this test. The preferred standard is obtained when the individual either goes beyond the 15-foot (4.6-meter) line or makes it to the top of a longer ramp that the individual frequently encounters (e.g., a 20-foot [6.1-meter] ramp leading to the school entrance). Therefore, testers can set a preferred standard between 15 and 30 feet (4.6 and 9.1 meters) based on the typical environment that a participant must negotiate. The test is not timed, and multiple trials are permissible as appropriate.

Test Modifications

The test can be conducted on a ramp that does not meet the ANSI incline standards, provided that it is otherwise safe, but in such cases the tester will have to develop individualized standards.

Suggestions for Test Administration

Safety precautions should be taken to ensure that the wheelchair cannot roll off the edge of the ramp. Participants should be spotted from behind in case the wheelchair begins to roll back down the incline.
Modified Apley Test

The participant attempts to reach back with one hand and touch the superior medial angle of the opposite scapula. The test is designed to measure upper-body flexibility.

**Equipment**

None.

**Scoring and Trials**

One trial is given for each arm. If the participant can successfully touch the superior medial angle of the opposite scapula and hold that position for 1 to 2 seconds, a score of 3 is awarded for that arm. If the participant cannot achieve a score of 3, he or she attempts to touch the top of the head; a successful attempt at this target obtains a score of 2. If the participant cannot achieve a score of 2, he or she attempts to touch the mouth and receives a score of 1 if successful. If the participant is unable to touch the mouth, a score of 0 is given for that arm. The scoring scheme is summarized as follows (also see figure 5.24, a–c):

- 3—Touch the superior medial angle of opposite scapula
- 2—Touch the top of the head
- 1—Touch the mouth
- 0—Unable to touch the mouth

**Figure 5.24** Scoring the modified Apley test: (a) scapula, score of 3; (b) top of head, score of 2; (c) mouth, score of 1.

**Test Modifications**

None.
Suggestions for Test Administration

- Testers can place their fingertips along the superior medial angle of the scapula (or on the top of the head) to provide a target for the participant and a more objective criterion for scoring (i.e., if the participant can touch the tester’s fingertips, a passing score is awarded).
- Participants should be given ample opportunity to practice this test. Physical assistance may be provided during practice but not during the test.
- Participants should be given encouragement and positive reinforcement.
- Testers must require youngsters to hold the test position briefly (1 to 2 seconds) to award a score of 3. Ballistic or reflexive touches are not acceptable.
- Testing should be preceded by sufficient warm-up, including shoulder-stretching activities.

**Back-Saver Sit-and-Reach**

The objective of this test is to reach across a sit-and-reach box while keeping one leg straight. The test item is designed to measure flexibility of the hamstring muscles. The participant begins the test by removing his or her shoes (very thin footwear is permitted) and sitting down at the test apparatus. One leg is fully extended with the foot flat against the end of the testing instrument. The other knee is bent, with the sole of this foot flat on the floor 2 to 3 inches (5 to 8 centimeters) to the side of the straight knee. The arms are extended forward over the measuring scale with the hands palms down, one on top of the other. The participant reaches directly forward with both hands along the scale four times and holds the position of the fourth reach for at least 1 second (figure 5.25). After that side is measured, the participant switches the position of the legs and reaches again. The participant can allow the bent knee to move to the side if necessary as the body moves by it.

![Figure 5.25 Back-saver sit-and-reach.](image)
Equipment
This measurement is best taken using a flexibility testing apparatus approximately 12 inches (30 centimeters) high and 12 inches wide. A measuring scale is placed on top of the apparatus with the zero end of the ruler nearest the participant and the 9-inch (23-centimeter) mark even with the vertical surface against which the foot rests (see appendix B and figures 5.25 and 5.26). The grid on the box should range from 0 to at least 16 inches (41 centimeters).

![Commercially built Flex-Tester.](image)

Figure 5.26 Commercially built Flex-Tester.

Scoring and Trials
One trial (four stretches, holding the last) is given for each leg. The tester records, to the nearest whole unit, the number of inches or centimeters reached in the last attempt on each side. Reaches beyond the criterion-referenced standards designated for this test item are not recommended.

Test Modifications
Subjects with intellectual disability should be given sufficient practice time to become completely familiar with the testing procedure. They should not be encouraged to exceed the recommended criterion-referenced standards for this test item.

For blind participants, provide verbal description of the testing environment and procedure. These participants may be given physical assistance as they practice the test and become familiar with the procedure. However, physical assistance may not be given during the test itself.

If a flexibility-testing apparatus is not available, measurements can be obtained with a ruler extended over a bench turned on its side. This approach may be less accurate than use of the recommended testing apparatus.

Suggestions for Test Administration
- The knee of the extended leg must remain straight. The tester should place one hand on the straightened leg to assist proper positioning.
- The participant’s hands should reach forward evenly, and the shoulders should be square to the test apparatus.
- Hips must remain square to the box. Do not allow participants to turn their hips away from the box as they reach.
- Require participants to stretch the hamstrings and lower back as a warm-up before testing.
- Because motivation is an important factor, participants should receive continual encouragement and positive reinforcement during the testing process.
- Emphasize a gradual reach forward. Do not permit bobbing or jerking movements forward.
Shoulder Stretch

This test item is used to determine whether a participant is able to touch the fingertips together behind the back by reaching over the shoulder and down the back with one arm and across the back with the other arm (figure 5.27). The test measures upper-body flexibility. The measure is designated right or left on the basis of the arm reaching over the shoulder; for example, when the right arm stretches over the right shoulder, it is a right-arm stretch.

![Shoulder Stretch](image)

**Figure 5.27**  Shoulder stretch: right shoulder.

**Equipment**
None.

**Scoring and Trials**
One test trial is permitted. The test is scored on a pass/fail basis. The participant passes if the fingers touch and fails if the fingers do not touch.

**Test Modifications**
Physical assistance and verbal direction may be given to participants as they practice the test. However, physical assistance may not be given during the test itself.

**Suggestions for Test Administration**
- Participants should be given ample opportunity to practice this testing procedure.
- The recommended warm-up is for upper-body stretching, including approximations of the test itself.
Modified Thomas Test

This test is designed to assess the length of the participant’s hip flexor muscles. It is conducted on a sturdy table (see figure 5.28, a–d). The tester places a thin strip of masking tape on the table 11 inches (28 centimeters) from one of the short edges. The participant lies in a supine position on the table so that the head of the femur is level with the strip of tape. (The tester should ensure that the hip joint is 11 inches from the edge of the table.) The lower legs can be relaxed and should hang off the narrow edge of the table. To test the right hip, the participant lifts the left knee toward the chest. The participant uses the hands to pull the knee toward the chest until the back is flat against the table. At that point, the tester should observe the position of the participant’s right thigh. Participants receive the maximum score if they can keep the thigh in contact with the table surface while the back is flat. To test the left hip, the procedure is repeated on the opposite side of the body.

Equipment

This test requires a sturdy table with a tape mark 11 inches (28 centimeters) from one of its short edges. File cards—measuring 3 by 5 inches (i.e., 7.6 centimeters tall) and 4 by 6 inches (15.2 centimeters wide)—or their equivalents are recommended to help with the scoring. A tape measure or ruler can also be used.

Scoring and Trials

One trial for each leg is appropriate for most participants. The test is scored on a scale of 0 to 3 points as follows:

3—The tested leg remains in contact with the surface of the table when the opposite knee is pulled toward the chest, and the back is flat. See figure 5.28a.

2—The tested leg does not remain in contact with the surface of the table, but the height of the participant’s leg above the edge of the table is less than 3 inches (7.6 centimeters). For example, if the leg is elevated but the tester cannot slide the 3-inch (7.6-centimeter) side of the small file card under the participant’s thigh at the edge of the table, a score of 2 is appropriate. See figure 5.28b.

1—The tested leg is raised more than 3 inches (7.6 centimeters) but less than 6 inches (15.2 centimeters) above the edge of the table. For example, if the 3-inch (7.6-centimeter) side of the small file card slides under the participant’s leg at the edge of the table, but the 6-inch (15.2-centimeter) side of the large card does not, a score of 1 is appropriate. See figure 5.28c.

0—The tested leg is raised more than 6 inches (15.2 centimeters) above the edge of the table. For example, if the 6-inch (15.2-centimeter) side of the large file card slides under the participant’s thigh at the edge of the table, a score of 0 is appropriate. See figure 5.28d.

Test Modifications

If necessary, a tester or spotter can gently assist the participant in pulling the opposite knee toward the chest. In any event, it is important that the back be flat on the table before scoring the test.

If a participant is unable to flatten the lower back after multiple attempts, the tester should score the test as previously indicated and note on the score sheet that the back was not flat. Scores obtained in this manner should not be compared with the standards recommended in this manual. Instead, these scores can be used to monitor future progress, and testers are encouraged to develop individualized standards for the participant.
Suggestions for Test Administration

- Participants should stretch or otherwise warm up the hip muscles before testing.
- If testers prefer to use a tape measure or ruler to measure the elevation of the tested leg, the measurement should be taken vertically from the edge of the table to the posterior aspect of the upper leg.
- Testers can determine flatness of the participant’s lower back by attempting to pass their hand between the hollow part of the lower back and the table. Ordinarily, the hand is unable to move between the lower back and the table if the back is flat.
- Testers should note any knee extension or thigh abduction that occurs during the test for participants who score a 3. If the rectus femoris extends the knee or the tensor fasciae latae abducts the thigh, some of the hip flexors (iliopsoas and sartorius) are of normal length but others may be shortened.

Figure 5.28  Scoring the modified Thomas test: (a) score of 3, (b) score of 2, (c) score of 1, and (d) score of 0.
Musculoskeletal Functioning: Flexibility or Range of Motion

**Target Stretch Test**

The target stretch test (TST) is a screening instrument used to estimate movement extent in a joint. It includes a series of tests illustrated in the sketches in form 5.1. For each individual test, testers ask participants to achieve their maximal movement extent for a given joint action and subjectively evaluate that limit against criteria provided in the sketches. Testers should demonstrate or clearly describe the optimal (i.e., complete) movement extent for each joint being tested. The needs of the youngster determine which joints are selected for testing. Individual test items are described in the following entries.

**Wrist Extension**

The participant’s recommended test position is either standing or seated with the elbow flexed to 90 degrees and the forearm pronated (palm down). Participants extend the wrist as far as possible, and testers read the angle made by the longitudinal axis (i.e., lengthwise middle) of the lateral aspect of the hand (not the fingers).

**Elbow Extension**

The participant’s recommended test position is either standing erect or seated with the upper arm at the side. Preferably, the forearm should be supinated (palm facing forward). Participants extend the elbow as far as possible, and testers read the angle made by the longitudinal axis of the forearm from elbow to wrist (not the hand or fingers).

**Shoulder Extension**

The participant’s recommended test position is either standing erect or seated with the arm at the side (palm facing the side). Participants extend the arm backward in a vertical plane as far as the shoulder allows, and testers read the angle made by the longitudinal axis of the upper arm from shoulder to elbow while ensuring that the participant’s trunk remains erect.

**Shoulder Abduction**

The participant’s recommended test position is either standing erect or seated with the arm at the side. Participants abduct the shoulder as far as possible, and testers read the angle made by the longitudinal axis of the upper arm from shoulder to elbow while ensuring that the participant’s trunk remains erect. When the shoulder is fully abducted, the palm should face inward (i.e., toward the midline of the body).

**Shoulder External Rotation**

The participant’s recommended test position is seated so that the tester can evaluate the movement by observing the participant’s shoulder from behind and above. The recommended position also requires 90 degrees of elbow flexion and contact between the upper arm and the lateral aspect of the trunk (i.e., adduction). Participants externally rotate the shoulder as far as possible by moving the wrist away from the trunk while maintaining an adducted upper arm and 90 degrees of elbow flexion (see figure 5.29). The tester reads the angle made by the longitudinal axis of the forearm from elbow to wrist from the starting position to the maximum rotated position.

![Position for the right shoulder external rotation test.](image-url)
Forearm Supination
The participant’s recommended test position is either standing or seated, facing the tester, with elbow flexed while holding a pencil (or similar object) in a closed fist. (The long end of the pencil should protrude up from the thumb side of the fist.) The participant supinates the forearm (palm up) as far as possible, and the tester reads the angle made by the long end of the pencil.

Forearm Pronation
The participant’s recommended test position is either standing or seated, facing the tester, with elbow flexed while holding a pencil (or similar object) in a closed fist. (The long end of the pencil should protrude up from the thumb side of the fist.) The participant pronates the forearm (palm down) as far as possible, and the tester reads the angle made by the long end of the pencil.

Knee Extension
The recommended test position is to have the participant in a side-lying position on a rug or mat. (The bottom leg may be bent for stability while the knee of the top leg is being evaluated.) The tester views the extended top leg from above while standing behind the knee being evaluated. The tester reads the angle made by the longitudinal axis of the tested leg from knee to ankle.

Equipment
A firm mat or comfortable rug is helpful for the knee extension test; no other equipment is necessary for participants who are able to achieve the recommended test positions. The tester compares the participant’s movements with the criteria provided in the sketches. The test can be administered to participants who cannot achieve the recommended test positions, but evaluation of performance may be enhanced by using a modified goniometer (figure 5.30). Use of this instrument is discussed under test modifications.

![Figure 5.30 Modified goniometer: (a) close-up view and (b) measuring wrist extension. Photos courtesy of Matthew J. Yeoman.](image)

Scoring and Trials
Participants must be able to hold their final position for at least 1 second. Using a TST worksheet (form 5.1), testers initially record the “time on the clock” (i.e., the degrees of the arc) of the movement extent to the nearest “half hour” (15 degrees), then convert the “time” to a test score (0 to 2) as given by the sketches. For example, a right wrist extension time of 1:00 receives a score of 2, and times between 1:30 and 2:00 receive a score of 1. Any time below 2:00 receives a score of 0. Noting time on the clock allows the tester to document changes in performance even if the test score does not change. The relationship between test scores and goniometric values is given in table 5.3.
### Table 5.3  Goniometric Values Associated With Target Stretch Test Scores

<table>
<thead>
<tr>
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<th>Normal(^a)</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrist extension</td>
<td>70°</td>
<td>60°</td>
<td>30°</td>
</tr>
<tr>
<td>Elbow extension</td>
<td>0°</td>
<td>0°</td>
<td>–15°</td>
</tr>
<tr>
<td>Shoulder extension</td>
<td>60°</td>
<td>60°</td>
<td>30°</td>
</tr>
<tr>
<td>Shoulder abduction</td>
<td>170°</td>
<td>165°</td>
<td>120°</td>
</tr>
<tr>
<td>Shoulder external rotation</td>
<td>90°</td>
<td>75°</td>
<td>30°</td>
</tr>
<tr>
<td>Supination/pronation</td>
<td>90°</td>
<td>90°</td>
<td>45°</td>
</tr>
<tr>
<td>Knee extension</td>
<td>0°</td>
<td>0°</td>
<td>–15°</td>
</tr>
</tbody>
</table>

\(^a\) Normal, or typical, range-of-motion values found in the literature vary somewhat from authority to authority. These values come from Cole and Tobis (1990). In some cases, values for test scores of 2 differ from Cole and Tobis’s values due to the recommendation that testers estimate movement extent to the nearest “half hour” (15°). In the case of shoulder external rotation, part of the difference between a normal score and a score of 2 involves differences in test procedures.

Adapted from Cole and Tobis, 1990.
Form 5.1 Target Stretch Test

a) Wrist extension (left)

Position ________________________________
Comments ________________________________

b) Wrist extension (right)

Position ________________________________
Comments ________________________________

c) Elbow extension (left)

Position ________________________________
Comments ________________________________

d) Elbow extension (right)

Position ________________________________
Comments ________________________________

e) Shoulder extension (left)

Position ________________________________
Comments ________________________________

f) Shoulder extension (right)

Position ________________________________
Comments ________________________________

(continued)
g) Shoulder abduction (left) 

<table>
<thead>
<tr>
<th>Position</th>
<th>Comments</th>
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<td></td>
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h) Shoulder abduction (right) 

<table>
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<th>Position</th>
<th>Comments</th>
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<td></td>
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i) Shoulder external rotation (left) 

<table>
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j) Shoulder external rotation (right) 

<table>
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<th>Comments</th>
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k) Forearm supination (left) 

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l) Forearm supination (right) 

<table>
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<th>Position</th>
<th>Comments</th>
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Test Modifications

If a participant cannot achieve the recommended test position depicted in the sketch, the joint action can still be assessed, but the clock must be rotated for scoring. For instance, the recommended test position for right wrist extension includes maintaining elbow flexion of 90 degrees. A participant could, however, be tested with the arm at the side and a completely extended elbow if the clock is rotated 90 degrees so that the 9 instead of the 12 is at the top of the clock. This approach may become conceptually difficult for the tester, so it is recommended that testers modify a transparent plastic goniometer to help rotate the clock into the proper position. The circular dial of the goniometer can be converted into a version of a clock face by placing the numerals 1 to 12 on strips of tape at 30-degree intervals (figure 5.30a). Once the goniometer is modified, it can be used to rotate the clock and estimate movement extent from a variety of test positions. When using the modified goniometer, it is recommended that testers stand, crouch, or kneel approximately 5 to 10 feet (about 1.5 to 3 meters) from the participant. The tester reads the time on the clock by holding the goniometer at arm’s length and viewing the limb in question through the face of the goniometer (figure 5.30b).

Testers who are knowledgeable about and comfortable with taking actual goniometry measures may prefer that approach to estimating movement extent via the clock. Test scores of 0, 1, and 2 can be assigned based on the goniometric values given in table 5.3.

Suggestions for Test Administration

- Testers should help participants maximize their movement extent. Changes in body position may influence a participant’s performance. Youngsters who have tonic neck reflexes, for instance, may enhance their performance by flexing, extending, or turning the head while being tested. Testers should help participants find the position that maximizes the movement extent in a joint, as long as the position is noted on the worksheet and the integrity of the scoring system is maintained (e.g., the clock may need to be rotated).
- When evaluating a number of participants, testers can expedite the process by recording the movement extent on the clock during testing and converting it to a score after the testing session.
- Participants should warm up the joints to be tested.
- Testers may find it helpful to tape photocopies of the sketches (enlargements work best) to a nearby wall in order to eliminate flipping back and forth between pages in the manual or worksheet.
- Testers who administer the TST may find the worksheet in form 5.1 helpful and are free to photocopy it as often as necessary. The sketches demonstrate the recommended test positions, the clock for scoring, and the criteria for both specific standards (a score of 1) and general standards (a score of 2). Spaces are available to the right of each sketch to record both time on the clock (degree of movement) to the nearest half hour and corresponding test score (0 to 2). Extra space is provided to allow multiple administrations of the test. Below each sketch, room is given to note any variation in test position that is necessary when a participant cannot attain the recommended test position. There is also room to note other relevant observations.