Course Measuring

Quick Guide:

Do

- Set revolution counter up properly, consult Appendix 1 or Appendix 2 depending on model of counter you are using.
- Inflate tyre to 90 - 100% of pressure specified on sidewall of tyre.
- Start measurement with magnet just in front of pick-up (at least 25mm).
- Ride over reference standard at least 3 times to ensure that tyre is giving a constant count. (If counts are inconsistent then fit another tyre).
- Ride over the reference standard both before and after course measuring to ensure that there is no significant difference in the constant over the standard.
- Ride the reference standard the same as you would ride the course that you will measure (it is no good riding the reference standard perfectly straight if you then ride the course you are measuring in a wobbly manner).
- Mark the START/FINISH points clearly (road marking crayon) and give a precise description of both using fixed reference points. (If possible use three reference points so the exact position of start/finish can be determined. Reference to an accurate Grid Reference is also useful).
- Look at the requirements of CTT Regulation 34.

Don't

- Measure when there are likely to be extremes of hot or cold (not advisable to measure at times in the winter or in the summer when temperatures are going to rise and fall rapidly).
- Exceed 20mph when course measuring (easily done on hills and slip roads).
- Use front brake to control speed (whenever possible use rear brake).
- Try to race round the new course you are measuring. Preferably ride at a constant speed but take the competitive line where possible.
- Use Kevlar belted tyres as these can give inconsistent readings.

SECTION 1

Introduction

One of the two key elements in fixed distance and fixed time events is accurate course measurement. This guidance note is intended to assist those who give up their free time so willingly to achieve these ends and it is also intended as an introduction to the technique for newcomers.

Responsibility for Accuracy of Measurement

The District Committee is responsible for ensuring that the specific requirements of the appropriate Regulation are met. No course of 'fixed distance' or 'fixed time' should be used until it has been approved as accurate and not shorter than claimed following measurement by at least two different course measurers.

Basic Method of Course Measurement

Measuring must be done by approved Cycling Time Trials course measurers by the method detailed in Section 3 using a measured reference standard, approved by the District Committee and which has been established using the method detailed in Section 2.

SECTION 2

Reference Standards

When laying down the reference standard you must use the method detailed below and not rely on any information from Local or County Highway Authorities, Police, Local Surveyors, milestones and the use of maps (Ordnance Survey) no matter what the scale.

Minimum Distance of Reference Standard

The minimum distance shall be a half mile but any longer distance may be used (e.g. one mile) if the road used is suitable. It is preferable that the location of start and finish points coincides with fixed reference points that are easily identifiable.

Siting of a Reference Standard

A reasonably straight, well-surfaced stretch of road should be used preferably with a kerb or white line running the length of the proposed reference standard. The measurement should normally be made 1 metre from the kerb/white line to avoid drains, debris, etc. If it is possible, it is recommended that both sides of the road have a measured standard so that readings can be taken in both directions.

Written Description of Reference Standard

A clear written description should be made of every reference standard in such a manner that a measurer without prior knowledge of the road concerned may be able to recognise and ride over the precise path of the reference standard.

This should be kept by the District Secretary.

The start and finish points should be clearly defined with reference to some permanent and accurately definable feature as close as possible to the line of measurement.

Mark the start and finish points with paint, marker stick or chisel marks in the kerb along with some form of identification.

The distance measured from the kerb/white line should be stated along with direction of measurement and on which side of the road. Measurements at the full length of the reference standard should be quoted to the nearest inch/cm.

Give a Grid Reference if possible to aid the location of the start and finish points.

SECTION 3

Course Measuring

Course measurements are calculated from the recorded revolutions of a cycle wheel. Before measuring a course, the cycle, fitted with an approved revolution counter, is ridden over the "reference standard" of half a mile or more and from these readings a ‘constant’ is obtained. (x revs per mile).

Revolution Counters

From time to time the Board of Directors of Cycling Time Trials (the “Board”) approve a revolution counter that meets the standards laid down on accuracy and reliability. From January 1997 the approved Cycling Time Trials revolution counters are those manufactured by "Smart" and "User One". These are the only counters that should be used when measuring Cycling Time Trials approved courses. Details of these revolution counters can be obtained from the Cycling Time Trials National Secretary (Competitions & Development). It should be noted however that “Smart” and “User One” revolution counters are no longer commercially available although some Districts do hold various spare parts.

Tyres and Tyre Pressure

It is advised that you use a good sport/touring tyre for course measurement, 20 to 28 mm wide, and inflate to 90-100% of the pressure indicated on the sidewall of the tyre.

Do Not use Kevlar belted or steel mesh belted tyres as these can give irregular readings when used for course measuring.

YOU MUST use butyl inner tubes as these maintain pressure better than latex tubes. It is advisable to use inner tubes that have not been previously punctured.

Wheels used should be of a laced spoke construction (for a 26" to 27" wheel). This is to enable accurate estimation of parts of a wheel revolution.

Obtaining the Constant

Ride the reference standard the same as you would ride the course that you will measure. It is no good riding the reference standard perfectly straight if you then ride the course you are measuring in a wobbly manner. You should ride over the reference standard at least three times, to determine the constant for that measuring condition. You should measure to the nearest complete revolution and then to the nearest spoke. (e.g. 778 revs + 12 spokes (36 spoked wheel) = 778.333).

If the difference exceeds 2 spokes when obtaining the constant further readings should be taken until a stable satisfactory constant is achieved. The most pessimistic reading must be used, (i.e. the highest reading). It is very important that you check the constant before and after every period of course measuring, using the same reference standard. Do not use tyres that give consistently wider variations than ±2 spokes per mile (or ± 4").

A fresh constant must be obtained if a change of tyre pressure occurs, e.g. puncture.

Measuring the Course

The course must be ridden in the style/position used when obtaining the constant.

Measurement should be carried out approximately 1 metre from the edge of the road, bearing in mind safe riding. At roundabouts the shortest practical line must be taken, even if it means waiting for suitable traffic conditions.

Measurement is to be avoided if a significant length of road has its surface under repair and/or a normal riding line cannot be followed.

Readings should be taken from the counter at clearly defined intermediate points, preferably not more than 4 or 5 miles apart. This will aid subsequent checking and avoid the need to re-measure the whole course should a puncture or another incident stop measurement.

When you stop during measuring, avoid stopping with the magnet in close proximity to the pick-up, (within 25mm), as this may add to your total without the wheel actually moving.

When measuring you should never exceed 20 mph, even if this means applying the rear brake, when travelling downhill or descending slip roads. When you start, the magnet must be just in front of the sensor.

Marking Start and Finish Points

As with the laying down of the reference standard you must mark and fully describe the precise points of start and finish so that someone with no knowledge of the course can identify accurately the exact points. It is recommended that Ordnance Survey grid reference points are also recorded.

Calculation of Distances

Converting wheel revolutions to distance is a matter of simple arithmetic. Wheel revolutions (including fractions) divided by the constant in revolutions per mile (including fractions) equals the distance in miles and decimals or even (by using the appropriate factor) in kilometres.

Weather Conditions

A major source of measurement error is due to changes in temperature. Tests have shown that there is a change of as much as 1 revolution per mile per 10oC. It is recommended that course measurement be carried out when temperatures are between 5oC and 26oC (40oF and 80oF) and to avoid any time when there could be large changes in temperature. Avoid measuring in very wet conditions, especially after a dry calibration. Before calibration or measurement the cycle should be ridden for at least 1 mile so that the tyre temperature reaches road temperature.

This is particularly important if using a car to travel to the reference standard or the course to be measured. It is recommended to avoid measuring when there is a strong wind as it effects riding style and line.

Safety Factor & Differences Between Measurements

No matter how accurately the measurements have been made, they can be affected by several small errors. For example no two measurements over several miles of the same course by the same or two different measurers are ever likely to give precisely the same result, since it is unlikely that exactly the same line on the road will be taken each time.

To ensure that the measurement of any fixed distance course is not short, an additional allowance of a minimum one yard per mile should be added to the overall measured distance. Note that this allowance must not be added to the standard. If differences occur between different measurements over the same course, or parts thereof, due allowance shall be made for possible measuring errors up to 1 yard per mile for each measurement. If the difference exceeds this amount, a third independent measurement shall be made. The course used must always be the longer of the two course measurements from different measurers.

SECTION 4

Course Measuring using GPS equipment.

Despite the improvement in the quality and accuracy of consumer GPS technical devices, following consideration, it is the view of the Board that NO cycling specific GPS devices are suitable for Cycling Time Trials course measurement. However, they may be used for approximate course design with the following recommendations.

Fitting & Operation on a cycle

Follow the manufacturer's instructions for setting up, initialising, clock setting, etc,
However, in general:
The device should be fitted to the cycle face up and turned on in an open outdoor area. If the GPS device has not been used in over two weeks or is used in a location 50 miles or more away from the last time it as used, then an "Auto Locate" should be performed before use. The device will then acquire satellite signals and on completion display the GPS accuracy, this should be +30 feet for best results.
The GPS device generally allows the user to customise the display, and it is recommended that distance, time and GPS accuracy are among those displayed.
Always start the readings away from tall buildings, trees or high vehicles. Most systems work best when they have a view of the sky down to 15 degrees above the horizon. Under trees or around buildings, GPS accuracy can reduce drastically. Starting in the clear and riding through the start point will improve the situation as the recordings will produce better points along the route. Note how the speed reading differs from your wheel-driven cycle computer.
When measuring, start the timer while stationary and wait one minute for the GPS to lock onto your position before setting away. The same instructions as measuring a course with a revolution counter apply. Even though there is little chance of the device malfunctioning at speeds over 20mph, it is still best not to race around the course. It is recommended that a course of 25 miles or less (or that section of a longer course) is measured in one continuous trip.
GPS devices work best if stops are kept to a minimum. The intermediate distances can be compiled during subsequent course checking. At the finish, stop and immediately note the actual finish position before looking for a suitable timekeeper position beyond the finish, as the GPS unit may drift while stationary. Locate an appropriate finish point and stop the GPS device.
When starting actual course measurement, observe the above suggestions, even if you need to make an adjustment to get to the true start or finish point.

Fitting & Operation in a motor vehicle

If the best method of measuring a course is from a car, have another person drive; do not try to do two things at one time. Safety First!

The GPS device should be placed on the dashboard of the car as close to the base of the windscreen as possible. (If the car is fitted with a heated windscreen, (eg. some Fords), then this will seriously impair the devices' ability to communicate with the satellites and should be avoided). The device can then be operated as above. However, the sampling rate of a GPS-enabled cycle computer is approximately once per second, so it is recommended that around junctions and on severely curved sections of road that the speed of the car be restricted to 30mph.

SECTION 5

Course Measuring using mapping software on a computer.

The CTT Board has seen demonstrated a software tool for use on a PC or laptop called Bikehike (www.bikehike.co.uk) and has been running courses to introduce it and instruct course measurers on its use along with Risk Assessment. Users should be aware that it takes a "middle-of-the carriageway" line that might not always be the same as a "racing line".

This is important at roundabouts but there is a "hand-draw" facility to allow this to be overcome. Most useful is the satellite view (actually, it is high-resolution aerial photography) to enable the user to locate known landmarks for start and finish points. Because the mapping is based on Ordnance Survey maps, it is probably more accurate than other software tools.

Appendix 1 – "Smart Electronic Counter"

Description

This electronic revolution counter was developed by 'Digital Gauges' for the measuring of time trial courses used by the Road Time Trials Council. The instrument consists of a modified calculator in a weatherproof box with a magnetic pick-up and is designed for fitting to a cycle. It can be programmed to count wheel revolutions or to measure directly in miles, kilometres, or any other desired unit.

General

The calculator can be operated on its solar power but will only operate as a counter when the battery power is on. In this mode the batteries power both the calculator and the pick-up and it is not affected by fading light. The lower light indicates the battery condition. (If the light is dim - replace batteries).
Access to replace the four HP7 batteries is via the back of the box - 4 screws secure the panel.
Standard batteries have a life of approx. 50 hours -Duracell type approx. 200 hours.

Fitting

Secure the calculator unit to the preferred side of the handlebars near to the extension. Fit the pick-up bracket to the front wheel spindle (either side) and secure the cable with clips provided. Fit the two activating magnets between the crossover positions of the wheel spokes diametrically opposite each other. The hexagon nuts should face the pick-up.
The spokes should fit snugly into the grooves of the magnets and should be carefully arranged to ensure the magnet face is parallel to the spokes.
Adjust the pick-up to leave a clearance of 3 to 5mm (1/2 – /16) between the magnet faces and the pickup sensor.

Operation

Switch the pick-up on by pushing the switch ON, the lower red light should now be lit indicating the batteries are in good order. Test the unit by spinning the front wheel, the two lights should flash alternately. If this does not happen check the gap between the magnets and sensor and re-adjust if necessary.
The number of revolutions per mile (or any other distance) must now be established.

1. Clear the counter by pressing the AC key.
2. Press 1 followed by + and + again.
3. Press 0 and the counter will now count 1 per wheel revolution.

Note - The calculator will only operate from battery power with the lower light lit. It will however operate from solar power when it is switched off and will retain figures in this way.
At the start of any measurement the wheel should be set with the count magnet (BLACK) just in front of the pick-up to ensure the first count occurs after the first wheel revolution. At the end of the measured standard the counter will show the number of completed revolutions and it will be necessary to add on any decimal part of a revolution by normal methods.

Having established the number of revolutions per mile, the counter can be used as either a revolution counter or as an Odometer. To use as a revolution counter proceed as above (see points 1 to 3).

To use as an Odometer proceed as follows:

1. Clear the counter by pressing the AC key.
2. Press 1 then divide by number of revolutions per mile/kilometre (to at least 3 decimal places) to establish the constant.
3. Press + twice and then 0.

The counter will now measure in miles/kilometres and decimal parts thereof, enabling the measure to be read direct.

Appendix 2 – "User One Counter"

Description

The electronic wheel revolution counter was developed by "User One", in conjunction with the National Technical SubCommittee. This design was first issued for use in 1995.

The instrument consists of a sealed box containing the counter module, which is weatherproof, and a detachable cable/sensor unit. The counter module has a six figure LCD display panel, a zeroing button and screw terminals.

Fitting

Secure the handlebar clip provided to a convenient position on the handlebars.

Slide the counter module into position in a similar way to a normal cycle computer.

Attach the magnet on a spoke at a position 90 to 110 mm (3.5"- 4.5") from the wheel centre (ensure this is the only magnet on that side of the wheel).

Mount the sensor unit so that the operating mark on sensor is in line with centre of the magnet.

Set gap between magnet and sensor at 3 to 5 mm (1/2 -3/16")

Route the sensor cable along the front fork, fastening at suitable points with cable ties and attach the spade terminals situated at the end of the cable to the sensor connectors.

Ensure that the screw terminals are tight (re-check to see these are tight before each use).

Operation

A starting mark is to be made on the tyre or spokes in such a position that the magnet is at least 25 mm (1") ahead of the sensor (some measurers set the magnet with the tyre valve at bottom dead centre).

This mark is used as a datum for commencement of measure and determining parts of a wheel revolution.

Set the display to zero, using the push button mounted on the side of the counter module. The wheel revolutions will now be displayed up to a maximum count before re-setting after 999999.

At the start of any measurement the wheel should be set so that the counter magnet is just in front of the sensor to ensure that the first count occurs after the first wheel revolution.

At the end of any measurement be careful to stop with the magnet at least 25mm (1") away from the sensor and avoid any further movement so that counting errors cannot occur (if necessary move forward, never back, to attain this).

Module Power

The module is battery powered. The battery is attached into the circuit and will be replaced by the manufacturers when necessary. The battery life should be at least 4 years. (NB: due to this revolution counter no longer being commercially manufacture this service is no longer available)

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