

# Endurance Physiology Testing and Monitoring Guidelines

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## 1. Testing and Monitoring

### 1.1 Rationale

Success in endurance cycling events on the road and track is underpinned by highly developed aerobic metabolic capacity, economy, and durability. Specialist road sprinters and track athletes also require highly developed anaerobic metabolic capacity and the ability to generate torque. Being able to characterise an athlete’s physiological profile and monitor changes in these respective characteristics is fundamental to tracking progression and individualising training prescription to better optimise performance outcomes.

It is recommended that a combination of both laboratory and field-based measures be assessed routinely to ensure the appropriate balance between ecological validity, practicality, sufficient rigor, and measurement of underlying physiological phenomena. Such data can be included with competition performance data as supporting evidence for categorisation.

Table 1. Decision Matrix for conducting lab and field testing

Criteria or Application	Lab Testing	Field Testing
Construct and individual athlete’s physiological and performance profile	Yes	Yes
Document physiological characteristics/phenomenon ( $\dot{V}O_{2peak}$ , economy, thresholds, fuel use)	Yes	No
Monitor physiological adaptations to training	Yes	Yes
Quantify physiological effects of an ergogenic aid	Yes	
Define exercise intensity zones relative to individual capabilities	Yes	Yes
Assess exercise capacity over different durations and cadences	Yes	Yes
Evaluate physiological demands of training sessions	Yes	Yes
Support talent identification	Yes	Yes
Predict performance	Yes	Yes

### 1.2 Athlete preparation

To enhance the reliability and validity of data, it is recommended that pretest preparation is standardized. This includes considering:

- Diet and health status
- Training
- Testing time
- Warm-up

## 2. Laboratory Performance Physiology Testing

### 2.1 2 in 1 Test

This protocol was originally adapted from the South Australian Sports Institute (SASI) “Protocols for the Cycling 2 in 1 Test” document released in September 2013 and was most recently shared by AusCycling Performance in the “Cycling Australia High Performance Unit High Performance Athlete Nomination Guidelines” released in February 2015. This update is current as of March 2023 includes updated advice on ergometer to use, individualization of workloads, para specific considerations, and metabolic insights.

The “2 in 1” test is a combination of a submaximal incremental step test and a time trial providing an efficient means by which to determine key physiological characteristics related to competition performance and required for individualised training prescription. Such characteristics include peak oxygen uptake ( $\dot{V}O_{2peak}$ ), peak power output (PPO), power output corresponding to the lactate threshold (LT1) and lactate turn point (LT2), gross efficiency and sub-maximal substrate utilisation (I.e., fuel use).

#### 2.1.1 Equipment

- Various standalone cycle ergometers including an SRM Ergometer, Wattbike or Lode which have been dynamically calibrated according to NSSQA stands can be used. However, for greatest specificity, it is suggested that in most cases (particularly with the prevalence of disc braked bikes) that a smart trainer (I.e., Wahoo Kick or Tacx Neo) be used in conjunction with the athlete’s own road bike fitted with a power meter. It is advised that the smart trainer be dynamically calibrated according to the NQSS standards. This allows for “calibration” of the athlete’s own power meter because the smart trainer recorded power for each step of the test can be compared with the athlete’s power meter data (see Zadow et al 2016, 2018). Some para-athletes may prefer the feel of a Lemond wind-braked ergometer depending on their unique impairment.
- Stopwatch
- Fan
- Metabolic cart/expired gas analysis system (I.e., Parvomedics TrueOne)
- Heart rate monitor/cycling head unit
- Lactate analyser (I.e., Lactate Pro 2) and associated capillary sampling equipment
- Body mass scales
- Stadiometer

#### 2.1.2 Testing Procedure

- The aim of this test component is for the athlete to achieve a blood lactate concentration between 4 and 6 mmol.L<sup>-1</sup> at the conclusion of five 5 min work increments that increase by the same number of watts.
- It is suggested that the workload for step 5 be determined by taking a fraction of the athlete’s estimated critical power (i.e., the power equivalent to 91% of the estimated critical power). This estimate can be derived by a) conducting a specific field test within 2 weeks prior to lab testing whereby a 2 min and 12 min mean maximal power (MMP) data are used to calculate critical power (CP) using the inverse time model (see section 3.2 Standardised Power Profile Test), or b) examining the record power profile (RPP) for the athlete for the previous 6 months and determining the CP following the methodology outlined in section 3.1 Record Power Profile.
- Once the workload for step 5 has been determined, the increment should be determined based on the athlete’s characteristics (mass, physical impairment etc.). See Table 1 for guidance.

- If the prediction for the workload for the fifth workload is incorrect, then a 6<sup>th</sup> or 7<sup>th</sup> stage can be utilised as a back-up. Conversely, if an athlete is within the 4 to 6 mmol.L<sup>-1</sup> range after the 4<sup>th</sup> stage, then the submaximal step test component should cease.
- Actual power output (W) from athlete’s own head unit, power from smart trainer (W) from trainer head unit (if available), heart rate (bpm),  $\dot{V}O_2$  (L.min<sup>-1</sup>), carbon dioxide release  $\dot{V}CO_2$  (L.min<sup>-1</sup>), blood lactate concentration (mmol.L<sup>-1</sup>), cadence (rpm), and rate of perceived exertion (RPE – Borg 6-20 or 1- 10).

Table 2. Workload characteristics for the 2in1 Test submaximal test component

	Senior Male	Junior Male	Senior Female	Junior Female	Para Male B/C/T	Para Male H	Para Female B/C/T	Para Female H
Workload increment (W)	50	50	25	25	25 or 50	10 or 15 or 25	10 or 15 or 25	10 or 15
Expected starting workload (W)	150-180	75-120	150-180	75-120	125-180	80-130	80-100	75-120

### 2.1.3 Submaximal test component

1. Ensure metabolic cart has been turned on with appropriate system checks and calibrations performed to manufacturers specifications.
2. Ensure the ergometer is adjusted to suit the athlete’s specifications (i.e., seat height/setback, crank length, reach etc.) or the athlete’s bike is set up on ergometer and gears and ergometer are functioning correctly.
3. Assess athlete height and body mass.
4. Provide the athlete a brief summary of testing protocol.
5. Perform “calibration” or “zero-offset” procedure as advised by power meter manufacturer.
6. Perform gas calibration is required by metabolic cart manufacturers pre-testing specifications.
7. Collect a pre-exercise blood sample from the fingertip for analysis of blood lactate concentration. Earlobe can be used as an alternative if preferred.
8. Position the gas collection apparatus (respiratory valves etc.) and ensure that the athlete is as comfortable as possible.
9. Activate the gas analysis system and allow 1 min of “resting” data to be collected. Athlete to remain passively on bike or pedal lightly (<50 W).
10. If using a smart trainer and have an associated head unit connected, start data recording.
11. Commence testing protocol with athlete holding the power required for the first workload. If the athlete is using their own bike, ensure that they start data recording on their own head unit and lap each step if possible.
12. Athletes should aim to target a cadence of 90-100 rpm as permitted by gearing.
13. As the athlete works through the testing protocol, provide feedback regarding target power and cadence.
14. A capillary blood sample should be collected and analyzed from fingertip (or earlobe if preferred at start) during the last ~30 s of each workload.
15. RPE should be collected during the last ~15 s of each workload.
16. Once the athlete has attained a blood lactate concentration of between 4 and 6 mmol.L<sup>-1</sup>, the submaximal component of the 2in1 test is ceased to not fatigue the athlete too much prior to the 4 min maximal test. Stopping the athlete within the target range may require an “educated guess” by testing staff which should consider the RPE (expected RPE for final workload 14-17), RER (between 0.96-1.02), and heart rate (likely 85-95% of maximal heart rate).

17. If gas analysis has been conducted, remove the breathing apparatus from the athlete as rapidly as possible after the completion of the last submaximal step.

#### 2.1.4 20 min recovery component

18. A stopwatch should be started at this time to monitor the duration of 20 min break commencing at the conclusion of the submaximal test component.
19. During the recovery interval the athlete should be provided the opportunity to drink and actively recover with low intensity cycling (I.e., 50-100 W) for at least 10 min. After which they have the option to get off the ergometer and sit passively.
20. Athletes should get back onto the ergometer and prepare for the commencement of the 4 min maximal test at about 17 min into the recovery component to avoid rushing.
21. A capillary blood sample should be collected at the 18-min mark of the rest interval to ensure the athlete is adequately recovered for the 4 min maximal test. It is expected that the blood lactate concentration should be below 2.5 mmol.L<sup>-1</sup>. If greater than this, immediately re-test and once confirmed, active recovery should continue with blood lactate concentrations being checked every 5 min until a concentration of below 2.5 mmol.L<sup>-1</sup> is recorded, or the total rest period reaches 30 min.

#### 2.1.5 4 min maximal test component

22. The athlete is required to complete as much work as possible in the allocated 4 min period. Whenever possible, the test should be completed with gas analysis.
23. Before commencement of the test, perform gas calibration is required by metabolic cart manufacturers pre-testing specifications.
24. Position the gas collection apparatus (respiratory valves etc.) and ensure that the athlete is as comfortable as possible.
25. Activate the gas analysis system and allow 1-min of “resting” data to be collected. Athlete to remain passively on bike or pedal lightly (<50 W).
26. If using a smart trainer and have an associated head unit connected, start data recording.
27. The athlete should aim for a cadence between 90 to 100 rpm throughout the test and pace the 4 min to ensure a true maximal average is achieved.
28. Verbal encouragement and/or the athlete’s motivational music might be beneficial.
29. At the end of the test, remove the breathing apparatus from the athlete as rapidly as possible.
30. Record RPE as soon as possible after completion.
31. A capillary blood sample should be collected at 1- and 4-min after the completion of the 4-min test.
32. Consideration for Para H classification athletes: The 4-min maximal test can be substituted with a short ramp test where workload is increased by 10 W every 30 s until exhaustion. The duration of the ramp test should be 5-8-min, so an educated guess by testing staff may be required. As a guide, the starting workload for the short ramp could be identical to the workload prescribed for the 4<sup>th</sup> step (or 2<sup>nd</sup> last completed) of the submaximal step component.

#### 2.1.6 Measurement

- Submaximal  $\dot{V}O_2$  and  $\dot{V}CO_2$  are calculated by averaging the reading recorded during the final 2-min of each submaximal workload.
- Submaximal heart rates are the average of the values for the final 30-s of each submaximal workload.
- The peak  $\dot{V}O_2$  and  $\dot{V}CO_2$  are recorded as the highest value attained over a period of 1-min during the 4-min max test component.
- Peak heart rate is the highest 10 s average for the 4-min maximal test component.

- For tests where the short ramp option is completed instead of the 4-min maximal test, the average power for the entire duration of the ramp is used.
- Energy expenditure and substrate oxidation (i.e., fuel use) can be estimated from submaximal  $\dot{V}O_2$  and  $\dot{V}CO_2$  stoichiometry transformation (Jeukendrup and Wallis 2005).
- Gross efficiency can be estimated as the ratio of work generated to the metabolic energy cost (Joyner and Coyle 2008).
- Maximal accumulated oxygen deficit (MAOD) can be calculated from the power versus  $\dot{V}O_2$  relationship from the submaximal component and predicting the  $\dot{V}O_2$  demand for the power held for the 4-min maximal test (Dorado et al 2004). Aerobic and anaerobic energy contributions to the 4-min maximal test can then be calculated.
- Computerized analysis allows for relatively simple determination of the various blood lactate transition thresholds and associated measures. The ADAPT (Automatic Data Analysis for Progressive Tests) software is to be used to calculate these thresholds from the 2in1 test data. ADAPT 3.0 software can be accessed by contacting [AISDevelopers@ausport.gov.au](mailto:AISDevelopers@ausport.gov.au). Earlier versions are available via the NIN. It is recommended to use the modified D-max method with LT1 set as calculated. It is advisable to sense check the LT1 and LT2 estimates with training/competition/lab data to ensure plausibility. In some cases, the experience of the practitioner will be required to adjust the predictions based on manipulating the blood lactate associated with LT2.

Table 3. Normative “2in1” performance physiological characteristics of Road and Track Endurance AusCycling Team (2018-2023) and South Australian Sports Institute (2015-2022) athletes (Mean ± SD). \* data from Long Graded Exercise Test.

Athlete Category	LT1 Power W	LT2 Power W	4 min TT (W)	4 min TT $\dot{V}O_{2peak}$ (L.min <sup>-1</sup> )	4 min TT $\dot{V}O_{2peak}$ (mL.kg <sup>-1</sup> .min <sup>-1</sup> )
Senior Women/U23 (N=10)	195 ± 10	265 ± 15	360 ± 15	3.9 ± 0.2	61.4 ± 3.0
Senior Men/U23 (N=10)	285 ± 15	390 ± 20	530 ± 25	5.6 ± 0.3	71.5 ± 3.5
Junior Women (N=10)	169 ± 22	231 ± 18	314 ± 34	3.5 ± 0.3	54.0 ± 4.6
Junior Men (N=16)	231 ± 30	329 ± 34	442 ± 44	4.9 ± 0.5	69.0 ± 3.9
Para Women B (Team)	276 ± 8	401 ± 13	542 ± 3	N/A	N/A
Para Women B (Stoker)	99 ± 3	157 ± 6	224 ± 13	2.5 ± 0.1	47.2 ± 3.4
Para Women B (Pilot)	177 ± 11	244 ± 20	318 ± 16	3.8 ± 0.1	52.5 ± 0.8
Para Men B (Team)	435 ± 74	640 ± 31	847 ± 3	N/A	N/A
Para Men B (Stoker) (N=1)	207 ± 15	281 ± 24	393 ± 6	4.5 ± 0.2	61.1 ± 0.6
Para Men B (Pilot) (N=1)	229 ± 63	359 ± 21	453 ± 6	5.5 ± 0.1	62.1 ± 4.2
Para Women C1 (N=1)	62	125	171	N/A	N/A
Para Women C2					
Para Women C3 (N=1)	131 ± 15	198 ± 19	259 ± 16	3.1 ± 0.0	54.3 ± 1.3
Para Women C4 (N=2)	177 ± 13	225 ± 4	293 ± 24	3.1 ± 0.4	52.8 ± 2.8
Para Women C5					
Para Men C1 (N=1)					
Para Men C2 (N=1)	177 ± 20	269 ± 6	361 ± 5	4.4 ± 4.4	61.8 ± 2.1
Para Men C3 (N=1)	170	284	379	4.4	58.4
Para Men C4 (N=1)	185	339	444	4.9	70.7
Para Men C5 (N=1)					
Para Women T2 (N=1)*	131 ± 7*	182 ± 3*	230 ± 7*	N/A	N/A
Para Men T2 (N=1)	165 ± 30	263 ± 23	358 ± 11	4.0 ± 0.4	46.0 ± 5.8
Para Women H3 (N=1)*					
Para Men H3 (N=1)	117	153	183	2.8	40.3
Para Men H4 (N=1)	144 ± 7	184 ± 16	230 ± 12	3.3 ± 0.1	58.8 ± 4.6
Para Men H5 (N=1)*	171 ± 8*	230 ± 14*	290 ± 19*	3.9 ± 0.1*	48.9 ± 0.8*

## 2.2 Torque-Cadence Testing (Laboratory)

This protocol was originally adapted from the AusCycling National Sprint program 2016-2020. For endurance athletes, this data is of increasing interest and has been used routinely at SASI and AusCycling for monitoring endurance athletes. Understanding this data may help individualize training content in the short-duration domain through a great appreciation of an athlete's bike-specific strength/neuromuscular characteristics. It is advised that the ergometer be dynamically calibrated according to NSSQA standards. If an SRM ergo is not available, then the field-based test may be utilized. The relationship between this protocol and the field-based protocol is currently being established.

### 2.2.1 Equipment

- For the lab:
  - SRM Ergo
  - Wattbike with air and magnetic brakes removed.
  - Laser tachometer
- For the field:
  - athlete's road bike with power meter and head unit

### 2.2.2 Testing Procedure (lab)

1. Ensure athlete is sufficiently warm-up to perform a series of maximal efforts.
2. Ensure the ergometer is adjusted to suit the athlete's specifications (i.e., seat height/setback, crank length, reach etc.) or the athlete's bike is set up on ergometer and gears and ergometer are functioning correctly.
3. Perform "calibration" or "zero-offset" procedure as advised by power meter manufacturer.
4. Provide the athlete a summary of testing protocol (i.e., 4-5 efforts in total, alternating between a maximal cadence effort and maximal isokinetic effort at 50 rpm as per instructions below).
5. SRM ergometer gear should be set at 14.
6. Maximal cadence (Cmax) effort on the Wattbike in a *seated* position. Athlete commences effort spinning at a self-selected submaximal cadence (i.e., 70-90 rpm). When ready, an increases cadence with the aim of achieving the highest possible cadence (typically within 4-s). Maximal cadence should be recorded as measured manually using the laser taco meter. Motivate the athlete to continue until a decline in cadence is observed.
7. Maximal isokinetic effort on SRM ergometer in a *seated* position (i.e., prescribed cadence 50 rpm; PC50). Athlete commences effort and slowly builds cadence as efficiently as possible over the course of 30-60-s. Once a cadence of 50 rpm is reached, the electronic brake should come on and the maximal PC50 effort can commence. In their own time the athlete should complete 4 maximal contractions with each leg (i.e., 4 complete crank turns - ~5-s duration).
8. Cmaxeffort on the Wattbike in a *seated* position.
9. Maximal isokinetic effort on SRM ergometer in an *out of the seat* position
10. Cmax effort on the Wattbike in an *out of the seat* position (optional).
11. Ideally 4-5-min separate the two PC50 efforts (Cmax can occur during this time), to ensure the athlete feels ready to produce maximal isokinetic efforts.

### 2.2.3 Testing Procedure (field)

1. Prior to commencing the test perform "calibration" or "zero-offset" procedure as advised by power meter manufacturer.
2. Out on the road or on an ergo, complete a low-intensity warm-up of at least 15 min.

3. Following the low intensity warm-up, complete 2 x 6 s preparation sprints (at 80% subjective effort) with 5 min active recovery in between. One sprint should be standing with gearing of 53/16 (or equivalent) from a rolling start at cadence of 80 rpm. One sprint should be seated with gearing of 39/28 (or equivalent) from a rolling start at cadence of 40 rpm.
4. Complete 10 min of active recovery.
5. The 6 x 6 s test sprints should then be completed in the follow way with 5-min of active recovery between each:
  6. 1 x seated sprint in 39/28 from 40 rpm rolling start,
  7. 2 x standing sprints in 53-54/15 and 53-54/16 from 80 rpm rolling start,
  8. 2 x standing sprints in 53-54/11 from 40 rpm rolling start, and
  9. 1 x seated sprint in 39/23 from a 40 rpm rolling start.
10. Sprints should be completed in the same order for each subsequent testing session with hands in the drops for all sprints. Ideally sprints should be undertaken on flat road (<2% gradient) and from a rolling start (I.e., cadence >40 rpm) to limit known sampling issues at low cadences.
11. Supervisors are recommended to use the first torque cadence test as a familiarization to account for the learning effect.

#### 2.2.4 Measurement

- The highest Cmax from the 2-3 maximal cadence efforts is retained for analysis.
- The highest power output and corresponding cadence from the 2 PC50 efforts is retained for analysis because sometimes the brake does not hold 50 rpm.
- Power and cadence data are used to calculate torque using the following formula:  
Torque (N.m) = Power (W) / (Cadence (rpm) x  $\pi$  / 30)
- The torque associated with Cmax is set as 0 N.m

- The torque-cadence relationship is then determined using a linear regression (Gardner et al 2007)
- The torque intercept of the regression equations represents maximal torque (Tmax) and the cadence intercept represents Cmax.
- The power-cadence relationship is determined by fitting a second-order polynomial to the Cmax (x<sub>2</sub>, maximal x intercept) and PC50 data and setting the minimum x intercept to 0 (i.e., x<sub>1</sub> runs through the origin).
- Optimum cadence (Copt) is defined as half the maximal x intercept (x<sub>2</sub>)
- Theoretical maximal power output (Pmax) is calculated using the following formula where a, b, and c are the constants of the polynomial function:  

$$P_{max} = a(C_{opt})^2 + b(C_{opt}) + c$$

Table 4. Normative laboratory torque cadence characteristics of Road and Track Endurance national team athletes (Mean ± SD). Data derived from 2018-2023.

Athlete Category	Cmax (rpm)	Tmax (Nm)	Copt (rpm)	Pmax (W)	T-C Slope
Senior Women/U23 (N=10)	226 ± 7	135 ± 15	113 ± 5	810 ± 110	-0.606 ± 0.061
Senior Men/U23 (N=10)	248 ± 7	185 ± 15	124 ± 4	1200 ± 85	-0.749 ± 0.081

*Cmax* – maximum cadence, *Tmax*, - maximum torque, *Copt* – optimum cadence, *Pmax* – peak power

## 3. Field Performance Physiology Testing and Monitoring

### 3.1 Record Power Profile (RPP)

The Record Power Profile (RPP) (Pinot & Grappe 2011) is a field-based performance capacity measurement where the mean maximal power for any given duration is recorded during training and competition during a specific time-period (i.e., previous 3-months, previous 12-months etc.) (Leo et al. 2021, Mateo-March et al. 2022, Valenzuela et al. 2022). The RPP can be used to monitor training progress, set performance goals, and for cross sectional or longitudinal comparisons within or between athletes. For categorisation (see Section 4), the RPP from the previous 12 months is required (i.e., 1<sup>st</sup> April 2025 to 31<sup>st</sup> July 2026), in addition to contextual information logged in TrainingPeaks of the total time trained (hours), total work completed (kJ) and athlete's average recorded body mass.

#### 3.1.1 Equipment

- Athlete's road/TT/track bike with power meter (should be regularly calibrated and zero-offset according to the manufacturer's recommendations) head unit.

#### 3.1.2 Data acquisition

1. Log into TrainingPeaks platform and go to the athlete's dashboard power profile table.
2. Adjust the selected time frame in the power profile table
3. Verify power output plausibility in conjunction with speed and cadence by checking the power-curve/table and spot outliers. In case of an outlier, delete the segment.
4. Go into table and copy all available duration and power outputs from 5s to 3h. Adjust the filter and remove reference series.
5. Copy the exported table into Excel (paste special 'match destination formatting')
6. Copy data exported into Excel and transpose to adjust data layout for the output sheet.
7. Copy the power profile information into the output spreadsheet.

Table 5. Normative Record Power Profiles values of Road and Track Endurance national team athletes (Mean  $\pm$  SD). Data derived from 2022-2025.

Athlete Category	5 s	2 min	5 min	10 min	12 min	20 min	1 h
<b>Senior Women/U23 (N=33)</b>	1043 $\pm$ 50	415 $\pm$ 21	335 $\pm$ 17	328 $\pm$ 16	302 $\pm$ 15	280 $\pm$ 14	240 $\pm$ 12
<b>Senior Men/U23 (N=40)</b>	1572 $\pm$ 80	613 $\pm$ 30	494 $\pm$ 25	445 $\pm$ 22	438 $\pm$ 22	404 $\pm$ 20	353 $\pm$ 18

### 3.2 Standardised Power Profile Test

The standardized power profile field test involves three maximum efforts interspersed by 30-40 min of active recovery (Simpson & Kordi 2017, Leo et al. 2021) during a single session or completed as multiple sessions over different days. This test is completed on an athlete’s own bike with power meter and can be performed 1) in the field as part of a training session, 2) in a controlled laboratory environment, 3) in the field and laboratory in a modified format when completed with a 2in1 test procedure. The cyclist’s performance characteristics can be assessed based on the power-duration parameter estimates (Leo et al. 2021) and include:

- Peak Power (Pmax)
- Sprint Power Reserve (SPR)
- Threshold Power (TP)
- Work Capacity above TP (W')

Table 6. Normative Power Profile Test characteristics of Road and Track Endurance national team athletes (Mean  $\pm$  SD)

Athlete Category	Peak Power (W)	SPR (W)	CP/TP	Work Cap. >CP/TP (kJ)
Senior Women/U23 (N=30)	990 $\pm$ 90	610 $\pm$ 30	270 $\pm$ 22	19.7 $\pm$ 4.3
Senior Men/U23 (N=30)	1474 $\pm$ 200	935 $\pm$ 45	395 $\pm$ 35	25.8 $\pm$ 4.8

SPR – Sprint Power Reserve, CP/TP – Critical Power / Threshold Power, W' – Work Capacity above CP/TP

### 3.2.1 Equipment

- Athlete’s road bike with power meter and head unit
- Smart trainer (for laboratory assessment option)
- Body mass scales (for laboratory assessment option)
- Stadiometer (for laboratory assessment option)

### 3.2.2 Test Procedure

1. Assess athlete height and mass (for laboratory assessment option)
2. Prior to commencing the test perform “calibration” or “zero-offset” procedure as advised by power meter manufacturer.
3. In the field or on an ergo, complete a self-selected race-specific warm-up of at least 15-30 min. The warm-up should include some time at high intensity (>LT<sub>2</sub>) for priming and an activation effort.
4. Following the warm-up, perform a 15 s maximal sprint from a rolling start (>40rpm) accelerating as hard and fast as possible. The maximal effort should be sustained for the 15 s duration. Gear selection should be chosen with peak power output in mind.
5. Complete 10 min of active recovery.

6. Perform a 3 min mean maximal power (MMP) effort (or 2 min MMP with the “2in1” combination). The goal is to attain the highest average workload for the entire duration of the effort (i.e., empty the tank). Preferably, this requires an even pacing strategy, and familiarisation is advised, if athletes are doing this procedure for the first time. Gear and cadence can be self-selected. It is advised to complete the effort on a slight uphill gradient (i.e., 4-7%) at a traffic safe road.
7. Complete 30-40 min of active recovery between efforts (if in the field, or combination of active/passive recovery if in the laboratory).
8. Perform a 12 min effort with the same procedure as mentioned beforehand.
9. Only very experienced and elite level athletes are allowed to self-determine effort order/randomization.

### 3.2.3 Measurement

- Extract the highest power outputs for corresponding durations from the training file on TrainingPeaks platform.
- Peak power is defined as the 5 s peak power output.
- Critical power (CP) represents the phase transition separating exercise in which physiological steady state can be maintained, from exercise that cannot (i.e., maximum metabolic steady state) (Jones et al. 2019). It is important to note that CP is similar but not identical to the lactate turn point (LT2) or maximal lactate steady state (MLSS). However, all these terms generally refer to an athlete’s threshold. The short and long effort (i.e., 3 min MMP and 12 min MMP) data can be used to calculate the estimates for CP and the fixed quantity of work that may be completed at intensities greater than CP (i.e.,  $W'$ ), a linear model can be used (Simpson & Kordi 2017).

Linear work-time:  $CP = \text{slope}$ ,  $W' = \text{x-intercept}$

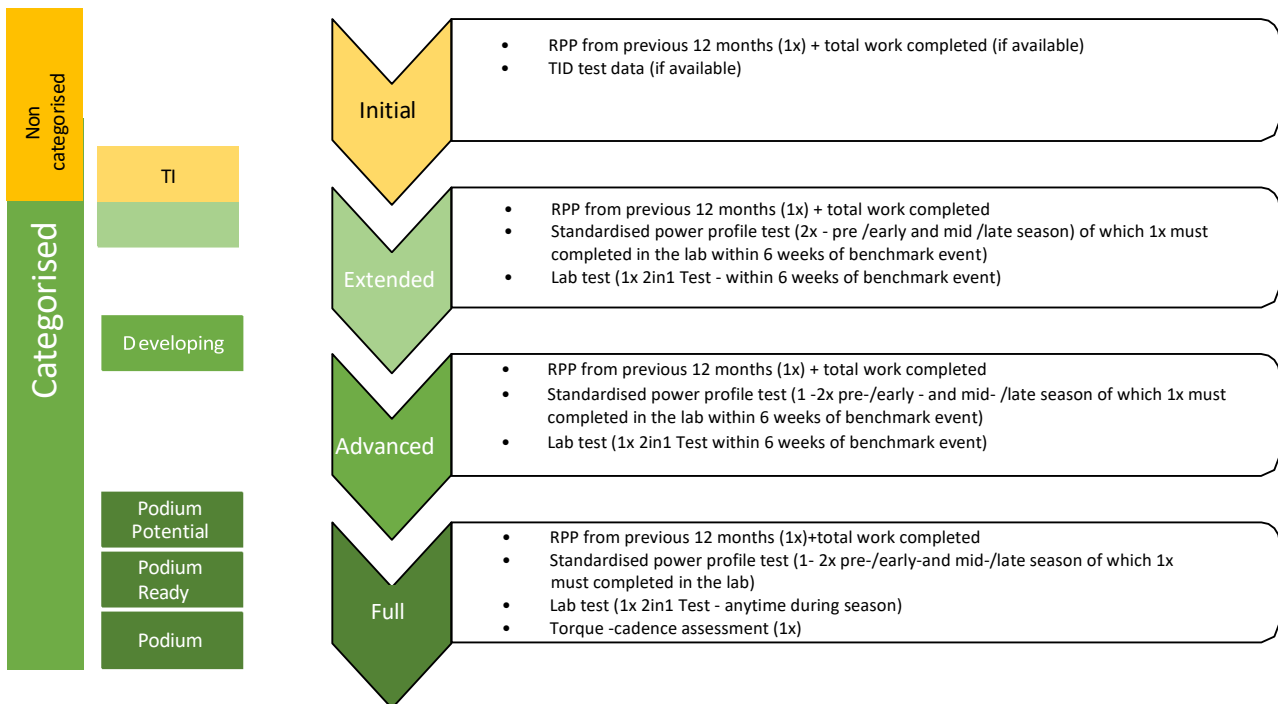
Linear power-inverse of time:  $CP = \text{x-intercept}$ ,  $W' = \text{slope}$

- If combining with the 4 min MMP from the 2in1 lab test, all three (2, 4, and 12 min) MMPs are used to estimate CP and  $W'$ . The estimate of CP from the model producing the lowest standard error of the estimate (SEE) should be used.
- The sprint power reserve (SPR) is defined as the difference between 5 s peak power and 3 min MMP (Sanders & Heijboer 2019). If the standardised power profile test has been done in conjunction with a 2in1 lab test, the 2 and 4 min MMPs can be used to estimate the expected 3 min MMP using the linear work-time model or power-inverse of time model:  $P = (W'/t) + CP$

## 4. Categorisation Nomination Requirements

The following framework is a guide on what physiological/physical testing and monitoring data is required for submission as part of an athlete categorisation assessment (see <https://auscycling.org.au/about/high-performance/categorisation> and associated Athlete Categorisation and Performance Standards document). The level of information required is related to an athlete's current level of categorisation or stage in the pathway.

Contextual data including athlete body mass (highest value), and total training completed should be submitted as both total hours and total kilojoules for the previous 12 months.



## 5. References

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## 6. Appendix

Power Profile Test: [2025 SPPT-Template.xlsx](#)

Torque Cadence Profile: [2025 TCP-Template.xlsx](#)