



## CHESTER STEP TEST

### FITNESS TEST

**Please do not hesitate to contact the Medfit Occupational Health physician prior to the appointment should you require any further clarification on how to perform the fitness test or if you feel that you are unable to perform the test.**

A fitness test will be required. The fitness test can be either a Chester step test or other equivalent like the YMCA step test, Queen's step test or the Harvard step test.

If you do not have a step available to conduct a step test a Chester Treadmill test may also be performed using a treadmill, alternatively a bicycle may be used to increase the individuals heart rate

Please clearly document the VO<sub>2</sub>max (aerobic capacity) and fitness level on the health questionnaire and submit the data sheet that is provided together with the rest of the results. If you are not able to perform the fitness test yourself cardiologists, physiotherapists, biokineticist or a sports physicians may also be able to perform this test.

#### Instructions how to perform the Chester Step test (CST)

The Chester step test (CST) is a multistage, sub-maximal test which requires the subject to step on to and off a low step at special rate. **Every two minutes the heart rate and exertion level (RPE) are checked and recorded and the stepping rate is then increased slightly.** The test continues in this progressive manner until the subject reaches 80%HRMax and/or reports a moderately vigorous level of exertion (RPE=14). Aerobic capacity (VO<sub>2</sub>Max) and fitness rating may then be determined using a Graphical Datasheet.

- Pre-participation health screening questionnaire  
All participants have to complete a pre-participation health screening questionnaire prior to testing. The medical examiner based on the answers provided by the applicant in the health questionnaire makes a decision if it is safe to perform the CST. If there is any doubt about an applicant's suitability for moderate physical exertion testing must be postponed and the applicant has to be sent to their GP for appropriate advice. Please document on the health check form if there is a medical reason why the CST could not be performed. Please also clearly document on the health check form if the applicant was not able to reach target heart rate (i.e. due to beta blocker use).
- Pre-test health screening
  - Blood pressure and resting pulse rate have to be checked before testing.
  - If the pre-test resting heart rate is above 100 beats/min, the applicant is likely to be very anxious and nervous about performing the test. If this is the case you are advised to try to relax the person before conduction the test.
- Pre-test conditions  
Ensure that the applicant has not eaten, smoked, exercised or drunk tea or coffee at least 2 hours before the test; is not recovering from illness or has a cold, or is taking beta blocker medicines which will depress heart rate scores or that applicant has not undertaken any heavy physical exercise for at least 24 hours before the test. The applicant should be wearing loose-fitting, comfortable clothing. The room should be quiet, well ventilated and between 18-20 degrees Celsius.
- Testing the overweight

If the patient's BMI greater than 30 and classified as 'Obese' then do not conduct the CST without appropriate medical clearance or surveillance.

➤ Equipment required

- Step with height suited to applicant (see below)
- Metronome (you can download several applications on your mobile phone)
- Heart rate monitor
- Stop watch (you can also use the timer on you mobile phone)
- Calculator
- Paperwork to graph VO<sub>2</sub> Max plot ( or use the Chester Step Test data sheet below if you do not have graph paper)

➤ Selection the step and height

- 12" (30cm) Step – is generally suitable for those under 40 years of age who regularly take physical exercise and are used to moderately vigorous exertion.
- 10" (25cm) Step – is generally suitable for those over 40 years of age who regularly take physical exercise and are used to moderately vigorous exertion.
- 8" (20cm) Step – is generally suitable for those under 40 years of age who take little or no regular physical exercise and for those under-40's who are moderately overweight.
- 6" (15cm) Step – is generally suitable for those over 40 years of age who take little or no regular physical exercise and for those under-40's who are moderately overweight.
- For testing over 60's, the lower step height of 15-20 cm is generally best suited.

The step below that are often used in gymnasiums may be used to perform the CST (the step does not have to be Reebok branded). These steps can be adjusted to different heights and are inexpensive to obtain.



➤ Prior to starting the test

- Record the resting hearth rate (applicant should still be wearing the monitor)
- Ask applicant their age
- Calculate 80% max HR ( $220 - \text{age} \times 0.8$ ) and record this on paperwork
- Explain to applicant: "This is the Chester Step Test which is designed to measure your aerobic fitness. You'll be asked to step onto and off the step at a set rate. Every 2 minutes your heart rate and exertion level will be checked and the stepping rate will be increased slightly. You can change your lead leg if you wish. The test will continue in this progressive manner until your heart rate reaches around 80% of its maximum or until you feel that the intensity is moderately hard. You should then stop and recover. If at any time you feel overtired, breathless or dizzy then please stop and recover."
- Demonstrate to the applicant how to perform the test by stepping up and down on the step keeping in time with the beat of the metronome.
- The applicant can lead with either foot and is able to change the leading leg during testing, but MUST stay in time with the metronome.
- The stepping must be UP / UP / DOWN / DOWN.
- The applicant should not be holding on to a railing / wall during the test.

➤ Conducting the test

Have the applicant start testing at the same time as starting the stop watch

- Watch for uneven weight bearing between left / right legs, use of hands on thighs for support, forward flexed posture, signs of fatigue etc.
- If the applicant deviates from the beat, instruct them a few times but if they keep slowing down due to fatigue, cease testing.
- Metronome pace increases every 2 minutes.
- At the conclusion of each 2 minute stage obtain RPE and HR.
- 3 levels are required to be completed in order to determine an outcome.

Metronome pacing

- Stage 1 = 15 steps per minute = 60 BPM
- Stage 2 = 20 steps per minute = 80 BPM
- Stage 3 = 25 steps per minute = 100 BPM

- Stage 4 = 30 steps per minute = 120 BPM
- Stage 5 = 35 steps per minute = 140 BPM

Start test

- Start audio file or set metronome 60 bpm.
    - After 2 minutes of stepping, check subject's heart rate and rating of perceived exertion (RPE) level and record on Chester Step Test data sheet.
    - Provided subject's heart rate is below 80%HRmax and RPE below 14, the subject should continue stepping at level 2 – a slightly faster rate.
  - Start of Level 2 = 80 bpm.
    - Check and record heart rate and RPE at 4 minutes or the end of level 2.
    - Provided subject's heart rate is below 80%HRmax and RPE below 14, the subject should continue stepping at level 3 – a slightly faster rate.
  - Start of Level 3 = 100 bpm.
    - Check and record heart rate and RPE at 6 minutes or the end of level 3.
- Scoring and validating the data collected (see CST data sheet page)
- Whilst aerobic capacity may be predicted from only 2 exercise heart rates (i.e. completing only 2 Levels), the accuracy of the test will be improved if the subject completes a minimum of 3 Levels.
  - Prior to plotting the line of best fit on the graphical datasheet: Exclude heart rate data points if they are less than 50%HRMax | Exclude heart rate data points if they are greater than 85%HRMax
  - If the pre-test resting heart rate is above 100 beats/min, the subject is likely to be very anxious and nervous about performing the test. If this is the case you are advised to try to relax the person before conduction the test. You may also find that the HR at Level 1 is also elevated and including this data-point does not produce a straight line relationship with data-points from later levels (when anxiety factors tend to be minimized). If this is the case, it is therefore advisable to omit this first point from your visual line of best fit
  - Heart rate increases linearly with increasing work intensity between 50-85% HRMax, hence data plotted within this range should show an approximate straight line graph. If this is not that case it may be that a procedural error has occurred. For example, incorrect or erratic stepping rate, poor technique (e.g. not stepping to fully height), heart rate monitor giving erroneous readings, talking during the test affecting heart rate, readings not accurately monitored by the tester top stepping. This is the end of the Chester Step Test.
- Predicting aerobic capacity using the graphical datasheet
- Mark the mlSO<sub>2</sub>/kg/min values for level 1, 2, and 3 for the step height used, the oxygen cost (mlSO<sub>2</sub>/kg/min) of stepping at Level 1=16, Level 2=21, Level 3=27, Level 4=32 and Level 5=37.
  - Plot the heart rates on the graph.
  - Use a ruler to draw the best visual straight line through the heart rate points and continue it up to the horizontal HR Max line.
  - Drop a perpendicular down from where the heart rate line crosses the HR Max line and read off the aerobic capacity score in mlSO<sub>2</sub>/kg/min and enter the score in the appropriate box.
  - Use the normative data tables to determine the applicant's fitness rating (see below).

<b>Male Age Groups</b>						
<b>Fitness Rating</b>	<b>15 - 19</b>	<b>20 - 29</b>	<b>30 - 39</b>	<b>40 - 49</b>	<b>50 - 59</b>	<b>60 - 65</b>
Excellent	60+	55+	50+	46+	44+	40+
Good	48 - 59	44 - 54	40 - 49	34 - 45	35 - 43	33 - 39
Average	39 - 47	35 - 43	34 - 39	32 - 36	29 - 34	25 - 32
Below Average	30 - 38	28 - 34	26 - 33	25 - 31	23 - 28	20 - 24
Poor	<30	<28	<26	<25	<23	<20
<b>Female Age Groups</b>						
<b>Fitness Rating</b>	<b>15 - 19</b>	<b>20 - 29</b>	<b>30 - 39</b>	<b>40 - 49</b>	<b>50 - 59</b>	<b>60 - 65</b>
Excellent	55+	50+	46+	43+	41+	39+
Good	44 - 54	40 - 49	36 - 45	34 - 42	33 - 40	31 - 38
Average	36 - 43	32 - 39	30 - 35	28 - 33	26 - 32	24 - 30
Below Average	29 - 35	27 - 31	25 - 29	22 - 27	21 - 25	19 - 23
Poor	<29	<27	<25	<22	<21	<19

- Cease Step Test Immediately if
- The applicant reaches 80% heart rate max at any point during testing
  - RPE = Moderately vigorous, i.e. 7+
  - Unable to maintain metronome set pace
  - Applicant reports needing to stop

### OR Instructions how to perform the Chester Treadmill test (CTT)

This test has two modes

1. CTT Prediction (of aerobic capacity)
2. CCT Performance

#### CTT Prediction

- CTT Prediction is a submaximal test designed to predict aerobic capacity. The treadmill walk protocol is exactly the same as for CTT Performance, however in this test a heart rate monitor is worn and the test is stopped when the subject reaches 80%HRMax and/or a Rating of Perceived Exertion (RPE) of 14. Heart rates are then plotted on the CTT Prediction graphical datasheet or inputted into the bespoke software - and aerobic capacity calculated.
- Test Protocol
  - Following a gentle loosening and limbering, the subject is then asked to walk on the treadmill at 0% for a 2-minute warm-up, the speed being gradually increased to 6.2km/hr, when the test is commenced.
  - Level 1: 0-2 minutes at 0% gradient. At the end of the level, record HR and RPE. If HR is below 80%HRMax and RPE is 14 or less, continue to level 2 by increasing the gradient to 3%.
  - Level 2: 2-4 minutes at 3%. At the end of the level, record HR and RPE. If HR is below 80%HRMax and RPE is 14 or less, continue to level 3, increasing the gradient to 6%.
  - Level 3: 4-6 minutes at 6%. At the end of the level, record HR and RPE. If HR is below 80%HRMax and RPE is 14 or less, continue to level 4, increasing the gradient to 9%.
  - Level 4: 6-8 minutes at 9%. At the end of the level, record HR and RPE. If HR is below 80%HRMax and RPE is 14 or less, continue to level 5, increasing the gradient to 12%.
  - Level 5: 8-10 minutes at 12%. At the end of the level, record HR and RPE. If HR is below 80%HRMax and RPE is 14 or less, continue to level 6, increasing the gradient to 15%.19
  - Level 6: 10-12 minutes at 15%. At the end of the level, check that RPE is 14 or less and HR is less than 80%HRMax. End of test.
- Please Note: The test should be stopped if/when the subject reaches 80%HRMax or reports an RPE of more than 14 – or appears unduly distressed.
- Prediction of Aerobic Capacity  
Record heart rates on the CTT Prediction graphical data sheets to predict aerobic capacity and ascertain fitness level.

#### CTT Performance

- CTT Performance is a 12-minute graded, treadmill walk test designed to assess whether or not the subject can achieve the minimum recommended standard for aerobic capacity, namely 42mlsO<sub>2</sub>/kg/min.
- Pre-test
  - There should be no medical contraindications to performing potentially exhaustive exercise. Additional health screening may be necessary.
  - The subject should wear loose-fitting clothing or shorts/T-shirt and trainers or similar footwear suitable for walking on a treadmill
  - The subject should be very familiar with walking briskly on a treadmill without using handrails for support.
  - An RPE Chart should be clearly visible to the subject.
- Test Protocol
  - Following a gentle loosening and limbering, the subject is then asked to walk on the treadmill at 0% for a 2-minute warm-up, the speed being gradually increased to 6.2km/hr, when the test is commenced.
  - Level 1: 0-2 minutes at 0% gradient. At the end of the level, check that RPE (see chart) is less than 18 and if so, continue to Level 2, increasing the gradient to 3%.
  - Level 2: 2-4 minutes at 3%. At the end of the level, check that RPE is less than 18 and if so, continue to Level 3, increasing the gradient to 6%.
  - Level 3: 4-6 minutes at 6%. At the end of the level, check that RPE is less than 18 and if so, continue to Level 4, increasing the gradient to 9%.
  - Level 4: 6-8 minutes at 9%. At the end of the level, check that RPE is less than 18 and if so, continue to Level 5, increasing the gradient to 12%.
  - Level 5: 8-10 minutes at 12%. At the end of the level, check that RPE is less than 18 and if so, continue to Level 6, increasing the gradient to 15%.
  - Level 6: 10-12 minutes at 15%. At the end of the level, check that RPE is less than 18. End of test.
  - After 12 minutes, the subject will have reached the required fitness standard of 42mlsO<sub>2</sub>/kg/min.

- Note: For those unable to complete all 6 stages, aerobic capacity may be estimated from the time and gradient that the subject was able to complete.
  - Completed 2 minutes: 14 mlsO<sub>2</sub>/kg/min
  - Completed 4 minutes: 19 mlsO<sub>2</sub>/kg/min
  - Completed 6 minutes: 25 mlsO<sub>2</sub>/kg/min
  - Completed 8 minutes: 31 mlsO<sub>2</sub>/kg/min
  - Completed 10 minutes: 36 mlsO<sub>2</sub>/kg/min
  - Completed 12 minutes: 42 mlsO<sub>2</sub>/kg/min
  - Approximate values may also be estimated if a subject stops in mid-Level (e.g. subject reaches an RPE of 18 after 7 minutes and decides to stop, the aerobic capacity will be around 28mlsO<sub>2</sub>/kg/ min).
- Please Note: CTT Performance is specifically designed to assess whether or not an individual has an aerobic capacity of at least 42 mlsO<sub>2</sub>/kg/min. For some, this can be a tough test and may require maximum or near maximum exertion for the less fit. It should be therefore carefully administered ensuring the participant is safe to perform high intensity exercise

Procedure:

- 1) Check that there are no medical contra-indication to vigorous exercise
- 2) Individual walks at 6,2 km./Hr at 0% for 2 mins
- 3) Every 2 mins increase by 3%
- 4) Test is completed when HR reaches 80% or RPE=14**
- 5) Test should be stopped if individual is showing overt signs or distress and exhaustion
- 6) Plot the Heart rates, draw a line best to fit to HRMax, **drop a perpendicular to predict aerobic capacity**

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Poor	29	27	25	22	21	19

Rating	Perceived Exertion
6	No exertion
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

Table 1. The Borg Rating of Perceived Exertion Scale

**The modified Kraus Weber flexibility test**

The flexibility test consists of 6 basic exercises that can easily be performed in the consulting room. In order to avoid strain to the neck please ask the applicant to cross their arms across their chest instead. For exercises where the feet must be stabilized the medical examiner can simply hold the applicant's feet.

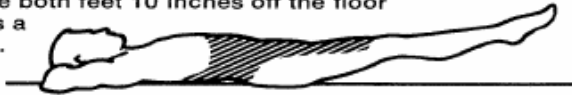
**Appendix 1 Kraus-Weber Test**

**SIX BASIC MUSCLE TESTS**


These six standardized tests of muscular function may help to "pinpoint" deficiencies of strength or flexibility (Test 6). They are done as slowly and smoothly as possible. Avoid jerky movements. Do not strain. Stop and rest briefly after each test.

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**TEST 1.** Lie on your back, hands behind your neck, legs straight. Keeping your legs straight, raise both feet 10 inches off the floor and hold for 10 seconds. This is a test of your hip-flexing muscles.



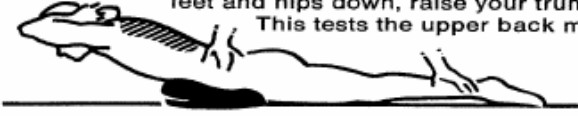
**TEST 2.** Lie on your back, hands behind your neck, feet under a heavy object which will not topple over. Try to "roll" up to a sitting position. This tests your hip-flexing and abdominal muscles.




**TEST 3.** Lie on your back, hands behind your neck, knees flexed, feet under a heavy object which will not topple over. Again try to "roll" up to a sitting position. This is a test of your abdominal muscles.




**TEST 4.** Lie on your stomach with a pillow under your abdomen, hands behind your neck. With someone holding your feet and hips down, raise your trunk and hold for 10 seconds. This tests the upper back muscles.



**TEST 5.** Taking the same position as that used for Test 4, but this time having someone holding your shoulders and hips down, try to raise your legs and hold for 10 seconds. This tests the muscles of the lower back.



**TEST 6.** Stand erect with shoes off, feet together, knees stiff, hands at sides. Try to touch the floor with your fingertips. If you can not, try it again. Relax, drop your head forward, and try to let your torso "hang" from your hips. Keep your knees stiff. Chances are you'll do better the second time. This is a test of muscle tension or flexibility.



**Scoring Key:**

A failed test occurs with any one of the following: 1. <10 seconds, 2. <90°, 3. <90°, 4. <10 seconds, 5. <10 seconds, 6. < toe touch.