

**TENNIS CANADA
PHYSIOLOGICAL GMP & TESTING PROTOCOL
WHEELCHAIR TENNIS**



A. OVERVIEW

As part of its 'Gold Medal Profile' Tennis Canada has identified a series of physiological key indicators - displayed by the world's best players - which are required to successfully implement the 'Winning Style of Play'.

Winnings Style of Play Implication for the Gold Medal Profile PHYSIOLOGY



This document contains a detailed description of the physical fitness protocols for the Tennis Canada wheelchair tennis high performance program. The assessment consists of a number of tests designed to evaluate several performance qualities that are important to tennis as laid out above.

1. **Anthropometry**
2. **Flexibility**
3. **Acceleration and speed**
4. **Strength and power**
5. **Change of direction**
6. **Cardiovascular fitness: anaerobic & aerobic endurance**

The outcomes will allow our National Coaches and fitness staff to regularly identify strengths and limitations for each athlete and determine the effectiveness of training interventions.

B. SCHEDULE

The minimum planned schedule for all Tennis Canada athletes to complete the full battery of fitness testing is once per year. Additional testing will occur when possible.

Incorporating testing at other times during the season can be done on an 'as needed' basis upon request. To keep the testing duration manageable, the protocols will be implemented over two days as follows:

Day 1 – Anthropometry and body composition, flexibility, hand grip, medicine ball throws, 20m sprint, anaerobic endurance.

Day 2 – 2m agility, change of direction and aerobic endurance

Testing over one day is possible if required. All testing must be conducted indoors in order to eliminate the potential impact environmental conditions might have on performance outcomes. Ideally, the testing should be performed at the same time of day across all training centre locations and be preceded by one day of rest or very low activity/training.

TESTING PROTOCOLS

1. ANTHROPOMETRY and BODY COMPOSITION

Seated Height

Equipment: Measuring tape on wall

Protocol:

- a) Have the athlete sit tall in their tennis chair as close to the wall as possible.
- b) Adjust the head to a neutral position.
- c) Have the athlete take a deep breath and hold it briefly.
- d) Place the height measurer on the top of the head.
- e) Record the height in cm.

Wing Span

Equipment: Measuring tape

Protocol:

- a) The athlete sits with the arms hanging loosely by the side of the body, fingers outstretched.
- b) A measurement is made from the acromiale landmark (lateral edge of the acromion process, e.g. bony tip of shoulder) to the tip of the little finger.
- c) Measurement is made on the right side, following the anthropometric standard, though a measurement of either side would be assumed to be the same in most cases.
- d) Record the height in cm.

Body Mass

Equipment: Scale

Protocol:

- a) Ensure the scale is on a hard, flat surface.
- b) Have the athlete take off their shoes, and stand or sit on the scale.
- c) Record the weight of the athlete in kg.

Body Composition

Equipment: BodPod (laboratory based test)

Protocol Option #1:

- a) The athlete wears minimal clothing (spandex shorts or swim suit) and a swim cap.
- b) The athlete is weighed on a calibrated digital scale.
- c) Next, the athlete is seated in the Bod Pod to measure body volume, which is subsequently used to calculate body density and estimate body composition.
- d) Record fat and fat free mass in kg.

Protocol Option #2:

Equipment: Skin Fold Calipers (The Durnin and Womersley skin fold protocol is suggested)

- a) Record measurements on the right side of the body for biceps, triceps, subscap, and suprailiac sites.

- b) Record the sum of skin folds as well percentage body fat.
- c) <http://www.linear-software.com/online.html> can be used for calculating percentage body fat.

Protocol Option #3:

Equipment: Measuring tape

- a) **Neck:** The neck measurement is taken immediately above the thyroid cartilage (the Adam's Apple). The subject should keep their head up and looking straight ahead. When recording, you need to make sure the tape is not too tight or too loose, is lying flat on the skin. Record measurement in cm's.
- b) **Arm:** First mark the site to be measured. This girth measurement is usually taken on the right side of the body. The arm is relaxed and hanging by the side, and the circumference is taken at the level of the mid-point between the acromion (boney point of shoulder) and the olecranon (boney point of elbow) processes. When recording, you need to make sure the tape is not too tight or too loose, is lying flat on the skin, and is horizontal. Record measurement in cm's.
- c) **Chest:** This measure is taken at the level of the middle of the sternum (breast-bone), with the tape passing under the arms. After the tape is in position, the arms should be relaxed by the side, and the measurement taken at the end of a normal expiration. When recording, you need to make sure the tape is not too tight or too loose, is lying flat on the skin, and is horizontal, particularly around the back. Record measurement in cm's.
- d) **Waist:** The waist measurement is taken at the narrowest waist level, or if this is not apparent, at the mid point between the lowest rib and the top of the hip bone (iliac crest). If you are unsure if this measurement was taken at the narrowest level, take several measurements at different levels and take the lowest measurement. When recording, you need to make sure the tape is not too tight or too loose, is lying flat on the skin, and is horizontal. Record measurement in cm's.
- e) **Mid-Thigh:** First mark the site to be measured. This girth measurement is usually taken on the right side of the body. The subject stands erect with their weight evenly distributed on both feet and legs slightly parted if possible. If standing is not possible, take the measurement with the athlete from a seated position and record for consistency. The circumference measure is taken at the level of the mid-point on the lateral (outer side) surface of the thigh, midway between the trochanterion (top of the thigh bone, femur) and tibiale laterale (top of the tibia bone). When recording, you need to make sure the tape is not too tight or too loose, is lying flat on the skin, and the tape held horizontal. Record measurement in cm's.

2. FLEXIBILITY

Neck Rotation

Equipment: Goniometer

- a) Instruct the athlete to tuck the chin slightly and while keeping the shoulders square measure the angle of the nose in relation to the shoulders.
- b) Your starting position with your head forward is 0 degrees and your nose directly over the shoulder is 90 degrees.
- c) Record the values for the R and L sides.

Lateral Neck Flexion

Equipment: Goniometer

- a) Instruct the athlete to tuck the chin slightly and while keeping the shoulders square measure the angle of the nose in relation to the shoulders.
- b) Your starting position with your head forward is 0 degrees and if the line from your chin through your nose was on a straight horizontal plane, it would be at 90 degrees.
- c) Record the values for the R and L sides.

Appley Scratch Test (External and Internal Shoulder Rotation)

Equipment: None

- a) Instruct the athlete to sit tall and in one smooth motion, reach over the shoulder and attempt to touch the top, inner edge of the opposite shoulder blade (This is external rotation).
- b) Then instruct the athlete in one smooth motion, to reach behind the back and attempt to touch the lower, inner edge of the opposite shoulder blade (This is internal rotation).
- c) Record the values for the R and L sides.

Thoracic Rotation

Equipment: Goniometer

- a) Place a dowel rod behind the neck, on the shoulders, as in a back squat bar position.
- b) The athletes' chair may be stabilized, but the hips must remain square.
- c) Instruct the athlete to rotate to one side as far as possible, without allowing the hips to move, or dowel to come off the shoulders.
- d) Your starting position is 0 degrees.
- e) Record the best of 2 attempts on each side.

Shoulder Flexion

Equipment: Goniometer

- a) Instruct the athlete to maintain a neutral spine, and raise the arm as far up and back as possible.
- b) Measure the angle from the hip, through the elbow and wrist.
- b) The biceps must stay close to the line of the ear and not abduct from the body.
- c) Record the R and L sides.

Shoulder Extension

Equipment: Goniometer

- a) Instruct the athlete to maintain a neutral spine, and extend the arm back as far as possible.
- b) Measure the angle from the hip, through the elbow and wrist.
- b) The arm must stay close to the body and not abduct from the body. Also, make sure the shoulders do not rotate forward and the trunk does not rotate.
- c) Record the R and L sides.

3. ACCELERATION & SPEED

20m Sprint test with racquet

Equipment: Infrared timing gates or stop watch, tape measure

Protocol:

- a) Infrared timing gates placed at 0m, 5m, 10m and 20m along the baseline at a height of approximately 0.5 metre.
- b) Athletes start in a ready position with the front edge of the foot plate positioned approximately 5 cm (thickness of the sideline on the tennis court) behind the initial infrared beam (i.e., start line).
- c) Athletes are instructed to push as fast as possible and well past the 20m mark.
- c) Two trials are completed with two minutes of rest between trials.

- d) If the values for 10m are more than 0.1 sec different, then allow a third trial after rest.
- e) Record time for each split in seconds.
- f) Enter the fastest splits into database.

* If 4 pairs of timing gates are not available, timing gates can be added in the following manner

2 Timing Gates	0m, 20m
3 Timing Gates	0m, 10m, 20m
4 Timing Gates	0m, 5m, 10m, 20m

If you do not have a timing system, a stop watch can be used. In this case, only put marks at the 0m and 20m line.

4. STRENGTH & POWER

Non-Counter Movement and Counter Movement Medicine Ball Chest Toss

Equipment: Measuring tape, tape, wall, dowel, 10lb medicine ball

Protocol:

- a) Lay the tape measure on the ground with 0.0 cm mark directly under the front edge of the foot plate. Extend the tape out upwards of 15m, using tape on a 1m interval to secure the tape measure to the ground.
- b) Have the athlete back their chair to a wall. Place weighted plates or a dowel in front of the wheels to lock the chair in place.
- c) The medicine ball should be held at chest level, with the elbows held out to the sides of the body at approximately 45-degrees to the trunk. Have the athlete throw the medicine ball as far as possible in a forward direction. The distance between the front edge of the footplate and the point where the medicine ball lands is recorded as the length of the throw.
- d) This test will first be performed as a non-counter movement throw (starting from a dead stop at the chest) and then as a counter movement throw (starting about 6-8 inches from the chest, quickly bringing the ball to the chest and then throwing the medicine ball).
- e) The longest of three attempts is recorded (in cm) for both the NCM and CM throws as the result. Allow the athletes at least 30 seconds recovery time between throws.

Maximal Hand Grip Strength

Equipment: Jamar handgrip dynamometer

Protocol:

- a) Adjust the dynamometer to fit the athlete's hand.
- b) Athlete sits with the shoulder adducted and neutrally rotated, the elbow flexed to 90°, and the forearm and wrist held in a neutral position.
- c) Athlete is instructed to hold the handle and squeeze as hard as possible.
- d) Specific instructions to "Squeeze.... Squeeze!... Squeeze!...Stop!" (3-4 seconds)
- e) Two trials are performed on the dominant and non-dominant sides with 30-60 seconds rest between trials.
- f) If values are greater than 1 kg different, then allow a third trial after rest.**
- g) Record the greatest value for each hand.

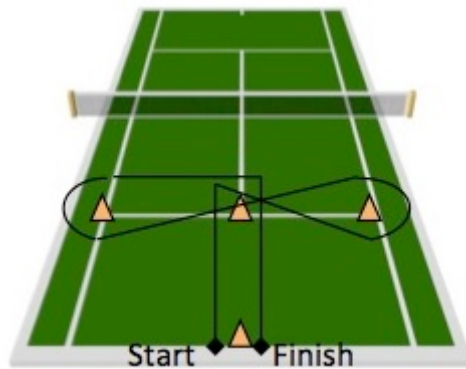
5. CHANGE of DIRECTION

a) T-Test Agility with racquet

Equipment: Infrared timing gates placed on the service line or a stop watch.

Protocol:

- a) Athletes start with their front castors just behind the baseline.
- b) On the athlete's first movement, the test begins.
- c) The athlete follows the pattern outlined in the diagram, being sure to always turn towards the net while going around the outside pylons.
- d) Record the time when the athlete crosses the baseline.
- e) The athlete will wheel back slowly and the next agility sprint begins in 30 seconds of the previous.
- f) Perform 2 attempts from each side and record the fastest times.

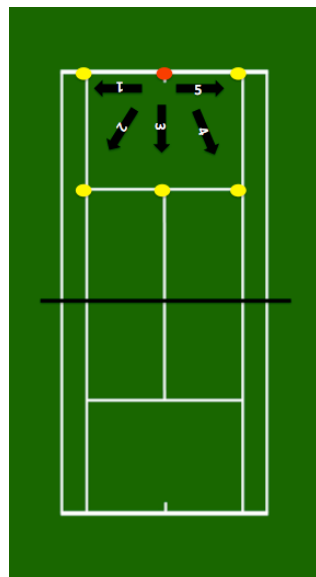


b) Reverse Mobility – ‘Star Sprint’ with racquet

Equipment: Infrared timing gates placed on the baseline or a stop watch

Protocol:

- a) Set up 6 cones on designated spots as per image below
- b) Player starts at baseline next to the red cone (away from the baseline) facing cone 1 with racquet in hand (timing starts)
- c) Player sprints to cone 1 and back to the red cone (2 and back,...5 and back) circumventing all cones clockwise and finishes by pushing past the red starting cone (timing stops)
- e) Repeat 2 more sets. allow 30 seconds rest between repetitions.
- f) Repeat the 3 sets of sprints going counter clockwise around all 6 cones



6.a) ANAEROBIC ENDURANCE

Anaerobic Speed Test

Equipment: Skating Treadmill or Wheelchair Treadmill

Protocol:

- a) Set the treadmill at 5mph for males and 4.5mph for females at an elevation of 5%.
- b) Place a spotting rope around the foot rest.
- c) Holding the spotting rope to keep the athlete in place, start the treadmill and allow the treadmill to get to the desired speed.
- d) Start the time, following an instruction of Ready...Set...Go
- e) Continue to hold the spotting rope and terminate the test when the athlete's back wheels touch the back of the treadmill.
- f) Record the time achieved.

6.b) AEROBIC ENDURANCE

20m Yo-Yo Intermittent Recovery Test (Level 1)

Equipment: Stereo with Yo-Yo IRT1 MP3 file and cones

Protocol:

- a) Place a line of cones 10 m apart as well as 5 m behind the start line
- b) Athletes begin at the start line and perform repeated 2X10 m shuttles with progressively increasing speed controlled by audible beeps.
- c) In between each shuttle (20 m total) participants have 10 seconds rest.
- d) Failure to reach the start line twice results in test termination.
- e) Record the total distance covered and the speed achieved.
- f) Assessment of peak heart rate (highest value achieved at the end of a maximal effort test) can be performed during this test by using heart rate monitors.

*This test modifies the standard 20m Yo-Yo Intermittent Recovery Test (Level 1) to a 10m version.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4314607/> (reference)

ASSESSMENT TOOLS AND MEASUREMENT PROCESS

As Tennis Canada is embarking on creating its Gold Medal Profile there are no benchmark measurements available against each of these identified 6 areas of the physiological profile. Therefore the initial stages of the measurement and assessment process will consist in gathering data for each of the identified key areas with the help of current National Team athletes. The data collected will help to build up a data base that will then allow to cross reference and help measure and assess the next generation of athletes coming through the system.

The following National team players will undergo the physical assessment in 2018:

- Thomas Venos (men's division)
 - Rob Shaw (quad division)
 - Mitch McIntyre (Quad division)
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