OVERVIEW

Five components of fitness are being evaluated to determine a baseline level of fitness for fire service personnel and to measure progress from year to year. The five components are: Body Composition, Aerobic Capacity, Muscular Strength, Muscular Endurance, and Flexibility. Fitness assessments may be conducted by the designated fire department’s certified fitness personnel. All data collected by the evaluator shall be maintained in a secure location and adhere to strict levels of confidentiality.

1. Body Composition: Skinfold measurements

There are many techniques available to estimate body composition. The WFI recommends a three-site skinfold measurement to estimate body composition. When performed correctly, skinfold measurements yield reliable, accurate, and cost-effective estimates with a standard error of ±3.5%.

2. Aerobic Capacity: WFI Treadmill/WFI Stepmill

There are many assessments currently available to evaluate aerobic capacity. The WFI recommends two submaximal tests to predict maximum aerobic capacity, the WFI Treadmill Protocol and the WFI Stepmill Protocol. The formula for calculating the heart rate limit, or Target Heart Rate (THR), has been modified. In order to determine THR for these assessments refer to Table 5.5.

A maximal aerobic capacity test can also be used to obtain maximal VO2 values. This protocol shall only be conducted in a medical facility under the supervision of a physician, including, ECG monitoring and resuscitation equipment.

3. Muscular Strength:
   Hand Grip, Static Arm, & Static Leg

There are many assessments currently available to evaluate maximum muscular strength. The WFI recommends isometric tests because they are reliable, valid, cost-effective, portable, easy to administer and safe. As with all forms of exercise there are inherent risks for injury; however, with comprehensive pre-screening, appropriate instruction, supervision, and proper execution, the risks are minimized.

Vertical Jump (Optional)

The Vertical Jump can be used as a substitute for the static leg strength evaluation. Some participants are apprehensive about the static leg dynamometer, despite the emphasis on prescreening, instruction, supervision and proper execution. This assessment may be offered as an alternative, but is not directly comparable to the results of static leg dynamometer. The static leg assessment evaluates muscular strength, which is only one component of power. The vertical jump employs a formula to calculate power, or the force produced by the legs to propel the body upward.

4. Muscular Endurance:
   Push-ups & Prone Static Plank

There are many protocols currently available to assess muscular endurance. The WFI recommends a combination of static and dynamic movements for evaluating muscular endurance, the prone static plank and push-ups.

Alternate Grip Push-up (Optional)

The alternate grip push-up (with stands) is an optional test for participants who experience muscular/skeletal discomfort in the performance of the standard WFI push-up. When utilizing the push-up handles, the height of the standard 5-inch range-of-motion prop must be adjusted to five inches, plus the height of the handles.

5. Flexibility: Sit & Reach

There are many protocols currently available to measure flexibility. The WFI recommends the modified sit-and-reach assessment which is used to assess gross posterior muscle flexibility. This evaluation adjusts for the differences in limb length among participants.

Equipment

All evaluation equipment must be as specified in these protocols. Equipment must not be substituted unless otherwise indicated. All equipment must be maintained and properly calibrated in accordance with the manufacturer’s instructions. Failure to do so may result in inaccurate or invalid data.
The WFI fitness assessment protocols, and the equipment needed to perform them, are described below:

**BODY COMPOSITION**
- Lange Skinfold Calipers or equivalent
- Flexible tape measure
- Water-soluble marker

**AEROBIC CAPACITY**
- Treadmill - The treadmill shall be a commercial treadmill capable of obtaining a minimum of 15% grade and 10 mph.
- Heart Rate Monitor
- Stopwatch
- Stepmill - The Stepmill should be a StairMaster 7000PT. Many generations of the Stepmill have been manufactured over the years. Consequently, the steps/min rate varies from model to model. The new WFI test was validated on a unit that has 20 intensity levels. It is imperative that the administrator insure that the unit is calibrated to the same steps-per-minute rate for each level indicated in the testing protocol. Refer to Table 5.0

Table 5.0

<table>
<thead>
<tr>
<th>Level</th>
<th>Steps/min</th>
<th>Level</th>
<th>Steps/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24</td>
<td>11</td>
<td>97</td>
</tr>
<tr>
<td>2</td>
<td>31</td>
<td>12</td>
<td>104</td>
</tr>
<tr>
<td>3</td>
<td>39</td>
<td>13</td>
<td>111</td>
</tr>
<tr>
<td>4</td>
<td>46</td>
<td>14</td>
<td>118</td>
</tr>
<tr>
<td>5</td>
<td>53</td>
<td>15</td>
<td>126</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
<td>16</td>
<td>133</td>
</tr>
<tr>
<td>7</td>
<td>65</td>
<td>17</td>
<td>140</td>
</tr>
<tr>
<td>8</td>
<td>75</td>
<td>18</td>
<td>147</td>
</tr>
<tr>
<td>9</td>
<td>82</td>
<td>19</td>
<td>155</td>
</tr>
<tr>
<td>10</td>
<td>89</td>
<td>20</td>
<td>162</td>
</tr>
</tbody>
</table>

Note: If your Stepmill is not calibrated to the same steps/min rate as the 20-level table, the test may be invalid for your Stepmill. Please refer to the manufacturer for options.

**MUSCULAR STRENGTH**
- Hand-Grip Dynamometer - Hand grip strength evaluations are performed with the JAMAR Hydraulic Hand dynamometer.
- Arm Dynamometer - The arm dynamometer shall be the Jackson Strength Evaluation System or a commercial dynamometer that includes an adjustable chain, handle bar, and test platform. The assessor must verify that the dynamometer is equivalent to the Jackson Strength Evaluation System.
- Leg Dynamometer - The leg dynamometer shall be the Jackson Strength Evaluation System or a commercial dynamometer system that includes an adjustable chain, and test platform. The assessor must verify that the dynamometer is equivalent to the Jackson Strength Evaluation System. A V-grip handle bar, or “chinning triangle,” is required.
- Vertical Jump (Optional) - The vertical jump shall be evaluated using a timing mat to estimate the vertical distance traveled. The timing mat shall be the “Just Jump” mat from Probotics or other commercial timing mat. If an alternative device is used, the test administrator must verify that the device is equivalent to the Probotics “Just jump” mat.

**MUSCULAR ENDURANCE**
- Static Plank - The static plank requires an exercise mat and a stopwatch.
- Push-up - The push-up evaluation requires a five-inch prop (e.g., cup, sponge), a metronome and a stopwatch. An exercise mat is optional.
- Alternate Grip Push-up (optional) - The alternate grip push-up requires a range-of-motion prop (e.g., cup, sponge), a metronome, stopwatch; and push-up stands or two 40 lb. hex dumbbells. Note: The range of motion prop shall be modified to ensure that the height is five inches, plus the height of the stands (e.g., a pair of five-inch push-up stands will require a ten-inch prop).

**FLEXIBILITY**
- Sit-and-Reach - The equipment required is a Novel Acuflex I or equivalent trunk flexibility test device that compensates for variable arm and leg lengths.
MANDATORY PRE-EVALUATION PROCEDURE

All personnel shall be medically cleared within the last 12 months prior to participating in the WFI assessments.

All personnel shall be health screened prior to conducting the WFI assessments (e.g., Par-Q, Health History).

Assessments shall be deferred if the following medical conditions exist:
- Chest pain, during or in the absence of physical activity
- Recent unexplained loss of consciousness
- Loss of balance due to dizziness (ataxia)
- Recent injury resulting in bone, joint or muscle problems that may be exacerbated by exercise
- Current prescribed drug that inhibits physical activity
- Chronic infectious disease (e.g., hepatitis)
- Pregnancy
- Any other reason the participant believes that he or she should not be physically evaluated

The following pre-evaluation procedures shall be conducted for all personnel prior to conducting fitness assessments:
- Obtain a resting heart rate and blood pressure. If resting heart rate is equal to or greater than 110 beats per minute and/or resting blood pressure is equal to or greater than 160/100 mm Hg, instruct the participant to rest for five minutes and re-evaluate. If the heart rate and/or blood pressure remain at these levels, cancel the fitness evaluation and refer the participant to the fire department physician. If the heart rate and/or blood pressure fall within the acceptable range, the assessment may continue.

The assessor shall:
- Instruct the participants to refrain from eating, drinking, smoking and any physical activity that may influence performance prior to the assessment. Activities that affect heart rate and/or blood pressure measurements may adversely impact performance.
- Assure that participants are wearing appropriate attire.
- Record participants’ age.
- Inform participants of the appropriate execution for each protocol.

ASSESSMENT SEQUENCE

The assessments are sequenced to minimize the effect of fatigue on subsequent performance, and to mitigate injury. The WFI requires that assessments be performed in the following sequence:
1. Body composition
2. Aerobic capacity
3. Muscular strength/power
4. Muscle endurance
5. Flexibility

Note: Personnel should have the opportunity to recover from the previous assessment before proceeding to the next.

INDICATIONS FOR STOPPING EVALUATION
- Onset of angina or angina-like symptoms
- Signs of poor perfusion: light-headedness, confusion, ataxia, poor pallor, cyanosis, nausea, or cold, clammy skin
- Failure of heart rate to increase with increase in exercise intensity
- Participant requests evaluation to stop
- Physical or verbal manifestations of severe fatigue
- Joint or muscle pain that becomes aggravated with exercise
- Failure of the testing equipment
WF ASSESSMENT PROTOCOLS: BODY COMPOSITION

EQUIPMENT
- Lange Skinfold Calipers or equivalent
- Flexible tape measure
- Water-soluble marker

ASSESSMENT
- Conduct pre-evaluation procedures.
- Obtain the participant's age.
- Note the gender-specific skinfold sites. Men are measured at the triceps, subscapular and pectoral sites; women are measured at the triceps, abdominal and suprailiac sites.
- All measurements should be made on the right side of the body, with the subject standing upright.
- Use the tape measure to mark the site to be measured with a water-soluble marker.
- Place calipers directly on the skin surface, 1 cm away from the thumb and finger; perpendicular to the skinfold; and halfway between the crest and base of the fold.
- Maintain pinch while reading the caliper.
- Wait 1 – 2 seconds (not longer,) before reading caliper.
- Rotate through all three sites or allow time for skin to regain normal texture and thickness.
- Take two measurements at each site. If the values are less than 1 millimeter of each other then calculate the average of the two measurements.
- If the difference between the two measurements is greater than or equal to 1 millimeter, then a third measurement must be taken.

If the differences between the three skinfold measurements are equal, then calculate the average of all three measurements. [e.g., (1) 6 mm, (2) 9mm, (3) 12 mm the average of all three measurements is 9 mm.]

If the three measurements are not equal distance apart then calculate the average of the two closest measurements. [e.g., (1) 7mm, (2) 4 mm, (3) 5 mm the average is calculated for measurement #2 and #3 only. The average of the two measurements is 4.5 mm.]

Once the skinfolds are collected for all three sites, calculate the sum of the average skinfold measurement for each site. (Note: Sites are specific to gender.)
To determine body fat percentage, cross-reference the sum of skin folds with the subject's age on the appropriate chart provided in this section (male - table 5.1; female – table 5.2).
**FEMALE SKINFOLD SITES**

- **Triceps** – located at the midpoint between the acromioclavicular (AC) joint and the olecranon process (center of the elbow) on the posterior aspect of the upper arm.

  - Figure 5.6
  - Figure 5.7

- **Abdominal** – located at the right of the umbilicus, on a vertical fold, 2 cm from the right lateral border.

  - Figure 5.8
  - Figure 5.9

- **Suprailiac** – located on a diagonal line, 1-2 cm anterior to the crest of the pelvis (ASIS). Grasp a diagonal skinfold just above and slightly forward of the crest of the Ilium.

  - Figure 5.10
  - Figure 5.11
Table 5.1
Percentage of Body Fat estimate for **MEN**
Based on the Sum of Triceps, Subscapular, and Pectoral Skinfolds

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8 - 10</td>
<td>1.5</td>
<td>2.0</td>
<td>2.5</td>
<td>3.1</td>
<td>3.6</td>
<td>4.1</td>
<td>4.6</td>
<td>5.1</td>
<td>5.6</td>
</tr>
<tr>
<td>11 - 13</td>
<td>3.0</td>
<td>3.5</td>
<td>4.0</td>
<td>4.5</td>
<td>5.1</td>
<td>5.6</td>
<td>6.1</td>
<td>6.6</td>
<td>7.1</td>
</tr>
<tr>
<td>14 - 16</td>
<td>4.5</td>
<td>5.0</td>
<td>5.5</td>
<td>6.0</td>
<td>6.5</td>
<td>7.0</td>
<td>7.6</td>
<td>8.1</td>
<td>8.6</td>
</tr>
<tr>
<td>17 - 19</td>
<td>5.9</td>
<td>6.4</td>
<td>6.9</td>
<td>7.4</td>
<td>8.0</td>
<td>8.5</td>
<td>9.0</td>
<td>9.5</td>
<td>10.0</td>
</tr>
<tr>
<td>20 - 22</td>
<td>7.3</td>
<td>7.8</td>
<td>8.3</td>
<td>8.8</td>
<td>9.4</td>
<td>9.9</td>
<td>10.4</td>
<td>10.9</td>
<td>11.4</td>
</tr>
<tr>
<td>23 - 25</td>
<td>8.6</td>
<td>9.2</td>
<td>9.7</td>
<td>10.2</td>
<td>10.7</td>
<td>11.2</td>
<td>11.8</td>
<td>12.3</td>
<td>12.8</td>
</tr>
<tr>
<td>26 - 28</td>
<td>10.0</td>
<td>10.5</td>
<td>11.0</td>
<td>11.5</td>
<td>12.1</td>
<td>12.6</td>
<td>13.1</td>
<td>13.6</td>
<td>14.2</td>
</tr>
<tr>
<td>29 - 31</td>
<td>11.2</td>
<td>11.8</td>
<td>12.3</td>
<td>12.8</td>
<td>13.4</td>
<td>13.9</td>
<td>14.4</td>
<td>14.9</td>
<td>15.5</td>
</tr>
<tr>
<td>32 - 34</td>
<td>12.5</td>
<td>13.0</td>
<td>13.5</td>
<td>14.1</td>
<td>14.6</td>
<td>15.1</td>
<td>15.7</td>
<td>16.2</td>
<td>16.7</td>
</tr>
<tr>
<td>35 - 37</td>
<td>13.7</td>
<td>14.2</td>
<td>14.8</td>
<td>15.3</td>
<td>15.8</td>
<td>16.4</td>
<td>16.9</td>
<td>17.4</td>
<td>18.0</td>
</tr>
<tr>
<td>38 - 40</td>
<td>14.9</td>
<td>15.4</td>
<td>15.9</td>
<td>16.5</td>
<td>17.0</td>
<td>17.6</td>
<td>18.1</td>
<td>18.6</td>
<td>19.2</td>
</tr>
<tr>
<td>41 - 43</td>
<td>16.0</td>
<td>16.6</td>
<td>17.1</td>
<td>17.6</td>
<td>18.2</td>
<td>18.7</td>
<td>19.3</td>
<td>19.8</td>
<td>20.3</td>
</tr>
<tr>
<td>44 - 46</td>
<td>17.1</td>
<td>17.7</td>
<td>18.2</td>
<td>18.7</td>
<td>19.3</td>
<td>19.8</td>
<td>20.4</td>
<td>20.9</td>
<td>21.5</td>
</tr>
<tr>
<td>47 - 49</td>
<td>18.2</td>
<td>18.7</td>
<td>19.3</td>
<td>19.8</td>
<td>20.4</td>
<td>20.9</td>
<td>21.4</td>
<td>22.0</td>
<td>22.5</td>
</tr>
<tr>
<td>50 - 52</td>
<td>19.2</td>
<td>19.7</td>
<td>20.3</td>
<td>20.8</td>
<td>21.4</td>
<td>21.9</td>
<td>22.5</td>
<td>23.0</td>
<td>23.6</td>
</tr>
<tr>
<td>53 - 55</td>
<td>20.2</td>
<td>20.7</td>
<td>21.3</td>
<td>21.8</td>
<td>22.4</td>
<td>22.9</td>
<td>23.5</td>
<td>24.0</td>
<td>24.6</td>
</tr>
<tr>
<td>56 - 58</td>
<td>21.1</td>
<td>21.7</td>
<td>22.2</td>
<td>22.8</td>
<td>23.3</td>
<td>23.9</td>
<td>24.4</td>
<td>25.0</td>
<td>25.5</td>
</tr>
<tr>
<td>59 - 61</td>
<td>22.0</td>
<td>22.6</td>
<td>23.1</td>
<td>23.7</td>
<td>24.2</td>
<td>24.8</td>
<td>25.3</td>
<td>25.9</td>
<td>26.5</td>
</tr>
<tr>
<td>62 - 64</td>
<td>22.9</td>
<td>23.4</td>
<td>24.0</td>
<td>24.5</td>
<td>25.1</td>
<td>25.7</td>
<td>26.2</td>
<td>26.8</td>
<td>27.3</td>
</tr>
<tr>
<td>64 - 67</td>
<td>23.7</td>
<td>24.3</td>
<td>24.8</td>
<td>25.4</td>
<td>25.9</td>
<td>26.5</td>
<td>27.1</td>
<td>27.6</td>
<td>28.2</td>
</tr>
<tr>
<td>68 - 70</td>
<td>24.5</td>
<td>25.0</td>
<td>25.6</td>
<td>26.2</td>
<td>26.7</td>
<td>27.3</td>
<td>27.8</td>
<td>28.4</td>
<td>29.0</td>
</tr>
<tr>
<td>71 - 73</td>
<td>25.2</td>
<td>25.8</td>
<td>26.3</td>
<td>26.9</td>
<td>27.5</td>
<td>28.0</td>
<td>28.6</td>
<td>29.1</td>
<td>29.7</td>
</tr>
<tr>
<td>74 - 76</td>
<td>25.9</td>
<td>26.5</td>
<td>27.0</td>
<td>27.6</td>
<td>28.2</td>
<td>28.7</td>
<td>29.3</td>
<td>29.9</td>
<td>30.4</td>
</tr>
<tr>
<td>77 - 79</td>
<td>26.6</td>
<td>27.1</td>
<td>27.7</td>
<td>28.2</td>
<td>28.8</td>
<td>29.4</td>
<td>29.9</td>
<td>30.5</td>
<td>31.1</td>
</tr>
<tr>
<td>80 - 82</td>
<td>27.2</td>
<td>27.7</td>
<td>28.3</td>
<td>28.9</td>
<td>29.4</td>
<td>30.0</td>
<td>30.5</td>
<td>31.1</td>
<td>31.7</td>
</tr>
<tr>
<td>83 - 85</td>
<td>27.7</td>
<td>28.3</td>
<td>28.8</td>
<td>29.4</td>
<td>30.0</td>
<td>30.5</td>
<td>31.1</td>
<td>31.6</td>
<td>32.2</td>
</tr>
<tr>
<td>86 - 88</td>
<td>28.2</td>
<td>28.8</td>
<td>29.4</td>
<td>29.9</td>
<td>30.5</td>
<td>31.1</td>
<td>31.6</td>
<td>32.2</td>
<td>32.8</td>
</tr>
<tr>
<td>89 - 91</td>
<td>28.7</td>
<td>29.3</td>
<td>29.8</td>
<td>30.4</td>
<td>31.0</td>
<td>31.5</td>
<td>32.1</td>
<td>32.7</td>
<td>33.3</td>
</tr>
<tr>
<td>92 - 94</td>
<td>29.1</td>
<td>29.7</td>
<td>30.3</td>
<td>30.8</td>
<td>31.4</td>
<td>32.0</td>
<td>32.6</td>
<td>33.1</td>
<td>33.4</td>
</tr>
<tr>
<td>95 - 97</td>
<td>29.5</td>
<td>30.1</td>
<td>30.6</td>
<td>31.2</td>
<td>31.8</td>
<td>32.4</td>
<td>32.9</td>
<td>33.5</td>
<td>34.1</td>
</tr>
<tr>
<td>98 - 100</td>
<td>29.8</td>
<td>30.4</td>
<td>31.0</td>
<td>31.6</td>
<td>32.1</td>
<td>32.7</td>
<td>33.3</td>
<td>33.9</td>
<td>34.4</td>
</tr>
<tr>
<td>101 - 103</td>
<td>30.1</td>
<td>30.7</td>
<td>31.3</td>
<td>31.8</td>
<td>32.4</td>
<td>33.0</td>
<td>33.6</td>
<td>34.1</td>
<td>34.7</td>
</tr>
<tr>
<td>104 - 106</td>
<td>30.4</td>
<td>30.9</td>
<td>31.5</td>
<td>32.1</td>
<td>32.7</td>
<td>33.2</td>
<td>33.8</td>
<td>34.4</td>
<td>35.0</td>
</tr>
<tr>
<td>107 - 109</td>
<td>30.6</td>
<td>31.1</td>
<td>31.7</td>
<td>32.3</td>
<td>32.9</td>
<td>33.4</td>
<td>34.0</td>
<td>34.6</td>
<td>35.2</td>
</tr>
<tr>
<td>110 - 112</td>
<td>30.7</td>
<td>31.3</td>
<td>31.9</td>
<td>32.4</td>
<td>33.0</td>
<td>33.6</td>
<td>34.2</td>
<td>34.7</td>
<td>35.3</td>
</tr>
<tr>
<td>113 - 115</td>
<td>30.8</td>
<td>31.4</td>
<td>32.0</td>
<td>32.5</td>
<td>33.1</td>
<td>33.7</td>
<td>34.3</td>
<td>34.9</td>
<td>35.4</td>
</tr>
<tr>
<td>116 - 118</td>
<td>30.9</td>
<td>31.5</td>
<td>32.0</td>
<td>32.6</td>
<td>33.2</td>
<td>33.8</td>
<td>34.3</td>
<td>34.9</td>
<td>35.5</td>
</tr>
</tbody>
</table>
Table 5.2
Percentage of Body Fat estimates for **WOMEN**
Based on the Sum of Triceps, Abdominal, and Suprailiac Skinfolds

<table>
<thead>
<tr>
<th>Skinfolds</th>
<th>Age up to Last Complete Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum (mm)</td>
<td>18 - 22</td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
</tr>
<tr>
<td>8 - 12</td>
<td>8.8</td>
</tr>
<tr>
<td>13 - 37</td>
<td>10.8</td>
</tr>
<tr>
<td>18 - 22</td>
<td>12.6</td>
</tr>
<tr>
<td>23 - 27</td>
<td>14.5</td>
</tr>
<tr>
<td>28 - 32</td>
<td>16.2</td>
</tr>
<tr>
<td>33 - 37</td>
<td>17.9</td>
</tr>
<tr>
<td>38 - 42</td>
<td>19.6</td>
</tr>
<tr>
<td>43 - 47</td>
<td>21.2</td>
</tr>
<tr>
<td>48 - 52</td>
<td>22.8</td>
</tr>
<tr>
<td>53 - 57</td>
<td>24.2</td>
</tr>
<tr>
<td>58 - 62</td>
<td>25.7</td>
</tr>
<tr>
<td>63 - 67</td>
<td>27.1</td>
</tr>
<tr>
<td>68 - 72</td>
<td>28.4</td>
</tr>
<tr>
<td>73 - 77</td>
<td>29.6</td>
</tr>
<tr>
<td>78 - 82</td>
<td>30.9</td>
</tr>
<tr>
<td>83 - 87</td>
<td>32.0</td>
</tr>
<tr>
<td>88 - 92</td>
<td>33.1</td>
</tr>
<tr>
<td>93 - 97</td>
<td>34.1</td>
</tr>
<tr>
<td>98 - 102</td>
<td>35.1</td>
</tr>
<tr>
<td>103 - 107</td>
<td>36.1</td>
</tr>
<tr>
<td>108 - 112</td>
<td>36.9</td>
</tr>
<tr>
<td>113 - 117</td>
<td>37.8</td>
</tr>
<tr>
<td>118 - 122</td>
<td>38.5</td>
</tr>
<tr>
<td>123 - 127</td>
<td>39.2</td>
</tr>
<tr>
<td>128 - 132</td>
<td>39.9</td>
</tr>
<tr>
<td>133 - 137</td>
<td>40.5</td>
</tr>
<tr>
<td>138 - 142</td>
<td>41.0</td>
</tr>
<tr>
<td>143 - 147</td>
<td>41.5</td>
</tr>
<tr>
<td>148 - 152</td>
<td>41.9</td>
</tr>
<tr>
<td>153 - 157</td>
<td>43.3</td>
</tr>
<tr>
<td>158 - 162</td>
<td>42.6</td>
</tr>
<tr>
<td>163 - 167</td>
<td>42.9</td>
</tr>
<tr>
<td>168 - 172</td>
<td>43.1</td>
</tr>
<tr>
<td>173 - 177</td>
<td>43.2</td>
</tr>
<tr>
<td>178 - 182</td>
<td>43.3</td>
</tr>
</tbody>
</table>
There are two submaximal assessments to determine a fire fighter's aerobic capacity: the WFI submaximal treadmill and the WFI sub-maximal Stepmill. Using the calculations provided in the respective section, both assessments estimate a fire fighter's maximal aerobic capacity, expressed as \( VO_2 \text{ max} \). Either the treadmill or Stepmill can be used as long as the results are calculated using the appropriate assessment formula. All aerobic capacity evaluation results must be recorded in milliliters (ml) of oxygen per kilogram (kg) of body weight per minute (\( VO_2 \text{ max} \)).

These aerobic assessments are submaximal and are based on the heart rate response during graded exercise. Accurate estimation of maximal heart rate (MHR) is critical to the submaximal prediction used in these assessments. A new formula for calculating maximal heart rate is utilized with these protocols, because it more accurately accounts for age-related reduction of MHR than did the previous formula (Table 5.5). Be aware that the heart rate can be affected by variables such as body temperature, hydration state, anxiety, stress and medications. In addition to heart rate, body mass (height-to-weight ratio), is also a significant variable in both prediction equations. The relationship between height and weight is recorded as Body Mass Index (BMI). It is important to note that BMI is not being used in these aerobic protocols to estimate body composition; rather, is used to represent the mass of each participant. Whereas all predictive tests are subject to varying degrees of error, it is believed that these new changes will provide vast improvements from previous protocols in reliability, validity and accuracy in estimating \( VO_2 \text{ max} \).

### PRE-EVALUATION PROCEDURES

Choose the aerobic capacity protocol and worksheet. Measure the participant's:
- Resting heart rate
- Resting blood pressure
- Age
- Height
- Weight
- Gender

- Determine the participants Body Mass Index (BMI). Refer to Table 5.3 & Table 5.4
- Determine the Target Heart Rate (THR). Refer to table 5.5 to determine the appropriate exercise heart rate for the participant's age.
- Record the target exercise heart rate on the protocol worksheet.
- Inform the participant of all evaluation components. Ensure that the participant is in proper clothing and footwear.
- Review all indicators for stopping the evaluation with the participant.

Secure heart rate monitor transmitter around the participant’s chest in accordance with the manufacturer’s instructions. Evaluator shall hold or wear the heart rate monitor wrist receiver.

### Table 5.3

<table>
<thead>
<tr>
<th>Metric: ( BMI = \frac{Weight ;(kg)}{Height ; (m)^2} )</th>
<th>US: ( BMI = \frac{703 \times Weight ; (lb)}{Height ; (in)^2} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>20</td>
</tr>
<tr>
<td>Height</td>
<td>50</td>
</tr>
<tr>
<td>Height</td>
<td>81</td>
</tr>
</tbody>
</table>

### Table 5.4

<table>
<thead>
<tr>
<th>Body Mass Index (BMI) Conversion Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>81</td>
</tr>
</tbody>
</table>
Table 5.5
Target Heart Rate for Respective Age

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>THR (BPM)</th>
<th>Age (yrs)</th>
<th>THR (BPM)</th>
<th>Age (yrs)</th>
<th>THR (BPM)</th>
<th>Age (yrs)</th>
<th>THR (BPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>166</td>
<td>19</td>
<td>165</td>
<td>20</td>
<td>165</td>
<td>21</td>
<td>164</td>
</tr>
<tr>
<td>18</td>
<td>166</td>
<td>19</td>
<td>165</td>
<td>20</td>
<td>165</td>
<td>21</td>
<td>164</td>
</tr>
</tbody>
</table>

THR Formula: \[208-(0.7\times\text{age})\times0.85\]

WFI AEROBIC CAPACITY EVALUATIONS

TREAD MILL EVALUATION

Equipment
- Commercial Grade Treadmill
- Calculator
- Stopwatch
- Heart Rate Monitor
- Height Scale
- Weight Scale

Figure 5.12

TREAD MILL EVALUATION

ASSESSMENT
The purpose of this assessment is to estimate the VO2 max of each participant.

1. Conduct Pre-Evaluation Procedures.
2. The participant straddles the treadmill belt until it begins to move. When the treadmill reaches approximately 1 mph, instruct the participant to step onto the belt. Then increase the speed to 3 mph at 0% grade. Monitor the participant’s heart rate continuously throughout the assessment.

3. Start the stopwatch when the treadmill reaches 3 mph at 0% grade. Continue with this speed and grade for 3 minutes (steady state).
4. After completing the 3-minute steady state interval, inform the participant that the speed will increase to 4.5 mph.
5. Advise the participant that the assessment is a series of 1-minute intervals, alternating between speed and percent grade. All subsequent speed increases occur at 0.5 mph.
6. At 4:01 minutes, increase the grade from 0% to 2%. At this time, inform the participant that all subsequent grade increases occur at 2% intervals.
7. The assessment will continue until the participant’s heart rate exceeds the THR rate for 15 seconds, or the subject exhibits the medical criteria for early termination.
8. Once the heart rate exceeds the Target Heart Rate (THR), note the time and continue the assessment for an additional 15 seconds. Do not make any changes to the assessment speed or grade during this time. If the participant’s heart rate remains above the THR for the full 15 seconds, then stop the assessment and proceed to the cool-down phase. Record the total time, including the 3-minute warm-up, at which point the participant exceeds the THR. If the participant’s heart rate exceeds the target, but then drops back to the THR or below within 15 seconds, then the assessment should continue.
The assessment is not complete until the participant's heart rate exceeds the THR for 15 seconds. If this does not occur within 18 minutes, then terminate the assessment and record the time.

9. Once the assessment is completed, the time is recorded. The participant should perform a cool-down for a minimum of 3 minutes at 3 mph, 0% grade. Continue to monitor the heart rate during the cool-down. Record the recovery heart rate at 1 minute of cool-down.

**TERMINATE THE ASSESSMENT IF ANY OF THE FOLLOWING OCCURS:**

a. The THR is exceeded for 15 seconds.
b. The THR has not been met after 18 minutes.
c. The participant asks to terminate the exercise.
d. The equipment malfunctions.
e. Medical conditions arise that prohibit completing the assessment.

- Record the reason for terminating the assessment and the initial time the THR was exceeded (if applicable). Record time in minutes and convert second(s) into decimal. See Treadmill Formula and Table 5.6
- Use the test time (TT) the participant completed the assessment (i.e. exceeded the THR) along with the treadmill conversion formula to estimate VO2 max.
- Record the VO2 max.

---

**Table 5.6**

<table>
<thead>
<tr>
<th>Time seconds</th>
<th>Decimal Equivalent</th>
<th>Time seconds</th>
<th>Decimal Equivalent</th>
<th>Time seconds</th>
<th>Decimal Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.02</td>
<td>21</td>
<td>0.35</td>
<td>41</td>
<td>0.68</td>
</tr>
<tr>
<td>2</td>
<td>0.03</td>
<td>22</td>
<td>0.37</td>
<td>42</td>
<td>0.70</td>
</tr>
<tr>
<td>3</td>
<td>0.05</td>
<td>23</td>
<td>0.38</td>
<td>43</td>
<td>0.72</td>
</tr>
<tr>
<td>4</td>
<td>0.07</td>
<td>24</td>
<td>0.40</td>
<td>44</td>
<td>0.73</td>
</tr>
<tr>
<td>5</td>
<td>0.08</td>
<td>25</td>
<td>0.42</td>
<td>45</td>
<td>0.75</td>
</tr>
<tr>
<td>6</td>
<td>0.10</td>
<td>26</td>
<td>0.43</td>
<td>46</td>
<td>0.77</td>
</tr>
<tr>
<td>7</td>
<td>0.12</td>
<td>27</td>
<td>0.45</td>
<td>47</td>
<td>0.78</td>
</tr>
<tr>
<td>8</td>
<td>0.13</td>
<td>28</td>
<td>0.47</td>
<td>48</td>
<td>0.80</td>
</tr>
<tr>
<td>9</td>
<td>0.15</td>
<td>29</td>
<td>0.48</td>
<td>49</td>
<td>0.82</td>
</tr>
<tr>
<td>10</td>
<td>0.17</td>
<td>30</td>
<td>0.50</td>
<td>50</td>
<td>0.83</td>
</tr>
<tr>
<td>11</td>
<td>0.18</td>
<td>31</td>
<td>0.52</td>
<td>51</td>
<td>0.85</td>
</tr>
<tr>
<td>12</td>
<td>0.20</td>
<td>32</td>
<td>0.53</td>
<td>52</td>
<td>0.87</td>
</tr>
<tr>
<td>13</td>
<td>0.22</td>
<td>33</td>
<td>0.55</td>
<td>53</td>
<td>0.88</td>
</tr>
<tr>
<td>14</td>
<td>0.23</td>
<td>34</td>
<td>0.57</td>
<td>54</td>
<td>0.90</td>
</tr>
<tr>
<td>15</td>
<td>0.25</td>
<td>35</td>
<td>0.58</td>
<td>55</td>
<td>0.92</td>
</tr>
<tr>
<td>16</td>
<td>0.27</td>
<td>36</td>
<td>0.60</td>
<td>56</td>
<td>0.93</td>
</tr>
<tr>
<td>17</td>
<td>0.28</td>
<td>37</td>
<td>0.62</td>
<td>57</td>
<td>0.95</td>
</tr>
<tr>
<td>18</td>
<td>0.30</td>
<td>38</td>
<td>0.63</td>
<td>58</td>
<td>0.97</td>
</tr>
<tr>
<td>19</td>
<td>0.32</td>
<td>39</td>
<td>0.65</td>
<td>59</td>
<td>0.98</td>
</tr>
<tr>
<td>20</td>
<td>0.33</td>
<td>40</td>
<td>0.67</td>
<td>60</td>
<td>1.00</td>
</tr>
</tbody>
</table>

---

**Treadmill Sub-maximal VO2 Prediction Formula**

\[
VO_2\text{max} = 56.981 + (1.242 \times TT) - (0.805 \times BMI)
\]

*Note: TT is the time in minutes that the participant’s THR was exceeded and the test terminated*

---

Example of the computations required to calculate VO2 max:

Age: 48 yrs  
Weight: 221 lbs  
Height: 6’  
BMI = 30  
THR = 148 bpm

Example Scenario:

At 7 minutes and 32 seconds the participant exceeds their THR. They continue with the assessment for the additional 15 second monitoring period. The HR remained above their THR. Test terminated and time recorded at 7min 32 sec. Using Table 5.6 convert 32 seconds to decimal = .53 7 min + .53 = test time 7.53

Calculate VO2 using treadmill formula:

\[
VO_2 = 56.981 + (1.242 \times \text{time}) - (0.805 \times \text{BMI})
\]

\[
VO_2 = 56.981 + (1.242 \times 7.53) - (0.805 \times 30)
\]

\[
VO_2 = 56.853 + 9.35 - 24.15
\]

\[
VO_2 = 42.1
\]
STAIRMILL EVALUATION

Equipment

- StairMaster 7000 PT Stepmill
- Heart Rate Monitor
- Stopwatch
- Height/Weight Scale
- Calculator

Stairmill Evaluation Figure 5.13

ASSESSMENT

The purpose of this assessment is to estimate the VO₂ max of each participant.

- Conduct Pre-Evaluation Procedures.
- Monitor the participant’s heart rate continuously throughout the assessment.
- Instruct the participant to temporarily grasp the handrails to reduce the possibility of losing balance when the stairs begin to move.
- The starting position is approximately two-thirds of the way up the stairs.
- The assessment starts at level 4 for 2 minutes, then level 5 for 1 minute (warm-up period). Start the stopwatch once the Stepmill begins. Inform the participant that the evaluation is a series of 1-minute intervals with increasing work loads on each subsequent minute.
- Once the assessment commences, do not allow the participant to hold or lean on the handrails; this will result in overestimation of aerobic capacity.
- At the completion of the 3 minute-warm-up, proceed to level 7 for 1 minute. *Note: This is marked by increasing the workload from level 5 to level 7.
- Once the heart rate exceeds the Target Heart Rate (THR), note the time and continue the assessment for an additional 15 seconds. Do not make any changes to the assessment intensity level during this time. If the participant’s heart rate remains above the THR for the full 15 seconds, then the participant has completed the assessment. Stop the assessment and record the time at which the participant exceeded the THR. The total Test Time (TT) begins from the time the participant starts on the Stepmill, to the point at which the participant exceeds their THR. It does not include the final 15 second monitoring period that the heart rate was above the THR.
- The assessment is complete once the participant’s heart rate exceeds the target for 15 seconds. If the participant’s heart rate exceeds the target, but then drops down to the THR or below within 15 seconds, then the assessment should continue.
- Once the assessment is completed, the participant will cool down for a minimum of 2 minutes at level 3. Continue to monitor the heart rate during the cool-down. Record the recovery heart rate at one minute of cool-down. The participant may grasp the handrails during the cool-down phase.
- Upon completion of the cool-down, instruct the participant to grasp the handrails. Stop the steppmill and assist the participant off the apparatus.

<table>
<thead>
<tr>
<th>Time</th>
<th>Level</th>
<th>Step/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00 – 1:00</td>
<td>4</td>
<td>46</td>
</tr>
<tr>
<td>1:01 – 2:00</td>
<td>4</td>
<td>46</td>
</tr>
<tr>
<td>2:01 – 3:00</td>
<td>5</td>
<td>53</td>
</tr>
<tr>
<td>3:01 – 4:00</td>
<td>7</td>
<td>65</td>
</tr>
<tr>
<td>4:01 – 5:00</td>
<td>8</td>
<td>75</td>
</tr>
<tr>
<td>5:01 – 6:00</td>
<td>9</td>
<td>82</td>
</tr>
<tr>
<td>6:01 – 7:00</td>
<td>10</td>
<td>89</td>
</tr>
<tr>
<td>7:01 – 8:00</td>
<td>11</td>
<td>97</td>
</tr>
<tr>
<td>8:01 – 9:00</td>
<td>12</td>
<td>104</td>
</tr>
<tr>
<td>9:01 – 10:00</td>
<td>13</td>
<td>111</td>
</tr>
<tr>
<td>10:01 – 11:00</td>
<td>14</td>
<td>118</td>
</tr>
<tr>
<td>11:01 – 12:00</td>
<td>15</td>
<td>126</td>
</tr>
<tr>
<td>12:01 – 13:00</td>
<td>16</td>
<td>133</td>
</tr>
<tr>
<td>13:01 – 14:00</td>
<td>17</td>
<td>140</td>
</tr>
<tr>
<td>14:01 – 15:00</td>
<td>18</td>
<td>147</td>
</tr>
<tr>
<td>15:01 – 16:00</td>
<td>19</td>
<td>155</td>
</tr>
</tbody>
</table>

Recovery Phase

<table>
<thead>
<tr>
<th>Time</th>
<th>Level</th>
<th>Step/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00 – 1:00</td>
<td>3</td>
<td>39</td>
</tr>
<tr>
<td>1:01 – 2:00</td>
<td>3</td>
<td>39</td>
</tr>
</tbody>
</table>
TERMINATE THE ASSESSMENT IF ANY OF THE FOLLOWING OCCURS:
- The participant’s heart rate exceeds THR for 15 seconds.
- The THR has not been met after 16 minutes.
- The participant asks to terminate the exercise.
- The equipment malfunctions.
- Medical conditions arise that prohibit completing the assessment.

Record the reason for terminating the assessment and the initial time the heart rate had been exceeded (if applicable). Record time in minutes and convert second(s) into decimal. See Table 5.6.

Insert the test time (TT) at which the participant completed the assessment, along with the stepmill conversion formula to estimate VO₂ max.

Record the VO₂ max.

**Stepmill Sub-maximal VO₂ Prediction Formula**

\[ \text{VO₂ max} = 57.774 + (1.757 \times \text{TT}) - (0.904 \times \text{BMI}) \]

*Note: TT is the time in minutes that the participant’s THR was exceeded and the test terminated.

The following example illustrates the computations required to calculate VO₂ max for the stepmill.

Age: 48 yrs  Weight: 221 lbs  Height: 6’
BMI = 30  THR = 148 bpm

**Example Scenario:**
At 5 minutes and 8 seconds the participant exceeds THR. Continue with the assessment for the additional 15 second monitoring period. If after 10 seconds of monitoring, the participants heart rate drops below the THR, the appropriate course of action is to continue with the assessment as if the participant hadn’t exceeded the THR. At 5 minutes and 52 seconds, the participant again exceeds the THR, continue with the assessment for the additional 15-second monitoring period. Should the participant’s HR stay above the THR during the 15-second monitoring period, the test would be terminated and the time recorded at 5 min 52 sec.

Using Table 5.6 convert 52 seconds to decimal = .87
5 min + .87 = test time 5.87

Calculate the VO₂ using stepmill formula:

\[ \text{VO₂} = 57.774 + (1.757 \times \text{TT}) - (0.904 \times \text{BMI}) \]
\[ \text{VO₂} = 57.774 + (1.757 \times 5.87) - (0.904 \times 30) \]
\[ \text{VO₂} = 57.774 + 10.31 - 27.12 \]
\[ \text{VO₂} = 40.96 \]
\[ \text{VO₂} = 41 \text{ ml/kg/min} \]
### WFI GRIP STRENGTH

**Equipment**
- JAMAR Hydraulic Hand dynamometer
- Towel

![Figure 5.14](image)

**ASSESSMENT**

The purpose of this assessment is to evaluate the maximum isometric muscular strength of the flexor muscles of the hands. There is a strong correlation between hand grip strength and upper body strength.

- Conduct Pre-Evaluation Procedures.
- Instruct the participant to towel-dry hands.
- Place the dynamometer in the participant’s hand to be sized for assessment. Ensure that the hand grip is adjusted to fit snugly in the first proximal interphalangeal joint. Prior to commencing the assessment, set the dynamometer to “zero” by rotating the red peak force indicator counterclockwise.
- Advise the participant that the evaluation is a series of 6 trails, 3 for each hand, alternating hands with each attempt.
- The participant will maintain the following positions for the duration of the assessment:
  - Stand upright with spine in neutral alignment.
  - Flex elbow at a 90° angle.
  - Adduct shoulder and place hand in neutral grip position (hand shake position).
- The participant will squeeze the device with maximum force for 3 seconds while exhaling.
- The participant will slowly release grip. The needle will automatically record the highest force exerted.
- Measure both hands, alternating between right and left, completing three trails per hand.
- Reset the peak-hold needle to zero before obtaining new readings.
- Record the scores for each trail in each hand to the nearest kilogram.
- Record the highest score for each hand.

### WFI ARM STRENGTH

**Equipment**
- Jackson Strength Evaluation System with or verified equivalent dynamometer
- Straight Handlebar
- Towel

![Figure 5.15](image)

**ASSESSMENT**

The purpose of this assessment is to evaluate the maximum isometric strength of the flexor muscles of the arm.

- Conduct Pre-Evaluation Procedures.
- Participant will towel-dry hands.
- Advise the participant that the evaluation is a series of 3 trials in which he will “ease into” the isometric arm contraction and release slowly, without moving the arms or jerking hands.
- Place the dynamometer base plate on a level and secure surface.
- Have the participant stand upon the dynamometer base plate, with feet shoulder width apart and equal distance from the chain. The chain should travel vertically from the base to the hands.
- The participant will stand erect with knees straight and arms flexed at 90° in the sagittal plane.
- The participant will hold the bar with a wide grip and bend elbows at 90°.
- Participants must stand erect without arching back.
- Adjust the chain so that the bar can be held in the hands while the arms are flexed at 90° in the sagittal plane.
- Ensure that elbows remain adducted.
- Verify this position and ensure the chain is taut.
- The participant must not shrug shoulders, bend back, or perform any other motion other than biceps flexion in an attempt to move the handlebar in a vertical direction.
- The participant will flex maximally for 3 seconds.
- After 3 seconds, the participant will slowly relax arms, and remain at a standing rest for 30 seconds.
- Once the participant has completed the 30-second recovery period, begin the 2nd trial.
- Repeat evaluation for the 3rd trial using the same procedure.
- Record the three trials to the nearest kilogram.
- Record the highest trial.

Note: Digital readout will display both the peak force (“p”) and the average force (“a”) achieved during the three evaluations.
**WFI LEG STRENGTH**

**Equipment**
- Jackson Strength Evaluation System or Verified equivalent dynamometer
- V-Grip Handlebar
- Towel
- Weight lifting belt (optional)

**Figure 5.16**

**ASSESSMENT**
- The purpose of this assessment is to evaluate the maximum isometric strength of the lower body by performing a static dead lift.
- Conduct Pre-Evaluation Procedures.
- The participants will towel-dry hands.
- The participant may use weight-lifting belts for support.

- Advise the participant that the evaluation is a series of 3 trials.
- Place the dynamometer base plate on a level and secure surface. Have the participant stand upon the dynamometer base plate, with feet spread shoulder width apart and equal distance from the lifting chain. Inform the participant to notify the assessor if he/she experiences any pain or discomfort, especially around the spine. If notified, terminate the assessment.
- Instruct the participant to stand erect with knees straight.
- Adjust the chain so the upper (inside) edge of the bottom cross-member of the V-grip handlebar is at the top of the participant’s patella; legs are straight). Verify this position.
- Instruct the participant to:
  - Flex at knees and hips until he/she can reach the handle.
  - Hold the bar and look straight ahead with neck in the neutral position.
  - Fully extend arms and maintain a straight (neutral) back.
- Ensure the participant maintains the following positions:
  - The hips are directly over the feet, with trunk and knees slightly bent.
  - The shoulders are “set” or retracted to ensure that the spine is neutral (cervical, thoracic and lumbar.)
  - The elbows are extended
- Advise the participant to “ease into” the isometric leg extension and release it slowly, without bending at the waist, flexing the arms, or jerking the hand.

- Instruct the participant to extend legs, using proper form and technique. Encourage the participant to limit the first trial to approximately 50% of maximal effort.
- Participant will apply — 50% force for a maximum of 3 seconds while exhaling.
- After 3 seconds, instruct the participant to slowly relax arms and legs, and to remain at a standing rest for 30 seconds. The device will record the peak force exerted.
- Once the participant has completed the 30-second recovery period, begin the 2nd trial.
- The participant should use maximum effort during the 2nd and 3rd trials.
- Record the two trials to the nearest kilogram.
- Record the highest trial.

Note: Digital readout will display the peak force (“p”) and the average force (“a”) achieved during the three evaluations.
WFI VERTICAL JUMP — Optional Assessment
LEG POWER ASSESSMENT

Equipment:
- Pressure Mat - “Just Jump” Probotics
- Safety Tape - or any object that can be suspended above the mat to act as a target
- Calculator

Figure 5.17 Figure 5.18

ASSESSMENT
- The purpose of this assessment is to estimate peak power produced in the lower body.
- Collect the participant’s body weight and record in kilograms (# lbs ÷ 2.2 = kg).
- Conduct pre-evaluation procedures.
- Place the jumping mat on a level surface. Connect the cord attached to the jumping mat to the handheld computer port.
- With the participant off the mat, turn the computer on. Choose “One Jump” on the computer menu. The display should read “Step on Mat”.
- Have the participant squat to a position where the knees are at a 90° angle and the hands by the sides (momentary pause @ 90°).
- Instruct the participant to jump straight up as high as he/she can, reaching toward the ceiling or a target object, without tucking the legs, and land with both feet on the mat.
- When the participant has completed the jump, the display will read the hang time and vertical jump in inches. The vertical jump mode resets automatically.
- Have the participant perform a series of 3 jumps and record the highest distance in inches.
- Convert the highest jump achieved in inches to centimeters (# inches × 2.54 = cm).
- Use the power formula provided below with the jump height (cm) and body weight (kg) to estimate leg power.

Power formula:
Leg Power (watts) = [(60.7 × jump height (cm)) + (45.3 × body weight (kg))] – 2055

Use the following conversions:
Height in inches to centimeters (# inches × 2.54 = cm)
Body weight in pounds to kilograms (# lbs ÷ 2.2 = kg)

Any deviations from the above techniques cannot be counted, and the participant must repeat the trial.

The following are examples of situations that require a re-evaluation:
- The participant fails to land with both feet on the mat.
- The participant tucks the legs instead of extending them while jumping. Note: Administrators can minimize the tendency of participants to tuck the legs by suspending a target object above the mat for the participant to attempt to touch.

Use the following conversions:
Height in inches to centimeters (# inches × 2.54 = cm)
Body weight in pounds to kilograms (# lbs ÷ 2.2 = kg)
**WFI PRONE STATIC PLANK — CORE STABILIZATION ASSESSMENT**

**Equipment:**
- Stopwatch
- Exercise Mat

**ASSESSMENT:**
The purpose of this assessment is to evaluate the muscular endurance of the core stabilizer muscles of the trunk.

- Conduct the pre-evaluation procedures.
- Instruct the participant to lay prone, keeping upper body elevated and supported by the elbows. Raise hips and legs off the floor, supporting the body on forearms and toes. Position elbows directly under the shoulders. Maintain straight body alignment from shoulder through hip, knee and ankle.
- The ankles should maintain a 90° angle, the scapulae should remain stabilized with elbows at 90°. The spine should remain in a neutral position throughout the assessment.
- Once the feet are in position, the participant then extends the knees, lifting off the floor. Start the stopwatch at this time.
- Instruct the participant to contract the abdominals so that the back will remain flat in the neutral position for the duration of the assessment.
- Any deviations from the above posture will warrant 2 verbal warnings. If a 3rd infraction occurs stop the watch and terminate the assessment.
- The assessor shall terminate the evaluation when the participant:
  - Reaches 4 minutes; or
  - Is unable to maintain proper form after the 2nd warning,
- Once the assessment termination criteria are met, stop the watch and record the time.

**WFI PUSH-UP**

**Equipment**
- Five inch prop (i.e. cup; sponge)
- Metronome
- Stopwatch

**ASSESSMENT**
The purpose of this assessment is to evaluate muscular endurance of the upper body.

- Conduct Pre-Evaluation Procedures.
- Advise the participant that the evaluation is a series of push-ups performed in a 2-minute time period, for a maximum of 80 push-ups. The evaluation is initiated from the “up” position (hands are shoulder width apart, back is straight, and head is in neutral position).
- Advise the participant of the following:
  - It is not permitted to prop feet against a wall or other stationary object.
  - Back must be straight at all times (neutral position).
  - Arms must be fully extended during the up-phase.
  - Cadence with the metronome must be maintained, (one beat up and one beat down).
  - Position the 5-inch prop on the ground beneath the participants chin.
  - The metronome is set at a speed of 80 bpm, allowing for 40 push-ups per minute, and a maximum of 80 push-ups in 2 minutes.
  - The participant must lower the body toward the floor until the chin touches the prop.

The assessor shall terminate the evaluation when the participant:
- Reaches 80 push-ups;
- Performs 3 consecutive incorrect push-ups; or
- Fails to maintain continuous motion with the metronome cadence.
- Once the assessment is complete, record the highest number of successfully completed push-ups.

* Participants with a history of shoulder and/or wrist injury that could be exacerbated by performing the conventional push-up protocol may perform the WFI alternate grip push-up evaluation.
OPTIONAL ASSESSMENT: WFI ALTERNATE GRIP PUSH-UP TEST

**Equipment:**
- Push-up handles
- Metronome
- Stopwatch
- Prop – 5”, plus the height of the handles

Figure 5.22

- Place the modified prop so that the chin of the participant will contact the prop during the lowering phase. (Prop height = 5” plus the height of stands).
- Set the metronome at a speed of 80 bpm, allowing for 40 push-ups per minute for 2 minutes.
- The assessor shall terminate the evaluation when the participant:
  - Reaches 80 push-ups;
  - Performs three consecutive incorrect push-ups; or
  - Fails to maintain continuous motion with the metronome cadence.
- Once the assessment is complete, record the highest number of successfully completed push-ups.

Figure 5.23

**ASSESSMENT:**

The purpose of this assessment is to evaluate muscular endurance of the upper body. The alternate grip push-up (with stands) is an optional assessment for participants who experience muscular/skeletal discomfort in the performance of the standard WFI push-up.

- Conduct the pre-evaluation procedures.
- Advise the participant that the evaluation is a series of push-ups performed in a 2-minute time period to complete a maximum of 80 push-ups. The evaluation is initiated from the “up” position (hands are shoulder width apart, back is straight, and head is in neutral position).
- Advise the participant of the following:
  - It is not permitted to prop feet against a wall or other stationary object.
  - Back must be straight at all times (neutral position).
  - Arms must be fully extended during the up-phase.
  - Cadence with the metronome must be maintained, (one beat up and one beat down).
- Instruct the participant to grasp the push up stands, and assume the “up” position. (Caution: hex dumbbells may roll)
WFI FLEXIBILITY EVALUATION

Equipment
- Novel Acuflex I or equivalent trunk flexibility test device

Figure 5.24

Figure 5.25

Assessment
The purpose of this assessment is to evaluate generalized flexibility of the shoulders, trunk, and hips.

- Conduct Pre-evaluation Procedures.
- Advise the participant that the evaluation is a series of 3 trials that evaluate the flexibility of the shoulders, trunk and hips.
- Advise the participant that the flexion required during this evaluation must be smooth and slow, as she advances the slide on the measuring device to the most distal position possible.
- Instruct the participant to sit on the floor ensuring the head, upper back, and lower back are in contact with the wall.
- The participant should then place legs together, fully extended.
- The administrator should position the sit-and-reach box flat against the feet.
- The participant should maintain head and upper/lower back in contact with the wall, scapulae retracted, while establishing arm length.
- Then, extend arms fully in front of the body with one hand over the other. (Check scapular retraction.)

- The assessor then sets the guide to 0.0 inches at the tips of the middle fingers.
- Instruct the participant to exhale continuously while stretching slowly forward, bending at the waist, and pushing the measuring device with the middle fingers. The participant will maintain full extension of the legs, and shoulders flexed, and fingers in contact with the gauge throughout the stretch. The participant will momentarily hold the stretch at the endpoint.
- The participant will perform three trials, resting for 30 seconds between trials.
- Once the assessment is complete, record the greatest reach distance from among the three trials (rounded to the nearest 1/4 inch).
- The trial must be repeated if the participant bounces, flexes knees or uses momentum to increase distance.
FITNESS EVALUATION
EQUIPMENT MANUFACTURES

Jackson Strength Evaluation System
Lafayette Instrument Company
Phone: 800-428-7545 or 765-423-1505
Website: www.licmef.com

JAMAR Hydraulic Hand Dynamometer
Lafayette Instrument Company
Phone: 800-428-7545 or 765-423-1505
Website: www.licmef.com

Novel Acuflex II Trunk Flexibility Tester
Novel Products, Inc.
Phone: 800-323-5143
E-mail: www.novelprod@aol.com

StairMaster StepMill 7000 PT
Nautilus, Inc.
Phone: 800-782-4799
Website: www.nautilus.com

Probotics “Just Jump” Mat
Probotics, Inc.
Phone: 256-489-9153
Website: www.probotics.org