# 101 Performance Evaluation Tests

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# Introduction

The success of a training program is largely dependent upon satisfying the performance aims associated with it and evaluation (testing and measuring) is the means of collecting information upon which subsequent performance evaluations and decisions can be made.

In constructing a test it is important to make sure that it really measure the factors required to be tested, and is thus objective rather than subjective. In doing so all tests should therefore be specific (designed to assess an athlete's fitness for the activity in question), valid (test what they purpose to test), reliable (capable of consistent repetition) and objective (produce a consistent result irrespective of the tester).

Evaluation tests can be broken down into two main types: Maximal tests, where the athlete works at maximum effort or tested to exhaustion, and Sub-Maximal tests, where the athlete works below maximum effort and extrapolation is used to estimate maximum capacity.

The results from an evaluation test can be used to:

- predict future performance
- indicate weaknesses
- measure improvement
- enable the coach to assess the success of the training program
- place the athlete in appropriate training group
- motivate the athlete.

It is important to bear in mind that there are many factors that can influence the outcome of an evaluation test – they include:

- the ambient temperature, noise level and humidity
- the amount of sleep the athlete had prior to testing
- the athlete's emotional state
- medication the athlete may be taking
- the time of day
- the time since the athlete's last meal
- the test environment – surface (track, grass, road, gym)
- the athlete's prior test knowledge/experience

- accuracy of measurements (times, distances *etc*)
- is the athlete actually applying maximum effort in maximal tests
- inappropriate warm up
- people present
- the personality, knowledge and skill of the tester.

As a coach I regularly test my athletes to ensure that their training program is achieving the performance objectives. On the following pages you will find a selection of evaluation tests for endurance, agility, mobility & balance, body composition, strength, speed & power and sports psychology that I have gathered and developed over the years and which I hope you will find beneficial in monitoring your athlete's or your athletic development.

Please let me know how you get on!

Best wishes

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# 1 Endurance

Fitness can be measured by the volume of oxygen you can consume while exercising at your maximum capacity. $VO_2$max is the maximum amount of oxygen in millilitres, one can use in one minute per kilogram of body weight. Those who are fit have higher $VO_2$max values and can exercise more intensely than those who are not as well conditioned. Numerous studies show that you can increase your $VO_2$max by working out at an intensity that raises your heart rate to between 65 and 85% of its maximum for at least 20 minutes three to five times a week. A mean value of $VO_2$max for male athletes is approx. 3.5 litres/minute and for female athletes it is about 2.7 litres/minute.

## Aerobic endurance

Aerobic fitness is primary for most sports. Trainers must think carefully about the fitness level they believe is appropriate for peak performance and then achieve that. For example, in elite football a high aerobic capacity is important, but for volleyball, a moderate level will suffice. For most games, aerobic fitness governs how quickly one recovers between high intensity sections, and how much distance can be covered in a game.

## Anaerobic endurance

During anaerobic (without oxygen) work, involving maximum effort, the body is working so hard that the demands for oxygen and fuel exceed the rate of supply and the muscles have to rely on the stored reserves of fuel. In this situation waste products accumulate, the chief one being lactic acid. The muscles, being starved of oxygen, take the body into a state known as oxygen debt. The body's stored fuel soon runs out and activity ceases and will not be resumed until the lactic acid is removed and the oxygen debt repaid. Fortunately the body can resume limited activity after even only a small proportion of the oxygen debt has been repaid.

## Endurance evaluation tests

The following are examples of aerobic endurance tests:

- Astrand treadmill test
- Balke treadmill test
- Balke $VO_2$max test
- Bruce treadmill test
- The 2.4km run test
- Conconi test
- Cooper $VO_2$max test
- Critical swim speed
- Harvard step test
- Astrand cycle test
- Home step test
- Three minute step test
- Multistage fitness test
- Queens college step test
- Rockport fitness walking test
- Tecumseh step test
- Treadmill $VO_2$max test
- $VO_2$max from a one mile jog
- $VO_2$max from non-exercise data
- Running based anaerobic sprint test (RAST)
- Tri-level aerobic test
- Tri-level lactic power test
- Tri-level Alactic Power Test
- Cunningham and Faulkner test

# 1.1 ■ Astrand Treadmill Test

*The objective of this test is to monitor the development of the athlete's general endurance ($VO_2$max).*

## Required resources

To undertake this test you will require:

- Treadmill where the speed can be set at 5 mph (8.05 km/hr) and grade of slope can be adjusted
- Stop watch
- Assistant.

## How to conduct the test

- The treadmill is set up at the start with a speed of 8.05km/hr (5 mph) and a grade of slope of 0%
- The athlete commences the test
- After 3 minutes the grade is set to 2.5% and then every 2 minutes the grade is increased by 2.5%
- The assistant starts the stop watch at the start of the test and stops it when the athlete is unable to continue.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

From the total running time an estimate of the athlete's $VO_2$max can be calculated as follows:

- $VO_2$max = (Time x 1.444) + 14.99
- "Time" is the total time of the test expressed in minutes and fractions of a minute.

*Example:*
The athlete stopped the test after 13 minutes 15 seconds of running (13.25 minutes).

- $VO_2$max = (13.25 x 1.444) + 14.99
- $VO_2$max = 34.123 mls/kg/min.

## Target group

This test is suitable for endurance athletes and players of endurance sports (*eg* football, rugby) but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published $VO_2$max tables (Appendix A) and the correlation to actual $VO_2$max is high.

## On-line calculator

Select the following link to access the on-line calculator

- astrand treadmill test.htm

# 1.2 ■ Balke Treadmill Test

*The objective of this test is to monitor the development of the athlete's general endurance ($VO_2$max).*

## Required resources

To undertake this test you will require:

- Treadmill where speed and grade of slope can be adjusted
- Stop watch
- Assistant.

## How to conduct the test

The athlete walks on a treadmill to exhaustion. At timed stages during the test the grade of slope (%) of the treadmill is increased as follows:

- Active and sedentary men
  - Treadmill speed set at 3.3 mph (5.3km/hr)
  - Start – Grade is 0%
  - After 1 minute – Grade set at 2%
  - After 2 minutes and each minute thereafter the grade is increased by 1%
- Active and sedentary women
  - Treadmill speed set at 3.0 mph (4.5 km/hr)
  - Start – Grade is 0%
  - After 3 minutes and every 3 minutes thereafter the grade is increased by 2.5%
- The assistant starts the stop watch at the start of the test and stops it when the athlete is unable to continue – this ideally should be between 9 and 15 minutes.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Active and sedentary men – Pollock *et al*. 1976

From the total time an estimate of the athlete's $VO_2$max can be calculated as follows:

- $VO_2\text{max} = 1.444 \times T + 14.99$
- "T" is the total time of the test expressed in minutes and fractions of a minute *eg* 13 minutes, 15 seconds = 13.25 minutes.

## Active and sedentary women – Pollock *et al*. 1982

From the total time an estimate of the athlete's $VO_2$max can be calculated as follows:

- $VO_2$max = 1.38 x T + 5.22
- "T" is the total time of the test expressed in minutes and fractions of a minute.

## Target group

This test is suitable for active and sedentary individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published $VO_2$max tables (Appendix A) and the correlation to actual $VO_2$max is high.

## On-line calculator

Select the following link to access the on-line calculator

- balke treadmill test.htm

# 1.3 ■ Balke $VO_2$max Test

*The objective of this test is to monitor the development of the athlete's general endurance ($VO_2$max).*

## Required resources

To undertake this test you will require:

- 400m track
- Stop watch
- Assistant.

## How to conduct the test

The Balke test is conducted as follows:

- Choose a windless day and run around a track for 15 minutes – the aim is to run as far as possible
- The assistant notes the total distance achieved in the 15 minutes to the nearest 25 metres.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement. The distance achieved can also be used to predict the athlete's $VO_2$max.

## Performance assessment

The formula used to calculate $VO_2$max (*Obsession for Running* by Frank Horwill) is:

- $VO_2max = (((Total\ distance\ covered / 15) - 133) \times 0.172) + 33.3$

*Example:*

- An athletes completes 5200 metres in 15 minutes
- $VO_2max = (((5200/15) - 133) \times 0.172) + 33.3$
- $VO_2max = 70$ mls/kg/min.

## Target group

This test is suitable for endurance athletes and players of endurance sports (*eg* football, rugby) but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published $VO_2$max tables (Appendix A) and the correlation to actual $VO_2$max is high.

## On-line calculator

Select the following link to access the on-line calculator

- balke vo2max test.htm

# 1.4 ■ Bruce Treadmill Test

*The objective of the Bruce treadmill test is to monitor the development of the athlete's general endurance ($VO_2$max).*

## Required resources

To undertake this test you will require:

- Treadmill where speed and grade of slope can be adjusted
- Stop watch
- Assistant.

## How to conduct the test

The athlete runs on a treadmill to exhaustion. At timed stages during the test the speed (km/hr) and grade of slope (%) of the treadmill are increased as detailed in the table below.

| Stage | Time (min) | km/hr | Slope |
|---|---|---|---|
| 1 | 0 | 2.74 | 10% |
| 2 | 3 | 4.02 | 12% |
| 3 | 6 | 5.47 | 14% |
| 4 | 9 | 6.76 | 16% |
| 5 | 12 | 8.05 | 18% |
| 6 | 15 | 8.85 | 20% |
| 7 | 18 | 9.65 | 22% |
| 8 | 21 | 10.46 | 24% |
| 9 | 24 | 11.26 | 26% |
| 10 | 27 | 12.07 | 28% |

The treadmill is set up with the Stage 1 speed (2.74 km/hr) and grade of slope (10%) and the athlete commences the test.

At the appropriate times during the test the speed and slope of the treadmill are adjusted.

So after 3 minutes into the test the speed is adjusted to 4.02 km/hr and the slope to 12%, after 6 minutes into the test the speed is adjusted to 5.47 km/hr and the slope to 14%, and so on.

The assistant starts the stop watch at the start of the test and stops it when the athlete is unable to continue – this ideally should be between 9 and 15 minutes.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Active and sedentary men – Foster *et al*. 1984

From the total walk/run time an estimate of the athlete's $VO_2$max can be calculated as follows:

- $VO_2max = 14.8 – (1.379 \times T) + (0.451 \times T^2) – (0.012 \times T^3)$
- "T" is the total time of the test expressed in minutes and fractions of a minute *eg* 13 minutes 15 seconds = 13.25 minutes.

## Active and sedentary women – Pollock *et al*. 1982

From the total walk/run time an estimate of the athlete's $VO_2$max can be calculated as follows:

- $VO_2max = 4.38 \times T – 3.9$
- "T" is the total time of the test expressed in minutes and fractions of a minute.

## Target group

This test is suitable for active and sedentary individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published $VO_2$max tables (Appendix A) and the correlation to actual $VO_2$max is high.

## On-line calculator

Select the following link to access the on-line calculator

- bruce treadmill test.htm

# 1.5 ■ The 2.4km Run Test

*The objective of this test is to monitor the development of the athlete's aerobic endurance.*

## Required resources

To undertake this test you will require:

- 400metre track
- Stop watch
- Assistant.

## How to conduct the test

The test is conducted as follows:

- Athlete to complete a 10 minute warm up
- Athlete to run 2.4 km (6 laps of a 400m track) as fast as possible
- Assistant to keep athlete informed of the number of laps remaining to complete the test
- Assistant to record the time taken for the athlete to run 2.4km.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 1.6 ■ Conconi Test

*The Conconi test (Conconi et al, 1982) is a simple method for measuring the approximate values of an individual's anaerobic and aerobic threshold rates.*

## Required resources

To perform the test you require:

- Heart Rate Monitor (HRM) which records your heart rate for subsequent analysis
- 400 metre track or treadmill
- Stop watch
- Assistant to record your 200 metre times.

## Conducting the Conconi test on a 400m Track

In the Conconi test the athlete increases their speed gradually every 200 metres and the time, at each 200 metre point, is recorded. This gradual increase in speed every 200 metres is maintained until the athlete is unable to maintain the pace.

Before you start the test you need to determine your starting speed and how much you increment your speed by every 200 metres. The total distance covered by the test should be between 2.5 km and 4 km to ensure sufficient information is available for subsequent calculations.

Speed versus heart rate is then plotted on a graph from which the athlete's anaerobic threshold can be determined.

- Perform a 5 to 10 minute warm up program
- Set the HRM to use a 5 second recording interval
- Start the HRM watch at the starting point
- Every 200 metres record the time
- Every 200 metres increase your speed
- End the test when you can no longer maintain the pace
- Stop the HRM recording
- Perform a 10 minute warm down program.

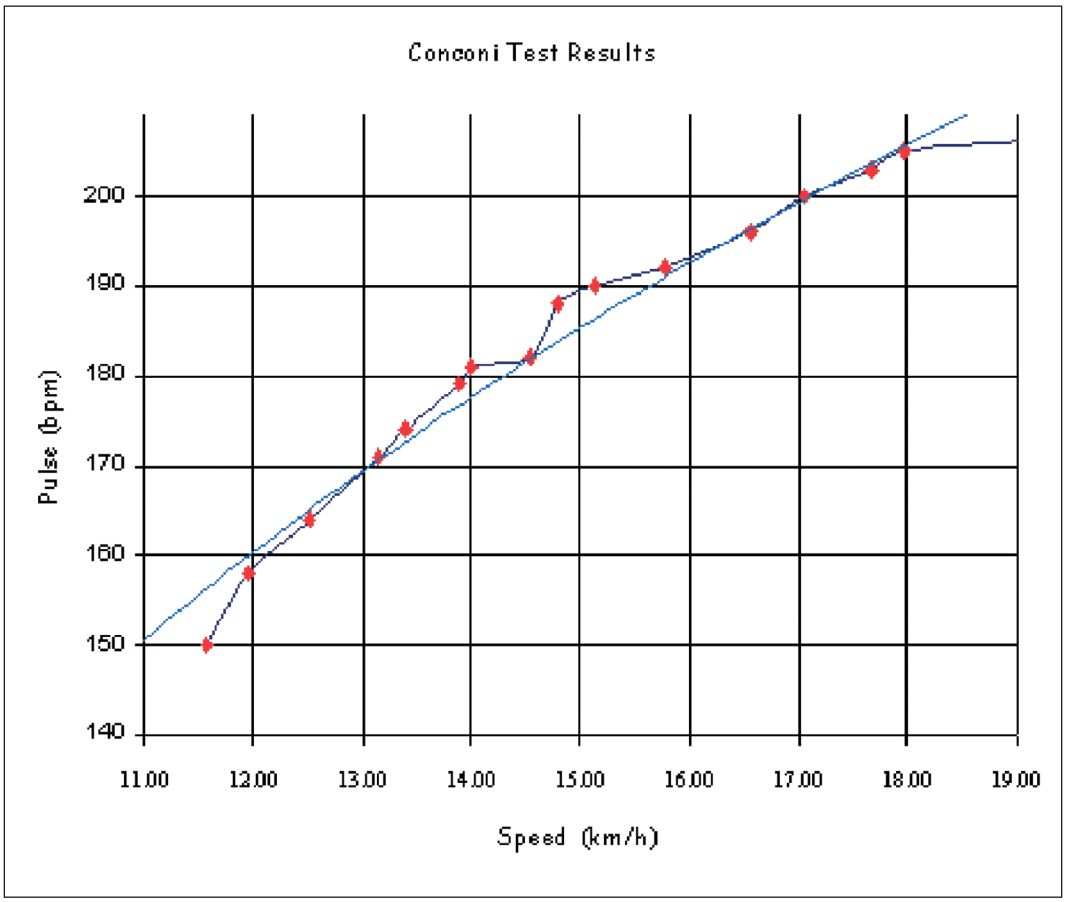
## Conducting the Conconi test on a treadmill

- Perform a 5 to 10 minute warm up program
- Set the HRM to use a 5 second recording interval
- Start the treadmill speed at the required start speed
- Start the HRM stop watch

- Record the time every 200 metres
- Increase the treadmill speed every 200 metres by 0.5km/hr
- End the test when you have reached your maximum heart rate or you can continue no longer
- Stop the HRM recording
- Perform a 10 minute warm down program.

## Calculation of anaerobic threshold

From the HRM determine the heart rate at each recorded time interval. Determine the speed for each 200 metres and then for each 200 metres plot speed versus heart rate on a graph. You will find the graph gradually rises to start with and then flattens before rising again. This flattening in the graph indicates the athlete's anaerobic threshold. In the example conconi graph below this flattening appears to be around 182 bpm.




## Calculation of aerobic threshold

A good estimate for aerobic threshold has proved to be the anaerobic threshold minus 20 bpm. In the example above this would be 182 – 20 = 162 bpm.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for endurance athletes and players of endurance sports (*eg* football, rugby) but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test. It has been shown that there is a lack of reliability in Conconi's heart rate deflection point (Jones, A and Doust, J [1995]).

## Validity

There are no published tables to relate results to potential performance in competition.

# 1.7 ■ Cooper $VO_2$max Test

*The objective of the Cooper test is to predict an athlete's $VO_2$max.*

## Required resources

To undertake this test you will require:
- 400 metre track – marked every 50m
- Stop watch
- Assistant.

## How to conduct the test

The test comprises of seeing how far an athlete can run/walk in 12 minutes. The assistant should record the total distance covered.

## Performance assessment

Based on the distance covered an estimate of the athlete's $VO_2$max can be calculated as follows:
- $VO_2$max = (Distance covered in metres – 504.9) / 44.73

*Example:*
The athlete, a male football player, completes a total distance of 3400m in the 12 minutes.
$VO_2$max = (3400 – 504.9) / 44.73
= 64.72 ml/kg/min.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

The result from the Cooper test can be used to:
- predict future performance
- indicate weaknesses
- measure improvement
- enable the coach to assess the success of his training programme
- place the athlete in appropriate training group
- motivate the athlete

## Ideal $VO_2$max scores for various sports

| $VO_2$max | Sport |
|---|---|
| >75 ml/kg/min | Endurance Runners and Cyclists |
| 65 ml/kg/min | Squash |
| 60-65 ml/kg/min | Football (male) |
| 55 ml/kg/min | Rugby |
| 50 ml/kg/min | Volleyball (female) |
| 50 ml/kg/min | Baseball (male) |

## Target group

This test is suitable for endurance athletes and players of endurance sports (*eg* football, rugby) but not for individuals where the test would be contraindicated.

## Reliability

The following factors may have an impact on the test result:

- The ambient temperature, noise level and humidity
- The amount of sleep the athlete had prior to testing
- The athlete's emotional state
- Medication the athlete may be taking
- The time of day
- The athlete's caffeine intake
- The time since the athlete's last meal
- The test environment – surface (track, grass, road, gym)
- The athlete's prior test knowledge/experience
- Accuracy of measurements (times, distances *etc*)
- Is the athlete actually applying maximum effort in maximal tests
- Inappropriate warm up
- People present
- The personality, knowledge and skill of the tester
- Athlete's level of motivation to give 100% effort.

## Validity

There are published VO2max tables (Appendix A) and the correlation to actual $VO_2$max is high.

## On-line calculator

Select the following link to access the on-line calculator

- cooper vo2max test.htm

# 1.8 ■ Critical Swim Speed

*The Critical Swim Speed (CSS) test, devised by Ginn [1] in 1993, can be used to monitor the athlete's aerobic capacity. The result of the test can also be used to determine the appropriate target time for each repetition of a swimmer's aerobic training session. CSS is defined as "the maximum swimming speed that can theoretically be maintained continuously without exhaustion" [2] – just below the swimmer's lactate threshold.*

## Required resources

To undertake the CSS test you will require:

- Swimming pool
- Stop watch
- Assistant.

## Test process

The following protocol should be followed:

- Start each swim from a push start – not a dive in
- Allow a full recovery between each swim
- Record the time for each swim in seconds
- Calculate the athlete's CSS.

## How to conduct the test

The test comprises of two maximal swims over 400 metres and 50 metres. A suitable rest period should be taken between each swim to allow the athlete to fully recover. The assistant should record the times for each swim.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Calculation of CSS

The calculation of the swimmer's CSS, based on their 400m and 50m times, and is as follows:

- CSS = (D2 – D1) / (T2 – T1)

Where D1 = 50, D2 = 400, T1 = time for 50m in seconds and T2 = time for 400m in seconds.

*Example:*
A swimmer completes a 50m swim in 31 seconds and a 400m swim in 291 seconds:

- CSS = (400-50) / (291-31)
- CSS = 350 / 260
- CSS = 1.35 m/second.

## Use of CSS to set training times

The calculated CSS can be used to determine training times for an aerobic training session [3].

*Example:*
Training session is 6 x 400m. The time per 400m repetition can be calculated as follows:

- Time per 400m repetition = Distance / CSS.

For an athlete with a CSS of 1.35 then the 400m repetition time would be:

- 400 / 1.35 = 296.3 seconds = 4 minutes 56.3 seconds.

## Target group

This test is suitable for swimmers but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## References

1. *Ginne, E. (1993), "The application of the critical power test to swimming and swim training programmes"*
2. *Wakayoshi, K. et al (1991) "Determination and validity of critical velocity as an index of swimming performance in the competitive swimmer", European Journal of Applied Physiology, 64, 153-157*
3. *http://www.athleticscoach.co.uk/css.htm.*

## On-line calculator

Select the following link to access the on-line calculator

- critical swim speed test.htm

# 1.9 ■ Harvard Step Test

*The objective of this test is to monitor the development of the athlete's cardiovascular system.*

## Required resources

To undertake this test you will require:

- Gym bench (45cm high)
- Stop watch
- Assistant.

## How to conduct the test

The Harvard step test is conducted as follows:

- Step up on to a standard gym bench once every 2 seconds for 5 minutes (150 steps)
- 1 minute after finishing the test take your pulse rate (bpm) – Pulse1
- 2 minutes after finishing the test take your pulse rate (bpm) – Pulse2
- 3 minutes after finishing the test take your pulse rate (bpm) – Pulse3.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

Using the three pulse rate your level of fitness can be determined as follows:

- Result = 3000 / (pulse1 + pulse2 + pulse3).

## Normative data for the Harvard step test

The following table is for 16 year old athletes:

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | >90 | 80-90 | 65-79 | 55-64 | <55 |
| Female | >86 | 76-86 | 61-75 | 50-60 | <50 |

*Table reference: McArdle W.D. et al; Essential of Exercise Physiology; 2000*

## Target group

This test is suitable for active and sedentary athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to a potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- harvard step test.htm

# 1.10 ■ Astrand Cycle Test

*The objective of this test is to monitor the development of the athlete's aerobic endurance.*

## Required resources

To undertake this test you will require:

- Stationary bicycle ergometer (Monarch or similar)
- Heart rate monitor
- Stop watch
- Assistant.

## How to conduct the test

The test is conducted as follows:

- Athlete to conduct a 10 minute warm up
- Athlete to fit heart rate monitor and check it is functioning
- Assistant to record resting heart rate
- Athlete to adjust the bicycle seat and handle bars
- Assistant to set initial work rate as follows
  - Sedentary females >40 years – 150 kpm/min (25W)
  - Sedentary females <40 years – 150 to 300 kpm/min (25 to 50W)
  - Active females <40 years – 300 to 450 kpm/min (50 to 75W)
  - Active females >40 years – 450 to 600 kpm/min (75 to 100W)
  - Sedentary males <40 years – 150 to 300 kpm/min (25 to 50W)
  - Sedentary males >40 years – 300 to 600 kpm/min (50 to 100W)
  - Active males <40 years – 600 kpm/min (100W)
  - Active males >40 years – 600 to 900 kpm/min (100 to 150W)
- Athlete starts exercising at the chosen work rate
- The assistant records the athlete's heart rate each minute. It is usual to use the last 10 seconds of each minute (*6) as the value for that minute
- For participants > 40 years, if heart rate is <120 bpm after 2 minutes of exercise, increase work rate by 150 to 300 kpm/min (25W to 50W). For participants < 40 years, if heart rate is < 130 bpm, after 2 minutes of exercise, increase work rate by 300 kpm/min (50W)
- Athlete to keep cycling for 6 minutes at the final work rate
- Stop the test if heart rate exceeds 170 bpm (or 85% of predicted maximum heart rate).

## Analysis

Analysis of the result is by comparing the final workload and the six heart rate readings with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement. The steady state heart rate can be looked up on published tables to determine an estimation of $VO_2$max.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 1.11 ■ Home Step Test

*The objective of this test is to monitor the development of the athlete's cardiovascular system.*

## Required resources

To undertake this test you will require:

- 12 inch high bench or step
- Stop watch
- Metronome or cadence tape
- Heart rate monitor (optional)
- Assistant.

## How to conduct the test

The home step test is conducted as follows:

- Step up and down, one foot at a time, onto the step or bench for 3 minutes
- Try to maintain a steady four beat cycle (approx. 22 to 24 steps/minute)
- Use a metronome or have someone to help you keep to the required pace
- On finishing the test count the number of heart beats for 15 seconds
- Multiply the number of beats in 15 seconds by 4
- Use this final value to assess your performance using the appropriate table below.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the home step test

Male athletes

| Age | 18-25 | 26-35 | 36-45 | 46-55 | 56-65 | 65+ |
|---|---|---|---|---|---|---|
| Excellent | <79 | <81 | <83 | <87 | <86 | <88 |
| Good | 79-89 | 81-89 | 83-96 | 87-97 | 86-97 | 88-96 |
| Above Average | 90-99 | 90-99 | 97-103 | 98-105 | 98-103 | 97-103 |
| Average | 100-105 | 100-107 | 104-112 | 106-116 | 104-112 | 104-113 |
| Below Average | 106-116 | 108-117 | 113-119 | 117-122 | 113-120 | 114-120 |
| Poor | 117-128 | 118-128 | 120-130 | 123-132 | 121-129 | 121-130 |
| Very Poor | >128 | >128 | >130 | >132 | >129 | >130 |

Female athletes

| Age | 18-25 | 26-35 | 36-45 | 46-55 | 56-65 | 65+ |
|---|---|---|---|---|---|---|
| Excellent | <85 | <88 | <90 | <94 | <95 | <90 |
| Good | 85-98 | 88-99 | 90-102 | 94-104 | 95-104 | 90-102 |
| Above Average | 99-108 | 99-108 | 103-110 | 103-110 | 103-110 | 103-115 |
| Average | 109-117 | 112-119 | 111-118 | 106-116 | 104-112 | 116-122 |
| Below Average | 118-126 | 1118-126 | 119-128 | 121-129 | 119-128 | 123-128 |
| Poor | 127-140 | 127-138 | 129-140 | 130-135 | 129-139 | 129-134 |
| Very Poor | >140 | >138 | >140 | >135 | >139 | >134 |

*Table reference: Canadian Public Health Association*

## Target group

This test is suitable for active and sedentary athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to a potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- home step test.htm

# 1.12 ■ Three Minute Step Test

*The objective of this test is to monitor the development of the athlete's aerobic fitness.*

## Required resources

To undertake this test you will require:

- 12 inch step
- Stop watch (or watch displaying seconds) for timing test and counting recovery heart rate
- Metronome to set cadence.

## How to conduct the test

The test is conducted as follows:

- The athlete conducts a warm-up
- Athlete steps up and down at a rate of 24 steps per minute (metronome setting of 96) for 3 minutes
- Immediately after the 3 minutes of stepping, the subject sits down on the bench and finds pulse (at neck)
- A 60 second heart rate is taken 5 seconds after completion of stepping
- This recovery heart rate is the athlete's score.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no tables published to relate results to potential performance in competition.

# 1.13 ■ Multi-Stage Fitness Test

*The objective of the Multi-Stage Fitness Test (MSFT) is to monitor the development of the athlete's maximum oxygen uptake ($VO_2$max).*

## Required resources

To undertake this test you will require:

- Flat, non slippery surface at least 20 metres in length
- 30 metre tape measure
- Marking cones
- Pre-recorded audio tape or CD
- Tape recorder
- Recording sheets
- Assistant
- Calculator.

## How to conduct the test

The test is made up of 23 levels where each level lasts approx. one minute. Each level comprises of a series of 20m shuttles where the starting speed is 8.5km/hr and increases by 0.5km/hr at each level. On the tape/CD a single beep indicates the end of a shuttle and 3 beeps indicates the start of the next level.

The test is conducted as follows:

- Measure out a 20 metres section and mark each end with a marker cone
- The athlete carries out a warm up program of jogging and stretching exercises
- The test is conducted
- The athlete must place one foot on or beyond the 20m marker at the end of each shuttle
- If the athlete arrives at the end of a shuttle before the beep, the athlete must wait for the bleep and then resume running
- The athlete keeps running for as long as possible until he/she can longer keep up with the speed set by the tape at which point they should voluntarily withdraw
- If the athlete fails to reach the end of the shuttle before the beep they should be allowed 2 or 3 further shuttles to attempt to regain the required pace before being withdrawn
- Record the level and number of shuttles completed at that level by the athlete
- At the end of the test the athletes conduct a warm down program, including stretching exercises.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

The algorithm below will provide you with an estimate of your $VO_2$max. Please note that, when compared to the MSF Table values, the calculator result can be in error by up to ± 0.3 mls/kg/min:

- $VO_2$max = 18.043461 + (0.3689295 x TS) +(–0.000349 x TS x TS)

Where TS is the total number of shuttles completed.

*Example:*
You finished at: Level 10 shuttle 5

From the table below determine the number of shuttles for the level you reached. In this example Level 10 is 95 shuttles.

| Level | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Shuttles | 8 | 16 | 24 | 33 | 42 | 52 | 62 | 73 | 84 | 95 | 107 |

| Level | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Shuttles | 119 | 132 | 145 | 158 | 172 | 186 | 201 | 216 | 232 | 248 | 264 |

Your total number of shuttles (TS) is 95 + 5 = 100

You can then calculate your $VO_2$max as follows:

- $VO_2$max = 18.043461 + (0.3689295 x 100) +(–0.000349 x 100 x 100)
- $VO_2$max = 48.114 mls/kg/min (± 0.3 mls/kg/min)

## Normative data for the multi-stage fitness test

The following are national team scores for the MSFT.

| Sport | Male | Female |
|---|---|---|
| Basketball | Level 11 – Shuttle 5 | Level 9 – Shuttle 6 |
| Hockey | Level 13 – Shuttle 9 | Level 12 – Shuttle 7 |
| Rugby League | Level 13 – Shuttle 1 | |
| Netball | | Level 9 – Shuttle 7 |
| Squash | Level 13 – Shuttle 13 | |

*Table Reference: Beashel P. et al; The world of sport examined; 1997*

## Target group

This test is suitable for endurance athletes and players of endurance sports (*eg* football, rugby) but not for individuals where the test would be contraindicated. A degree of caution is required in administering the test, in that you have to push yourself relatively hard to the point where you can no longer maintain the pace dictated by the tape. If you are suffering from any injury or illness, or if you have any reason to think you may not be in a good general state of health, you should consult a doctor before doing this test.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test. As the audio-tapes may stretch over time, the tapes need to be calibrated which involves timing a one-minute interval and making adjustment to the distance between markers. The recording is also available on compact disc, which does not require calibration.

## Validity

There are published $VO_2$max tables (Appendix A) and the correlation to actual $VO_2$max is high.

## On-line calculator

Select the following link to access the on-line calculator

- multi stage fitness test.htm

# 1.14 ■ Queen's College Step Test

*The objective of this test is to monitor the development of the athlete's cardiovascular system.*

## Required resources

To undertake this test you will require:

- Step 16.25 inches or 41.3 cm high
- Stop watch
- Metronome or cadence tape
- Heart rate monitor (optional)
- Assistant.

## How to conduct the test

The Queens College step test is conducted as follows:

- Step up and down on the step for 3 minutes at the following rate:
  - Male – 24 steps per minute
  - Female – 22 steps per minute
- Use a metronome or have someone to help you keep to the required pace
- 5 seconds after finishing the test – count the heart beats for 15 seconds (PR).

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

You can calculate your $VO_2$max as follows:

- Male = 111.33 – (1.68 x PR)
- Female = 65.81– (0.7388 x PR).

## Normative data for the Queen's College step test

Multiply your PR value by 4.

The following are national norms for 16 to 19 year olds.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | <121 | 148 – 121 | 156 – 149 | 162 – 157 | >162 |
| Female | <129 | 158 – 129 | 166 – 159 | 170 – 167 | >170 |

*Table Reference: Davis B. et al; Physical Education and the Study of Sport; 2000*

## Target group

This test is suitable for active and sedentary athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published $VO_2$max tables (Appendix A) and the correlation to actual $VO_2$max is high.

## On-line calculator

Select the following link to access the on-line calculator

- queens college step test.htm

# 1.15 ■ Rockport Fitness Walking Test

*The objective of this test is to monitor the development of the athlete's $VO_2$max.*

## Required resources

To undertake this test you will require:

- 400 metre track
- Stop watch
- Assistant.

## How to conduct the test

The Rockport fitness walking test is conducted as follows:

- Choose a windless day to conduct the test
- Record your weight
- Walk one mile (1609 metres) as fast as possible
- Record the time to complete the one mile walk
- Immediately on finishing the walk record your heart rate (beats per minute)
- Determine you $VO_2$max.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

The formula used to calculate VO2max is:

- 132.853 – (0.0769 x Weight) – (0.3877 x Age) + (6.315 x Gender) – (3.2649 x Time) – (0.1565 x Heart rate).

Where:

- Weight is in pounds (lbs)
- Gender Male = 1 and Female = 0
- Time is expressed in minutes and 100ths of minutes
- Heart rate is in beats/minute
- Age is in years.

## Target group

This test is suitable for sedentary individuals but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published VO2max tables (Appendix A) and the correlation to actual $VO_2$max is high.

## On-line calculator

Select the following link to access the on-line calculator

- rockport fitness walking test.htm

# 1.16 ■ Tecumseh Step Test

*The objective of this test is to monitor the development of the athlete's cardio-respiratory fitness.*

## Required resources

To undertake this test you will require:

- Gym bench or step (8 inches/20.3 cm high)
- Stop watch
- Assistant.

## How to conduct the test

The Tecumseh step test is conducted as follows:

- Perform a step cycle of four-step cadence (right foot up, left foot up, right foot down and left foot down) completing 24 cycles in one minute. This is 2 cycles in a 5 second period
- Have someone to help you keep to the required pace or you could use a metronome set at 96 beats/minute
- Perform the test for 3 minutes
- 30 seconds after finishing the test count the number of pulse beats for 30 seconds.

The number of beats counted in 30 seconds is then used in the table below to determine the athlete's grade.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Performance assessment

For an evaluation of the athlete's performance select the age group and gender, enter the number of beats in 30 seconds and then select the 'Calculate' button.

The following table is for male athletes over the age of 19.

| Classification | 20-29 | 30-39 | 40-49 | 49+ |
|---|---|---|---|---|
| Outstanding | 34-36 | 35-38 | 37-39 | 37-40 |
| Very Good | 37-40 | 39-41 | 40-42 | 41-43 |
| Good | 41-42 | 42-43 | 43-44 | 44-45 |
| Fair | 43-47 | 44-47 | 45-49 | 46-49 |
| Low | 48-51 | 48-51 | 50-53 | 50-53 |
| Poor | 52-59 | 52-59 | 54-60 | 54-62 |

The following table is for Female athletes over the age of 19.

| Classification | 20-29 | 30-39 | 40-49 | 49+ |
|---|---|---|---|---|
| Outstanding | 39-42 | 39-42 | 41-43 | 41-44 |
| Very Good | 43-44 | 43-45 | 44-45 | 45-47 |
| Good | 45-46 | 46-47 | 46-47 | 48-49 |
| Fair | 47-52 | 48-53 | 48-54 | 50-55 |
| Low | 53-56 | 54-56 | 55-57 | 56-58 |
| Poor | 57-66 | 57-66 | 58-67 | 59-66 |

*Table Reference: McArdle W.D. et al; Essential of Exercise Physiology; 2000*

## Target group

This test is suitable for active and sedentary athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to a potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- tecumseh step test.htm

# 1.17 ■ Treadmill $VO_2$max Test

*The objective of this test is to monitor the development of the athlete's general endurance ($VO_2$max).*

## Required resources

To undertake this test you will require:

- Treadmill where speed and grade of slope can be adjusted
- Stop watch
- Assistant.

## How to conduct the test

The athlete runs on a treadmill to exhaustion. At timed stages during the run the slope of the treadmill is increased as detailed in the table below.

| Time (minutes) | km/hour | Slope |
|---|---|---|
| 0 | 11.3 | 0° |
| 1 | 11.3 | 2° |
| 2 | 11.3 | 4° |
| 3 | 11.3 | 6° |
| 4 | 11.3 | 8° |
| 5 | 11.3 | 10° |
| 6 | 11.3 | 11° |
| 7 | 11.3 | 12° |
| 8 | 11.3 | 13° |
| 9 | 11.3 | 14° |
| 10 | 11.3 | 15° |
| 11 | 11.3 | 16° |
| 12 | 11.3 | 17° |
| 13 | 11.3 | 18° |
| 14 | 11.3 | 19° |
| 15 | 11.3 | 20° |

The treadmill is set up with a speed of 11.3 km/hour (7.02 miles/hr) and a slope of 0° and the athlete commences the test. At minute intervals during the test the slope of the treadmill is adjusted.

The assistant starts the stop watch at the start of the test and stops it when the athlete is unable to continue – this ideally should be between 9 and 15 minutes.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

From the total running time an estimate of the athlete's VO2max can be calculated as follows:

- $VO_2max = 42 + (Time \times 2)$

"Time" is the total time of the test expressed in minutes and fractions of a minute.

*Example:*
The athlete stopped the test after 13 minutes 15 seconds of running (13.25 minutes):

- $VO_2max = 42 + (13.25 \times 2)$
- $VO_2max = 68.5$ mls/kg/min

## Target group

This test is suitable for endurance athletes and players of endurance sports (*eg* football, rugby) but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published $VO_2max$ tables (Appendix A) and the correlation to actual $VO_2max$ is high.

## On-line calculator

Select the following link to access the on-line calculator

- treadmill vo2max test.htm

# 1.18 ■ $VO_2$max from a One Mile Jog

*Using statistical techniques, Brigham Young University (USA) scientists used the heart rates, body weights, and one mile jog times from 54 students to create a fairly simple mathematical equation for $VO_2$max. They then checked the predictive power of the equation by using it to forecast the $VO_2$max of another 52 runners involved in the study. When these predicted $VO_2$max were compared with the runners' $VO_2$max determined in the exercise physiology laboratory, the equation was determined to be remarkably accurate.*

## Required resources

To undertake this test you will require:

- 400 metre track
- Stop watch
- Heart rate monitor.

## How to conduct the test

- Warm up by jogging for a couple of minutes
- Jog one mile at an easy, steady pace, making sure that you take longer (yes longer) than eight minutes (males), or more than nine minutes (females)
- Record how long it actually takes you to jog one mile
- Record your heart rate immediately on completing the mile.

## Analysis

The algorithms to calculate your $VO_2$max are:

- Male Athletes $VO_2$max = 108.844 – 0.1636W – 1.438T – 0.1928H
- Female Athletes $VO_2$max = 100.5 – 0.1636W – 1.438T – 0.1928H

Where W = Weight in kg, T = Time for the one mile run and H = Heart Rate at the end of the run.

## Target group

This test is suitable for endurance athletes and players of endurance sports (*eg* football, rugby) but not for individuals where the test would be contraindicated.

The test result will be most accurate for athletes aged 18-29, but older athletes can still use this test to monitor gains in fitness and obtain a ballpark figure for their $VO_2$max.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published $VO_2$max tables (Appendix A) and the correlation to actual $VO_2$max is high.

## On-line calculator

Select the following link to access the on-line calculator

- vo2max from a one mile run test.htm

# 1.19 ■ $VO_2$max from Non-exercise Data

*This calculation of $VO_2$max using non-exercise data can provide a useful initial estimate of an athlete's $VO_2$max for screening purposes.*

## Required information

The data required to predict an athlete's $VO_2$max is: Gender, Body Mass Index, Physical Activity Rating and Perceived Functional Ability.

## Estimation of $VO_2$max

### Physical Activity Rating

In the following table please note the value for the appropriate statement that indicates the overall physical activity in the past six months.

0. **Inactive:** avoid walking or exertion; *eg* drive when possible instead of walking
1. **Light activity:** walk for pleasure, occasionally exercise sufficiently to cause heavy breathing or perspiration
2. **Moderate activity:**10 to 60 minutes per week of moderate activity such as golf, walking for exercise, weight lifting
3. **Moderate activity:** over 1 hour per week of moderate activity described above
4. **Vigorous activity:** run less than one mile per week or spend less than 30 minutes per week in comparable activity such as running or jogging, swimming, cycling, rowing, or engaging in vigorous aerobic-type activity such as soccer, basketball, tennis or handball
5. **Vigorous activity:** run 1 mile to less than 5 miles per week or spend 30 min to less than 60 min per week in comparable physical activity as described above
6. **Vigorous activity:** run 5 mile to less than 10 miles per week or spend 1 hour to less than 3 hours per week in comparable physical activity as described above
7. **Vigorous activity:** run 10 mile to less than 15 miles per week or spend 3 hours to less than 6 hours per week in comparable physical activity as described above
8. **Vigorous activity:** run 15 mile to less than 20 miles per week or spend 6 hours to less than 7 hours per week in comparable physical activity as described above
9. **Vigorous activity:** run 20 mile to less than 25 miles per week or spend 7 hours to less than 8 hours per week in comparable physical activity as described above

10. **Vigorous activity:** run over 25 miles per week or spend over 8 hours per week in comparable physical activity as described above.

**Perceived Functional Ability – 1 Mile**

In the following table please note the value for the appropriate statement that indicates your perceived ability to maintain a steady pace (not too easy or not too hard) on an indoor track for one mile.

1. **Walking at a slow pace** (18 minute/mile or more)
2. **Walking at a slow pace** (17 minute/mile)
3. **Walking at a medium pace** (16 minute/mile)
4. **Walking at a medium pace** (15 minute/mile)
5. **Walking at a fast pace** (14 minute/mile)
6. **Walking at a fast pace** (13 minute/mile)
7. **Jogging at a slow pace** (12 minute/mile)
8. **Jogging at a slow pace** (11 minute/mile)
9. **Jogging at a medium pace** (10 minute/mile)
10. **Jogging at a medium pace** (9 minute/mile)
11. **Jogging at a fast pace** (8 minute/mile)
12. **Running at a fast pace** (7 minute/mile)
13. **Running at a fast pace** (less than 7 minute/mile).

**Perceived Functional Ability – 3 Miles**

In the following table please note the value for the appropriate statement that indicates your perceived ability to maintain a steady pace to cover 3 miles without becoming breathless or over fatigued

1. **I could walk the entire distance at slow pace** (18 minute/mile or more)
2. **I could walk the entire distance at a medium pace** (17 minute/mile)
3. **I could walk the entire distance at a medium pace** (16 minute/mile)
4. **I could walk the entire distance at a medium pace** (15 minute/mile)
5. **I could walk the entire distance at a fast pace** (14 minute/mile)
6. **I could walk the entire distance at a medium pace** (13 minute/mile)
7. **I could jog the entire distance at a slow pace** (12 minute/mile)
8. **I could jog the entire distance at a medium pace** (11 minute/mile)
9. **I could jog the entire distance at a medium pace** (10 minute/mile)
10. **I could jog the entire distance at a medium pace** (9 minute/mile)
11. **I could jog the entire distance at a fast pace** (8 minute/mile)
12. **I could run the entire distance at a fast pace** (7 minute/mile)
13. **I could run the entire at a fast pace** (less than 7 minute/mile).

## $VO_2$max estimate

The following equation can be used to obtain an estimate of the athlete's $VO_2$max:

- $VO_2$max = 44.895 + (7.042 x Sex) – (0.823 x BMI) + (0.688 x PAR ) + (0.738 x PFA1) + PFA3.

where:

- Weight in kilograms
- Height in metres
- BMI = Weight / (Height x Height)
- Sex = Male = 1 and Female = 0
- PAR = Physical Activity Rating
- PFA1 = Perceived Functional Ability – 1 mile
- PFA3 = Perceived Functional Ability – 3 mile.

The standard error of estimate for predicting $VO_2$max = ± 3.44 ml/kg/min (George, J.D., *et al.*: *Nonexercise $VO_2$max estimation for physically active college students* Med. Sci. Sports Exerc., 29:415, 1997).

## On-line calculator

Select the following link to access the on-line calculator

- vo2max from non exercise data test.htm

# 1.20 ■ Running-based Anaerobic Sprint Test (RAST)

*The Running-based Anaerobic Sprint Test (RAST) was developed at the University of Wolverhampton (United Kingdom) to test an athlete's anaerobic performance. RAST is similar to the Wingate Anaerobic 30 cycle Test (WANT) in that it provides coaches with measurements of power and fatigue index.*

## Required resources

To undertake this test you will require:

- 400m track – with a 35m marked section on the straight
- 2 cones to mark the 35m section
- Stop watch
- Assistant
- Calculator will be advantageous.

## How to conduct the test

### The athlete

- is weighed prior to the test
- undertakes a 10 minute warm session
- has a 5 minute recovery
- completes six 35m runs at maximum pace (10 seconds allowed between each sprint for turnaround).

### The assistant

- records the time taken for each 35m sprint to the nearest hundredth of a second
- makes appropriate calculations.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Calculations

Power output for each sprint is found using the following equations:

- Velocity = Distance ÷ Time
- Acceleration = Velocity ÷ Time

- Force = Weight x Acceleration
- Power = Force x Velocity OR Power = Weight x Distance$^2$ ÷ Time$^3$.

From the six times calculate the power for each run and then determine:

- Maximum power – the highest value
- Minimum power – the lowest value
- Average power – sum of all six values ÷ 6
- Fatigue Index – (Maximum power – Minimum power) ÷ Total time for the 6 sprints.

*Example*:
Athlete's weight is 76 kilograms and the times for each 35 sprint are:

1. 4.52 seconds
2. 4.75 seconds
3. 4.92 seconds
4. 5.21 seconds
5. 5.46 seconds
6. 5.62 seconds.

The power (Weight x Distance$^2$ ÷ Time$^3$) for each 35 sprint are as follows:

1. 1008 watts (76 x 352 ÷ 4.523)
2. 869 watts (76 x 352 ÷ 4.753)
3. 782 watts (76 x 352 ÷ 4.923)
4. 658 watts (76 x 352 ÷ 5.213)
5. 572 watts (76 x 352 ÷ 5.463)
6. 525 watts (76 x 352 ÷ 5.623).

Maximum Power = 1008 watts
Minimum Power = 525 watts
Average Power = 736 watts
Fatigue Index = 483 ÷ 30.48 = 15.8 watts/sec.

**Maximum Power:** This is a measure of the highest power output and provides information about strength and maximal sprint speed. Research range is 1054 watts to 676 watts.

**Minimum Power:** This is the lowest power output achieved in the six 35 metre sprints and is used to calculate the Fatigue Index.

**Average Power:** This provides an indication of an athlete's ability to maintain power over time. The higher the score indicates the athlete's ability to maintain anaerobic performance.

**Fatigue Index:** Indicates the rate at which power declines for the athlete. A low value (<10) indicates the ability for the athlete to maintain anaerobic performance. A high fatigue index value (>10) indicates the athlete may need to focus on improving their lactate tolerance.

## When to use

RAST can be used on a regular basis (3 to 6 weeks) throughout the season. The period between tests will be determined by the training phase and the amount of training being conducted.

## Target group

This test is suitable for sprint and endurance athletes and players of endurance sports (*eg* football, rugby) but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- running based anaerobic sprint test.htm

# 1.21 ■ Tri-level Aerobic Test

*The objective of this test is to assess the athlete's aerobic capacity.*

## Required resources

To undertake this test you will require:

- Repco front access cycle ergometer (which uses air resistance to modify resistance)
- Heart rate monitor
- Work monitor unit (optional, some bikes have a workload dial attached to the cycle)
- Stop watch
- Scales to determine the body weight of the athlete prior to the test
- Assistant.

## How to conduct the test

- The athlete is weighed
- The athlete's 75% MHR is determined – if unknown calculate MHR as 220-age
- The athlete pedals in one minute increments of 25 Watts (starting at 25 Watts) until their heart rate reaches 75% of their predicted maximum heart rate.
- The athlete continues pedalling until the end of the minute period during which the target heart rate is achieved
- The workload at which the 75% predicted heart rate is achieved is recorded

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

The athlete's Aerobic Index is determined by dividing the workload at which the 75% predicted heart rate is achieved by the athlete's body weight.

## Target group

This test is suitable for sprint and endurance athletes and players of endurance sports (*eg* football, rugby) but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 1.22 ■ Tri-level Lactic Power Test

*The objective of this test is to assess the ability of the athlete's muscle groups involved to utilise the anaerobic system to generate power and maintain work (capacity) during intense exercise.*

## Required resources

To undertake this test you will require:

- Exertech EX-10 cycle ergometer with interfaced work monitor unit
- Stop watch
- Assistant.

## How to conduct the test

The test is conducted as follows:

- Adjust cycle ergometer seat and ensure that equipment is operating satisfactorily
- Athlete to complete a 5 minute warm up on the bike at a steady pace
- Athlete to rest for 2 minutes
- Athlete to take up the starting position on the bike – standing stationary on the pedals, with the front pedal a little higher than the back pedal
- Assistant to reset the work monitor unit to zero and set the readings to the "high" range
- On the command "Go", the athlete is to exert near maximum efforts for the 30 seconds duration.
- Assistant to inform the athlete of the elapsed time intervals of 10 seconds and 20 seconds and count down the final 5 seconds.
- At exactly 30 seconds, the hold switch is pressed and the accrued kilojoules (KJ) score, together with the frozen watts reading on the circular scale meter are recorded
- The athlete should cool down with 2 to 3 minutes easy pedalling.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 1.23 ■ Tri-level Alactic Power Test

*The objective of this test is to assess the ability of the athlete's muscle groups involved to utilise the anaerobic system to generate power and maintain work (capacity) during intense exercise.*

## Required resources

To undertake this test you will require:

- Exertech EX-10 cycle ergometer with interfaced work monitor unit
- Stop watch
- Assistant.

## How to conduct the test

The test is conducted as follows:

- Adjust cycle ergometer seat and ensure that equipment is operating satisfactorily
- Athlete to complete a 5 minute warm up on the bike at a steady pace
- Athlete to rest for 2 minutes
- Athlete to take up the starting position on the bike – standing stationary on the pedals, with the front pedal a little higher than the back pedal
- Assistant to reset the work monitor unit to zero and set the readings to the "high" range
- On the command "Go" the subject pedals with maximum effort 10 seconds, with the last 5 seconds being counted aloud
- At exactly 10 seconds, the hold switch is pressed and the kilojoules score together with the "frozen" watts reading on the circular scale meter are recorded. The "frozen" or stored watts represent the kinetic energy stored in the bicycle
- The athlete should cool down with 2 to 3 minutes easy pedalling.

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## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 1.24 ■ Cunningham and Faulkner Test

*The objective of the test is to monitor the athlete's anaerobic capacity.*

## Required resources

- Treadmill capable of 20% gradient
- Stop watch
- Assistant.

## How to conduct the test

- The athlete undertakes a warm-up on the treadmill
- A few short practice starts getting onto the treadmill at the test speed should also be performed
- The treadmill is set at 8.0 miles/hr (12.9 km/hr) speed and incline of 20%
- The assistant starts the stopwatch when the athlete starts running unsupported
- The test continues until exhaustion, meaning the athlete cannot maintain the speed required
- The assistant records the time to the nearest 0.5 seconds.

## Analysis

Analysis of the result is by comparing the time with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for sprint and endurance athletes and players of endurance sports (*eg* football, rugby) but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 2 Agility

The multi dimensional movement demands of field and court games dictate a revaluation of the traditional approach to the development of agility. This demands a systematic multi factored approach that results in significant improvement in game speed. Possibly we have put the cart before the horse by training agility in isolation without considering the underlying coordinative abilities and strength. Full development of coordinative abilities provides a repertoire of motor skills that can be adapted to deal with sport specific movement demands.

According to Dr.Drabik in his book *Children & Sports Training* the coordinative abilities are:

- **Balance** – Maintenance of the centre gravity over the base of support. It has a static and a dynamic quality
- **Kinaesthetic Differentiation** – Ability to feel tension in movement to achieve the desired movement
- **Spatial Orientation** – The control of the body in space
- **Reaction to Signals** – The ability to respond quickly to auditory, visual and kinaesthetic cues
- **Sense of Rhythm** – The ability to match movement to time
- **Synchronization of Movements in Time** – Unrelated limb movements completed in a synchronised manner
- **Movement Adequacy** – Ability to choose movements appropriate to the task.

The co-coordinative abilities never work in isolation, they are all closely related. They are the underlying foundation for agility and the prerequisite for technical skills.

## Agility Evaluation Tests

The following are examples of agility tests:

- Hexagonal obstacle agility test
- Zig-zag test
- 505 agility test
- Illinois agility run test

- Lateral change of direction test
- Quick feet test
- Burpee test
- 'T' drill test.

# 2.1 ■ Hexagonal Obstacle Test

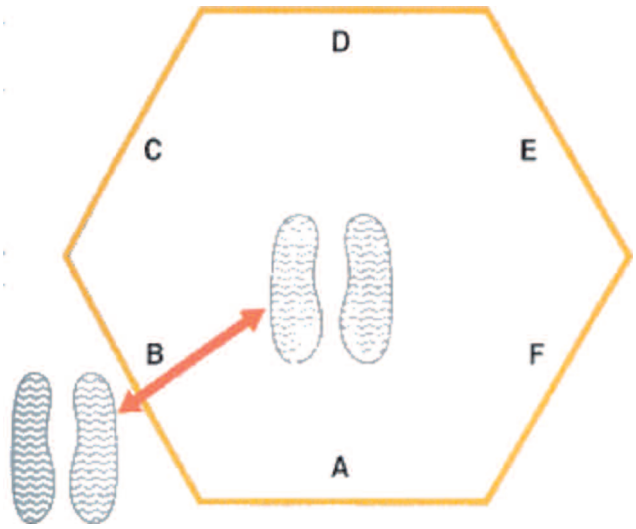
*The objective of the hexagonal obstacle test is to monitor the athlete's agility.*

## Required resources

To undertake this test you will require:

- 66 cm sided hexagon marked out on the floor
- Stop watch
- Assistant.

## How to conduct the test




The Hexagonal Obstacle Test is conducted as follows:

- The athlete stands in the middle of the hexagon, facing line A
- At all times throughout the test the athlete is to face line A
- On the command GO the watch is started and the athlete jumps with both feet over line B and back to the middle, then over line C and back to the middle, then line D and so on
- When the athlete jumps over line A and back to the middle this counts as one circuit
- The athlete is to complete three circuits
- On completion of three circuits the watch is stopped and the time recorded
- The athlete rests and then repeats the test
- On completion of the second test determine the average of the two recorded times
- If you jump the wrong line or land on a line then the test is to be restarted.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement in the athlete's agility.

## Performance assessment

For an evaluation of the athlete's performance determine the average time from the two tests and then see the normative table below for an assessment.

## Normative data for the hexagonal obstacle test

The following are national norms for 16 to 19 year olds.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | <11.2 secs | 11.2-13.3 secs | 13.4-15.5 secs | 15.6-17.8 secs | >17.8 secs |
| Female | <12.2 secs | 12.2-15.3 secs | 15.4-18.5 secs | 18.6-21.8 secs | >21.8 secs |

*Table Reference: Arnot R and Gaines C, Sports Talent, 1984*

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- hexagonal obstacle test.htm

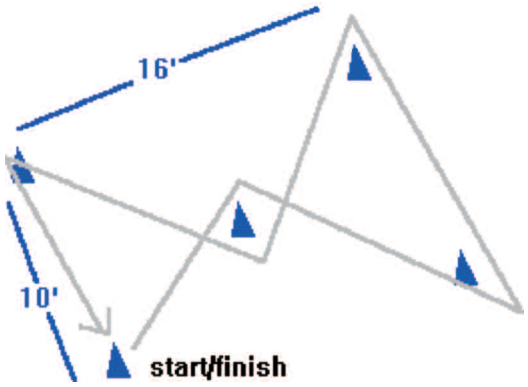
# 2.2 ■ Zig-Zag Test

*The objective of the zig-zag test is to monitor the athlete's speed and agility.*

## Required resources

To undertake this test you will require:

- 5 cones
- Non slip surface
- Stop watch
- Assistant.




## How to conduct the test

The Zig-Zag Test is conducted as follows:

- Mark out the course with four cones placed on the corners of a rectangle 10 by 16 feet, with one more cone placed in the centre
- The athlete follows the grey route identified on the diagram
- The athlete completes one circuit of the course starting and finishing at the Start/Finish cone (see diagram)
- The assistance records the time for the athlete to complete the course.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement in the athlete's agility.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

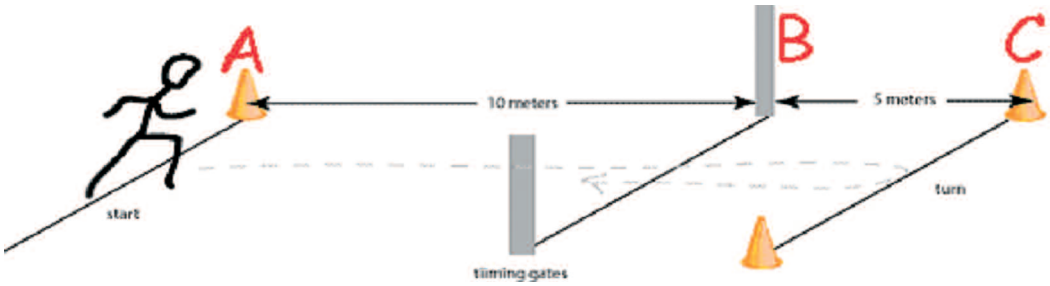
# 2.3 ■ 505 Agility Test

*The objective of the 505 agility test is to monitor the athlete's speed and agility with a 180 degree turn.*

## Required resources

To undertake this test you will require:

- 6 cones
- Tape measure
- Non slip surface
- Stop watch
- Assistant.




## How to conduct the test

The 505 agility test is conducted as follows:

- Mark out the course as per the diagram above. The distance from A to B is 10m and the distance from B to C is 5m
- The athlete runs from the start line (A) towards the 10m line (B)

(run in distance to build up speed)

- The assistant starts the stop watch as the athlete passes through the 10m line (B)
- The athlete runs on to the 15m line (C), turns and runs back towards the start line
- The assistant stops the stop watch when the athlete passes through the 10m line (B) on their return to the start line
- The best of two trails is recorded.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement in the athlete's agility.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 2.4 ■ Illinois Agility Run Test

*The objective of the Illinois Agility Run Test is to monitor the development of the athlete's speed and agility.*

## Required resources

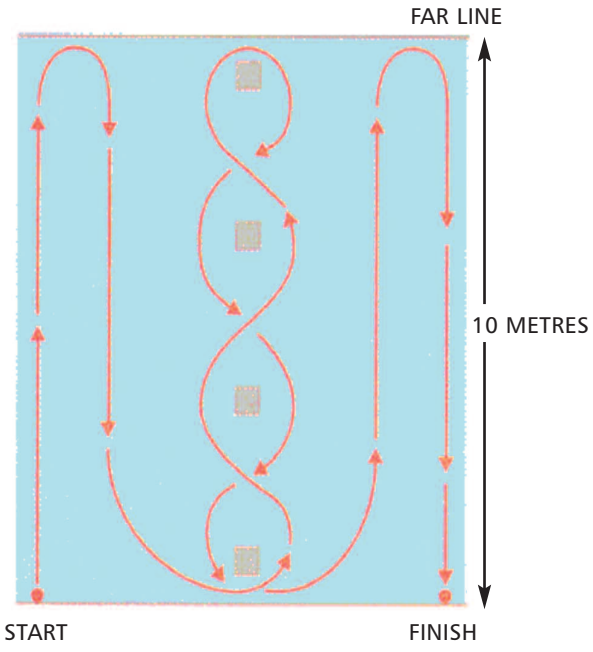
To undertake this test you will require:

- Flat surface – 400 metre track
- 8 cones
- Stop watch
- Assistant.

## The Illinois course

The length of the course is 10 metres and the width (distance between the start and finish points) is 5 metres. On the track you could use 5 lanes.

4 cones can be used to mark the start, finish and the two turning points. Each cone in the centre is spaced 3.3 metres apart.




## How to conduct the test

The Illinois Agility Run Test is conducted as follows:

- The athlete lies face down on the floor at the start point
- On the assistant's command the athlete jumps to his/her feet and negotiates the course around the cones to the finish

- The assistant records the total time taken from their command to the athlete completing the course.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the Illinois agility run test

The following are national norms for 16 to 19 year olds.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | <15.2 secs | 15.2-16.1 secs | 16.2-18.1 secs | 18.2-18.3 secs | >18.3 secs |
| Female | <17.0 secs | 17.0-17.9 secs | 18.0-21.7 secs | 21.8-23.0 secs | >23.0 secs |

*Table Reference: Davis B. et al; Physical Education and the Study of Sport; 2000*

## Target group

This test is suitable for team sports but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to a potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- illinois agility run test.htm

# 2.5 ■ Lateral Change of Direction Test

*The objective of this test is to monitor the development of the athlete's speed with directional change.*

## Required resources

To undertake this test you will require:

- Flat surface – track
- 3 cones
- Stop watch
- Assistant.

## How to conduct the test

- The 3 cones are set 5 metres apart on a straight line
- The athlete starts at the middle cone
- The assistant gives the signal to start and points in a specific direction, right or left
- The athlete moves to and touches the first cone, returns past the middle cone (start) to the far cone and touches that one and then returns to the middle cone, touching that one
- The assistant starts the stop watch on giving the 'Go'command and stops the watch when the athlete touches the middle cone
- The better of two trails in each starting direction, right and left, are recorded and the best score in each direction is used for scoring.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the lateral change of direction test

The following data has been obtained from the results of tests conducted with world class athletes.

| % Rank | Females | Males | % Rank | Females | Males |
|---|---|---|---|---|---|
| 91-100 | 3.22-3.37 secs | 2.90-3.05 secs | 41-50 | 4.02-4.17 secs | 3.70-3.85 secs |
| 81-90 | 3.38-3.53 secs | 3.06-3.21 secs | 31-40 | 4.18-4.33 secs | 3.86-4.01 secs |
| 71-80 | 3.54-3.69 secs | 3.22-3.37 secs | 21-30 | 4.34-4.49 secs | 4.02-4.17 secs |
| 61-70 | 3.70-3.85 secs | 3.38-3.53 secs | 11-20 | 4.50-4.65 secs | 4.18-4.33 secs |
| 51-60 | 3.86-4.01 secs | 3.54-3.69 secs | 1-10 | 4.66-4.81 secs | 4.34-4.49 secs |

*Table reference: D.A. Chu; Explosive Power and Strength; Human Kinetics; 1996*

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to a potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- lateral change of direction test.htm

# 2.6 ■ Quick Feet Test

*The quick feet test provides information on the presence of fast-twitch muscle fibre in the muscles involved in sprinting and indicates your potential to execute quick movements. Hereditary factors such as limb length, muscle attachments, and proportion of fast-twitch fibres do place a limit on one's maximum potential, but we can improve our speed and quickness with proper training.*

## Required resources

To undertake this test you will require:

- Flat surface
- 20 two-foot long sticks or a 20-rung rope ladder
- Stop watch
- Assistant.

## How to conduct the test

- Place 20 two-foot long sticks 18 inches apart or a 20-rung stride rope ladder on grass or athletics track
- Athletes should pump their arms vigorously in a sprint-arm motion and use very little knee lift while running down the ladder without touching the sticks/rungs
- The coach starts the stopwatch when the athlete's foot first touches the ground between the first and second stick/rung and stops the watch when contact is first made with the ground beyond the last stick/rung
- Record the better of two trials.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement in the athlete's foot speed.

Speed through a ladder can indicate much about an athlete's quickness. A time of less than 2.8 seconds for males and 3.4 seconds for females for running the length of a 20 rung ladder, one foot in each rung at a time, is considered as excellent for college athletes.

## Normative data for the hexagonal obstacle test

| Males | Time | Females | Time |
|---|---|---|---|
| Jnr High School | < 3.8 seconds | Jnr High School | < 4.2 seconds |
| Snr High School | < 3.3 seconds | Snr High School | < 3.8 seconds |
| College | < 2.8 seconds | College | < 3.4 seconds |

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to a potential level of fitness and the correlation is high.

# 2.7 ■ Burpee Test

*The objective of this test is to assess the athlete's agility and balance.*

## Required resources

To undertake this test you will require:

- Dry surface
- Assistant.

## How to conduct the test

The test is conducted as follows:

- The athlete practises the technique which involves:
  - standing erect, arms by the side
  - placing the hands on the floor in front of the feet (squat position)
  - thrusting the legs back to assume a push up position with a straight line from the shoulders to the heels
  - returning to the squat position
  - returning to the starting position
- The athlete performs as many repetitions as possible in 15 seconds
- A point is given for every successfully completed repetition
- Half a point is deducted for each repetition in which poor technique is demonstrated, such as:
  - not resuming the erect position
  - kicking the feet back prior to hand placement
  - not assuming a straight push up body position.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 2.8 ■ 'T' Drill Test

*The objective of this test is to monitor the development of the athlete's speed with directional change.*

## Required resources

To undertake this test you will require:

- Flat surface
- 4 cones
- Stop watch
- Assistant.

## How to conduct the test

- 3 cones are set five metres apart on a straight line.
- A fourth cone is placed 10 metres from the middle cone so that the cones form a 'T'.
- The athlete starts at the cone at the base of the 'T'
- The coach gives the signal to 'Go' and starts the stop watch
- The athlete runs to the middle cone, touches the cone
- The athlete then side steps 5 metres to the left cone, touches that cone
- The athlete then side steps 10 metres to the far cone and touches that one
- The athlete the side steps 5 metres back to the middle cone, touching that one
- The athlete then runs 10 metres backwards to the base of the 'T' and touches that cone
- The coach stops the watch and records the time..

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement in the athlete's speed.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 3 Mobility and Balance

Mobility is the ability to perform a joint action through a range of movement. In any movement there are two groups of muscles at work: the protagonistic muscles which cause the movement to take place and opposing the movement and determining the amount of mobility are the antagonistic muscles.

If athletes are to learn and utilise effectively the techniques associated with their events and are to avoid injury successfully, they require a good level of mobility. An athlete will find it difficult, if not impossible, to learn a new technique if their mobility is poor. A good level of mobility is also essential for the development of specific conditioning (*ie* the application of strength or speed in a particular event).

Balance is the ability to maintain equilibrium when stationary or moving (*ie* not to fall over) through the co-ordinated actions of our sensory functions (vision, hearing and proprioception).

Balance comprises of static balance (the ability to retain the centre of mass above the base of support in a stationary position) and dynamic balance (the ability to maintain balance under changing conditions of body movement).

## Mobility and balance evaluation tests

The following are examples of mobility tests:

- Modified sit and reach test
- Sit and reach test
- Hip flexion test
- Static flexibility test – ankle
- Static flexibility test – hip & trunk
- Static flexibility test – shoulder
- Static flexibility test – shoulder & wrist
- Static flexibility test – trunk & neck
- Trunk flexion test.

The following are examples of balance tests:

- Standing stork test
- Standing stork test – blind.

# 3.1 ■ Modified Sit & Reach Test

*The objective of this test is to monitor the development of the athlete's hip and trunk flexibility.*

## Required resources

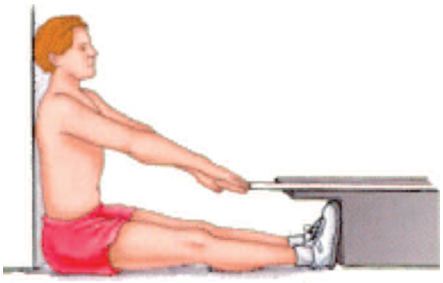
To undertake this test you will require:

- 'Sit & reach' table
- Yard stick
- Assistant.

## How to conduct the test

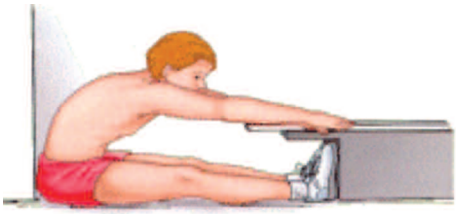
### Starting position

- Sit on the floor with the back and head against a wall, legs fully extended with the bottom of the feet against the sit-and-reach box
- Place the hands on top of each other, stretching the arms forward while keeping the head and back against the wall
- Measure the distance from the finger tips to the box edge with a ruler. This becomes zero or starting point.



### Movement

- Slowly bend and reach forward as far as possible sliding the fingers along the ruler
- Hold the final position for 2 seconds
- Record the distance reached to the nearest 1/10 of an inch
- Repeat the test 3 times and note the best distance.



## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the modified sit & reach test

The following are national norms for 16 to 19 year olds.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | >14cm | 11-14cm | 7-10cm | 4-6cm | <4cm |
| Female | >15cm | 12-15cm | 7-11cm | 4-6cm | <4cm |

*Table Reference: Davis B. et al; Physical Education and the Study of Sport; 2000*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- modified sit and reach test.htm

# 3.2 ■ Sit and Reach Test

*The objective of this test is to monitor the development of the athlete's lower back and hamstring flexibility.*

## Required resources

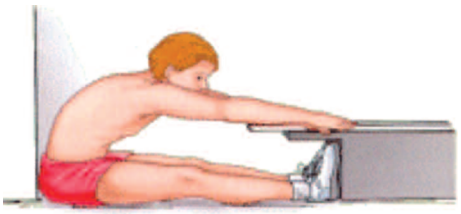
To undertake this test you will require:

- 'Sit & reach' table or a bench with a ruler
- Assistant.

## How to conduct the test

The sit and reach test is conducted as follows:

- The starting position is sitting on the floor with shoes removed, feet flat against the table, and legs straight
- Reach forward and push the fingers along the table as far as possible
- The distance from the finger tips to the edge of the table represents the score for that person



- As the 'sit and reach' table has an overhang of 15 cm, a person who reaches 10 cm past their toes scores 25 cm
- It is important to have several warm-up attempts first, and to record the best score.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the sit & reach test

The following are national norms for 16 to 19 year olds.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | >14cm | 11-14cm | 7-10cm | 4-6cm | <4cm |
| Female | >15cm | 12-15cm | 7-11cm | 4-6cm | <4cm |

*Table Reference: Davis B. et al; Physical Education and the Study of Sport; 2000*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- sit and reach test.htm

# 3.3 ■ Hip Flexion Test

*The objective of this test is to monitor the development of the athlete's hip flexors (the muscles that lift your knees).*

## How to conduct the test

The test is conducted as follows:

- The athlete lies on their back
- The athlete lifts the left knee and using their hands pulls the left knee to their chest
- Normal flexibility is indicated when their right leg remains flat on the floor
- Hip flexors are considered tight if, as they attempt to lift their left knee toward their chest, their right leg leaves the floor
- Repeat with your other leg

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 3.4 ■ Static Flexibility Test – Ankle

*The objective of this test is to monitor the development of the athlete's ankle flexibility.*

## Required resources

To undertake this test you will require:

- Wall
- 1 metre ruler
- Assistant.

## How to conduct the test

### Starting position

- Stand facing a wall
- Feet flat on the ground toes touching the wall
- Lean into the wall.

### Movement

- Slowly slide the feet back from the wall as far as possible
- Keep the feet flat on the ground, body and knees fully extended and the chest in contact with the wall
- Measure the distance between the toe line and the wall – to the nearest 1/4 of an inch
- Repeat the test 3 times and record the best distance.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the ankle flexibility test

Measurements are in inches.

| Rating | Men | Women |
|---|---|---|
| Excellent | >35.00 | >32.00 |
| Good | 35.00-32.51 | 32.00-30.51 |
| Average | 32.50-29.51 | 30.50-26.51 |
| Fair | 29.50-26.50 | 26.50-24.25 |
| Poor | <26.50 | <24.25 |

*Table adapted from Johnson B.L. & Nelson J.K. Practical Measurements for Evaluation in PE 4th Ed. 1986*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of flexibility and the correlation is high

## On-line calculator

Select the following link to access the on-line calculator

- static flexibility test – ankle.htm

# 3.5 ■ Static Flexibility Test – Hip and Trunk

*The objective of this test is to monitor the development of the athlete's hip and trunk flexibility.*

## Required resources

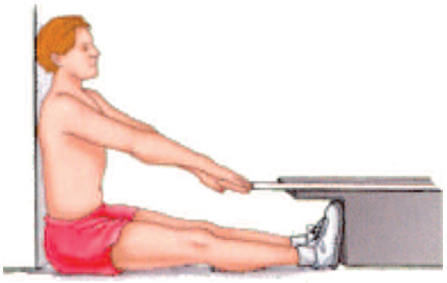
To undertake this test you will require:

- 'Sit & reach' table or a bench with a ruler
- Assistant.

## How to conduct the test

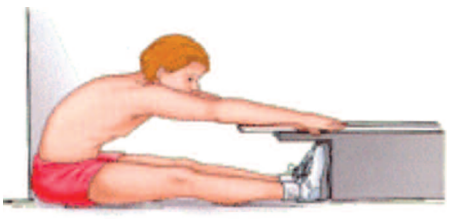
### Starting position

- Sit on the floor with the back and head against a wall, legs fully extended with the bottom of the feet against the sit-and-reach box
- Place the hands on top of each other, stretching the arms forward while keeping the head and back against the wall
- Measure the distance from the finger tips to the box edge with a ruler. This becomes zero or starting point.



### Movement

- Slowly bend and reach forward as far as possible sliding the fingers along the ruler
- Hold the final position for two seconds
- Record the distance reached to the nearest 1/10 of an inch
- Repeat the test 3 times and note the best distance.



## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the Hip and Trunk flexibility test

Age <36

| Rating | Men | Women |
|---|---|---|
| Excellent | >17.9 | >17.9 |
| Good | 17.00-17.9 | 16.7-17.9 |
| Average | 15.8-16.9 | 16.2-16.6 |
| Fair | 15.0-15.7 | 15.8-16.1 |
| Poor | <15.0 | <15.4 |

Age 36 to 49

| Rating | Men | Women |
|---|---|---|
| Excellent | >16.1 | >17.4 |
| Good | 14.6-16.1 | 16.2-17.4 |
| Average | 13.9-14.5 | 15.2-16.1 |
| Fair | 13.4-.13.8 | 14.5-15.1 |
| Poor | <13.4 | <14.5 |

*Tables adapted from Johnson B.L. & Nelson J.K. Practical Measurements for Evaluation in PE 4th Ed. 1986*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of flexibility and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- static flexibility test – hip and trunk.htm

# 3.6 ■ Static Flexibility Test – Shoulder

*The objective of this test is to monitor the development of the athlete's shoulder flexibility.*

## Required resources

To undertake this test you will require:

- 1 metre piece of rope
- Tape measure
- Assistant.

## How to conduct the test

### Starting position

- Grasp one end of the rope with the left hand
- Four inches away grasp the rope with the right hand.

### Movement

- Extend both arms in front of the chest and rotate the arms overhead and behind the neck until the rope touches the back
- As resistance occurs allow the right hand to slide along the rope
- Measure the distance between the two thumbs – to the nearest 1/4 of an inch
- Measure shoulder width from deltoid to deltoid – to the nearest 1/4 of an inch
- Subtract the shoulder width distance from the thumb distance
- Repeat the test 3 times and record the best distance.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the Shoulder flexibility test

| Rating | Men | Women |
|---|---|---|
| Excellent | <7.00 | <5.00 |
| Good | 11.5-7.00 | 9.5-5.00 |
| Average | 14.5-11.49 | 13.00-9.74 |
| Fair | 19.75-14.49 | 17.75-12.99 |
| Poor | >19.5 | >17.75 |

*Table adapted from Johnson B.L. & Nelson J.K. Practical Measurements for Evaluation in PE 4th Ed. 1986*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of flexibility and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- static flexibility test – shoulder.htm

# 3.7 ■ Static Flexibility Test – Shoulder and Wrist

*The objective of this test is to monitor the development of the athlete's shoulder and wrist flexibility.*

## Required resources

To undertake this test you will require:

- 18 inch stick
- 1 metre ruler
- Assistant.

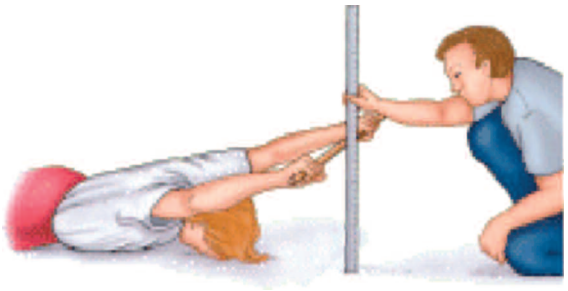
## How to conduct the test

### Starting position

- Lay prone on the floor with the arms fully extended holding a stick.

### Movement

- Raise the stick as high as possible, keeping the nose on the ground
- Measure the vertical distance the stick rises from the floor to the nearest 1/2 inch
- Repeat the test 3 times and record the best distance
- Measure the arm length from the acromial extremity to the tip of the longest finger
- Subtract the best score from the arm length.



## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the shoulder & wrist flexibility test

| Rating | Men | Women |
|---|---|---|
| Excellent | >12.50 | >11.75 |
| Good | 12.50-11.50 | 11.75-10.75 |
| Average | 11.49-8.25 | 10.74-7.50 |
| Fair | 8.24-6.00 | 7.49-5.50 |
| Poor | <6.00 | <5.50 |

*Table adapted from Johnson B.L. & Nelson J.K. Practical Measurements for Evaluation in PE 4th Ed. 1986*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of flexibility and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- static flexibility test – shoulder and wrist.htm

# 3.8 ■ Static Flexibility Test – Trunk and Neck

*The objective of this test is to monitor the development of the athlete's trunk and neck flexibility.*

## Required resources

To undertake this test you will require:

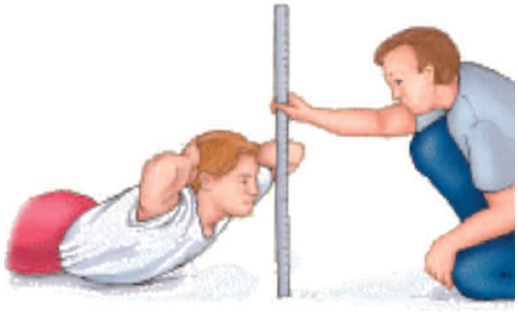
- 1 metre ruler
- Assistant.

## How to conduct the test

### Starting position

- Lay prone on the floor with hands clasped at the side of the head.

### Movement



- Raise the trunk as high as possible whilst keeping the hips in contact with the ground
- An assistant can hold the feet down
- Record the vertical distance, to the nearest 1/4 of an inch, from the tip of the nose to the ground
- Repeat the test 3 times and record the best distance.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the Trunk and Neck flexibility test

| Rating | Men | Women |
|---|---|---|
| Excellent | >10.00 | >9.75 |
| Good | 10.00-8.00 | 9.75-7.75 |
| Average | 7.99-6.00 | 7.74-5.75 |
| Fair | 5.99-3.00 | 5.74-2.00 |
| Poor | <3.00 | <2.00 |

*Table adapted from Johnson B.L. & Nelson J.K. Practical Measurements for Evaluation in PE 4th Ed. 1986*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of flexibility and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- static flexibility test – trunk and neck.htm

# 3.9 ■ Trunk Flexion Test

*The objective of this test is to monitor the development of the athlete's lower back and hamstrings flexibility.*

## Required resources

To undertake this test you will require:

- Yardstick
- Assistant.

## How to conduct the test

The test is conducted as follows:

- Athlete to remove their shoes and sit with their knees straight and feet 12 inches apart
- Place a yardstick between their legs with the 15 inch mark level with their feet – the zero inch mark should be closer to their knees
- Athlete places one of their hands on top of the other with the tips of their fingers aligned
- Athlete exhales and slowly leans forward by dropping their head toward their arms, sliding their fingers along the yardstick as far as possible
- The assistant records the best of three measurements.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Performance assessment

An excellent score for men is greater than 20 inches. An excellent score for women is more than 24 inches.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 3.10 ■ Standing Stork Test

*The objective of this test is to monitor the development of the athlete's ability to maintain a state of equilibrium (balance) in a static position.*

## Required resources

To undertake this test you will require:

- Warm dry location – gym
- Stop watch
- Assistant.

## How to conduct the test

- Stand comfortable on both feet
- Hands on your hip
- Lift one leg and place the toes of that foot against the knee of the other leg
- On command from the assistant, raise the heel and stand on your toes
- Assistant starts the stop watch
- Balance for as long as possible without letting either the heel touch the ground or the other foot move away from the knee.
- Coach records the time you were able to maintain the balance.
- Repeat the test for the other leg.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the Stork test

The following are national norms for 16 to 19 year olds.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | >50 secs | 50-41 secs | 40-31 secs | 30-20 secs | <20 secs |
| Female | >30 secs | 30-23 secs | 22-16 secs | 15-10 secs | <10 secs |

*Table reference: Arnot R and Gaines C, Sports Talent, 1984*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- standing stork test.htm

# 3.11 ■ Standing Stork Test – Blind

*The objective of this test is to monitor the development of the athlete's ability to maintain a state of equilibrium (balance) in a static position.*

## Required resources

To undertake this test you will require:

- Warm dry location – gym
- Stop watch
- Assistant.

## How to conduct the test

- Stand comfortable on both feet
- Hands on your hip
- Stand on your preferred leg with the foot flat on the ground, lift the other leg and place the toes of that foot against the knee of the preferred leg.
- On command from the assistant, close your eyes
- Assistant starts the stop watch
- Balance for as long as possible
- The watch is stopped when you open your eyes or move your hands or take your foot off your knee or move your standing foot
- Assistant records the time you were able to maintain the balance
- Repeat the test three times.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the stork test – blind

| Best Time Seconds | Male Points | Female Points | Best Time Seconds | Male Points | Female Points |
|---|---|---|---|---|---|
| 60 | 20 | | 30 | 8 | 17 |
| 55 | 18 | | 25 | 6 | 14 |
| 50 | 16 | | 20 | 4 | 11 |
| 45 | 14 | | 15 | 3 | 8 |
| 40 | 12 | | 10 | 2 | 4 |
| 35 | 10 | 20 | 5 | 1 | 2 |

*Table reference: Arnot R and Gaines C, Sports Talent, 1984*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- standing stork test blind.htm

# 4 Body Composition

The most accurate assessment of your ideal weight takes into account the composition of your body – how much of your weight is lean body mass (muscle and bone) and how much is body fat. For optimum health, body fat should be no more than 20% of total body weight for men and 30% for women.

Fat is produced by the body when an excess intake of calories in the form of food or drink occurs. When the diet provides the body with more calories than it needs for general maintenance and its current level of physical activity, this excess energy is stored in the form of body fat. Females tend to accumulate fat around their thighs and hips and males accumulate fat around the midriff.

An increase in regular exercise will help to increase your calorie expenditure. The more physical activity you do the more calories you will burn. Accordingly, if you increase your physical activity, and do not increase your intake of food, you will draw the extra energy needed from your stored body fat.

## Body Composition Evaluation Tests

The following are examples of body composition tests:

- Body mass index
- Body fat percentage
- Jackson and Pollock skinfold test
- Yuhasz skinfold test.

# 4.1 ■ Body Mass index

*The objective of this test is to monitor the athlete's weight.*

## Required resources

To undertake this test you will require:
- Tape measure to determine your height
- Set of scales to measure your weight
- Assistant.

## How to conduct the test

**Assistant to:**
- Measure the athlete's height in metres
- Measure the athlete's weight in kilograms.

To determine BMI divide the weight by the height squared:
BMI = weight / (height x height)

## Analysis

The normal acceptable range of this measurement is 20.1 to 25.0 for men and 18.7 to 23.8 for women. The only exceptions are athletes and body builders, whose extra muscle may tip their BMI over the normal range.

## Normative data

| BMI | Assessment |
|---|---|
| 20 to 25 | Normal |
| 25 to 30 | Pre Obese |
| 30 to 35 | Obese |
| > 35 | Grossly Obese |

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- body mass index test.htm

# 4.2 ■ Body Fat Percentage

*Measuring body fat percentage is an easy method of discovering correct body weight and composition. Beneath the skin is a layer of subcutaneous fat, and the percentage of total body fat can be measured by taking the 'skinfold' at selected points on the body with a pair of callipers. This test only requires four measurements.*

## Required resources

To undertake this test you will require:

- Measurement callipers
- Assistant.

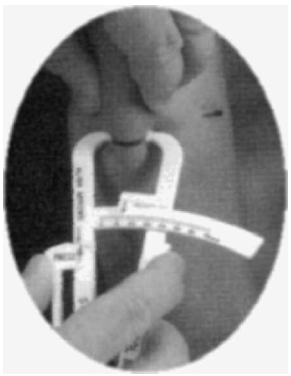
## Measurement sites

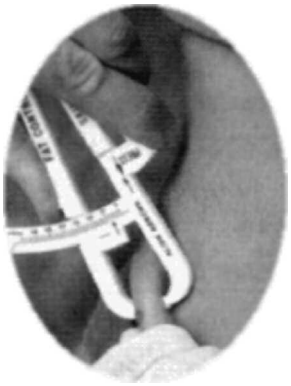
Take measurements form the following sites:

**Triceps**
With the arm resting comfortably at the side, take a vertical fold parallel to the long axis of the arm midway between the shoulder and the tip of the elbow.

**Subscapula**
Take a diagonal fold across the back, just below the shoulder blade.

**Biceps**
With the arm resting comfortably at the side, take a vertical fold halfway between the elbow and top of the shoulder on the front of the upper arm





**Suprailiac**
Take a diagonal fold following the natural line of the iliac crest, just above the hip bone.

## How to conduct the test

The method is as follows:

- Ensure that all of the skinfold measurements are located on the right side of the body and that the measurements are taken in millimetres
- Pick up the skinfold between the thumb and the index finger so as to include two thicknesses of skin and subcutaneous fat
- Apply the callipers about one centimetre from the fingers and at a depth about equal to the thickness of the fold
- Repeat the procedure three times as the measurement may vary and record the average value
- Add the results of each measurement to get a total value in millimetres.

## Analysis

Using the total value obtained from the four measurements determine the percentage body fat from the table below:

| | Percent of fat, Males (Age In Years) | | | | Percent of fat, Females (Age In Years) | | | |
|---|---|---|---|---|---|---|---|---|
| Skinfold (mm) | 17-29 | 30-39 | 40-49 | 50+ | 16-29 | 30-39 | 40-49 | 50+ |
| 15 | 4.8 | — | — | — | 10.5 | — | — | — |
| 20 | 8.1 | 12.2 | 12.2 | 12.6 | 14.1 | 17.0 | 19.8 | 21.4 |
| 25 | 10.5 | 14.2 | 15.0 | 15.6 | 16.8 | 19.4 | 22.2 | 24.0 |
| 30 | 12.9 | 16.2 | 17.7 | 18.6 | 19.5 | 21.8 | 24.5 | 26.6 |
| 35 | 14.7 | 17.7 | 19.6 | 20.8 | 21.5 | 23.7 | 26.4 | 28.5 |
| 40 | 16.4 | 19.2 | 21.4 | 22.9 | 23.4 | 25.5 | 28.2 | 30.3 |
| 45 | 17.7 | 20.4 | 23.0 | 24.7 | 25.0 | 26.9 | 29.6 | 31.9 |
| 50 | 19.0 | 21.5 | 24.6 | 26.5 | 26.5 | 28.2 | 31.0 | 33.4 |
| 55 | 20.1 | 22.5 | 25.9 | 27.9 | 27.8 | 29.4 | 32.1 | 34.6 |
| 60 | 21.2 | 23.5 | 27.1 | 29.2 | 29.1 | 30.6 | 33.2 | 35.7 |
| 65 | 22.2 | 24.3 | 28.2 | 30.4 | 30.2 | 31.6 | 34.1 | 36.7 |
| 70 | 23.1 | 25.1 | 29.3 | 31.6 | 31.2 | 32.5 | 35.0 | 37.7 |
| 75 | 24.0 | 25.9 | 30. | 32.7 | 32.2 | 33.4 | 35.9 | 38.7 |
| 80 | 24.8 | 26.6 | 31.2 | 33.8 | 33.1 | 34.3 | 36.7 | 39.6 |
| 85 | 25.5 | 27.2 | 32.1 | 34.8 | 34.0 | 35.1 | 37.5 | 40.4 |
| 90 | 26.2 | 27.8 | 33.0 | 35.8 | 34.8 | 35.8 | 38.3 | 41.2 |
| 95 | 26.9 | 28.4 | 33.7 | 36.6 | 35.6 | 36.5 | 39.0 | 41.9 |
| 100 | 27.6 | 29.0 | 34.4 | 37.4 | 36.4 | 37.2 | 39.7 | 42.6 |

| | Percent of fat, Males (Age In Years) | | | | Percent of fat, Females (Age In Years) | | | |
|---|---|---|---|---|---|---|---|---|
| Skinfold (mm) | 17-29 | 30-39 | 40-49 | 50+ | 16-29 | 30-39 | 40-49 | 50+ |
| 105 | 28.2 | 29.6 | 35.1 | 38.2 | 37.1 | 37.9 | 40.4 | 43.3 |
| 110 | 28.8 | 30.1 | 35.8 | 39.0 | 37.8 | 38.6 | 41.0 | 43.9 |
| 115 | 29.4 | 30.6 | 36.4 | 39.7 | 38.4 | 39.1 | 41.5 | 44.5 |
| 120 | 30.0 | 31.1 | 37.0 | 40.4 | 39.0 | 39.6 | 42.0 | 45.1 |
| 125 | 30.5 | 31.5 | 37.6 | 41.1 | 39.6 | 40.1 | 42.5 | 45.7 |
| 130 | 31.0 | 31.9 | 38.2 | 41.8 | 40.2 | 40.6 | 43.0 | 46.2 |
| 135 | 31.5 | 32.3 | 38.7 | 42.4 | 40.8 | 41.1 | 43.5 | 46.7 |
| 140 | 32.0 | 32.7 | 39.2 | 43.0 | 41.3 | 41.6 | 44.0 | 47.2 |
| 145 | 32.5 | 33.1 | 39.7 | 43.6 | 41.8 | 42.1 | 44.5 | 47.7 |
| 150 | 32.9 | 33.5 | 40.2 | 44.1 | 42.3 | 42.6 | 45.0 | 48.2 |
| 155 | 33.3 | 33.9 | 40.7 | 44.6 | 42.8 | 43.1 | 45.4 | 48.7 |
| 160 | 33.7 | 34.3 | 41.2 | 45.1 | 43.3 | 43.6 | 45.8 | 49.2 |
| 165 | 34.1 | 34.6 | 41.6 | 45.6 | 43.7 | 44.0 | 46.2 | 49.6 |
| 170 | 34.5 | 34.8 | 42.0 | 46.1 | 44.1 | 44.4 | 46.6 | 50.0 |
| 175 | 34.9 | — | — | — | — | 44.8 | 47.0 | 50.4 |
| 180 | 35.3 | — | — | — | — | 45.2 | 47.4 | 50.8 |
| 185 | 35.6 | — | — | — | — | 45.6 | 47.8 | 51.2 |
| 190 | 35.9 | — | — | — | — | 45.9 | 48.2 | 51.6 |
| 195 | — | — | — | — | — | 46.2 | 48.5 | 52.0 |
| 200 | — | — | — | — | — | 46.5 | 48.8 | 52.4 |
| 205 | — | — | — | — | — | — | 49.1 | 52.7 |
| 210 | — | — | — | — | — | — | 49.4 | 53.0 |

The average man has 15 to 17% body fat, while the average woman is between 18 and 22%. Typical scores for elite athletes are 6% to 12% for men and 12% to 20% for women.

## Normative data

The following table details the percentage body fat for male and female athletes for a variety of sports.

| Sport | Male | Female |
|---|---|---|
| Baseball | 12-15% | 12-18% |
| Basketball | 6-12% | 20-27% |
| Cycling | 5-15% | 15-20% |
| Field & Ice Hockey | 8-15% | 12-18% |
| Rowing | 6-14% | 12-18% |
| Swimming | 9-12% | 14-24% |
| Track – Runners | 8-10% | 12-20% |
| Track – Jumpers | 7-12% | 10-18% |
| Track – Throwers | 14-20% | 20-28% |
| Triathlon | 5-12% | 10-15% |
| Volleyball | 11-14% | 16-15% |

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- body fat percentage test.htm

# 4.3 ■ Jackson and Pollock Skinfold Test

*Measuring body fat percentage is an easy method of discovering correct body weight and composition. Beneath the skin is a layer of subcutaneous fat, and the percentage of total body fat can be measured by taking the 'skinfold' at selected points on the body with a pair of callipers. The Jackson and Pollock technique requires three measurements.*

## Required resources

To undertake this test you will require:

- Skinfold calliper
- Assistant.

## Measurement sites

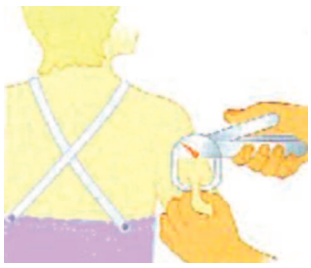
Take measurements from the following sites according to gender:

- Male athletes measure the Chest, Abdomen and Thigh
- Female athletes measure the Triceps, Thigh and Suprailium.

Chest

Abdomen

Thigh



Triceps

Thigh

Suprailium

## How to conduct the test

The method is as follows:

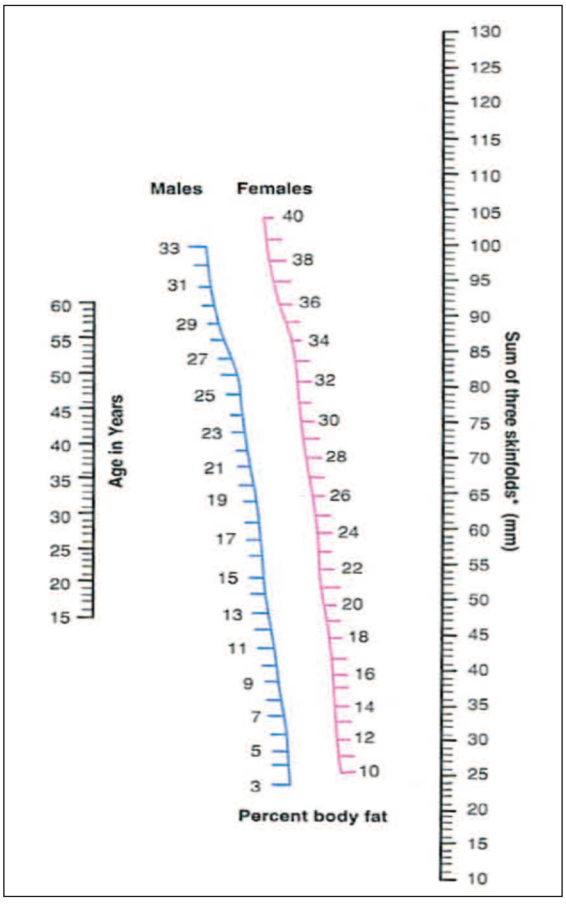
- Ensure that all of the skinfold measurements are located on the right side of the body and that the measurements are taken in millimetres
- Pick up the skinfold between the thumb and the index finger so as to include two thicknesses of skin and subcutaneous fat

- Apply the callipers about one centimetre from the fingers and at a depth about equal to the thickness of the fold
- Very slightly release the pressure of the fingers so the greater pressure is exerted by the calliper
- Repeat the procedure three times as the measurement may vary and record the average value
- Add the results of each measurement to get a total value in millimetres.

## Analysis

The percentage body fat is determined by placing a ruler at a point on the "Age in Years" line according to your age and a point on the "Sum of three skinfolds" line according to the test result. You can then read off the athlete's percentage fat on the appropriate "Males" or "Females" line.

*Example:*
A 20 year old male athlete with a skinfold total of 40mm has a percentage body fat of 12%.




The average man has 15 to 17% body fat, while the average woman is between 18 and 22%. Typical scores for elite athletes are 6% to 12% for men and 12% to 20% for women.

## Normative data

The following table details the percentage body fat for male and female athletes for a variety of sports.

| Sport | Male | Female |
|---|---|---|
| Baseball | 12-15% | 12-18% |
| Basketball | 6-12% | 20-27% |
| Cycling | 5-15% | 15-20% |
| Field & Ice Hockey | 8-15% | 12-18% |
| Rowing | 6-14% | 12-18% |
| Swimming | 9-12% | 14-24% |
| Track – Runners | 8-10% | 12-20% |
| Track – Jumpers | 7-12% | 10-18% |
| Track – Throwers | 14-20% | 20-28% |
| Triathlon | 5-12% | 10-15% |
| Volleyball | 11-14% | 16-15% |

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

# 4.4 ■ Yuhasz Skinfold Test

*Measuring body fat percentage is an easy method of discovering correct body weight and composition. Beneath the skin is a layer of subcutaneous fat, and the percentage of total body fat can be measured by taking the 'skinfold' at selected points on the body with a pair of callipers. The Yuhasz Technique requires six measurements.*

## Required Resources

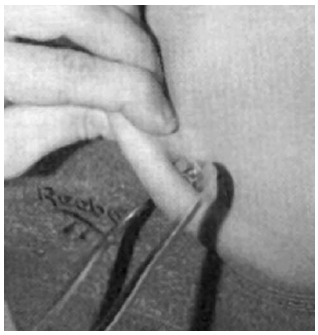
To undertake this test you will require:

- Skinfold calliper
- Assistant.

## Measurement sites

Take measurements form the following sites:

**Triceps**
The skin fold is located midway on the back of the upper arm. The arm hangs freely and the skinfold is lifted parallel to its long axis.

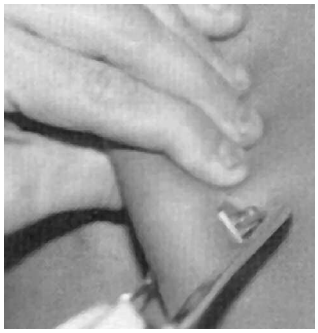


**Subscapula**
The skinfold is lifted vertically and measured below the tip of the scapula.

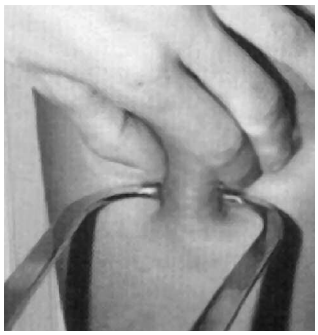
**Suprailiac**
The skinfold is located immediately above the crest of the ilium. The fold is lifted at a slight angle to the vertical along the normal fold line.

**Abdomen**
The skinfold is located to the left of, adjacent to, and in line with the navel. The fold is lifted parallel to the long axis of the body.

**Front Thigh**
The skinfold is located midway on the front of the upper leg over the quadriceps. The foot is placed on a six-inch step with the knee slightly flexed and muscles relaxed. The fold is lifted parallel to the long axis of the leg.



**Chest (male only)**
The site is located above and slightly to the right of the right nipple. The skinfold is taken at a 45-degree angle of the horizontal.



**Rear thigh (female only)**
The skinfold is located midway on the back of the upper leg. The leg is held in the same position as the front thigh measurements. The skinfold is lifted parallel to the axis of the leg.

## How to conduct the test

The method is as follows:

- Ensure that all of the skinfold measurements are located on the right side of the body and that the measurements are taken in millimetres
- Pick up the skinfold between the thumb and the index finger so as to include two thicknesses of skin and subcutaneous fat

- Apply the callipers about one centimetre from the fingers and at a depth about equal to the thickness of the fold
- Very slightly release the pressure of the fingers so the greater pressure is exerted by the calliper
- Repeat the procedure three times as the measurement may vary and record the average value
- Add the results of each measurement to get a total value in millimetres

## Analysis

Using the total skinfold value (SFV) obtained from the test determine the percentage body fat using the appropriate algorithm

| Gender | Age | Algorithm |
|---|---|---|
| Male | 16 to 30 | % body fat = (SFV x 0.097) + 3.64 |
| | 30+ | % body fat = (SFV x 0.1066) + 4.975 |
| Female | 16 to 30 | % body fat = (SFV x 0.217) – 4.47 |
| | 30+ | % body fat = (SFV x 0.224) – 2.8 |

The average man has 15 to 17% body fat, while the average woman is between 18 and 22%. Typical scores for elite athletes are 6% to 12% for men and 12% to 20% for women.

## Normative data

The following table details the percentage body fat for male and female athletes for a variety of sports.

| Sport | Male | Female |
|---|---|---|
| Baseball | 12-15% | 12-18% |
| Basketball | 6-12% | 20-27% |
| Cycling | 5-15% | 15-20% |
| Field & Ice Hockey | 8-15% | 12-18% |
| Rowing | 6-14% | 12-18% |
| Swimming | 9-12% | 14-24% |
| Track – Runners | 8-10% | 12-20% |
| Track – Jumpers | 7-12% | 10-18% |
| Track – Throwers | 14-20% | 20-28% |
| Triathlon | 5-12% | 10-15% |
| Volleyball | 11-14% | 16-15% |

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- yuhasz skinfold test.htm

# 5 Strength

The nature of strength is always difficult to define. The strong runner, the strong shot-putter and the strong jumper clearly have little in common and yet we consistently lump strength attributes together as if we are looking for the same result for each event. Strength is a generic term used to describe many dissimilar abilities. Examples of 'strengths' include the following:

- **Strength Endurance** – the ability to move a light resistance for an extended period of time
- **Absolute Dynamic Strength** – the maximum force that a muscle can generate and apply to create movement
- **Absolute Static Strength** – the maximum force that a muscle can generate and apply without producing movement
- **Reactive Strength** – the maximum force that muscles can apply in response to a force in the opposite direction
- **Power** – which most people confuse with 'strength', but is actually the absolute dynamic strength multiplied by the speed it can be applied.

From these it is clear that different events/sports need different 'strengths', and different 'strengths' need different training methods.

## Strength Evaluation Tests

The following are examples of core strength tests:

- Core muscle strength and stability test
- Curl up test
- Canadian crunch test
- Sit ups test.

The following are examples of elastic strength tests:

- Jumps decathlon
- Leg strength test
- Standing long jump test
- Sprint bound Index test
- Sergeant jump test.

The following are examples of general strength tests:

- Chin up test
- Grip strength test
- Medicine ball javelin quadrathlon
- Press up test
- Bench press test
- Universal bench press test
- Metronome bench press test
- Overhead press test
- Leg press test
- Leg curl test
- Dynamic knee extension test
- Bicep curl test
- Squats test
- Handgrip strength test
- Wall squat test
- Flexed arm hang test.

The following are examples of general strength and aerobic tests:

- The McCloy physical fitness test
- The Quadrathlon
- The Wilf Paish rugby football tests.

# 5.1 ■ Core Muscle Strength and Stability Test

*The Core Muscle Strength Test can be used to monitor the development of the athlete's core strength.*

## Required resources

To undertake this test you will require a flat surface, an assistant, a mat or something to support the elbows and arms and a watch.

## How to conduct the test

The assistant is responsible for instructing the athlete as to the position to assume at the appropriate time sequence. Throughout the test the back, neck and head should be maintained in the posture as per Figure 1. If the athlete is unable to hold this position then the test is to be stopped.

*Figure 1*

The Core Muscle Strength Test is conducted as follows:

**Stage 1**
- Using the mat to support your elbows and arms assume the Chinese Press Up position as in Figure 1 above
- Once the correct position is assumed the assistant starts the watch
- Hold this position for 60 seconds.

**Stage 2**
- Lift your right arm off the ground
- Hold this position for 15 seconds.

**Stage 3**
- Return your right arm to the ground and lift the left arm off the ground
- Hold this position for 15 seconds.

**Stage 4**
- Return your left arm to the ground and lift the right leg off the ground
- Hold this position for 15 seconds.

**Stage 5**
- Return your right leg to the ground and lift the left leg off the ground
- Hold this position for 15 seconds.

**Stage 6**
- Lift your left leg and right arm off the ground
- Hold this position for 15 seconds.

**Stage 7**
- Return you left leg and right arm to the ground
- Lift your right leg and left arm off the ground
- Hold this position for 15 seconds.

**Stage 8**
- Return to the basic Chinese Press Up position – as in Figure 1 above
- Hold this position for 30 seconds.

**Stage 9**
- End of test.

Record the stage at which the athlete is unable to maintain the correct body position or is unable to continue with the test.

## Analysis

Analysis of the result is by comparing it with previous test results. It is expected that, with appropriate training between each test, the analysis would indicate an improvement. If the athlete is able to complete the test, up to and including stage 8, then it indicates they have good core strength.

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strictly the test is conducted.

## Validity

There are no published tables to relate results to potential performance in competition.

# 5.2 ■ Curl Up Test

*The objective of the curl-up test is to assess the endurance of the athlete's abdominal muscles.*

## Required resources

To undertake this test you will require:

- Flat surface
- Mat
- Watch
- Assistant.

## How to conduct the test

The test is conducted as follows:

- Lie on the mat with the knees bent, feet flat on the floor, the hands resting on the thighs and the back of the head on the partner's hands – see Figure 1
- Curl up slowly using the abdominal muscles and slide the hands up the thighs until the finger tips touch the knee caps – see Figure 2
- Return slowly to the starting position – see Figure 1
- The feet are not to be held
- A complete curl-up is to take 3 seconds – that is 20 repetitions/minute
- Repeat as many curls as possible at this rate
- Record the total number of curls.

Figure 1

Figure 2

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the curl-up test

The following table is for Male athletes.

| Classification | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| <35 | 60 | 45 | 30 | 15 |
| 35-44 | 50 | 40 | 25 | 10 |
| >45 | 40 | 25 | 15 | 5 |

The following table is for Female athletes.

| Classification | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| <35 | 50 | 40 | 25 | 10 |
| 35-44 | 40 | 25 | 15 | 6 |
| >45 | 30 | 15 | 10 | 4 |

*Table reference: McArdle W.D. et al; Essential of Exercise Physiology; 2000*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- curl up test.htm

# 5.3 ■ Canadian Crunch Test

*The objective of this test is to monitor the development of the athlete's abdominal strength.*

## Required resources

To undertake this test you will require:

- Strips of tape
- Tape measure
- Metronome
- Assistant

## How to conduct the test

The test is conducted as follows:

- Set the metronome to 40 beats per minute
- Athlete to lie on their back with arms extended to your sides
- Place a strip of tape on the floor at the end of their fingertips
- Place another piece of tape 3 inches away from the first strip
- To perform a proper crunch, the athlete curls their rib cage toward their pelvis so their fingers move from one strip of tape to the next
- Athlete to perform as many crunches as possible to a 40 BPM metronome
- The test is completed when the athlete cannot execute another crunch in time with metronome
- Assistant counts the number of correctly completed crunches

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Performance assessment

An excellent score for men is 60 and excellent score for women is 50 repetitions.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 5.4 ■ Sit Ups Test

*The objective of this test is to monitor the development of the athlete's abdominal muscles.*

## Required resources

To undertake this test you will require:

- Flat surface
- Mat
- Partner to hold the feet.

## How to conduct the test

The sit ups test is conducted as follows:

- Lie on the mat with the knees bent, feet flat on the floor and the arms folded across the chest
- Start each sit up with back on the floor.
- Raise yourself to the 90 degree position and then return to the floor
- The feet can be held by a partner
- Record the number of sits up completed in 30 seconds.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the sit ups test

The following are national norms for 16 to 19 year olds.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | >30 | 26-30 | 20-25 | 17-19 | <17 |
| Female | >25 | 21-25 | 15-20 | 9-14 | <9 |

*Table reference: Davis B. et al; Physical Education and the Study of Sport; 2000*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- sit ups test.htm

# 5.5 ■ Jumps Decathlon

*The Jumps Decathlon is easy to carry out and is an excellent way to test an athlete's elastic strength and can used for developing jumping skills as well as specific strength.*

## The jumps decathlon comprises 10 events:

1. Standing long jump
2. Standing triple jump
3. 2 hops, step and jump
4. 2 hops, 2 steps and jump
5. 2 hops, 2 steps and 2 jumps
6. 5 spring jumps (bunny hops)
7. Standing 4 hops and jump
8. Running 4 hops and jump
9. 25 metre hop for time
10. 5 stride long jump.

## Practical uses

The Jumps Decathlon can be used to gauge whether an athlete is becoming more powerful. The benefits are threefold:

1. If the athlete's scores increase, then their power has increased
2. Weakness can be identified if the athlete underscores and these areas can be worked on
3. Motivational help during the long winter months.

## How to conduct the test

For each event allow two three successful attempts recording the best distance/time.

1. **Standing long jump** – Place feet over the edge of the sandpit. The athlete crouches, leans forward, swings their arms backwards, then jumps horizontally as far as possible, jumping with both feet into the sandpit. Measure from the edge of the sandpit to the nearest point of contact. The start of the jump must be from a static position.
2. **Standing triple jump** – Take-off foot to remain in flat contact with the ground and free swinging of the non contact leg can be used
3. **2 hops, step and jump** – As per standing triple jump
4. **2 hops, 2 steps and jump** – As per standing triple jump
5. **2 hops, 2 steps and 2 jumps** – The second jump is a two footed take off

6. **5 spring jumps (Bunny hops)** – 5 successive two-footed bounds (bunny hops) with the feet kept together in a continuous movement
7. **Standing 4 hops and a jump** – As per standing triple jump – repeat test for each leg and record the mean distance
8. **Running 4 hops and jump** – Length of run unlimited – repeat test for each leg and record the mean distance
9. **25 metre hop** – Start from a standing position – repeat test for each leg and record the mean time
10. **5 stride long jump** – Normal long jump rules apply.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

Points are allocated from the Jumps Decathlon tables depending on the distance or time achieved. Scores should be compared with the athlete's previous scores to determine the level of improvement. Competition can be based on the improvement from the previous test for each event.

| Event | Points |
|---|---|
| Standing long jump | = –19.40182 + (D x 34.38485) + (D x D x –0.636364) |
| Standing Triple jump | = –35.50103 + (D x 12.53057) + (D x D x 0.0344445) |
| 2 hops, step and jump | = –45.46265 + (D x 12.876771) + (D x D x –0.129795) |
| 2 hops, 2 steps and jump | = –52.96077 + (D x 10.128824) + (D x D x –0.018391) |
| 2 hops, 2 steps and 2 jumps | = –74.64828 + (D x 12.458996) + (D x D x –0.174359) |
| 5 spring jumps (Bunny hops) | = –68.09148 + (D x 12.173418) + (D x D x –0.136018) |
| Standing 4 hops and jump | = –56.97374 + (D x 10.563032) + (D x D x –0.095043) |
| Running 4 hops and jump | = –55.31376 + (D x 7.5941124) + (D x D x –0.044598) |
| 25 metre hop for time | = 99.540643 + (T x 4.2533081) + (T x T x –1.512287) |
| 5 stride long jump | = –13.07164 + (D x 2.9149238) + (D x D x 1.73309) |

D = Distance and T = Time

## Target group

This test is suitable for jumpers (*eg* long jump, high jump) but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- jumps decathlon test.htm

# 5.6 ■ Leg Strength Test

*The objective of this test is to monitor the development of the athlete's elastic leg strength.*

## Required resources

To undertake this test you will require:

- 400m track – 25m marked section on the straight
- Cones
- Stop watch
- Assistant.

## How to conduct the test

- Mark out a 25m section on the straight section of the track with 2 cones
- The athlete starts 10 to 15m behind the starting line.
- Using a jog run up, the athlete starts hopping on the dominant leg from the first cone.
- The time taken to hop between the 2 cones is recorded.
- The test is then repeated with the other leg.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the leg strength test

The following data has been obtained from the results of tests conducted with world class athletes.

| % Rank | Females | Males |
|---|---|---|
| 91-100 | 3.13-3.75 secs | 2.70-3.25 secs |
| 81-90 | 3.76-4.50 secs | 3.36-3.90 secs |
| 71-80 | 4.51-5.70 secs | 3.91-5.00 secs |
| 61-70 | 5.71-6.90 secs | 5.01-6.10 secs |
| 51-60 | 6.91-8.15 secs | 6.11-7.20 secs |
| 41-50 | 8.16-8.90 secs | 7.21-7.90 secs |
| 31-40 | 8.91-9.45 secs | 7.91-8.40 secs |
| 21-30 | 9.46-10.05 secs | 8.41-8.95 secs |
| 11-20 | 10.06-10.34 secs | 8.96-9.25 secs |
| 1-10 | 10.35-10.70 secs | 9.26-9.60 secs |

*Table reference: D.A. Chu; Explosive Power and Strength; Human Kinetics; 1996*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- leg strength test.htm

# 5.7 ■ Standing Long Jump Test

*The objective of this test is to monitor the development of the athlete's elastic leg strength.*

## Required resources

To undertake this test you will require:

- Long jump pit
- 30 metre tape measure
- Assistant.

## How to conduct the test

The athlete places their feet over the edge of the sandpit. The athlete crouches, leans forward, swings their arms backwards, the jumps horizontally as far as possible, jumping with both feet into the sandpit. The coach should measure from the edge of the sandpit to the nearest point of contact. The start of the jump must be from a static position.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the standing long jump test

The following data has been obtained from the results of tests conducted with world class athletes.

| % Rank | Females | Males |
|---|---|---|
| 91-100 | 2.94-3.15m | 3.40-3.75m |
| 81-90 | 2.80-2.93m | 3.10-3.39m |
| 71-80 | 2.65-2.79m | 2.95-3.09m |
| 61-70 | 2.50-2.64m | 2.80-2.94m |
| 51-60 | 2.35-2.49m | 2.65-2.79m |
| 41-50 | 2.20-2.34m | 2.50-2.49m |
| 31-40 | 2.05-2.19m | 2.3-2.49m |
| 21-30 | 1.90-2.04m | 2.20-2.34m |
| 11-20 | 1.75-1.89m | 2.05-2.19m |
| 1-10 | 1.60-1.74m | 1.90-2.04m |

*Table reference: D.A. Chu; Explosive Power and Strength; Human Kinetics; 1996*

The following table is for 15 to 16 year old athletes.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | >2.01m | 2.00-1.86m | 1.85-1.76m | 1.75-1.65m | <1.65m |
| Female | >1.66m | 1.65-1.56m | 1.55-1.46m | 1.45-1.35m | <1.35m |

The following table is for male and female adults.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | >3.0m | 2.7m | 2.5m | 2.3m | <2.0m |
| Female | >2.8m | 2.5m | 2.2m | 1.9m | <1.7m |

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- standing long jump test.htm

# 5.8 ■ Sprint Bound Index Test

*The objective of this test is to monitor the development of the athlete's elastic leg strength.*

## Required resources

To undertake this test you will require:

- 400m track – 30m marked section on the straight
- Cones
- Stop watch
- Two assistants.

## How to conduct the test

- Begin with one foot on the start line and place the other foot 2 to 3 feet behind you
- Place both of your helpers at the finish line – one to count the number of foot contacts and the other to time your sprint-bound effort over the 30m distance
- On your own command, sprint-bound down the track for the entire 30m distance
- The timer should start the watch when the foot on the start line breaks contact with the ground and then stop the watch when your torso crosses the finish line
- The time is recorded by rounding up to the nearest tenth of a second
- Your second helper is responsible for counting the number of bounds it takes you to reach the finish line
- The number of bounds should be rounded down to the nearest half-bound
- Perform three trials, with 3 to 5 minutes between each trial
- Record the results of all three trials.

## Analysis

Calculate the 'sprint-bounding index' for each trial using the following formula:

- Sprint-bound index (SBI) = (no. of bounds) x (time for 30m)

*Example:*
You have taken 15.5 bounds to cover the 30m, in a time of 4.5 seconds.

- SBI = 15.5 x 4.5 = 69.75.

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement. A reduction in the Sprint-bound index indicates an improvement.

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- sprint bound index test.htm

# 5.9 ■ Sergeant Jump Test

*The objective of this test is to monitor the development of the athlete's elastic leg strength.*

## Required resources

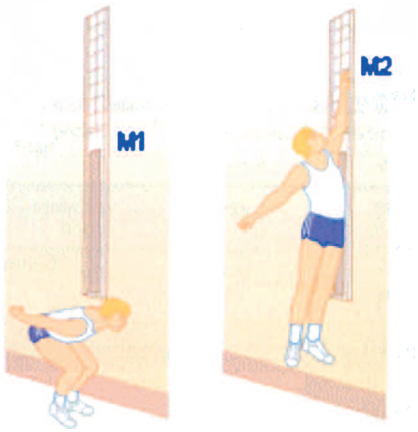
To undertake this test you will require:

- Wall
- 1 metre Tape Measure
- Chalk
- Assistant.

## How to conduct the test

**The athlete:**

- chalks the end of his finger tips
- stands side onto the wall, keeping both feet remaining on the ground, reaches up as high as possible with one hand and marks the wall with the tips of the fingers (M1)
- from a static position jumps as high as possible and marks the wall with the chalk on his finger tips (M2).




**The coach:**

- measures the distance from M1 to M2. The test can be performed as many times as the athlete wishes.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the Sergeant jump test

The following are national norms for 16 to 19 year olds.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | >65cm | 50-65cm | 40-49cm | 30-39cm | <30cm |
| Female | >58cm | 47-58cm | 36-46cm | 26-35cm | <26cm |

The following normative data has been obtained from the results of tests conducted with world class athletes.

| % Rank | Females | Males |
|---|---|---|
| 91-100 | 76.20- 81.30 cm | 86.35-91.45 cm |
| 81-90 | 71.11-76.19 cm | 81.30-86.34 cm |
| 71-80 | 66.05-71.10 cm | 76.20-81.29 cm |
| 61-70 | 60.95-66.04 cm | 71.10-76.19 cm |
| 51-60 | 55.90-60.94 cm | 66.05-71.09 cm |
| 41-50 | 50.80-55.89 cm | 60.95-66.04 cm |
| 31-40 | 45.71-50.79 cm | 55.90-60.94 cm |
| 21-30 | 40.65-45.70 cm | 50.80-55.89 cm |
| 11-20 | 35.55-40.64 cm | 35.55-40.64 cm |
| 1-10 | 30.50-35.54 cm | 40.65-45.69 cm |

*Table reference: D.A. Chu; Explosive Power and Strength; Human Kinetics; 1996*

The following table is for male and female adults.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | >65cm | 60cm | 55cm | 50cm | <46cm |
| Female | >55cm | 50cm | 45cm | 40cm | <36cm |

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- sergeant jump test.htm

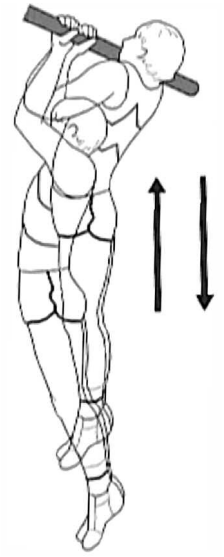
# 5.10 ■ Chin Up Test

*The objective of this test is to monitor the development of the athlete's arm and shoulder muscular endurance.*

## Required resources

To undertake this test you will require :

- Chinning bar
- Assistant.



## How to conduct the test

The chins test is conducted as follows:

- Hang from the bar with your palms facing your body
- Pull up until your chin is level with the bar
- Lower so as to straighten your arms
- Repeat as many chins as possible
- Record the number of chins.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the chins test

The following are national norms for ages 16 to 19.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | >13 | 9-13 | 6-8 | 3-5 | <3 |
| Female | >6 | 5-6 | 3-4 | 1-2 | 0 |

*Table reference: Davis B. et al; Physical Education and the Study of Sport; 2000*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- chin up test.htm

# 5.11 ■ Grip Strength Test

*The objective of this test is to monitor the development of the athlete's grip strength.*

## Required resources

To undertake this test you will require a Dynamometer.

## How to conduct the test

- Use a hand grip dynamometer to measure grip strength
- Record the maximum reading (kg) from three attempts using the dominant hand.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the grip strength test

The following are national norms for 16 to 19 year olds.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | >56 | 51-56 | 45-50 | 39-44 | <39 |
| Female | >36 | 31-36 | 25-30 | 19-24 | <19 |

*Table reference: Davis B. et al; Physical Education and the Study of Sport; 2000*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- grip strength test.htm

# 5.12 ■ Medicine Ball Javelin Quadrathlon

*The objective of this test is to monitor the development of the athlete's fitness and strength.*

## Required resources

To undertake this test you will require:

- 1.5kg, 2Kg and a 3Kg medicine balls
- 30 metre tape measure
- Assistant.

## How to conduct the test

The test comprises of four medicine ball throws:

- Standing throw one (Men 2Kg – Ladies 1.5Kg)
- Standing throw two (Men 3Kg – Ladies 2Kg)
- 3 step throw one (Men 2Kg – Ladies 1.5Kg)
- 3 step throw two (Men 3Kg – Ladies 2Kg).

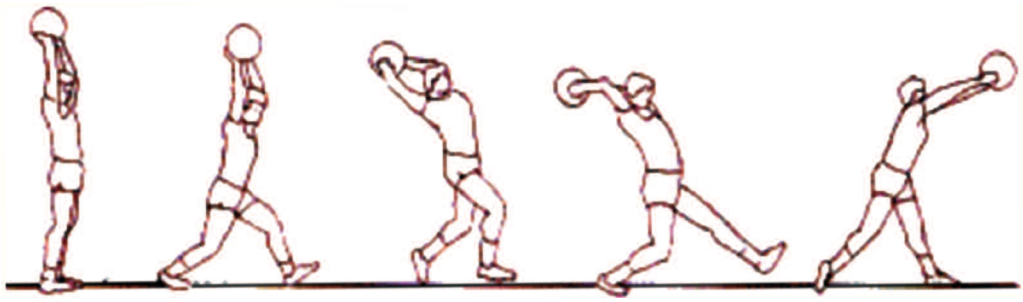
The athlete performs each throw and the assistance records the distance achieved.

## Explanation of the throws

### Standing throw

- Face forward with the medicine ball held overhead in two hands
- Feet should be parallel and toeing the measuring line
- Throw the ball for distance
- A follow through step is allowed

Distance is measured from the front foot (on release) to where the ball lands.



### Three step throw

- Start with both feet together in a stationary position
- Take three steps forward with the medicine ball held overhead in two hands

- Throw the ball for distance
- A follow through step is allowed

Distance is measured from the front foot (on release) to where the ball lands.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement in the athlete's fitness and strength.

Points are calculated for each throw from the table below. Add the 4 sets of points together to give a total score.

The world best score for this test is 76 points and the UK best score is 66 points.

| Points | Standing Throw One Distance (metres) | Standing Throw Two Distance (metres) | 3 Step Throw One Distance (metres) | 3 Step Throw Two Distance (metres) |
|---|---|---|---|---|
| 1 | 3.00 | 2.00 | 4.50 | 2.75 |
| 2 | 4.50 | 3.25 | 6.00 | 4.00 |
| 3 | 6.00 | 4.50 | 7.50 | 5.25 |
| 4 | 7.50 | 5.75 | 9.00 | 6.50 |
| 5 | 9.00 | 7.00 | 10.50 | 7.75 |
| 6 | 10.50 | 8.25 | 12.00 | 9.00 |
| 7 | 12.00 | 9.50 | 13.50 | 10.25 |
| 8 | 13.50 | 10.75 | 15.00 | 11.50 |
| 9 | 15.00 | 12.00 | 16.50 | 12.75 |
| 10 | 16.00 | 13.00 | 17.50 | 14.00 |
| 11 | 17.00 | 14.00 | 18.50 | 15.25 |
| 12 | 18.00 | 15.00 | 19.50 | 16.50 |
| 13 | 19.00 | 16.00 | 20.50 | 17.75 |
| 14 | 20.00 | 16.75 | 21.50 | 18.50 |
| 15 | 21.00 | 17.50 | 22.50 | 19.25 |
| 16 | 22.00 | 18.25 | 23.50 | 20.00 |
| 17 | 23.00 | 19.00 | 24.50 | 20.75 |
| 18 | 24.00 | 19.75 | 25.50 | 21.50 |
| 19 | 25.00 | 20.50 | 26.75 | 22.25 |
| 20 | 26.00 | 21.25 | 28.00 | 23.00 |
| 21 | 27.00 | 22.00 | 28.75 | 23.75 |
| 22 | 28.00 | 22.75 | 29.50 | 24.50 |
| 23 | 29.00 | 23.50 | 30.25 | 25.25 |
| 24 | 30.00 | 24.25 | 31.00 | 26.00 |
| 25 | 31.00 | 25.00 | 31.75 | 26.75 |

## Target group

This test is suitable for throwers (*eg* javelin, discus) but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential performance in competition and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- medicine ball javelin quadrathlon.htm

# 5.13 ■ Press-ups Test

*The objective of this test is to assess the endurance of your athlete's upper body muscles.*

## Required resources

To undertake this test you will require:

- Flat surface
- Mat
- Stop watch
- Partner.

## How to conduct the test

The press-ups test is conducted as follows:

- Lie on the mat, hands shoulder width apart & fully extend the arms – see Figure 1
- Lower the body until the elbows reach 90° – see Figure 2
- Return to the starting position with the arms fully extended – see Figure 1
- The feet are not to be held
- The push up action is to be continuous with no rest
- Complete as many press-ups as possible
- Record the total number of full body press-ups.

Figure 1

Figure 2

Female athletes tend to have less relative strength in the upper body and therefore can use the modified press up position to assess their upper body strength. The test is then performed as follows:

- Lie on the mat, hands shoulder width apart, bent knee position & fully extend the arms – see Figure 3
- Lower the upper body until the elbows reach 90° – see Figure 4
- Return to the starting position with the arms fully extended – see Figure 3
- The feet are not to be held
- The push up action is to be continuous with no rest
- Complete as many modified press-ups as possible
- Record the total number of modified press-ups.

Figure 3

Figure 4

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Assessment

The table below provide standards for scoring the full body push-up and the modified push-up test.

| Number push-ups completed | | | | | |
|---|---|---|---|---|---|
| Rating | Age | | | | |
| | 20-29 | 30-39 | 40-49 | 50-59 | 60+ |
| **Full body push-up** | | | | | |
| Excellent | >54 | >44 | >39 | >34 | >29 |
| Good | 45-54 | 35-44 | 30-39 | 25-34 | 20-29 |
| Average | 35-44 | 25-34 | 20-29 | 15-24 | 10-19 |
| Fair | 20-34 | 15-24 | 12-19 | 8-14 | 5-9 |
| Poor | <20 | <15 | <12 | <8 | <5 |
| **Modified push-up** | | | | | |
| Excellent | >48 | >39 | >34 | >29 | >19 |
| Good | 34-48 | 25-39 | 20-34 | 15-29 | 5-19 |
| Average | 17-33 | 12-24 | 8-19 | 6-14 | 3-4 |
| Fair | 6-16 | 4-11 | 3-7 | 2-5 | 1-2 |
| Poor | <6 | <4 | <3 | <2 | <1 |

*From Pollock, M.L., et al.: Health and Fitness Through Physical Activity. New York: John Wiley & Sons, 1984.*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high

## On-line calculator

Select the following link to access the on-line calculator

- press up test.htm

# 5.14 ■ Bench Press Test

*The objective of this test is to evaluate an athlete's upper body strength.*

## Required resources

To undertake this test you will require:

- Bar bell and weights
- Bench
- Assistant.

## How to conduct the test

- Load the bar bell with a weight close to your one repetition maximum load
- Conduct as many bench presses you can before failure
- Assistant to act as a spotter for the athlete and count the number of successful bench presses
- If the number of bench presses exceeds 12 then:
  - rest for 15 minutes
  - Increase the weight
  - repeat the test.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

The following equation provides a good estimate of the maximum load providing the number of repetitions does not exceed 12.

- = Weight / (1.0278 – (0.0278 x Number of repetitions))

For an assessment of your one repetition maximum divide your one repetition maximum (kgs) by your body weight (kgs) and then determine an assessment of your score from the normative table.

*Example:*

- Male athlete
- Body weight – 85kgs
- Age – 32
- Weight lifted – 80kgs
- Number of repetitions – 5

One repetition maximum is: = 80 / (1.0278 – (0.0278 x 5)) = 90kgs
Score = 90 / 85 = 1.059 Assessment = Good

## Normative data for the bench press test

| Rating | Age | | | |
|---|---|---|---|---|
| | 20-29 | 30-39 | 40-49 | 50-59 |
| | | **Male** | | |
| Excellent | >1.26 | >1.08 | >0.97 | >0.86 |
| Good | 1.17-1.26 | 1.01-1.08 | 0.91-0.97 | 0.81-0.86 |
| Average | 0.97-1.16 | 0.86-1.00 | 0.78-0.90 | 0.70-0.80 |
| Fair | 0.88-0.96 | 0.79-0.85 | 0.72-0.77 | 0.65-0.69 |
| Poor | <0.87 | <0.78 | <0.71 | <0.60 |
| | | **Female** | | |
| Excellent | >0.78 | >0.66 | >0.61 | >0.54 |
| Good | 0.72-0.77 | 0.62-0.65 | 0.57-0.60 | 0.51-0.53 |
| Average | 0.59-0.71 | 0.53-0.61 | 0.48-0.56 | 0.43-0.50 |
| Fair | 0.53-0.58 | 0.49-0.52 | 0.44-0.47 | 0.40-0.42 |
| Poor | <0.52 | <0.48 | <0.43 | <0.39 |

*Table reference: Adapted from: Cooper Institute for Aerobics Research 1997*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- bench press test.htm

# 5.15 ■ Universal Bench Press Test

*The objective of this test is to monitor the strength of the athletes elbow extensors and the pectoral muscles.*

## Required resources

To undertake this test you will require:

- Universal bench press station.

## How to conduct the test

The test is conducted as follows:

- The athlete assumes the hook lying position on the bench with knees flexed, and feet on the bench
- The initial resistance will depend upon the estimated strength of the subject, but as a guide, select 50% of body mass for males and 33% for females
- If the athlete can successfully complete one repetition, repeat the procedure after one minute, adding an additional weight to the previous resistance
- Continue with this procedure, allowing one minute recovery between attempts until the 1RM has been determined
- Record the final resistance.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

No published tables to relate results to potential performance in competition.

# 5.16 ■ Metronome Bench Press Test

*The objective of this test is to monitor the development of the athlete's upper body strength.*

## Required resources

To undertake this test you will require:

- Bar bell and weights
- Metronome
- Spotter.

## How to conduct the test

The test is conducted as follows:

- Set up the bar barbell with 80lbs for men and 35 pounds for women
- Set the metronome to 60 beats per minute
- Lie on a flat bench
- Bench press the weight in time to the metronome
- Spotter counts the repetitions ensuring the elbows are fully extended (not locked) and the bar bell comes down to the chest
- The test concludes when the athlete is unable to maintain form in time with the metronome.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Performance assessment

An excellent score for men is 37 repetitions and an excellent score for women is 35 repetitions.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 5.17 ■ Overhead Press Test

*The objective of this test is to monitor the strength of the athletes elbow extensors and superior shoulder girdle muscles.*

## Required resources

To undertake this test you will require:

- Universal overhead press station
- A supportive lumbar lifting belt.

## How to conduct the test

The test is conducted as follows:

- The athlete stands and leans into the apparatus with the back leg straight and the front foot leg bent at the knee at about 150 degrees
- The hand grips are adjacent to the front of the shoulders
- The initial resistance should be about 33% of male body mass and 25% of female body mass
- As the weight is lifted, the body should move slightly forward so that the extended arms and trunk and rear leg should form a straight line
- If the athlete can successfully complete one repetition, repeat the procedure after one minute, adding an additional weight to the previous resistance
- Continue with this procedure, allowing one minute recovery between attempts until the 1RM has been determined
- A supportive lumbar lifting belt is recommended for this exercise during maximal lifts
- Record the final resistance.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

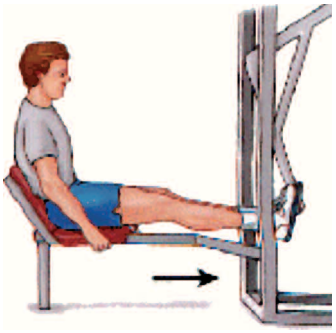
# 5.18 ■ Leg Press Test

*The objective of this test is to evaluate an athlete's lower body strength.*

## Required resources

To undertake this test you will require:

- Leg press machine
- Assistant.



## How to conduct the test

- Select a weight close to your one repetition maximum load
- Conduct as many leg presses you can before failure
- Assistant to count the number of successful bench presses
- If the number of bench presses exceeds 12 then:
  - rest for 15 minutes
  - Increase the weight
  - repeat the test.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

The following equation provides a good estimate of the maximum load providing the number of repetitions does not exceed 12.

- = Weight / ( 1.0278 – ( 0.0278 x Number of repetitions ) )

For an assessment of your one repetition maximum divide your one repetition maximum (kgs) by your body weight (kgs) and then determine an assessment of your score from the normative table.

*Example:*

- Female athlete
- Body weight – 65kgs
- Age – 32
- Weight pressed – 80kgs
- Number of repetitions – 5

One repetition maximum is: = 80 / (1.0278 – (0.0278 x 5) = 90kgs
Score = 90 / 65 = 1.38 Assessment = Good

## Normative data for the leg press test

| Rating | Age | | | |
|---|---|---|---|---|
| | 20-29 | 30-39 | 40-49 | 50-59 |
| | | **Male** | | |
| Excellent | >2.08 | >1.88 | >1.76 | >1.66 |
| Good | 2.00-2.07 | 1.80-1.87 | 1.70-1.75 | 1.60-1.65 |
| Average | 1.83-1.99 | 1.63-1.79 | 1.56-1.69 | 1.46-1.59 |
| Fair | 1.65-1.82 | 1.55-1.62 | 1.50-1.55 | 1.40-1.45 |
| Poor | <1.64 | <1.54 | <1.49 | <1.39 |
| | | **Female** | | |
| Excellent | >1.63 | >1.42 | >1.32 | >1.26 |
| Good | 1.54-1.62 | 1.35-1.41 | 1.26-1.31 | 1.13--1.25 |
| Average | 1.35-1.53 | 1.20-1.34 | 1.12-1.25 | 0.99-1.12 |
| Fair | 1.26-1.34 | 1.13-1.19 | 1.06-1.11 | 0.86-0.98 |
| Poor | <1.25 | <1.12 | <1.05 | <0.85 |

*Table Reference: Adapted from: Cooper Institute for Aerobics Research 1997*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- leg press test.htm

# 5.19 ■ Leg Curl Test

*The objective of this test is to assess the strength of the athlete's knee flexors (hamstrings).*

## Required resources

To undertake this test you will require:

- Universal knee flexor/extensor bench.

## How to conduct the test

The test is conducted as follows:

- The athlete lies face down on the bench, knees extended, with the heels hooked behind the top of the foot pads
- The athlete holds the front of the machine for support
- They are to inhale as they curl up and exhale as they lower the weight
- The final knee joint angle should be less than 90 degrees
- As a guide, the initial resistance should be approximately 30% of male body mass and 20% of female body mass
- If the athlete can successfully complete one repetition, repeat the procedure after one minute, adding an additional weight to the previous resistance
- Continue with this procedure, allowing one minute recovery between attempts until the 1RM has been determined
- Record the final resistance.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 5.20 ■ Dynamic Knee Extension Test

*The objective of this test is to assess the strength of the athlete's knee extensor muscles.*

## Required resources

To undertake this test you will require:

- Universal knee flexor/extensor bench.

## How to conduct the test

The test is conducted as follows:

- The athlete sits on the end of the bench with the padded edge of the bench against the posterior surface of the knee joint
- The feet are hooked behind the padded rollers. The hands grasp the sides of the bench just behind their buttocks
- The correct technique involves a complete extension of the knee, conducted in a smooth and continuous movement
- The initial resistance should be approximately 33% of male body mass and 25% of female body mass
- If the athlete can successfully complete one repetition, repeat the procedure after one minute, adding an additional weight to the previous resistance
- Continue with this procedure, allowing one minute recovery between attempts until the 1RM has been determined
- Record the final resistance.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 5.21 ■ Biceps Curl Test

*The objective of this test is to monitor the strength of the athlete's elbow flexors.*

## Required resources

To undertake this test you will require:

- Set of dumbbells ranging from 1.4kg (3lbs) to at least 22.7kg (50lb). The smaller the dumbbell increments the better the resolution for determining 1RM
- Seat with back rest adjusted to an angle of 30 degrees to the vertical
- Assistant.

## How to conduct the test

The test is conducted as follows:

- Check that the inclined back rest is at 30 degrees to the vertical
- The initial dumbbell weight should be selected according to the estimated strength of the athlete. For untrained subjects this ranges from 6 kg to 12 kg for males and 3 kg to 6 kg for females
- The correct technique requires that the subject stands behind the inclined surface with the arm and supinated (palm up) forearm resting on the inclined surface
- The assistant hands the athlete the dumbbell which also rests against the inclined surface
- Avoiding any jerking motions, the athlete attempts to flex the elbow to a vertical forearm position. When this position is attained, the dumbbell is taken by the tester.
- If the athlete can successfully complete one repetition, repeat the procedure after one minute, adding an additional weight to the previous resistance
- Continue with this procedure, allowing one minute recovery between attempts until the 1RM has been determined
- Record the final resistance.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 5.22 ■ Squats Test

*The objective of this test is to monitor the development of the athlete's leg strength.*

## Required resources

To undertake this test you will require:

- Chair that makes your knees bend at right angles when you are sitting
- Assistant.

## How to conduct the test

The test is conducted as follows:

- Stand in front of a chair, facing away from it, with your feet shoulders width apart
- Squat down and lightly touch the chair with your backside before standing back up
- Keep doing this until you are fatigued
- Record the number of squats completed.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Performance assessment

| Rating | Age | | | | | |
|---|---|---|---|---|---|---|
| | 18-25 | 26-35 | 36-45 | 46-55 | 56-65 | 65+ |
| **Squat test (Men)** | | | | | | |
| Excellent | >49 | >45 | >41 | >35 | >31 | >28 |
| Good | 44-49 | 40-45 | 35-41 | 29-35 | 25-31 | 22-28 |
| Above average | 39-43 | 35-39 | 30-34 | 25-38 | 21-24 | 19-21 |
| Average | 35-38 | 31-34 | 27-29 | 22-24 | 17-20 | 15-18 |
| Below Average | 31-34 | 29-30 | 23-26 | 18-21 | 13-16 | 11-14 |
| Poor | 25-30 | 22-28 | 17-22 | 13-17 | 9-12 | 7-10 |
| Very Poor | <25 | <22 | <17 | <9 | <9 | <7 |

| Rating | Age | | | | | |
|---|---|---|---|---|---|---|
| | 18-25 | 26-35 | 36-45 | 46-55 | 56-65 | 65+ |
| **Squat test (Women)** | | | | | | |
| Excellent | >43 | >39 | >33 | >27 | >24 | >23 |
| Good | 37-43 | 33-39 | 27-33 | 22-27 | 18-24 | 17-23 |
| Above average | 33-36 | 29-32 | 23-26 | 18-21 | 13-17 | 14-16 |
| Average | 29-32 | 25-28 | 19-22 | 14-17 | 10-12 | 11-13 |
| Below Average | 25-28 | 21-24 | 15-18 | 10-13 | 7-9 | 5-10 |
| Poor | 18-24 | 13-20 | 7-14 | 5-9 | 3-6 | 2-4 |
| Very Poor | <18 | <20 | <7 | <5 | <3 | <2 |

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- squats test.htm

# 5.23 ■ Handgrip Strength Test

*The objective of this test is to assess the athlete's grip strength.*

## Required resources

To undertake this test you will require:
- Handgrip dynamometer.

## How to conduct the test

The test is conducted as follows:
- Reset the dynamometer to zero
- Adjust the handgrip dynamometer to fit the size of the athlete's hand
- The athlete stands with the heels, buttocks and back resting against a wall
- The athlete grips the dynamometer vertically above the head
- When ready the athlete grips as hard as possible while moving through a 180 degree arc to the count of three. The arm remains locked and straight at the elbow throughout the grip manoeuvre
- Record the final resistance on the dynamometer
- Repeat with the other hand.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 5.24 ■ Flexed Arm-Hang Test

*The objective of this test is to monitor the muscular endurance of the athlete's elbow flexors and shoulder extensors.*

## Required resources

To undertake this test you will require:

- Bar above head height
- Stop watch
- Assistant.

## How to conduct the test

The test is conducted as follows:

- Athlete uses a flexed arm hang position using a supinated grip (palm facing the subject) grip. The chin is above the bar, hips and knees are extended
- Once the athlete is in position the assistant start the stopwatch
- The athlete attempts to maintain this position for as long as possible (maximum time is 30 seconds)
- The timing is stopped when the chin drops below the top of the bar or 30 seconds elapse
- The assistant records number of seconds that the flexed arm-hang position can be maintained (maximum of 30 seconds).

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 5.25 ■ Wall Squat Test

*The objective of this test is to monitor the development of the athlete's quadriceps strength endurance.*

## Required resources

To undertake this test you will require:

- Warm dry location – gym
- Smooth wall
- Stop watch
- Assistant.

## How to conduct the test

- Stand comfortable on both feet with your back against a smooth wall
- Slide your back down the wall to assume the position shown in the diagram
- There is to be a 90° angle at the hip and knee
- When you are ready
- Lift one foot 5cm off the ground
- Assistant starts the stop watch
- Balance for as long as possible
- The watch is stopped when you put your foot back on the ground
- Take a rest and then repeat the test with the other leg.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the wall squat test

The following are national norms for 16 to 19 year olds.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | >102 secs | 102-76 secs | 75-58 secs | 57-30 secs | <30 secs |
| Female | >60 secs | 60-46 secs | 45-36 secs | 35-20 secs | <20 secs |

*Table Reference:Arnot R and Gaines C, Sports Talent, 1984*

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- wall squat test.htm

# 5.26 ■ The McCloy Physical Fitness Test

*The objective of this test is to monitor the development of the athlete's fitness.*

## Required resources

To undertake this test you will require:
- Gym with mats and a bar on which to do pull ups
- Stop watch
- Assistant.

## How to conduct the test

The athlete undertakes a series of exercises with the assistant recording the number of repetitions completed for each exercise.

A three minute recovery is allowed between each exercise.

The test comprises of the following exercises:
- Chins (pull ups) to maximum
- Press ups to maximum
- Squat thrusts for 1 minute
- Squat jumps for 1 minute
- Sit ups for 2 minutes.

## Analysis

The Physical Fitness Index (P.F.I.) is calculated by adding together the repetitions completed for each exercise and then dividing the total by five.

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- mccloy physical fitness test.htm

# 5.27 ■ The Quadrathlon

*The Quadrathlon was devised in 1982 to test for explosive power improvement of the Great Britain National Throws Squad. The Quadrathlon is easy to carry out and is an excellent way to test an athlete's fitness and progress during the winter months.*

## The Quadrathlon comprises of 4 activities:

1. Standing long jump
2. Three jumps
3. 30 metre sprint
4. Overhead shot throw.

The Quadrathlon can be used to gauge whether an athlete is becoming more powerful. The benefits are threefold:

- If the athlete's scores increase, then their power has increased
- Weakness can be identified if the athlete underscores and these areas can be worked on
- Motivational help during the long winter months.

## Required resources

To undertake this test you will require:

- Track – 30m marked section
- Shot
- Long jump pit
- 30 metre tape measure
- Assistant.

## How to conduct the test

### Standing long jump

Athlete to place their feet over the edge of the sandpit, crouch and lean forward, swing the arms backwards, swing the arms forward and jump horizontally as far as possible, jumping with both feet into the sandpit. Measure the distance from the edge of the sandpit to the nearest point of contact. The start of the jump must be from a static position.

### Three jumps

Start with the feet comfortably apart with the toes just behind the take off mark. The athlete takes three continuous two footed bounds. Measure the

distance covered. The start must be from a static position and the feet must be parallel on each jump phase. Spikes allowed.

**30 metre sprint**
The athlete sprints from a stationary position (standing or from blocks) as fast as possible to the 30 metre finish line. The time keeper stands at the finish line and times the run from the moment that the runner contacts the ground on the first stride to the moment when the runner's torso crosses the line. Spikes allowed.

**Overhead shot throw**
The athlete stands on the shot stop-board, facing away from the landing area, with their feet a comfortable distance apart. The shot is held cupped in both hands. The athlete crouches, lowering the shot between the legs, then drives upwards to cast the shot back over the head. There is no penalty for following through, but the athlete must land feet first and remain upright. Measurement is taken from the inside of the stop-board to the nearest point of contact. Shot weight as per the IAAF Competition Rules book age group. Please watch the safety aspect.

## Analysis

Analysis of the scores is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

Points are allocated depending on the distance or time achieved for each activity. Scores should be compared with the athlete's previous activity scores to determine the level of improvement.

The number of points for each event can be calculated using the following equations:

| Event | Points Equation |
|---|---|
| Standing Long Jump | Points = –36.14048 + (D x 37.268536) + (D x D x –0.128057) |
| Three Jumps | Points = –36.36996 + (D x 12.478922) + (D x D x –0.007423) |
| 30 Metre Sprint | Points = 209.70039 + (T x –36.94427) + (T x T x 0.165766) |
| Overhead Shot | Points = –22.32216 + (D x 5.8318756) + (D x D x –0.000334) |

Where D is the distance in metres and T is the time in seconds

The following tests results indicate an athlete may mature into a high standard club athlete.

| Boys | | | | |
|---|---|---|---|---|
| Event/Age | 14 | 15 | 16 | 17 |
| 30 metres | 4.15 | 4.00 | 3.90 | 3.75 |
| S L Jump | 2.35 | 2.60 | 2.75 | 2.90 |
| 3 Jumps | 7.20 | 7.60 | 8.25 | 8.70 |
| OH Shot | 15.00 4kg | 15.50 5kg | 17.20 5kg | 18.00 7.26kg |

| Girls | | | | |
|---|---|---|---|---|
| Event/Age | 14 | 15 | 16 | 17 |
| 30 metres | 4.35 | 4.20 | 4.10 | 4.00 |
| S L Jump | 2.15 | 2.30 | 2.40 | 2.60 |
| 3 Jumps | 6.40 | 7.05 | 7.20 | 7.70 |
| OH Shot | 13.20 3.25kg | 13.40 4kg | 14.10 4kg | 15.00 4kg |

## Target group

This test is suitable for all athletes especially throwers (*eg* javelin, discus, shot, hammer) but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential performance in competition and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- quadrathlon test.htm

# 5.28 ■ The Wilf Paish Rugby Football Tests

*The objective of this test is to monitor the general fitness of a rugby player.*

## Required resources

To undertake this test you will require:

- Rugby pitch
- 400m track
- 30 metre tape measure
- Cones
- Assistant.

## How to conduct the tests

**Test 1** – The Cooper 12 minutes run test or multistage fitness test

**Test 2** – 30 metre sprint time, best of three attempts

**Test 3** – Count the number of squat thrusts that can be completed in 1 minute

**Test 4** – Count the number of sit-ups that can be completed in 1 minute

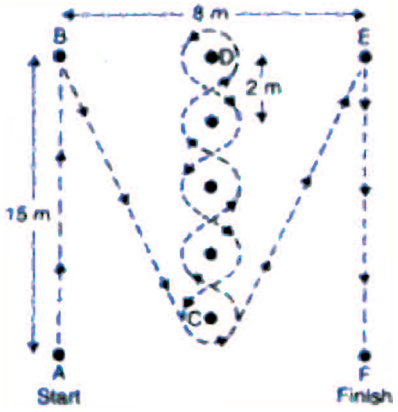
**Test 5** – Count the number of press-ups that can be completed in 1 minute

**Test 6** – Stamina bound over 22 metres, shuttle system, immediate turnabouts, in the following sequence:

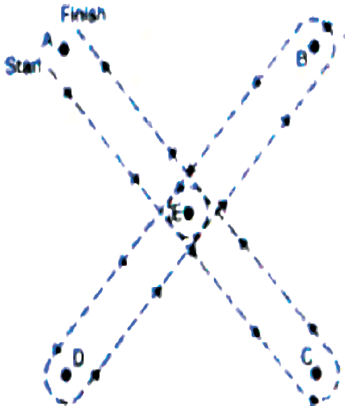
- hop right leg;
- giant strides
- hop left leg
- giant strides
- double foot bounds
- sprint

Record the total time taken for the shuttle sequence

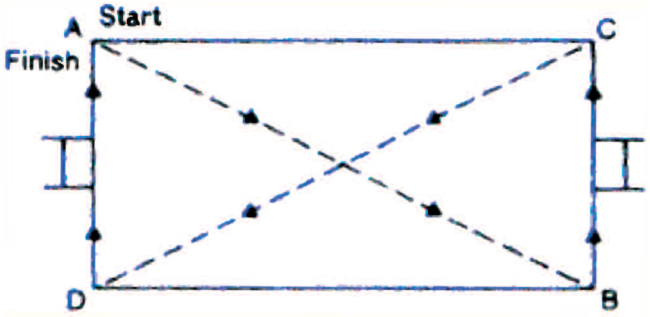
**Test 7** – Zig zag run
Record the time taken to run from A to B, pick up a ball and run to C, zig-zag between cones to D, and then zig-zag back to C. Sprint to E, put the ball down and sprint to F



**Test 8** – Star run
Balls are placed at A and E. The player starts at A with the ball and runs to E, changes the balls over, sprints around the cone at B and back to E to change the balls over. He then runs round cones C and D in turn, changing the ball over at E each time before returning to A. The distance from A to B is 8 metres and from A to D is 15 metres. Record the total time taken to complete the agility run.




**Test 9** – Diagonal pitch run
Record the time taken to sprint from A to B, to C to D, and finish back at A.




## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement in the athlete's fitness and strength.

Points are allocated as follows:

- Test 1 = (Distance – 2560) / 14.4
- Test 2 = (6.7 – Time in seconds) / 0.032
- Test 3 = (number of squats – 25) / 0.65
- Test 4 = (number of sit ups – 15) / 0.5
- Test 5 = (number of press ups – 25) / 0.75
- Test 6 = (78 – total time) / 0.48
- Test 7 = (25.8 – zig zag time) / 0.098
- Test 8 = (16.8 – agility run total time) / 0.068
- Test 9 = (100 – diagonal pitch run time) / 0.4

Add the points for each test to give a total score.

Analysis of the total points is as follows:

- Total points > 800 Excellent
- Total points 700 to 800 Very Good
- Total points 600 to 699 Good
- Total points 500 to 599 Average
- Total points < 500 Poor

## Forward & back differential

In certain circumstances the coach might need to compare the test results of a heavy forward with a much lighter back. When making this comparison a total of 50 points should be added to those achieved by the forward.

## Injury return

In rugby football, a coach is frequently faced with a situation of deciding when a key player is ready to return to squad training and playing. When the injured player is able to score the same total from the tests as was scored prior to the injury then he/she is probably ready for squad training and competition.

## Target group

This test is suitable for players of team sports (Rugby, football *etc*) but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- the wilf paish rugby football tests.htm

# 6 Speed and Power

It is important to remember that the improvement of running speed is a complex process which is controlled by the brain and nervous system. In order for a runner to move more quickly, the leg muscles of course have to contract more quickly, but the brain and nervous systems also have to learn to control these faster movements efficiently. If you maintain some form of speed training throughout the year, your muscles and nervous system do not loose the feel of moving fast and the brain will not have to re-learn the proper control patterns at a later date.

Power is a measure of force being applied at speed and therefore is a fitting commodity in the majority of sports requiring fast dynamic movements such as sprinting, jumping, throwing, weightlifting and most field sports.

## Speed and power evaluation tests

The following are examples of speed and power tests:

- 10 stride test
- 30 metre acceleration test
- 60 metre speed test
- Shuttle run test
- 150 metre endurance test
- 250 metre endurance test
- 400 metre sprint test
- 300 yard shuttle test
- 400 metre drop off test
- Margaria Kalamen power test
- 400 metre control tests
- 40 metre sprint test
- 30 metre sprint fatigue power maintenance test
- Concept 2 rowing step test
- Flying 30 metre speed test
- Kosmin test
- LAS (lactic vs. speed) test
- PWC-170 test
- Wingate anaerobic 30 cycle test
- Sprint speed test
- Multiple sprint test.

# 6.1 ■ 10 Stride Test

*The objective of this test is to monitor the athlete's ability to effectively and efficiently accelerate from a standing start.*

## Required resources

To undertake this test you will require:

- 400m track – with a 20m marked section on the straight
- 30m tape measure
- Stop watch
- Assistant.

## How to conduct the test

The test comprises of 6 x 20m sprints from a standing start and with a full recovery between each run. The assistant should record the:

- time to complete 10 strides (Time) – start the watch on the first foot strike
- the distance covered by the first 10 strides (Distance).

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

From the test results determine for each run:

- Speed in metres/second = Distance / Time (target is >7.5m/sec)
- Average stride length = Distance / 10 (target is >1.5m)
- Strides/second = 10 / Time (target is >4.5 strides/sec)

## Target group

This test is suitable for sprinters but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- ten stride test.htm

# 6.2 ■ 30 Metre Acceleration Test

*The objective of this test is to monitor the development of the athlete's ability to effectively and efficiently accelerate from a standing start or from starting blocks to maximum speed.*

## Required resources

To undertake this test you will require:

- 400m track – with a 30m marked section on the straight
- Stop watch
- Assistant.

## How to conduct the test

The test comprises of 3 x 30m runs from a standing start or from starting blocks and with a full recovery between each run. The assistant should record the time for the athlete to complete the 30m.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Normative data for the 30 metre test

The following are national norms for 16 to 19 year olds.

| Gender | Excellent | Above Average | Average | Below Average | Poor |
|---|---|---|---|---|---|
| Male | <4.0 | 4.2-4.0 | 4.4-4.3 | 4.6-4.5 | >4.6 |
| Female | <4.5 | 4.6-4.5 | 4.8-4.7 | 5.0-4.9 | >5.0 |

*Table reference: Davis B. et al; Physical Education and the Study of Sport; 2000*

## Target group

This test is suitable for sprinters but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high.

## On-line calculator

Select the following link to access the on-line calculator

- 30 metre acceleration test.htm

# 6.3 ■ 60 Metre Speed Test

*The objective of this test is to monitor the development of the athlete's acceleration and pick up to full flight.*

## Required resources

To undertake this test you will require:

- 400m – 60m marked section on the straight
- Stop watch
- Assistant.

## How to conduct the test

The test comprises of 3 x 60m runs from a standing start and with a full recovery between each run.

The athlete uses the first 30m to build up to maximum speed and then maintains the speed through to 60m.

The coach should record the time for the athlete to complete 30m and 60m.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Predictions for 100 and 200 metres

The athlete's 100m time can be predicted from their 60m time using the following algorithm:

- 7.3829894 + ("60m Time" x –0.431975) + ("60m Time" x "60 Time" x 0.1394189)

The athlete's 200m time can be predicted from their 60m time using the following algorithm:

- 13.795573+("60m Time" x –0.720532) + ( "60m Time" x "60m Time" x 0.2806044)

## Target group

This test is suitable for sprinters but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- 60 metre speed test.htm

# 6.4 ■ Shuttle Run Test

*The objective of this test is to assess the athlete's ability to accelerate between marked lines and to rapidly change direction.*

## Required resources

To undertake this test you will require:

- 2 marked parallel lines 9.14m (30ft) apart
- 2 wooden blocks 5cm x 5cm x 10cm
- Stop watch
- Assistant.

## How to conduct the test

- The athlete is required to sprint from the starting line to pick up a block and then place it on the ground behind the starting line. The athlete then sprints to pick up the second block and turns to sprint over the starting line
- The stopwatch is started on the command "Go" and stopped when the athlete's chest crosses the line
- An attempt is not counted if the block is dropped rather than placed on the floor. Also the block must be placed behind and not on the line
- Repeat the test 3 times
- Record the best time.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 6.5 ■ 150 Metre Endurance Test

*The objective of this test is to monitor the development of the athlete's specific endurance for 100 metres.*

## Required resources

To undertake this test you will require:

- 400m track – 15m marked section
- Stop watch
- Assistant.

## How to conduct the test

- The athlete undertakes a 150m run from a standing start
- The assistant records the time for the athlete to complete 150m.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Predicted time for the 100 metres

The athlete's 100m time can be predicted from their 150m time using the following algorithm:

- = –2.496488 + ("150m Time" x 0.9996637) + ( "150m Time" x "150m Time" x –0.010305)

## Target group

This test is suitable for sprinters but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- 150 metre endurance test.htm

# 6.6 ■ 250 Metre Endurance Test

*The objective of this test is to monitor the development of the athlete's specific endurance for 200 metres.*

## Required resources

To undertake this test you will require:

- 400m track – 250m marked section
- Stop watch
- Assistant.

## How to conduct the test

- The athlete undertakes a 250m run from a standing start
- The assistant records the time for the athlete to complete 250m.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Predicted 200m time

The athlete's 200m time can be predicted from their 250m time using the following algorithm:

- =14.531737 + ( "250m Time" x –0.19884) + ( "250m Time" x "250m Time" x 0.0164982)

## Target Group

This test is suitable for sprinters but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- 250 metre endurance test.htm

# 6.7 ■ 400 Metre Sprint Test

*The objective of this test is to monitor the development of the athlete's lactic anaerobic power and capacity and leg speed.*

## Required resources

To undertake this test you will require:

- 400m track
- Cones
- Stop watch
- Assistant.

## How to conduct the test

The test is conducted as follows:

- Place a cone every 50m around the 400m track
- Athlete use a standing start with leading foot behind the starting line
- On the command "Go", the athlete sprints as fast as possible around the 400m track
- Assistant records the time past each cone and the final 400m time.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 6.8 ■ 300 yard Shuttle Test

*The objective of this test is to monitor the athlete's intermediate anaerobic power (lactate system).*

## Required resources

To undertake this test you will require:

- 2 cones placed 25yds (22.8m) apart
- Stop watch
- Assistant.

## How to conduct the test

- The athlete starts at one cone
- The assistant gives the command to 'Go'
- The athlete performs 12 shuttle runs between the two cones
- At each turn the athlete is to touch the cone
- The assistant records the time taken to complete the 12 shuttle runs.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 6.9 ■ 400 Metre Drop Off Test

*The objective of this test is to monitor the athlete's anaerobic efficiency.*

## Required resources

To undertake this test you will require:
- 400m track
- Stop watch
- Assistant.

## How to conduct the test

The test is conducted as follows:
- The athlete is timed running at full speed over 100 metres
- The athlete takes a five-minute recovery
- The athlete is timed running at full speed over 400m
- The time for the 400m is converted to 100m splits by dividing the time by 4
- The 100 metre sprint time is then subtracted from the split-time, giving the drop off time.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

*Example:*
- 100m time = 13.0 seconds
- 400m time = 60.0 seconds
- 60 ÷ 4 = 15 seconds
- 15 – 13 = a drop off time of 2 seconds

The aim is always to reduce the 'drop off' time by increasing anaerobic efficiency.

A top female 400m runner has a 'drop off' time of around 0.7 seconds

## Target group

This test is suitable for sprinters but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- 400m drop off test.htm

# 6.10 ■ Margaria-Kalamen Power Test

*The objective of this test is to monitor the development of the athlete's power.*

## Required resources

To undertake this test you will require:

- Stop watch
- Assistant
- Flight of 12 steps with a starting line of 6m in front of the first step – each step is about 17.5cm high with the 3rd, 6th and 9th step brightly coloured.

## How to conduct the test

The test is conducted as follows:

- The athlete's weight is determined (kg) and recorded
- The athlete undertakes 2 or 3 practice runs up the steps to warm up
- The athlete stands ready at the starting line
- On the command "Go", the athlete sprints to the steps and up the flight of steps taking three steps at a time (3rd, 6th and 9th stairs).
- Assistant records the time to get from the 3rd step to the 9th step – the stopwatch is to be started with foot contact on the 3rd step and stopped with foot contact on the 9th step
- Athlete repeats the test 2 more times – allow a 2-3 minute recovery between each test.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

Power (Watts) is calculated from the formula: $P = (M \times D) * 9.8/t$
where

- P = Power (Watts)
- M = Body mass (kg)
- D = Vertical distance (m)
- t = Time (s).

The vertical distance between the 3rd and 9th step must be accurately measured and used when calculating the power.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- margaria kalamen power test.htm

# 6.11 ■ 400 Metre Control Tests

*The objective of this test is to monitor the speed, speed endurance, strength/general endurance of a 400 metre athlete.*

## Required resources

To undertake this test you will require:

- 400m track
- Cones to mark 150m, 300m and 600m points
- Stop watch
- Assistant.

## How to conduct the test

- The athlete undertakes three separate runs over 150m, 300m and 600m from a standing start and with a full recovery between each run
- The assistant records the time for the athlete to complete each distance.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## 400 metre control test calculations

- Speed endurance index = 300m time – (2 x 150m time)
- Target index value = –11.54156 + (1.1226216 x "150m time") + ("150m time" x "150m time" x –0.015101)

- Strength & general endurance index = 600m time – (2 x 300m time)
- Target index value = –0.733763 + (0.2408302 x "300m Time") + ("300m Time" x "300m Time" x 0.0008366).

*Example:*

- 150m = 15 seconds
- 300m = 32 seconds
- 600m = 71 seconds

- Speed endurance index = 2.0
- Target index value = 1.9

- Strength & general endurance index = 7.0
- Target index value = 7.83

## Speed endurance index

If the athlete's speed endurance index is greater than the target index value, and provided the 150m time is in line with training targets, then more speed endurance work (lactic anaerobic) is indicated.

## Strength & general endurance index

If the athlete's strength & general endurance index is greater than the target index value, and provided the 300m time is in line with training targets, then more strength and general endurance work (aerobic) is indicated.

## Target group

This test is suitable for sprinters but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- 400 metre control tests.htm

# 6.12 ■ 40 Metre Sprint Test

*The objective of this test is to monitor the development of the athlete's acceleration and speed.*

## Required resources

To undertake this test you will require:

- 400m track
- Cones
- Stop watch
- Assistant.

## How to conduct the test

The test is conducted as follows:

- Mark with cones a 40m section on the track
- Athlete use a standing start with leading foot behind the starting line
- On the command "Go", the athlete sprints as fast as possible through to the finish line
- Assistant records the time
- Athlete should have two attempts with approximately 2-5 minutes recovery period.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

No published tables to relate results to potential performance in competition.

# 6.13 ■ 30 Metre Sprint Fatigue – Power Maintenance Test

*In sports such as basketball, hockey, rugby and soccer, players often have to reproduce sprints in quick succession. The ability to recover between sprints and produce the same level of power over and over again is a measure of your sprint fatigue.*

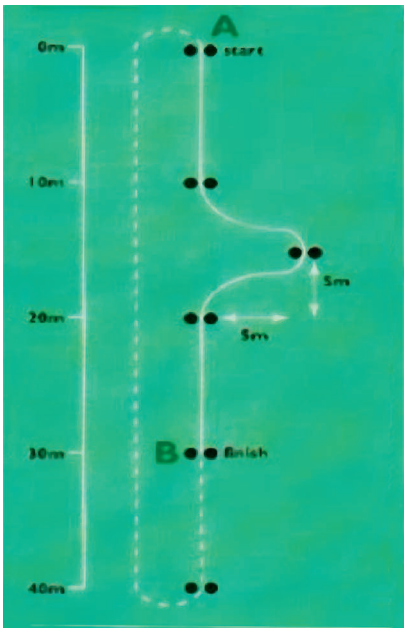
## Required resources

To undertake this test you will require:

- 40m section of a track
- 12 Cones to mark out the course (see diagram)
- Stop watch
- Assistant.

## How to conduct the test

- The athlete sprints from A to B between the cones deviating 5m sideways in the middle of the sprint
- The assistant records the time for the athlete to complete the sprint from A to B
- The athlete jogs slowly back to point A (taking no longer than 30 seconds to do so) following the route on the diagram
- When the athlete reaches point A repeat the sprint to point B
- The athlete is to complete a total of 10 sprints.




## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Sprint fatigue

Using the 10 recorded sprint times subtract your fastest time from your slowest time. For example if your slowest sprint was 7.8 seconds and your fastest sprint was 6.9 seconds your sprint fatigue is 0.9 (7.8 – 6.9).

## Power maintenance

Determine the average speed of the first 3 trials and divide it by the average speed of the last 3 trials. So if your times were:

7.1 seconds, 6.9 seconds, 6.9 seconds,
7.0 seconds, 7.2 seconds, 7.1 seconds, 7.3 seconds,
7.3 seconds, 7.4 seconds, 7.5 seconds,

the average of the first 3 times (7.1, 6.9, and 6.9) is 6.97 seconds and the average of the last 3 times (7.3, 7.4, and 7.5) is 7.40 seconds.

$6.97 \div 7.40 = 0.94$

- Excellent = 0.9
- Good = 0.85 to 0.89
- Average = 0.80 to 0.84
- Poor = <0.79.

## Target group

This test is suitable for active individuals but not for those where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 6.14 ■ Concept 2 Rowing Step Test

*The objective of this test is to monitor the development of the athlete's anaerobic threshold.*

## Required resources

To undertake this test you will require:

- Concept 2 Rowing Machine
- Heart rate monitor
- Assistant.

## How to conduct the test

The test consists of five four minute rows, each rowed at a constant 500m pace. The pace is increased for each step and you have a 30 second recovery between each row. The 5th step is at 100% (maximum) effort.

For each step you need to record the set 500m/pace, distance rowed in 4 minutes, the stroke rate, the actual 500m pace and steady state heart rate. Heart rate reaches its steady state after approximately 3 minutes of rowing.

*Example:*
The following is an example of a test for an athlete whose best time for the 2000m is 6 minutes 32 seconds, which is an average 500m split of 1 minute 38 seconds.

- Step 1 – 4 minutes at 1 minute 59 seconds/500m
  - 30 seconds recovery – record distance, stroke rate, set & actual 500m pace and steady pace heart rate
- Step 2 – 4 minutes at 1 minute 54 seconds/500m
  - 30 seconds recovery – record distance, stroke rate, set & actual 500m pace and steady pace heart rate
- Step 3 – 4 minutes at 1 minute 50 seconds/500m
  - 30 seconds recovery – record distance, stroke rate, set & actual 500m pace and steady pace heart rate
- Step 4 – 4 minutes at 1 minute 47 seconds/500m
  - 30 seconds recovery – record distance, stroke rate, set & actual 500m pace and steady pace heart rate
- Step 5 – 4 minutes at Maximum effort
  - Record distance, stroke rate, actual 500m pace and steady pace heart rate.

## Analysis

Analysis of the results is by comparing it with the results of previous tests. Improvement in endurance is indicated when you find that the steady state heart rate is lower for any given 500m pace when compared to a previous test. It is expected that, with appropriate training between each test, the analysis would indicate an improvement in the athlete's anaerobic threshold.

Iimprovement in endurance is indicated when the heart rate is lower for any given step – the heart is doing less work for the same pace/effort.

## Target group

This test is only suitable for competitive rowers whose time for the 2000m is less than 8 minutes 30 seconds but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- concept 2 rowing step test.htm

# 6.15 ■ Flying 30 Metre Test

*The objective of this test is to monitor the development of the athlete's maximum speed.*

## Required resources

To undertake this test you will require:

- 400m track – 60m marked section on the straight
- Cone to mark 30m point
- Stop watch
- Assistant.

## How to conduct the test

The test comprises of 3 x 60m runs from a standing start and with a full recovery between each run.

The athlete uses the first 30m to build up to maximum speed and then maintains the speed through to 60m.

The assistant should record the time for the athlete to complete the:

- first 30m
- whole 60m.

To determine the athletes flying 30m time subtract the time for the first 30m from the time for the whole 60m.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Predictions for 100 and 200m

The athlete's 100m time can be predicted from their flying 30m time using the following algorithm:

- 4.8793289 + (Time x 2.2011769) + (Time x Time x –0.040363).

The athlete's 200m time can be predicted from their flying 30m time using the following algorithm:

- 8.9693467 + (Time x 4.787071) + (Time x Time x –0.107128).

## Normative data for the flying 30 metre test

The following data has been obtained from the results of tests conducted with world class athletes.

| % Rank | Females | Males |
|---|---|---|
| 91-100 | 2.90-2.99 seconds | 2.50-2.59 seconds |
| 81-90 | 3.00-3.09 seconds | 2.60-2.69 seconds |
| 71-80 | 3.10-3.19 seconds | 2.70-2.79 seconds |
| 61-70 | 3.20-3.29 seconds | 2.80-2.89 seconds |
| 51-60 | 3.30-3.39 seconds | 2.90-2.99 seconds |
| 41-50 | 3.40-3.49 seconds | 3.00-3.09 seconds |
| 31-40 | 3.50-3.59 seconds | 3.10-3.19 seconds |
| 21-30 | 3.60-3.69 seconds | 3.20-3.29 seconds |
| 11-20 | 3.70-3.79 seconds | 3.30-3.39 seconds |
| 1-10 | 3.80-3.89 seconds | 3.40-3.49 seconds |

*Table reference: D.A. Chu; Explosive Power and Strength; Human Kinetics; 1996*

## Target group

This test is suitable for sprinters but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential level of fitness and the correlation is high with experienced athletes.

## On-line calculator

Select the following link to access the on-line calculator

- flying 30 metre test.htm

# 6.16 ■ Kosmin Test

*The Kosmin test was devised in the USSR to predict an athlete's 800 metre or 1500 metre time.*

## Required resources

To undertake this test you will require:

- 400m track
- Stop watch
- Assistant.

## How to conduct the test

### 800 metres

The athlete is required to run two controlled maximal efforts of 60 seconds with a recovery of 3 minutes. The athlete commences their second run from the point where the first run was completed. The total distance covered by the two runs is recorded:

- Run for 60 seconds
- 3 minute recovery
- Run for 60 seconds – start from the point at which you finished the last 60 second run
- Record total distance covered.

### 1500 metres

The athlete is required to run four controlled maximal efforts of 60 seconds with a diminishing recovery of 3 minutes, 2 minutes and 1 minute. The athlete commences their next run from the point where the previous run was completed. The total distance covered by the four runs is recorded

- Run for 60 seconds
- 3 minute recovery
- Run for 60 seconds – start from the point at which you finished the last 60 second run
- 2 minutes recovery
- Run for 60 seconds – start from the point at which you finished the last 60 second run
- 1 minute recovery
- Run for 60 seconds – start from the point at which you finished the last 60 second run
- Record total distance covered.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

The athlete's potential 800m or 1500m time can be predicted by using the total distance covered in the following appropriate equation.

| Distance | Equation |
|---|---|
| 800m | Time = 217.77778 – (Total Distance x 0.119556) |
| 1500m | Time = 500.52609 – (Total Distance x 0.162174) |

## Target group

This test is suitable for middle distance athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are published tables to relate results to potential performance in competition and the correlation is high.

## Limitations

The equations can be used for male and female athletes but they do tend to over predict for female athletes. For females I recommend you add 5 seconds for the 800ms time and 10 seconds for the 1500m time.

## On-line calculator

Select the following link to access the on-line calculator

- kosmin 1500m test.htm
- kosmin 800m test.htm

# 6.17 ■ The LAS (Lactic vs. Speed) Test

*The objective of this test is to monitor the 400 metre athlete's speed endurance.*

## Required resources

To undertake this test you will require:

- 400m track
- Stop watch
- Assistant.

## How to conduct the test

- Have the athlete perform a 500m time trial
- Record the time (T1)
- At least 48 hours later have the athlete perform the following sprints:
  - 50m – record the time (T2)
  - 4 minutes recovery
  - 100m – record the time (T3)
  - 4 minutes recovery
  - 150m – record the time (T4)
  - 4 minutes recovery
  - 200m – record the time (T5)

## Analysis

Sum the times S1 = T2 + T3 + T4 + T5

Compare the times T1 (time for the 500m run) and S1 (total time for the sprints) – In my experience the difference should not exceed 5 seconds. If the difference is more than 5 seconds then this indicates a lack of endurance and a difference less than 5 seconds indicates a lack of speed.

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Target group

This test is suitable for male and female 400m runners.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- the las (lactic vs speed ) test.htm

# 6.18 ■ PWC-170 Cycle Test

*The objective of the PWC-170 test is to predict the power output (watts) at a projected heart rate of 170 beats per minute (bpm).*

## Required resources

To undertake this test you will require:

- Bicycle ergometer
- Heart rate monitor
- Stop watch
- Assistant.

## How to conduct the test

The athlete performs two consecutive six minute bicycle ergometer rides in which the work loads are selected to produce a heart rate between 120 and 140 bpm on the first session and 150 and 170 bpm on the second session. For each session the average Heart Rate (bpm) and Power Output (watts) are recorded.

## Analysis

Analysis of the result is by comparing it with the result of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Calculations

- Use a graph to plot the two points: X axis = Power (Watts) and Y axis = Heart Rate (bpm). Draw a straight line through the two points so that it is extended to 170 bpm.
- Draw a perpendicular line from the point plotted at a heart rate of 170 bpm to the X axis
- Read off the projected power output at this point.

An alternative mathematical approach to determining the power output at 170 bpm is the Polynomial Approximation method.

- Power output $=((P1 \times HR2) - (P2 \times HR1)) / (HR2 - HR1) + (170 \times ((P1 - P2) / (HR1 - HR2)))$

Where:

- P1 = Power (watts) for session 1
- P2 = Power (watts) for session 2

- HR1 = Heart rate for session 1
- HR2 = Heart rate for session 2

*Example:*

An athlete produces the following test results:

- Session 1 – average heart rate of 130 bpm at 100 watts (600 kg/minute)
- Session 2 – average heart rate of 153 bpm at 150 watts (900 kg/minute)
- The predicted power output at 170 bpm is approximately 187 watts.

Power output = ((100 x 153) – (150 x 130)) / (153 – 130) + (170 x ((100 – 150) / (130 – 153)))
Power output = (15300 – 19500) / 23 + (170 x (–50/–23))
Power output = –182.6 + 369.57
Power output = 186.96 watts.

## Target group

This test is suitable for sprint cyclists and sprinters but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- pwc-170 cycle test.htm

# 6.19 ■ The Wingate Anaerobic 30 Cycle Test

The Wingate anaerobic 30 cycle test (WANT) was developed during the 1970s at the Wingate institute in Israel. The WANT has been the most popular anaerobic test to date but as a cycle ergometer test it is more specific to cycle based sports. The most commonly used test length has been thirty seconds. This is a time period for maximal efforts where the major fuel source is anaerobic.

The test is used to determine peak anaerobic power and anaerobic capacity. Anaerobic power is the ability to produce energy by the ATP-PC energy pathway. Anaerobic capacity is the combined ability of both anaerobic pathways to produce energy and so is shown as the average power output during the test

## How to conduct the test

The testing device is a mechanically-braked bicycle ergometer. After a 10 minute warm up the athlete begins pedalling as fast as possible without any resistance. Within 3 seconds, a fixed resistance is applied to the flywheel and the athlete continues to pedal "all out" for 30 seconds. An electrical or mechanical counter continuously records flywheel revolutions in 5 second intervals.

## Resistance

Flywheel resistance equals 0.075 kg per kg body mass. For a 70 kg person, the flywheel resistance would equal 5.25 kg (70 kg x 0.075). Resistance often increases to 1.0 kg x body mass or higher (up to 1.3 kg) when testing power and sprint athletes.

## Analysis

Analysis of the result is by comparing it with the result of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Calculations

**Peak Power Output (PP)**

The highest power output, observed during the first 5 sec of exercise, indicates the energy generating capacity of the immediate energy system (intramuscular high energy phosphates ATP and PC). PP is calculated as follows:

- PP = Force x Distance (number of revolutions x distance per revolution) / Time in minutes (5 seconds = 0.0833 minutes).

Percentile norms for Peak Power for active young adults are:

| | Male | Female |
|---|---|---|
| % Rank | Watts/kg | Watts/kg |
| 90 | 822 | 560 |
| 80 | 777 | 527 |
| 70 | 757 | 505 |
| 60 | 721 | 480 |
| 50 | 689 | 449 |
| 40 | 671 | 432 |
| 30 | 656 | 399 |
| 20 | 618 | 376 |
| 10 | 570 | 353 |

*Maud, P.J., and Schultz B.B: 1989*

### Relative Peak Power Output (RPP)

Peak power output relative to body mass is calculated as follows:

- RPP = PP / Body mass (kg).

Percentile norms for Relative Peak Power for active young adults are:

| | Male | Female |
|---|---|---|
| %Rank | Watts/kg | Watts/kg |
| 90 | 10.89 | 9.02 |
| 80 | 10.39 | 8.83 |
| 70 | 10.20 | 8.53 |
| 60 | 9.80 | 8.14 |
| 50 | 9.22 | 7.65 |
| 40 | 8.92 | 6.96 |
| 30 | 8.53 | 6.86 |
| 20 | 8.24 | 6.57 |
| 10 | 7.06 | 5.98 |

*Maud, P.J., and Schultz B.B: 1989*

### Anaerobic Fatigue (AF)

AF represents the systems total capacity to produce ATP via the immediate and short-term energy systems. AF provides percentage decline in power output and is calculated as follows:

- AF = Highest 5 sec PP – Lowest 5 sec PP / Highest 5 sec PP x 100.

**Anaerobic Capacity (AC)**
Total work accomplished in 30 seconds. AC is calculated as follows:

- AC = Sum of each 5 sec PP or
- AC = Force x Total distance in 30 seconds.

## Target group

This test is suitable for sprint cyclists and sprinters but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

Assessment of anaerobic performance can provide the coach with valuable information about the athlete's fitness status as well as allowing them to monitor progress through training. The test scores can reliably determine peak anaerobic power, anaerobic fatigue, and total anaerobic capacity.

# 6.20 ■ 35 Metre Speed Test

*The objective of the sprint speed test is to assess maximum running speed. It involves running a single maximum sprint over a set distance.*

## Required resources

To undertake this test you will require:

- Measuring tape or marked track
- Stop watch or timing gates
- Markers
- Assistant.

## How to conduct the test

- The athlete undertakes a warm up
- A cone/marker is placed at 35m from the start line
- The athlete sprints the 35m from a sprint start
- The assistance records the time the athlete takes to complete the 35m
- The best of 3 x 35m sprints is recorded.

## Analysis

Analysis of the result is by comparing it with the result of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

The following table is for adults

| Rating | Male | Female |
|---|---|---|
| Excellent | < 4.80 | < 5.30 |
| Good | 4.80-5.09 | 5.30-5.59 |
| Average | 5.10-5.29 | 5.60-5.89 |
| Fair | 5.30-5.60 | 5.90-6.20 |
| Poor | > 5.60 | > 6.20 |

## Target group

This test is suitable for sprinters but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- 35 metre speed test.htm

# 6.21 ■ Multiple Sprint Test

*The objective of this test is to monitor the development of the athlete's speed.*

## Required resources

To undertake this test you will require:

- Track
- Marker cones
- Stop watch
- Assistant.

## How to conduct the test

The test is conducted as follows:

- A 40m straight section on the track is marked with cones
- The athlete performs six 40m sprints with 30 seconds recovery between each sprint
- The assistant records the time for each of the 40m sprints.

## Analysis

The quickest sprint time is multiplied by 6 to give an optimal sprint time.

The difference between the total and optimal times indicates the level of fatigue experienced in the performer.

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement.

## Performance assessment

A difference between the total and optimal times of less than 0.8s would be regarded as excellent for a senior player.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# 7 Sports Psychology

The increased stress of competitions can cause athletes to react both physically and mentally in a manner which can negatively affect their performance abilities. They may become tense, their heart rates race, they break into a cold sweat, they worry about the outcome of the competition, they find it hard to concentrate on the task in hand.

This has led coaches to take an increasing interest in the field of sport psychology and in particular in the area of competitive anxiety. That interest has focused on techniques which athletes can use in the competitive situation to maintain control and optimise their performance. Once learned, these techniques allow the athlete to relax and to focus his/her attention in a positive manner on the task of preparing for and participating in competition.

## Sports Psychology evaluation tests

The following are examples of psychology tests:

- Sport Competition Anxiety Test (SCAT)
- TEOSQ – Task and Ego Orientation in Sport Questionnaire

# 7.1 ■ Sport Competition Anxiety Test (SCAT)

## Assessing Your Anxiety

*Read each statement below, decide if you "Rarely", "Sometimes" or "Often" feel this way when competing in your sport, and tick the appropriate box to indicate your response.*

| | Rarely | Some-times | Often |
|---|---|---|---|
| 1. Competing against others is socially enjoyable | ☐ | ☐ | ☐ |
| 2. Before I compete I feel uneasy | ☐ | ☐ | ☐ |
| 3. Before I compete I worry about not performing well | ☐ | ☐ | ☐ |
| 4. I am a good sportsman when I compete | ☐ | ☐ | ☐ |
| 5. When I compete, I worry about making mistakes | ☐ | ☐ | ☐ |
| 6. Before I compete I am calm | ☐ | ☐ | ☐ |
| 7. Setting a goal is important when competing | ☐ | ☐ | ☐ |
| 8. Before I compete I get a queasy feeling in my stomach | ☐ | ☐ | ☐ |
| 9. Just before competing, I notice my heart beats faster than usual | ☐ | ☐ | ☐ |
| 10. I like to compete in games that demands a lot of physical energy | ☐ | ☐ | ☐ |
| 11. Before I compete I feel relaxed | ☐ | ☐ | ☐ |
| 12. Before I compete I am nervous | ☐ | ☐ | ☐ |
| 13. Team sports are more exciting than individual sports | ☐ | ☐ | ☐ |
| 14. I get nervous wanting to start the game | ☐ | ☐ | ☐ |
| 15. Before I compete I usually get uptight | ☐ | ☐ | ☐ |

**Athlete's Name** _____

**SCAT Score** _____

Less than 17 : You have a low level of anxiety
17 to 24 : You have an average level of anxiety
More than 24 : You have a high level of anxiety

## Analysis

The score for the response to each question is detailed below. Enter the score for each question in the "Athlete's Score" column and then total the column up to provide a SCAT score.

Note that questions 1, 4, 7, 10 and 13 score zero regardless of the response.

| Question No | Rarely | Sometimes | Often | Athlete's Score |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | |
| 2 | 1 | 2 | 3 | |
| 3 | 1 | 2 | 3 | |
| 4 | 0 | 0 | 0 | |
| 5 | 1 | 2 | 3 | |
| 6 | 3 | 2 | 1 | |
| 7 | 0 | 0 | 0 | |
| 8 | 1 | 2 | 3 | |
| 9 | 1 | 2 | 3 | |
| 10 | 0 | 0 | 0 | |
| 11 | 3 | 2 | 1 | |
| 12 | 1 | 2 | 3 | |
| 13 | 0 | 0 | 0 | |
| 14 | 1 | 2 | 3 | |
| 15 | 1 | 2 | 3 | |
| | | | **Total** | |

| SCAT Score | | Analysis |
|---|---|---|
| Less than 17 | : | You have a low level of anxiety |
| 17 to 24 | : | You have an average level of anxiety |
| More than 24 | : | You have a high level of anxiety |

## On-line calculator

Select the following link to access the on-line calculator

- sport competition anxiety test.htm

# 7.2 ■ TEOSQ – Task and Ego Orientation in Sport Questionnaire

*The Task and Ego Orientation in Sport Questionnaire (TEOSQ) can be used to assess whether an individual defines success in a sporting context as mastery (task orientated) or outperforming others (ego orientated).*

## Questionnaire

TEOSQ is a 13 item questionnaire measuring task orientation (7 questions) and the other ego orientation (6 questions). Before completing the questionnaire, the individual is asked to think of a time when they felt most successful in their sport and answer the questions based on this. The answers are indicated on a 5 point scale, where 1 = strongly agree and 5 = strongly disagree.

## Questions

Consider the statement "I feel most successful in sport when…" and read each of the following statements listed below and indicate how much you personally agree with each statement by entering an appropriate score where:

- 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree

I feel most successful in sport when…

1. I am the only one who can do the play or skill
2. I learn a new skill and it makes me want to practise more
3. I can do better than my friends
4. The others cannot do as well as me
5. I learn something that is fun to do
6. Others mess up "and" I do not
7. I learn a new skill by trying hard
8. I work really hard
9. I score the most points/goals/hits, *etc*
10. Something I learn makes me want to go practise more
11. I am the best
12. A skill I learn really feels right
13. I do my very best.

## Analysis

The ego orientated questions are questions: 1, 3, 4. 6, 9 and 11

The task orientated questions are questions: 2, 5, 7, 8, 10, 12 and 13

A mean score is calculated by adding all the scores for all the task orientated questions and dividing by 7 and doing the same for the ego orientated questions but dividing by 6.

This gives a mean score between 1 (low) and 5 (high) for each orientation.

## Target group

This test is suitable for all athletes.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- the task and ego orientation in sport questionnaire.htm

# 8 General Health

Athletes are often under a lot of pressure to perform well on a regular basis. This pressure can result in the athlete overtraining and/or becoming stressed. It is therefore important to be proactive in monitoring the athlete's state of health.

## General health status tests

The following are examples of general health status tests:

- Orthostatic heart rate test
- Urine colour measurement
- Waist to hip ratio evaluation test

# 8.1 ■ Orthostatic Heart Rate Test

*The objective of this test is to monitor the athlete's state of health. Athletes are often under a lot of pressure to perform well on a regular basis. This pressure can result in the athlete overtraining and/or becoming stressed.*

## Required resources

To undertake this test you will require:

- Stop watch
- Knowledge of how to take you pulse rate.

## How to conduct the test

The test is conducted as follows:

- Lay down and rest for at least 15 minutes
- Record your pulse rate (beats/min) – R1
- Stand up
- 15 seconds later record you pulse rate (beats/minute) – R2
- Record the difference between R1 and R2.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate recovery between training sessions, the analysis would indicate an improvement.

## Performance assessment

If the difference (R2-R1) is greater than 15 to 20 beats then it is probable that the athlete has not recovered from the previous days training or is under stress. The athlete should consider adjusting the training programme to allow them to fully recover.

## Target group

This test is suitable for all athletes.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

## On-line calculator

Select the following link to access the on-line calculator

- orthostatic heart rate test.htm

# 8.2 ■ Urine Colour Measurement

*The objective of the test is to monitor the athlete's level of hydration.*

## Required resources

To undertake this test you will require:

- Clip boards
- Recording sheets
- Pens
- Urine specimen containers
- ice bucket for storage
- Ice
- Colour rating chart
- Gloves.

## How to conduct the test

The first part of the urine stream is discarded and then a small sample of urine is collected into a clear jar. Measurement may be done immediately, or the specimen can be stored for later analysis. The sample is usually collected first thing in the morning. It may also be of interest to collect samples prior to or post exercise, though there may be a time delay for the effect of dehydration to show in the urine colour.

## Analysis

The sample should be held up in front of a white background, in good light, and the colour compared to the chart below. A urine colour rating of 1, 2 or 3 is considered to be well-hydrated (Armstrong, 2000). Based on these results, changes in fluid intake can be made.

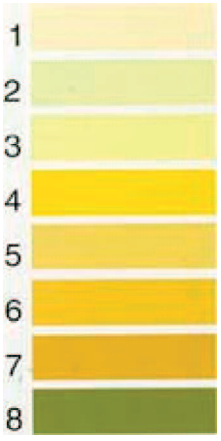



*Chart adapted from Armstrong 2000*

## Precautions:

- Certain medicines and vitamins may cause the colour of the urine to change. If any of these have been taken, this test is unreliable
- The colours your see on the screen, or when you print the image out, may appear different to the original chart. Therefore this chart should only be used as a guide. If more accurate comparison is required, please go to an original source.

# 8.3 ■ Waist to Hip Ratio Evaluation Test

*The more weight you carry in your stomach, the higher your risk for coronary artery disease (CAD).*

## Required resources

To undertake this test you will require:

- Tape measure.

## How to conduct the test

The test is conducted as follows:

- Use a tape measure to measure your waist and hips in inches.

## Analysis

Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate diet and training between each test, the analysis would indicate an improvement.

## Performance assessment

Divide your waist by your hip measurement.

High CAD risk for men is greater than 1.0 and for women, high risk is greater than 0.85.

*Example*

- If your waist is 36 inches and your hips are 42 inches
- 36 / 42 = 0.85
- This signifies a moderate/high risk for CAD.

## Target group

This test is suitable for active athletes but not for individuals where the test would be contraindicated.

## Reliability

Reliability would depend upon how strict the test is conducted and the individual's level of motivation to perform the test.

## Validity

There are no published tables to relate results to potential performance in competition.

# Appendix A ■ $VO_2$max Tables

*The following tables provide an assessment of an athlete's $VO_2$max score.*

**Female (values in ml/kg/min)**

| Age | Very Poor | Poor | Fair | Good | Excellent | Superior |
|---|---|---|---|---|---|---|
| 13-19 | <25.0 | 25.0-30.9 | 31.0-34.9 | 35.0-38.9 | 39.0-41.9 | >41.9 |
| 20-29 | <23.6 | 23.6-28.9 | 29.0-32.9 | 33.0-36.9 | 37.0-41.0 | >41.0 |
| 30-39 | <22.8 | 22.8-26.9 | 27.0-31.4 | 31.5-35.6 | 35.7-40.0 | >40.0 |
| 40-49 | <21.0 | 21.0-24.4 | 24.5-28.9 | 29.0-32.8 | 32.9-36.9 | >36.9 |
| 50-59 | <20.2 | 20.2-22.7 | 22.8-26.9 | 27.0-31.4 | 31.5-35.7 | >35.7 |
| 60+ | <17.5 | 17.5-20.1 | 20.2-24.4 | 24.5-30.2 | 30.3-31.4 | >31.4 |

**Male (values in ml/kg/min)**

| Age | Very Poor | Poor | Fair | Good | Excellent | Superior |
|---|---|---|---|---|---|---|
| 13-19 | <35.0 | 35.0-38.3 | 38.4-45.1 | 45.2-50.9 | 51.0-55.9 | >55.9 |
| 20-29 | <33.0 | 33.0-36.4 | 36.5-42.4 | 42.5-46.4 | 46.5-52.4 | >52.4 |
| 30-39 | <31.5 | 31.5-35.4 | 35.5-40.9 | 41.0-44.9 | 45.0-49.4 | >49.4 |
| 40-49 | <30.2 | 30.2-33.5 | 33.6-38.9 | 39.0-43.7 | 43.8-48.0 | >48.0 |
| 50-59 | <26.1 | 26.1-30.9 | 31.0-35.7 | 35.8-40.9 | 41.0-45.3 | >45.3 |
| 60+ | <20.5 | 20.5-26.0 | 26.1-32.2 | 32.3-36.4 | 36.5-44.2 | >44.2 |

*Table reference: The Physical Fitness Specialist Certification Manual, The Cooper Institute for Aerobics Research, Dallas TX, revised 1997 printed in Advance Fitness Assessment & Exercise Prescription, 3rd Edition, Vivian H. Heyward, 1998.p48*