

# LECTURE 8

## Fitness Tests

- 35m Sprint test
- Back-strength Dynamometer
- Balance Stork Test
- Body Mass Index (BMI)
- Coordination Test
- Hand-grip Test
- Harvard Step Test
- Waist: Hip-ratio & Weight
- Illinois Agility Run
- One Step Max
- Peak Flow Test
- Press-up Test
- Reaction-time Test
- Simple Step Test
- Sit & reach Test
- Sit-up Test
- Static Flexibility Test – shoulder & wrist
- Vertical Jump Test
- VO2 Max Test – treadmill
- Wingate Test

The following tests are examples of the dozens that are widely available. Some of them are very basic and suitable for the average client while some are for serious, elite athletes. Some need only very basic equipment while others need expensive specialised equipment.

Once again, we want to reiterate that tests should only be used if you have a specific purpose in mind – that you wish to find out information about the client which will help you design an appropriate programme for them.

# 35 Metre Sprint Test

Before doing this test, make sure that the client has enough tolerance to perform it and not get injured. The test is more suitable for performance athletes.

## Equipment needed:

A space more than 35 metres in length.

## Protocol:

- Warm the client up first with several minutes of jogging
- Mark out a 35m straight, level run, clearly marked at each end
- From a standing start ask the client run as fast as they can down the course
- They shouldn't stop until they are well past the finish line
- Let them recover over several minutes then repeat the test

## Normative data for the 35 Metre Sprint Test:

Time to run 35m (in seconds)

Rating	Men	Women
Very good	< 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

Client scores:

Attempt 1

Attempt 2

# Back Strength Dynamometer

## Equipment needed:

This test would only be used in specialised circumstances with particular athletes such as Olympic weight-lifters or maybe rowers who need to measure their back strength. It requires a quite expensive, dedicated piece of equipment.

## Protocol - how to use the equipment:

### Press the ON/C button

The power is turned on and the display shows 0.0kg after a few seconds of changing indication.

### Perform the first measurement

The display shows the reading of the first measurement.

### Perform the second measurement

The display indicates the reading of the second measurement.  
After about 3 seconds, the display flashes the maximum value.

**Note:** After two times of measurement, the display flashes the maximum value as the final reading of the instrument.  
The maximum value will not be indicated if you press the ON/C button for each measurement.

### Record the measured value

To repeat the measurement, press the ON/C button.

### Press the OFF button when the measurement is completed.

**Note:** When the instrument is left unused for about one minute, the power will be turned off automatically.

### Important Note

After a measurement the client should stop pulling immediately. The instrument starts measuring when the force applied goes above 20kg and stops measuring when it goes below 17kg.

## Protocol:

- The client stands on the platform with their feet about 15cm apart from each other
- They hold the handles with both hands. Legs are straight and the chain is adjusted so that the back tilts forward at an angle of 30 degrees.
- They then pull the handle by gradually raising their upper body. The legs must be kept straight.

## Normative Data for the Back Strength Dynamometer:

Average values of back strength by age (kg)								
Age	Male	Female	Age	Male	Female	Age	Male	Female
10	57.5	48.4	30	143.5	86.0	50	122.0	76.0
11	69.0	57.3	31	143.0	85.9	51	119.0	75.0
12	82.3	63.2	32	142.5	85.8	52	117.9	74.0
13	99.8	72.0	33	142.0	85.7	53	114.0	73.0
14	116.0	75.8	34	141.5	85.6	54	110.0	72.0
15	121.6	76.9	35	141.0	85.5	55	108.0	70.0
16	131.5	77.4	36	140.5	85.4	56	105.0	68.0
17	136.6	79.4	37	140.0	85.3	57	102.0	66.0
18	138.3	80.9	38	139.5	85.2	58	100.0	64.0
19	142.0	83.5	39	139.0	85.1	59	98.0	62.0
20	144.4	85.0	40	138.0	84.4	60	97.0	60.0
21	147.2	87.2	41	137.0	84.0	61	95.0	56.0
22	145.0	87.6	42	136.0	83.4	62	94.0	54.0
23	143.6	87.4	43	135.0	83.0	63	92.0	52.0
24	144.4	87.2	44	134.0	82.4	64	90.0	49.0
25	142.8	87.0	45	133.0	81.4	65	89.0	47.0
26	145.7	86.8	46	132.0	80.4	66	88.0	45.0
27	143.0	86.6	47	130.0	79.4	67	86.0	44.0
28	144.8	86.4	48	128.0	78.4	68	85.0	43.0
29	144.1	86.2	49	125.0	77.4	69	84.0	41.3
						70	83.0	40.0

Source: "Standard Values of Physical Strength of the Japanese 2000" by the Standard Physical Strength Survey Team, Tokyo Metropolitan University

# Balance Stork Test

## Equipment needed:

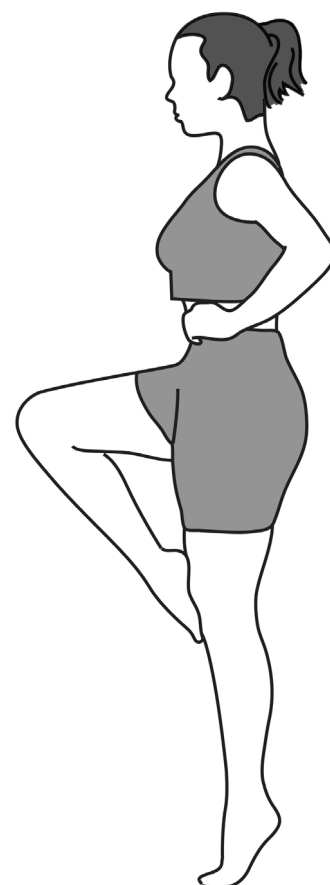
Flat, non-slip surface, stopwatch, methods for recording results.

## Protocol:

Remove the shoes and place the hands on the hips, then position the non-supporting foot against the inside knee of the supporting leg. The subject is given one minute to practise the balance. The subject raises the heel to balance on the ball of the foot. The stopwatch is started as the heel is raised from the floor. The stopwatch is stopped if any of the following occur:

- The hand(s) come off the hips
- The supporting foot swivels or moves (hops) in any direction
- The non-supporting foot loses contact with the knee.
- The heel of the supporting foot touches the floor

Rating	Score (seconds)
Excellent	> 50
Good	40 - 50
Average	25- 39
Fair	10 - 24
Poor	< 10



## Scoring:

The total time in seconds is recorded. The score is the best of three attempts. The table lists general ratings for this test.

## Variations:

The Stork Balance Test is also sometimes conducted with the eyes closed, giving it a higher level of difficulty. See also the similar Flamingo Balance Test.

## Alpha-Fit Version:

In the Alpha-Fit version of this test, the hands do not need to be placed on the hip, and timing stops if the hands go above the horizontal level. There is also a 60 second maximum score.

## Reference:

Johnson BL, Nelson JK. Practical Measurements for Evaluation in Physical Education. 4th ed. Minneapolis: Burgess, 1979.

# Body Mass Index (BMI)

## Equipment needed:

Tape measure and weighing scales.

## Protocol:

1. Take the height of client in metres (m)
2. Take the weight of client in kilogrammes(kg)
3. Using the equation below calculate the client's Body Mass Index (BMI).

## Body Mass:

Height    Kg <input type="text"/>	<input type="text"/> Kg m <sup>2</sup>
Height    m <input type="text"/> m <sup>2</sup> <input type="text"/>	BMI = <input type="text"/>

## Normative Data for BMI and Health Risks:

Body Mass Index Classifications		
Classification	Health Risk	BMI Score
Under weight	Moderate	Less than 18.5
Normal	Very Low	18.5 – 24.9
Overweight	Low	25.0 – 29.9
Obese Class 1	Moderate	30.0 – 34.9
Obese Class 2	High	35.0 – 39.9
Extremely Obese	Very High	Greater then 40

# Alternate Hand Wall Toss Test

The purpose of this test is to measure hand-eye coordination.

## Equipment needed:

Tennis ball or baseball, smooth wall, marking tape, stopwatch (optional).

## Protocol:

- A mark is placed a certain distance from the wall (e.g. 2 metres, 6 feet)
- The client stands behind the line facing the wall
- The ball is thrown from one hand in an underarm action against the wall and attempted to be caught with the opposite hand
- The ball is then thrown back against the wall and caught with the initial hand.

The test can continue for a nominated number of attempts or for a set time period (e.g. 30 seconds).

By adding the constraint of a set time period, you also add the factor of working under pressure.

## Normative Data for the Alternate Hand Wall Toss Test:

This table lists general ratings for the Wall Toss Test, based on the score of the number of successful catches in a 30 second period.

<b>Rating</b>	<b>Score (seconds)</b>
Excellent	> 35
Good	30 - 35
Average	20- 29
Fair	15 - 19
Poor	< 15

## Variations / modifications:

There are numerous variations that can be made to the procedures of this test depending on the desired outcomes. The size, weight and shape of the object, the distance from the wall, the number of attempts or time period can all be varied. The procedure should be recorded with the results and kept consistent for future testing of the same subjects.

## Advantages:

Minimal equipment and costs are involved in conducting this test, and it can be self-administered.

## Disadvantages:

The ability to catch the ball can be affected by how hard and straight the ball is thrown to the wall. You may want to draw a target on the wall to help with throwing accuracy. The test results may be skewed if the subject 'flukes' a few catches, so repeating the test a few times may result in more accurate results.

## Reference

<http://www.topendsports.com/testing/tests/wall-catch.htm>



# Hand Grip Strength

## Equipment needed:

A grip dynamometer, widely available quite cheaply.

## Protocol:

- Using a grip dynamometer, adjust it so that it fits the client's dominant hand comfortably
- Ask them to squeeze the dynamometer vigorously. A downward thrust is allowed
- Repeat the test three times and record your best score



## Score:

Attempt 1

Attempt 2

Attempt 3

Best score

## Normative Data for the Grip Strength Test:

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

# Harvard Step Test

There's also St Mary's Step Test which is slightly different. Harvard is used in military and public services. There is also simple step test.

## Equipment needed:

Gym bench (45cm high) and stopwatch.

## Protocol:

- This test requires the client to step up and down off a 45cm high gym bench for 5 minutes at a rate of 30 steps/minute
- The client warms up for 10 minutes
- Give the command "GO" and starts the stopwatch
- The client steps up and down onto a standard gym bench once every two seconds for five minutes (150 steps)
- Stop the test after 5 minutes
- Measure the client's heart rate (bpm) one minute after finishing the test – Result 1
- Measure the client's heart rate (bpm) two minutes after finishing the test Result 2
- Measure the client's heart rate (bpm) three minutes after finishing the test

Result 3

## Normative Data for the Harvard Step Test:

<b>Gender Excellent</b>	<b>Above Average</b>	<b>Average</b>	<b>Below Average</b>	<b>Poor</b>
Male >90.0	80.0 - 90.0	65.0 - 79.9	55.0 - 64.9	<55
Female >86.0	76.0 - 86.0	61.0 - 75.9	50.0 - 60.9	<50

Using the three pulse rates (bpm), an estimate of the client's level of fitness can be determined as follows:

Result =  $30000 \div (\text{Result 1} + \text{Result 2} + \text{Result 3})$

# How fit are you?:

## Analysis:

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

## Target Group:

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

## Reliability:

Test reliability refers to how a test is consistent and stable in measuring what it is intended to measure. Reliability will depend upon how strict the test is conducted and the individual's level of motivation to perform the test. The following link provides various factors that may influence the results and therefore, the test reliability.

## Validity:

Test validity refers to the degree to which the test measures what it claims to measure and the extent to which inferences, conclusions, and decisions made based on test scores are appropriate and meaningful. This test provides a means to monitor on the athlete's physical development.

## Advantages:

Minimal equipment required

Simple to set up and conduct

Can be conducted almost anywhere

Disadvantages

Assistant required to administer the test

Calculator needed

# Waist-to-hip ratio and weight

## Equipment needed:

Tape measure.

## Protocol:

The assessment of waist-to-hip ratio is used to establish an individual's risk for chronic heart disease (CHD). Fat in the stomach and thighs is more metabolically active than fat in the rest of the body. This means that it is more readily released into the blood stream and therefore at a greater risk of clogging up the arteries.

- Ensure tape measure is horizontal at the belly button when measuring the waist and that no clothing is caught in the tape measure
- Take the hip measurement around minimal clothing and at the widest point of the hips/ buttocks. Ensure the tape is horizontal
- Take care not to pull the tape measure too tight or be too invasive in the client's personal space
- Using Equation below calculate the subjects waist hip ratio:

$$\frac{\text{Waist (cm)}}{\text{Hip (cm)}} = \text{waist: hip ratio} \quad \frac{\text{_____ cm}}{\text{_____ cm}} =$$

## Normative Data for the Waist-to-hip Ratio and Weight Test:

Result	Criteria
Males: <0.94	Greater than these readings indicates an increase risk of the individual developing CHD.
Females: <0.82	

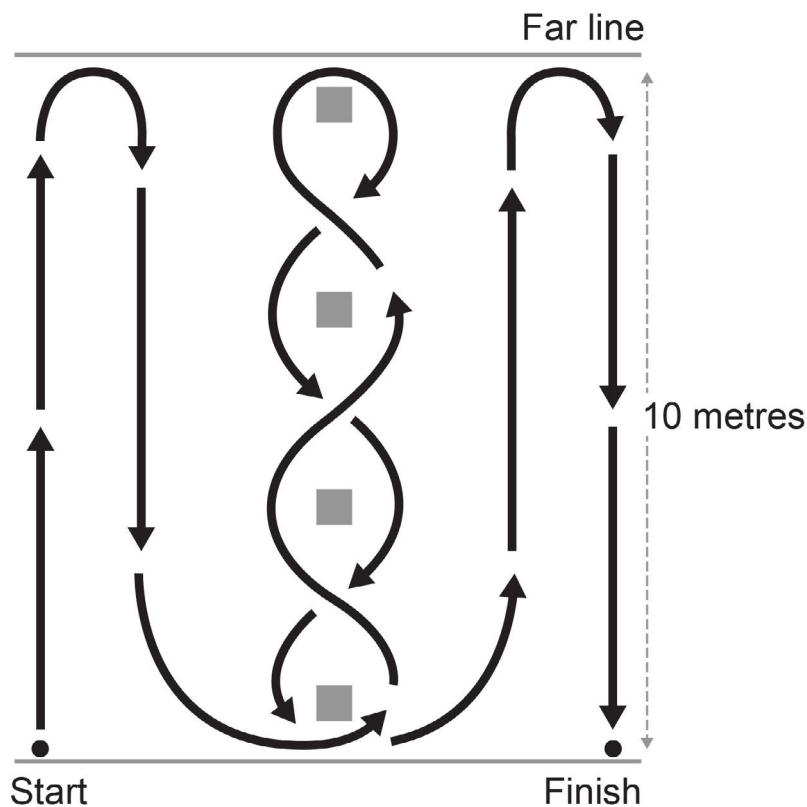
# Illinois Agility Run

## Equipment needed:

A space more than 10 metres by 8 metres. Four floor markers.

## Protocol:

- The client lies face down with their forehead in line with the starting line and their hands beside their chest
- As soon as the starting signal is given, they jump up and follow the zig-zag pattern as shown:



## Normative Data for the Illinois Agility Run:

Rating	Men	Women
Excellent	15.0 – 16.2	18.4 – 19.7
Good	16.3 – 17.2	19.8 – 20.8
Average	17.2 – 17.9	20.9 – 21.4
Poor	18.0+	21.5+

# One Rep Max Test

This test would only be used in specialised circumstances with particular athletes such as Olympic weight-lifters.

## Equipment needed:

A free weight (barbell or dumbbell).

## Protocol:

- The client should warm up thoroughly first
- They select a weight they feel they can lift
- They choose a weight that they can only repeat one full rep and correct lift at that weight
- Record their 1-RM for each muscle group...

Name of muscle group worked	1-RM (kg)

- To work out their 1-RM in relation to their body weight for each exercise.
- You must divide the weight lifted by their body weight and multiply this figure by 100

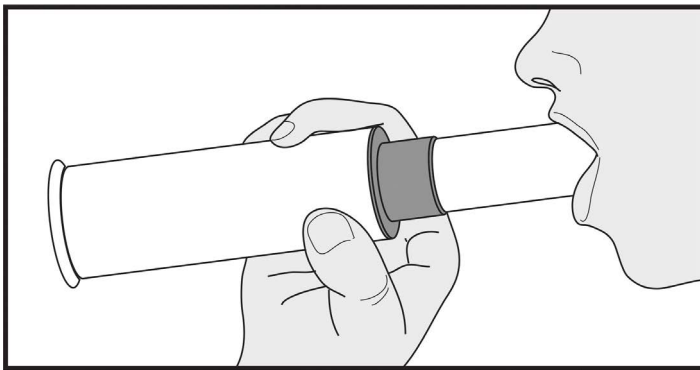
$$\frac{\text{Weight Lifted (kg)}}{\text{Body Weight (kg)}} \times 100$$

Name of muscle group worked	1-RM (kg)	% of body weight

# Peak Flow Test

## Equipment needed:

A Peak Flow Meter (widely available quite cheaply). Some have disposable cardboard mouthpieces; others have plastic mouthpieces which would need to be cleaned after use.



## Protocol:

- Insert the disposable mouthpiece
- Ask the client to take a deep breath in and seal the lips around the mouthpiece
- On the count of 3, they blow out as hard and as forcefully as possible in one short sharp breath
- Take each measurement 2 times then take an average

## Peak flow

Reading 1	Reading 2	Average

## Normative Data for Peak Flow Test:

Height	Women	Men
0.90m	109	98
1.0m	139	128
1.10m	171	162
1.20m	208	201
1.30m	250	247
1.40m	297	298
1.50m	348	355
1.60m	403	418
1.70m	462	488
1.80m	526	565

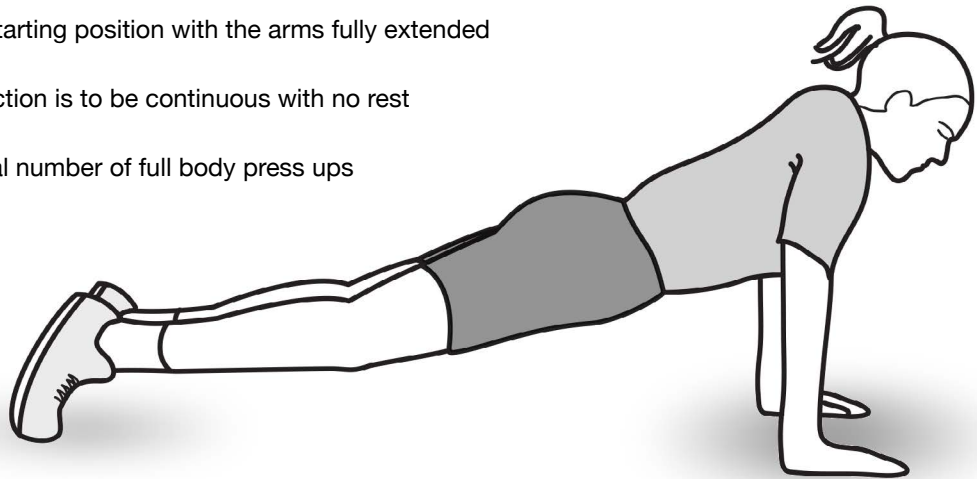
# Press-Up Test

## Equipment needed:

A mat or possible cushioning for the knees.

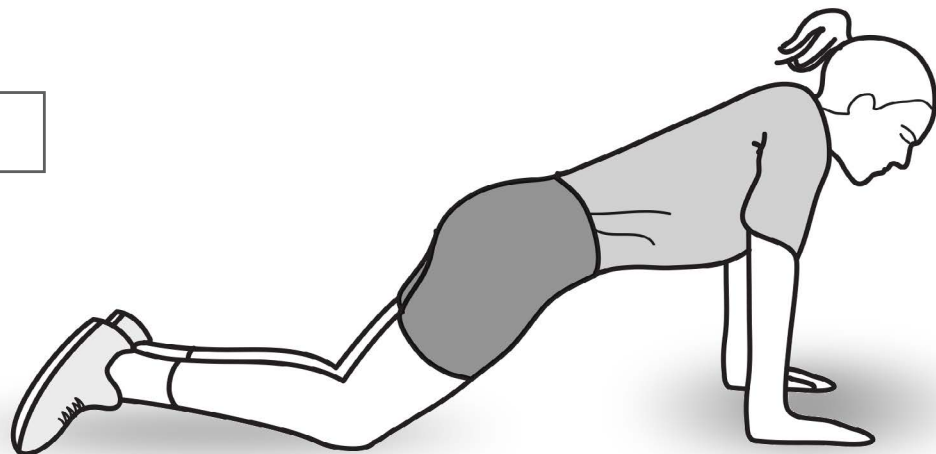
## Protocol:

- The client to lies on the mat, hands shoulder width apart & fully extend the arms
- Lower the body until the elbows reach 90°
- Return to the starting position with the arms fully extended
- The push-up action is to be continuous with no rest
- Record the total number of full body press ups



Female athletes tend to have less relative strength in the upper body and therefore they can use the modified press-up position to assess their upper body strength. The test is then performed the same as above but with the knees resting on the floor.

Score:





## Normative Data for Males:

Age	Superior	Excellent	Very good	Good	Average	Poor	Very poor
15 – 29	> 54	51 - 54	45 - 50	35 - 44	25 - 34	20 - 24	15 – 19
30 – 39	> 44	41 - 44	35- 40	25 - 34	20 - 24	15 -19	8 – 14
40 – 49	> 39	35 - 39	30 - 35	20 - 29	14 - 19	12 - 13	5 – 11
50 – 59	>34	31 - 34	25 - 30	15 - 24	12 - 14	8 -11	3 -7
60 +	>29	26 - 29	20 - 25	10 - 19	8 - 9	5 - 7	0 – 4

## Normative Data for Females:

Age	Superior	Excellent	Very good	Good	Average	Poor	Very poor
15 – 29	> 48	46 – 48	34 – 45	17 – 33	10 – 16	6 – 9	0 – 5
30 – 39	> 38	33 – 38	25 – 32	12 –24	8 – 11	4 – 7	0 – 3
40 – 49	> 33	29 - 33	20 - 28	8 -19	6 - 7	3 - 5	0 –3
50 – 59	> 26	21 - 26	15 - 20	6 - 14	4 –5	2 - 3	0 - 1
60 +	>20	15 - 20	5 –14	3 – 4	2	1	0

# Reaction Time Test

## Equipment needed:

A metre ruler.

## Protocol:

- Hold the top of a meter ruler vertically at the 1cm mark
- The client places their thumb and fingers at the 60cm mark **without touching the ruler**. Their arm should rest on the edge of a table with only hand extending over the edge
- You drop the ruler without warning and the client catches it as quick as possible between the thumb and the fingers

Score:

## Normative data for the Reaction Time Test:

Rating	Position on the ruler
Excellent	52 – 60cm mark
Good	45 – 51cm mark
Fair	35 – 44cm mark
Poor	35 cm mark and below

# Simple Step Test

## Equipment needed:

A 12 inch high step.

## Protocol:

- Step on and off for three minutes. Step up with one foot then the other, step down with one foot then the other
- Try to maintain a steady four beat cycle, up-up, down-down
- Go at a steady and consistent pace
- At the end of three minutes remain standing and take your pulse for one minute

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

3 Minute Step Test (Women)						
Age	18-25	26-35	36-45	46-55	56-65	65+
<b>Excellent</b>	<85	<88	<90	<94	<95	<90
<b>Good</b>	85-98	88-99	90-102	94-104	95-104	90-102
<b>Above Average</b>	99-108	100-111	103-110	105-115	105-112	103-115
<b>Average</b>	109-117	112-119	111-118	116-120	113-118	116-122
<b>Below Average</b>	118-126	120-126	119-128	121-129	119-128	123-128
<b>Poor</b>	127-140	127-138	129-140	130-135	129-139	129-134
<b>Very Poor</b>	>140	>138	>140	>135	>139	>134

# Sit & Reach Test

## Equipment needed:

A sit & reach box as in the picture.

## Protocol:

- Sit on the floor with shoes removed and feet flat against the box, keep legs straight
- Breath in and place arms together above your head
- Breath out and reach forward and push the fingers along the box as far as possible
- The distance gained is recorded
- Get the client to loosen up their legs and have two more attempts
- Record all three scores and take the best score for as you result.

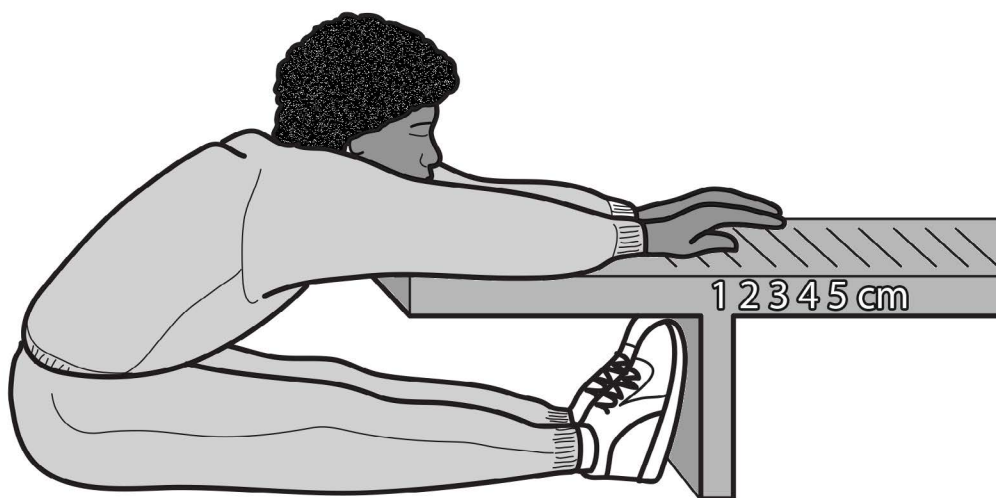
### Client scores:

Attempt 1

Attempt 2

Attempt 3

Best score



## Normative Data for Sit & Reach Test:

Rating	Very poor	Poor	Average	Very good	Excellent
	< -10	-10 - 0	0 - 10	10 -20	20+

# Abdominal Curl Test

## Protocol:

- Client lies down on a mat in the supine position with the knees bent, slightly apart and 20-30 cm from the buttocks
- The arms are crossed and the hands placed on the opposite shoulder
- The client is required to curl up to a vertical position, breathing out as they come up.
- Curl down again controlled with the shoulders touching the floor
- When the technique is correct, begin the clock and start the test. Count out loud and encourage the client
- Count the number of completed sit ups in one minute

Score

## Normative Data for the Abdominal Endurance Test:

Abdominal Curl Test (Men)						
Age	<20	21-30	31-40	41-50	51-60	60+
Excellent	>49	>44	>39	>34	>29	>29
Above average	44-48	39-43	34-38	29-33	24-28	24-28
Average	37-43	32-38	27-33	22-28	17-23	17-23
Below Average	24-36	20-31	16-26	12-21	8-16	8-16
Poor	<24	<20	<16	<12	<8	<8

Abdominal Curl Test (Women)						
Age	<20	21-30	31-40	41-50	51-60	60+
Excellent	>42	>36	>30	>24	>18	>18
Above average	32-41	27-35	22-29	17-23	12-17	12-17
Average	25-31	21-26	17-21	13-16	9-11	9-11
Below Average	19-24	15-20	11-16	7-12	3-8	3-8
Poor	<19	<15	<11	<7	<3	<3

# Static Flexibility Test - Shoulder & Wrist

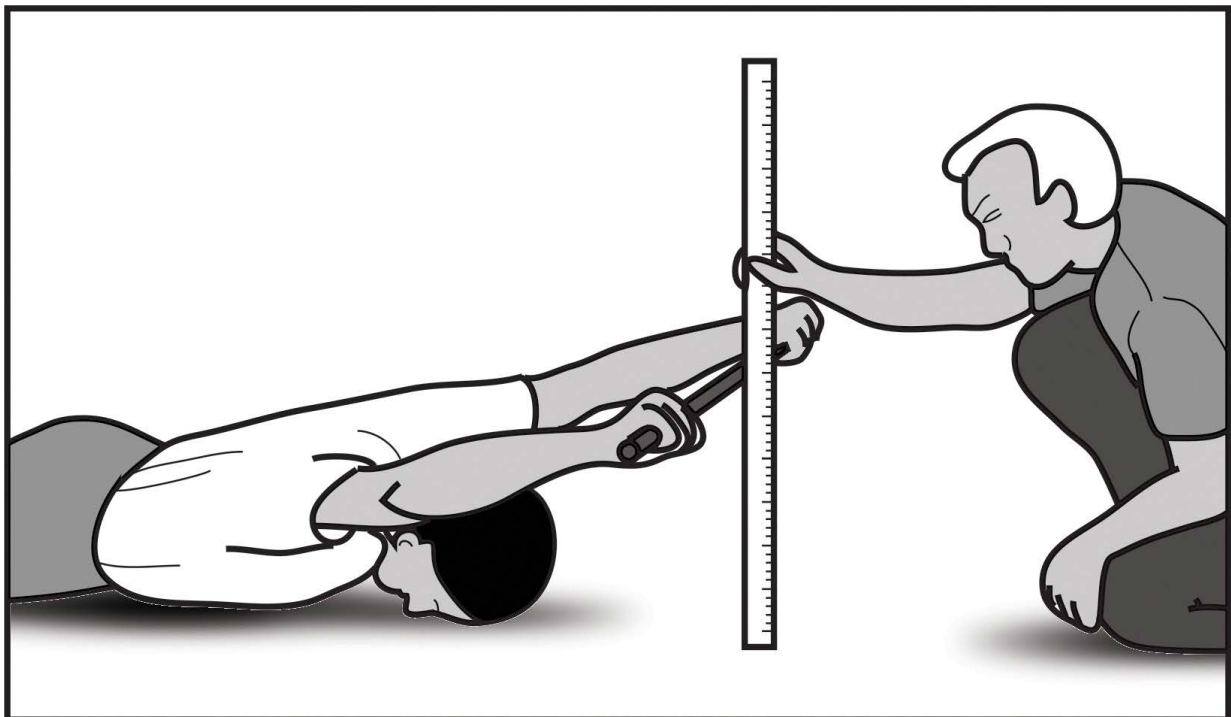
## Equipment needed:

Stick approximately 40 cms long. A metre ruler.

## Protocol:

### Starting position

- The client lies prone on the floor with the arms, shoulder width apart, fully extended holding a stick
- They 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 centimetre
- 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



Score

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 and Wrist Flexibility Test:

<b>Rating</b>	<b>Men</b>	<b>Women</b>
Poor	>12.50	>11.75
Fair	12.50 - 11.50	11.75 - 10.75
Average	11.49 - 8.25	10.74 - 7.50
Good	8.24 - 6.00	7.49 - 5.50
Excellent	<6.0	<5.50

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

# Standing Vertical Jump Test

The test is used to determine explosive power output in one explosive movement. The client has to jump as high as they can – and you measure the height.

## Equipment needed:

There are a number of pieces of equipment available such as a “Jump and Reach Board” or you could simply pin a tape measure to the wall.

## Protocol:

- Ask the client to face the jumping board (or wall) and stand slightly in front of it, with their feet flat on the floor and both arms fully extended overhead. Note the point where the extended tips of the middle fingers touch on the board
- Without moving their feet, they turn, so that one side of the body is to the jump board. (they are not allowed to step into the jump)
- Take a deep squat jump, touching the board as high as possible with fingers nearest the board
- Rest and try a second and third jump then take the best result
- Record the distance obtained between the standing reach and the jump. Record all three results and highlight their best jump.

Record the result below:

Height jumped in centimetres  
of the best jump

## Normative Data for the Waist: Hip Ratio and Weight Test:

	Men	Women
<b>Superior</b>	65cm+	43.6cm+
<b>Excellent</b>	61. – 64.9cm	38.0 – 43.5cm
<b>Good</b>	57.0 – 59.9cm	34.6 – 37.9cm
<b>Average</b>	53.0 – 56.9cm	31.6 – 34.5cm
<b>Fair</b>	50.0 – 52.9cm	27 – 31.5cm
<b>Poor</b>	44.1 – 49.9cm	16.6 – 26.9cm
<b>Very Poor</b>	< 44.0cm	<16.5cm



# Treadmill VO2 Max Test

This test is for athletes/high performers and for specialised purposes. It wouldn't normally be used for regular clients as it can be dangerous pushing someone to their absolute limit. But this is what you have to do with a VO2 Max test.

There are many different VO2 Max tests but the following is simply an example of one of them which involves running on a treadmill. But if you were conducting a VO2 Max test for a cyclist, they may very well score quite poorly on this test as their body would be adapted to cycling. Therefore, for a cyclist it would be better to look for a test which involves a stationary bike

## Objective:

To monitor the development of the athlete's general endurance (VO2 max).

## Equipment/resources needed:

To undertake this test you will require:

- Treadmill where speed and grade of slope can be adjusted
- Stopwatch
- An assistant
- 6-20 Rate of Perceived Exertion (RPE) scale & Heart Rate (HR) monitor

## Protocol:

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 starts the test. At minute intervals during the test the slope of the treadmill is adjusted.

The assistant starts the stopwatch 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. HR and RPE are recorded every minute.

## 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<sub>2</sub> max can be calculated as follows:

$$\text{VO}_2 \text{ max} = 42 + (\text{Time} \times 2)$$

"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).

- $\text{VO}_2 \text{ max} = 42 + (13.25 \times 2)$

- $\text{Vo}_2 \text{ max} = 68.5 \text{ mls/kg/min}$

## Target Group

As we said above, this test is suitable for endurance athletes and players of endurance sports (e.g. football, rugby) but not an average gym-goer.

## 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<sub>2</sub>max tables and the correlation to actual VO<sub>2</sub>max is high.



# Wingate Anaerobic Cycle Test

This test would only be used in specialised circumstances with particular cyclists. It requires a quite expensive, dedicated piece of equipment.

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.

## Equipment needed:

The testing device is a mechanically-braked bicycle ergometer..

## Protocol:

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 ( $70 \text{ kg} \times 0.075$ ) or 4.2 kp ( $1 \text{ kg} = 0.8 \text{ kp}$  so  $5.25 \times 0.8 = 4.2 \text{ kp}$ ). Resistance often increases to 1.0 kg x body mass or higher (up to 1.3 kg) when testing power and sprint athletes.

## 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).

## Normative data for the Wingate Anaerobic Cycle Test:

<b>%Rank</b>	<b>Men / Watts</b>	<b>Women / Watts</b>
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