Swimming Australia Pathways Testing Protocols

swimming australia | SPORT AUS arena | HANCOCK PROSPECTING

PARTNERS

PATRON

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1. Athlete & Environment Preparation

Prior to testing, a standardised pre-test preparation is recommended to enable reliable and valid physiological data to be obtained.

1.1 Diet

A normal high carbohydrate - low fat diet should be followed on the days before and on the day of testing. Swimmers should be instructed to abstain from food and beverages containing caffeine or alcohol, in the two h prior to testing. Adequate hydration with either water or a sports drink should be encouraged. This practice is particularly important when testing is conducted outdoors or indoors in conditions of high temperature and humidity.

1.2 Training

No highly stressful swimming training should be undertaken within the previous 18 h. It is also recommended that no heavy weight training or exercise to which the swimmer is not accustomed be undertaken within the preceding 24 h.

1.3 Testing

Swimmers should be reasonably well-rested and free of illness and injury prior to testing. If there is any doubt whether the swimmer is ready to undertake testing, it may be appropriate to postpone testing to another day. Results of testing with swimmers who are not adequately prepared or motivated can be difficult to interpret.

A standardised warm-up of 1000-1500-m, consisting primarily of low-to-moderate intensity aerobic swimming and some pace work, should be completed prior to pool testing. The warm-up is normally undertaken in freestyle with some elements of pull, kick and the main stroke used in the subsequent testing (if this is not freestyle). Coaches may elect to have their swimmers perform their standard pre-race warm-up. A swimmer should complete the same warm-up prior to the same test from session to session.

1.4 Testing Environment

Most pools have closely monitored water temperature (usually 27.0 ± 1.0 C; mean ± SD) and water quality levels. These conditions should be checked with pool staff if there is any doubt over the suitability of the pool. Poor results may be obtained if the water temperature is outside comfortable limits. Pool testing can be completed either indoors or outdoors. If testing outdoors, ambient air temperature and wind may affect swimmers who are waiting to be tested. Close cooperation with coaches and swimmers is needed to ensure appropriate timing of warm-up procedures and testing. The tests described here are

typically completed in a long course (50-m) pool with the exception of the 12x25 m test – a short course (25-m) pool can be used, but the results between long course and short course are not interchangeable and should be noted when reporting results. As far as is practicable pool length should be kept consistent between testing occasions.

2. Anthropometry

Rationale

A swimmer's size and shape can have a substantial impact on competitive performance. Anthropometric measures are important in both talent identification and development of junior or age group swimmers and in the management of training and dietary practices in senior swimmers.

Test Procedure

Measurement of stature, sitting stature, arm span, body mass, and skinfolds should be carried out prior to swim testing. Skinfolds are recorded over seven sites (triceps, biceps, subscapular, supraspinale, abdominal, front thigh and medial calf). The individual skinfold measures as well as the sum of the seven sites should be reported. Refer to anthropometry protocols outlined by ISAK, for a detailed description of all anthropometric test procedures.

*The testing must be conducted by an ISAK accredited tester. All results should be added to Swimming Australia's Athlete Management System (AMS).

Physical Maturity Rationale

The assessment of Age at Peak Height Velocity is a surrogate, non-invasive measure which gives an indication of an athlete's physical maturity. This variable is intended to split swimmers into three categories, those who are yet to have their biggest growth spurt, those who are currently experiencing the growth spurt, and those already passed this point. While this measure provides valuable information to coaches to assist in assessing their swimmer's position within long term athlete development frameworks, it should not be used to exclude early developers or shorter swimmers. To do so would be well beyond current scientific knowledge and could be detrimental to the Australia's long term international performance in the pool.

3. Physiotherapy Screening

MSK Physiotherapy screening must follow the SAL screening protocol and be conducted by a SIS/SAS network physiotherapist, and preferably a Swimming Australia network physiotherapist.

SA Level 1 MSK Physiotherapy Screening:

SITTING

Abduction/internal rotation – Performed sitting. The athlete is asked to place their thumbs at their armpits before the physio PASSIVELY abducts the shoulders maximally. No overpressure is applied. Examiner records the angle of the shaft of humerus relative to vertical using a goniometer.

Measures: green >150°, orange 130°-149°, red <130°.

Hip extension/Thomas test – Performed in a modified Thomas test position off the end of the bed. The physio puts the hip into full flexion, the athlete is asked to hold one leg in the fully flexed position, while allowing the opposite leg to relax into the hip extension. Measurement is taken using a goniometer with the 1st arm maintained in a horizontal position and the second arm in line with the greater trochanter proximally and the lateral femoral condyle distally.

Measures: green >10°, orange 0 - 9°, red <0°.

SUPINE

Shoulder external rotation – Performed with the athlete supine, the shoulder at 90° pure abduction (a folded towel or examiners knee may be used under the upper arm to avoid horizontal extension), and the elbow flexed to 90°. The examiner stabilisers the shoulder to prevent scapular movement, the PASSIVELY externally rotate the shoulder. The second examiner then measures the rotation angle using a goniometer with the 1st arm maintained in a vertical position and the second arm placed along the shaft of the ulna, while maintaining forearm supination.

Measures: green >95°- 105, **orange 85 - 94° & >105**, **red <85°**.

Shoulder internal rotation – Method performed as per the external rotation. The examiner PASSIVELY internally rotates the shoulder.

Measures: green >45°, **orange 30 - 44°**, **red <30°**.

Hamstring – Performed with the athlete supine, the knee in full extension and the foot in plantargrade dorsiflexion. One examiner elevates the leg while the second examiner measures using a goniometer, the 1st arm horizontal and the 2nd arm in line with the greater trochanter and the lateral femoral condyle.

Measures: green >80°, **orange 60 - 79°**, **red <60°**.

Ankle plantarflexion – Performed with the athlete sitting or supine with heels off the end of the bed. The athlete is then asked to perform maximal active ankle plantarflexion. Range is measured between the shaft of 5th metatarsal and central line of the lower leg.

Measures: green > 165°, **orange 155°** - 164˚, **red <155°**.

PRONE

Combined elevation test - Performed prone, chin resting near the end of the plinth with arms hanging off the end. With the tips of the thumbs interlocked, and maintaining full elbow extension, the athlete is asked to elevate their arms as high as possible while maintaining their chin on the plinth. Examiner records the angle of the shaft of the humerus achieved relative to horizontal using a goniometer.

Measures: green 5°-15°, orange <5° or >15°, red <0° or >25°.

Hip internal rotation (breastrokers and IMers only) – Performed with the athlete prone, legs together and knees flexed to 90°. Allow the feet to fall out passively thus moving the hips into internal rotation, while keeping knees together. Measure using a goniometer with the 1st arm vertical and the 2nd arm along the line of the tibia.

Measures: must be symmetrical with **green >40°, orange 30° - 39˚, red <30°.**

4. Strength & Condition: Movement Competency Assessment (MCA)

Rationale:

Good function (*balance, control, stability, coordination, mobility and flexibility*) is essential for the development of optimal strength, power, and movement economy in swimming; including reducing injury risk. Specifically, this may be described as:

a) Arm pulling ability and how it relates to good shoulder-scapula connection.
b) Healthy thoracic rotation, relative to...
c) Strong lumbo-pelvic connection and good hip range of motion in extension.
d) Postural strength, endurance and alignment – vertical and horizontal planes.
e) Jumping ability and how it relates to diving and turning motor patterning (legs & trunk).
f) Assessing bilateral symmetry.

Test Procedure:

Evaluation of an athlete's movement competency should be conducted prior to any high intensity exercise that may fatigue the athlete in question. Shoes must be worn and jewellery removed before assessment. Assessment and evaluation of the MCA need to be conducted by an ASCA - level two - Strength and Conditioning coach. Please see testing protocols for further guidance on the scoring and assessment criteria. All tests are required to be filmed in both the frontal and sagittal planes of the athlete to ensure scoring reliability is obtained.

Equipment required:

- Scoresheet, including all athlete's names, date and time.
- Swift Yardstick (vertical jump)
- Video camera: contrast and compare pre/post measures for functional based tests.
- Athlete must wear correct training attire: shorts, t-shirt and sneakers.

N.B. Testing activities are detailed below and should be fully understood before any testing is carried out using athletes.

Exercise	Selection Rationale	Assessment Items	Score		
			3	2	1
Vertical Jump (VJ) Testing	This test is designed to assess jumping performance by outcome and should NOT be confused with the Squat Jumping Test, which is a technique focused assessment. It is recommended that this test is carried out first when the athlete is in a non-fatigued state.	• The yardstick® is the preferred equipment for VJ testing as it is a more familiar jumping action for athlete to perform. • The athlete has no inhibitions about jumping into a wall; there are no space restrictions, which can occur in vertical jump pits; and athletes reach directly upwards to displace the yardstick® veins and not to the side to touch the wall mounted board. Ensure that athlete has performed an appropriate warm-up. • It is recommended that athlete's standing reach height be recorded by having athlete displace as many vanes on jump device as possible while standing flat-footed and side-on to the apparatus. Athlete should reach vertically with preferred hand. • Starting from an upright position the athlete should stand side-on to the apparatus. • Using an arm-swing and counter-movement the athlete is required to perform a vertical jump for maximal height; at the peak of the jump the athlete moves vanes on apparatus out of the way. • Athlete should perform at least 3-5 trials. • Record height achieved for each jump (centimetres). Calculate vertical jump height by subtracting standing reach height from highest	**No technical score recorded for this test**		

		absolute jump height. Highest of all jumps performed should be recorded as maximum jump height. **<u>Technique</u>** valid repetition is one in which athlete performs maximal vertical jump movement and moves vanes of apparatus at peak of jump. **Technical Violations:** The following technical violations will result in the trial being invalid. • Holding of counter-movement squat position • Excessive forward lean of upper body (NSSQAP 2007)			
Forward lunge and Twist 3 Repetitions ea side (6 repetitions total)	Lunge positions incorporate hip mobility, trunk stability, strength, and motor control, in one exercise. The complex interaction of these components illustrates dysfunctional patterns or components of athletic movement pertaining to various elements in swimming, e.g., starts, turns and free swimming.	Hip/ Knee/Ankle alignment	Perfect alignment and control of Hip/Knee/Ankle for every repetition – view from front and side.	Inconsistent technique with some perfect repetitions **OR** minor misalignment on all repetitions	Poor alignment throughout **OR** high variability
		Lunge	<u>Forward lunge:</u> Landing without overloading toes (maintain heel pressure) <u>Range:</u> front thigh finishes lunge parallel to ground and rear knee close to ground (not touching), <u>Return to standing:</u> Return to extended standing position in one movement without dragging front foot across floor.	Inconsistent technique with some perfect repetitions **OR** minor misalignment on all repetitions	

		Trunk Posture during rotation	Head in neutral, ears remain over shoulders, back straight, chest up neutral shoulders/ Scapula depressed and no protraction as shoulders rotate *to or past* 45° over forward leg	Inconsistent positioning (repositioning) throughout 6 repetitions	Unable to attain correct position
		Hip and Pelvis positioning	Neutral hip and pelvis positioning with no anterior/posterior tilt, lateral rocking and/or rotation – *view from front and side*	Inconsistent positioning (repositioning) throughout 6 repetitions	Unable to attain correct position
Chin ups *(shoulder width pronated grip)* Minimum repetitions = 10 reps [male], 5 reps [female]	Pulling strength and control is vital for long term shoulder health and a sound indicator of upper body strength. Chin ups should highlight gross upper body pulling strength. Chin ups will also indicate sound scapula rhythm and muscle recruitment patterns in a vertical direction under bodyweight conditions	Scapulohumeral rhythm	Scapula depressed throughout hang. Symmetry of Scapulohumeral rhythm during pull and lowering phase of exercise. No scapula elevation or winging.	Inconsistent technique. Some perfect repetitions **OR** slight asymmetry	Poor scapula positioning and control for all repetitions
		Body Control & leg control	No swinging. Knees to remain below or slightly in front of hips for all repetitions.	Perfect body and leg control for some but not all repetitions	Poor body control and/or alignment for all repetitions.
		Complete Repetitions	M ≥ 10 F ≥ 5		M < 10 F < 5
Push ups *(hands – thumb knuckle outside shoulder)* Minimum repetitions = 20 reps [male], 12 reps [female]	The ability to move and control bodyweight is vital for swimming and dry-land training. This ability should incorporate correct movement mechanics of the upper body, particularly scapula and trunk position and synchronicity of movement.	Scapulohumeral rhythm	Scapula depression and no protraction or flaring of the elbows throughout movement.	Inconsistent technique. Some perfect repetitions.	Poor scapula positioning and control for all repetitions
		Body Control & leg control	Perfect body alignment and control for all repetitions	Perfect body alignment and control for some but not all repetitions	Poor body control and/or alignment for all repetitions.
		Complete Repetitions	M ≥ 20 F ≥ 12		M < 20 F < 12

Squat Jumping (Broomstick on shoulders) Repetitions = 3	Jumping with good movement mechanics is important for swimming (starting and turning), as it demonstrates good joint mobility, flexibility and the ability to transfer forces from the ground through the body, culminating in being able to hold body alignment.	Hip/ Knee/Ankle alignment	Perfect alignment and control of Hip/Knee/Ankle for every repetition – view from front and side.	Inconsistent technique with some perfect repetitions **OR** minor misalignment on all repetitions	Poor alignment throughout **OR** high variability
		Foot position	Ability to maintain heel contact during set phase for each repetition	Inconsistent technique. Some perfect repetitions.	Not able to hold or maintain heel contact during set position for each repetition
		Alignment, Balance & Control	With broomstick across shoulders, scapula depressed and no protraction. Dip and hold bottom of squat for 2 seconds, whilst holding good hip/knee/ankle alignment. Jump as high as possible whilst maintaining hip/knee/ankle alignment before fully extending hips and knees during flight. *Landing* - quietly, and quickly transferring weight into heels with perfect balance and control.	Inconsistent technique. Some perfect repetitions.	Poor alignment, inability to adopt and hold positions throughout **OR** high variability

5. Swimming Performance Tests

Aerobic 2000 m time trial

Rationale: This test assesses a swimmer's maximal sustainable aerobic speed, which corresponds to the speed at lactate threshold. This measure is particularly relevant to longer events as this will be the fastest speed that swimmers can maintain for an extended period of time. It is also important as training speeds can be calculated using this test.

Pool: Long Course
Timing: Hand timed from the starter's signal
Stroke Rates: 1 per 500m (10th and 20th 50m)
Splits: Each 500m splits
Stroke Counts: 1 per 500m (10th and 20th 50m)
Stroke: All performed freestyle

Starting should be as per a normal competition dive start.

This test can be completed with multiple swimmers in a lane, ensure that swimmers are appropriately spaced so as to minimise their interaction with the others in their lane. Swimmers' starts should be staggered appropriately.

Anaerobic Capacity test 12 x 25m

Rationale:

Pool: Short Course
Timing: Starting as the feet leave the wall, stopping when hand touches the opposing wall
Stroke Rates: 1 per 25 m, taken in the middle of the lap
Splits: 1 per 25 m effort
Stroke: Main Stroke

Pre-session preparation

As much as is practical within the confines of the daily training environment scientists should try to ensure the following:

- Swimmers should not have completed any strenuous (Lactate threshold or higher intensity) exercise over the past 24 hours
- Swimmers should have had their standard pre-training nutrition and caffeine intake. This should be kept the same for subsequent tests.

Warm up

Swimmers should complete their standard race warm up or a warm up prescribed by their coach of 800-1500 m in length. This should include a minimum of 300-400 m of slow swimming to finish.

Once swimmers are prepared to complete the test they should sit passively for 3-4 minutes to allow phosphocreatine stores in their muscles to replenish. This can be either in or out of the water.

Protocol

12 x 25 m maximal efforts on 5 seconds rest

- Important to note that swimmers should push off the wall at 5 seconds, send off signal from coach/scientist will have to occur before this point
- Timed from feet leave to hand touch

Pacing

It is important to explain to athletes that the test should be 'unpaced'. This means the first 25 m should be at maximal speed and each 25 m after that should be trying to repeat that speed. To properly quantify the fatigue curve, it is important that the swimmer performs each 25 m lap at maximal effort.

Butterfly swimmers, unless they are capable of swimming butterfly consistently at an easy speed (eg. Can do 2km butterfly reasonably easily), should complete in freestyle due to the potential for technical breakdown towards the end of the test.

Make sure swimmers are instructed to only perform 2 dolphin kicks off each wall to maintain a standard number of kicks throughout the test. Breaststroke swimmers can complete a pull out or decide to push straight to the surface and swim. However, this should be recorded and kept the same each time the swimmer completes the test.

Analysis and Feedback

The measures derived from this test are:

- **Peak Speed** – Fastest speed attained throughout the set
  - Typical error = 0.08 sec/25 m, 0.5%
- **Critical Speed** – Is the average of the slowest 2 x 25 m efforts within the last 4.
  - Typical error = 0.22 sec/25 m, 1.2%

  where:
  Speed = measured speed
  Time = cumulative time during the test
  CS = Critical speed
  - Typical error = 0.21 sec/25 m, 1.2 %
- **D'** – Calculated as:

$$D' = 25 - (CS \times time_1) + \int_{time_{total}}^{time_1} Speed = a.e^{b.time} + c$$

  where:
  time1 = time for the first 25 m
  timetotal = sum of time taken for all 25 m efforts

  - Typical error = 1.22 m, 5.7%
- **Drop off %** – This is a comparison between the Peak Speed and the CS and the difference between these as a % of the Peak Speed.
  - Typical error = 0.7 percentage points, 4.5%

Stroke efficiency test - 6 x 50m

Rationale: Swimming is a technically demanding sport and a substantial proportion of training time is devoted to the refinement of a swimmer's technique. In practice, distance per stroke is difficult to measure in the pool without sophisticated biomechanical analysis. Simply counting strokes per lap may be inaccurate as this does not account for how much distance was travelled underwater and whether the lap finished on a complete stroke. Distance per stroke can be calculated from velocity and stroke rate by recording stroke characteristics over a known distance in the pool.

Pool: Long Course
Timing:
Stroke Rates: Mid pool each 50m
Splits: 50m
Stroke Counts: With each 50
Stroke: All swimmers perform their main stroke. Individual medley (IM) swimmers should use butterfly (their lead off stroke) or if they have a secondary main event, they should complete the test using this stroke.
Measures: 6 x 50m (2 sec improvement per 50m to reach target time on last effort)

Protocol

6 x 50m swims on 2 min.

A series of 6 x 50m swims of progressively increasing speed is used to establish the relationship between swimming velocity (V), stroke rate (SR) and distance per stroke (DPS). Firstly, establish swimmer's target time. The first 50m should be completed the slowest which should be approximately 10s slower than the target time (backend 100m – 200m speed).

Each 50m should be completed ~2 seconds faster than the predicted time for the step before.

Swimmers are instructed to <u>only perform 2 dolphin kicks off each wall and surface by the 5m mark</u> to maintain a standard number of kicks and distance throughout the test. Breaststroke swimmers are encouraged to push off without the underwater pull out phase. This will allow for coaches to utilise the 50m time to identify efficiency.

This test is recommended as an objective outcome measure of stroke mechanics which allows scientists and coaches to identify changes in stroke efficiency over time.

Example

Swim	1	2	3	4	5	6
50 m (s)	40.6	37.8	35.7	33.9	32.6	30.2
Velocity ($m.s^{-1}$)	1.00	1.09	1.18	1.23	1.32	1.44
Stroke Rate ($Stroke.min^{-1}$)	32.8	37.1	42.9	45.1	50.5	54.7
Stroke Length (m)	1.83	1.77	1.65	1.64	1.57	1.58
Stroke Efficiency (Index)	1.83	1.94	1.95	2.03	2.08	2.28
Stroke Count (Strokes/50m)	22	21	23	22	24	25

Anaerobic 4 x 25m

Rationale: This test is to assess the maximal anaerobic power of the athlete. To obtain reliable and useful results it is important the swimmer performs each 25m at a maximal effort. The test is performed in the swimmers' main stroke.

Pool: Long Course
Timing: Hand timed from the starter's signal
Stroke Rates: 1 per 25m
Splits: 15 m and 25m

Starting should be as per normal competition dive start.

Each swimmer will swim 25m at maximal effort on 3 minute time cycle.

Times and stroke rates are to be recorded.

2 x 25m -200m Kick Time Trial

Rationale: Kicking is an essential skill for maintaining body position and providing propulsion throughout a race. This test measures a swimmer's kicking endurance.

To produce comparable results for pathways testing please ensure the following.

Pool: Long Course
Timing: Hand timed, feet off the wall
Splits: 100m

This test should be completed in the swimmers' main stroke. Butterfly, Freestyle and Breaststroke should be completed with a kickboard, Backstroke kick is swum in a streamline position.

Swimmers will perform 2 x 25m on a 2 minute cycle from a push start with a kickboard. The time will be taken when the head passes through the 25m mark.

This test will be followed by a 200m kick time trial from a push start.

The 200m kick should start ~4 min after finishing the 2 x25m test.

When completing a turn a swimmer is allowed one stroke into the wall and a tumble turn is permitted. When finishing swimmers should keep two hands on their kickboard. Backstroke swimmers should not break a streamlined position.

2 x 25m - 200m Pull Time Trial

Rationale: Pull is the most important propulsive section of a swimmer's stroke in butterfly, backstroke and freestyle. This test measures a swimmer's upper body contribution to their swimming speed.

Pool: Long Course
Timing: Hand timed, feet off the wall
Splits: 100m
Stroke Rates: 1 per 50m – mid-pool
Stroke Counts: On the 2nd and 4th 50m of the 200m
Stroke: This test should be completed in the swimmers' main stroke.

Swimmers will perform 2 x 25m on a 2 minute cycle from a push start. The time will be taken when the head passes through the 25m mark.

The 200m pull test should start ~4min after finishing the 2 x25m test.

This will be followed by a 200m pull time trial from a push start.

The test should be completed with a pull buoy and a band, no paddles.

The Breaststroke pull test involves no kicking including no fly kicking.

6. SA Pathways Assessment Results and Athlete/Coach Feedback

All results from the SA protocols completed on state camps are to be entered into the AMS by each SSA.

SA, SSA and the State Technical Director will have access to their own state's results.

Coaches will have access to their athlete's individual results.

Each SSA and State Technical Director to provide feedback of results to athletes and coaches to implement into their home program.

SSA State Technical Director to monitor progress on program visits.

7. Suggested Camp Timeline

Pre-Camp – Home program
2000 m time trial
Day 1
AM 12x25 m test 2 x 25 m + 200 m kick 2 x 25 m + 200 m pull
MIDDAY Anthropometry MSK Screening Functional movement assessment
PM 4x25 m 6x50 efficiency

RPE Scale

0	Rest
1	Very, very easy
2	Easy
3	Moderate
4	Somewhat Hard
5	Hard (heavy)
6	
7	Very Hard
8	
9	
10	Maximal