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THE CALIBRATED BICYCLE METHOD OF ROAD RACE COURSE MEASURING

Increasing traffic adds to the difficulty of selecting safe road race courses. The future will probably see road races largely confined to suburbs, small towns and parklands, and races held in the early hours.

To get a race course certified as "reasonably accurate," complete measurement details must be sent to the National AAU Standards Committee Chairman (currently: Ted Corbitt, Apt. 8H Sect. 4, 150 W. 225 St., New York, N.Y. 10463). This information is evaluated by the Committee.

It is difficult to get an accurate road course measurement. The race promoter must select a safe course that is easy to follow and then measure it accurately using one of the following acceptable measuring methods: Steel Tape; Calibrated Bicycle Method; Calibrated Surveyor's Measuring Wheel; or Large Scale Maps. The Standards Committee urges that the Calibrated Bicycle Method be used to measure courses since it is relatively quick and it is accurate.

THE CALIBRATED BICYCLE METHOD

The basic method consists of riding a bicycle, fitted with a counter over the route to be measured. Before measuring the course, the bicycle is ridden over an accurately measured Road Calibration Course. A "constant" is arrived at and is used to calculate/measure actual distances by then riding the bicycle over the race course. Next the bicycle is again ridden over the road calibration course to check the functioning of the counter and to confirm the "constant."

STANDARD MILE or Road Calibration Course--To use the Calibrated Bicycle Method, a road calibration course is needed. Running tracks are not acceptable for this purpose, which is to find out what the bicycle records for a known distance on the ground. The selected road, for the calibration course, should be paved, straight, level and lightly travelled. It should be one mile long. However, if it is impossible to find such a strip, any lesser distance will serve, but not less than 1/2 mile in length. It should be carefully measured at least twice (preferably more) with a good steel tape, with a team of three or more men, at least one of whom has had experience in measuring with a steel tape. The tape should be stretched strongly and the increments carefully marked. Avoid measuring in extreme temperatures, as it affects the accuracy of the measurement. Take the average of the several measurements and permanently mark the start and finish with nails or chiselled cross-cuts (if concrete surface), and paint. If a city "measured mile" is available and suitable, it may be used after re-measuring it. Do not measure on very windy days.

WHERE TO MEASURE--Measure the course along the shortest path the runner will be expected to take, including all short cuts, ~~and use the IAAF rule of measuring one meter (3 ft, 3 inches) from the curb or parked vehicles or obstacles, in the running direction~~. Note that runners will generally take short cuts at every opportunity. Road races should be on the roads, but a course may be laid out on lightly used sidewalks or other paths when necessary. It is usually a good idea to run facing or against traffic. In seeking the shortest path, and when running on roads with many turns, runners will often run on each side of the road. Measure where the runners will run. In a heavy traffic situation the course may be laid out on one side only and the runners directed to run only on that side.

① Measure shortest path possible on roads available to the runners coming as close as 12 inches from curbs or 8 inches from uncurbed roads, where applicable.

METRIC SYSTEM--Consideration should be given, at least in the marathon and in the metric races, to setting up checkpoint timing stations in 5 kilometer increments. A kilometer = 0.62137 mile.

CHECKING MEASUREMENTS--When possible, a course should be cross-checked by a second method, such as large-scale maps, or by remeasuring the course, perhaps on a different day. A course measured by steel tape definitely should be cross-checked by a different method.

IMPORTANT--Select a safe course for the runners, in terms of traffic, footing, etc., and make an all out effort to keep the runners on the measured course (directional signs and personnel at all turns). Time the race carefully. Have stopwatches serviced and calibrated periodically. If the winner or the runners go off course, report this fact in all releases of race results. Do not adjust the time. Statisticians all over the world record results and they assume all is well.

D.2 calibrated bicycle measuring method

In the calibrated bicycle method, a bicycle is fitted with a special mechanical wheel-revolution counter. It counts revolutions and fractions of a revolution of the wheel. The counting assembly may be a Veeder-Root 5 star wheel revolution counter, or a lever or a gear-actuated counter. Another possibility is a resettable automobile trip odometer combined with a bicycle cable/gear, measuring in odometer and fractions of a wheel circumference units. A road course can be measured at about 10 miles an hour with an accuracy within one yard per mile.

A. Equipment Needed

1. A bicycle with good tires and tubes. The tire should be inflated hard but not "board" hard.

2. The bicycle is fitted with a wheel revolution counter. Carry a wrench and a screw-driver while out with the bicycle. There are 3 counter systems commonly used on bicycles for measuring: a) The Veeder-Root 5 Star Wheel Counter, with which Revolutions of the wheel are recorded on the meter, and Spokes are counted for fractions of a revolution; b) The Jones Assembly, with which "counts" are recorded from the meter; c) The Senechalle Assembly in which you deal with Odometer Units and Wheel Units.

3. Steel tape to make short measurements on the course in special situations, e.g. stretches of dirt and grass, or to locate checkpoint or reference marks in relation to fixed landmarks, such as start and finish lines.

4. Pencil and notebook to record figures and results. Record and date everything done.

5. Marking materials to establish checkpoint marks: hammer, cold chisel, paint, nails, adhesive or masking tape, red pencil.

6. A steel-taped road calibration course, one mile long. If necessary, the distance may be 880 or 1100 yards (one kilometer rounded off), minimum. It must be measured at least twice and a thorough check made of the number of tape lengths or increments used. Do not measure on windy days or in extreme temperatures. The tape expands in hot weather and shrinks in cold.

B. Method

1. Attach the revolution counter or odometer/bicycle cable-gear, as directed in the installation instructions. The procedures for a Veeder-Root Star-Wheel counter are described below, and they will serve as a guide for using the other two counters (Jones and the Senechalle assemblies).

a. Attach and adjust the counter on the axle and put the striker on a spoke so that the striker turns the counter blade. Test the adjustment by turning the wheel. The adjustment is a delicate one and care is needed. Recheck this before each measurement.

b. Paint or mark the spoke carrying the striker so that it can be easily seen. Or, use the tire valve as a guide by having the spoke next to it as the zero or starting point on the ground under the axle, as the spoke holding the striker has just left the counter blade. This also provides a means of counting the spokes to determine a fraction of a revolution.

c. The tire should be inflated hard, but not too hard or the wheel will bounce unduly. It should be free of suspicion of leakage. If used, tire air pressure gauges should not be used except immediately after pumping the tire up.

2. Warm the bicycle mechanism up by riding it a few minutes. Check the counter operation again for smoothness.

3. Immediately before and immediately after measuring the race course, ride the bicycle over the accurately measured Road Calibration Course (standard distance) of not less than 1/2 mile, preferably one mile long. From the readings obtained, the number of revolutions and fraction of a revolution of the bicycle wheel per mile is calculated. Take at least four rides over the calibration course before measuring the race course and take at least two rides afterwards. This provides the "constant" for that particular measuring occasion, and it is used to calculate actual distances from the revolution counter readings.

a. At the starting line of the calibration course, on the roadway, put the axle of the front bicycle wheel over the line and set the counter at the "zero" position, that is, with the striker on the point of leaving the star wheel, or just past the activating lever or cam of the counter.

b. Write down the meter reading (there are no fractions of a revolution on the starting line reading), or reset the meter to zero when possible.

c. Ride over the road calibration course at least four times to obtain the constant.

(1) The same cyclist should ride over the calibration course and the race course. Each rider has his own riding pattern.

(2) Ride exactly the same way and with the "same" weight and equipment on the bicycle as will be used during the actual race course measurement and subsequent recalibration of the bicycle,

(3) At the end of the road calibration course, stop the bicycle so that the axle is over the end line. Count the number of spokes of the striker past the counter, or spokes past the zero point of the wheel, and record this along with the number of revolutions registered on the meter. Subtract the starting figure from the finish figure. The result is the revolutions for that trial. Fractions of a revolution are calculated from the wheel spokes. For instance, if the wheel has 32 spokes and the striker is two spokes past the counter, it is 2/32nds of a revolution or "two spokes." In recording the result, give the number of revolutions from the meter and the number of spokes obtained by counting them, e.g. 1671 8/32 revolutions. Convert the fractions (spokes) to a decimal figure by dividing--in this case 32 into 8--e.g. 8/32 = 0.25 revolution, or 1671.25 revolutions. Carry the decimal fraction to two places.

(4) Ride over the calibration course at least four times and record the results. If you get a cluster of readings around a certain figure and one or more readings vary significantly from the general trend, e.g. 1/2 revolution, discard the offbeat recording in calculating the "constant."

(5) Add the results of each ride and divide by the number of rides. The result is the working constant for measuring the racing course--once you determine the number of revolutions for one mile. The constant is good for that day only.

(6) Always recalibrate the bicycle after the race course measurement. Take at least two rides over the calibration course and average the result with the pre-course measurement constant, for the final constant. The two results should be very close.

(7) Obtain a new constant on each occasion that a course is measured.

NOTES: 1. The road should be dry for the calibration and course measurement, and all must be done on the same day. 2. Avoid the hottest part of the day in measuring. 3. Ride the bicycle all the way over the course. 4. Avoid extreme weather conditions and do not measure on very windy days. 5. Measure where the runners will run, including short cuts. 6. Check the measurement by an alternate method when possible; or better, measure the course a second time, if possible.

4. Ride the bicycle over the race course and record the number of revolutions needed to cover the course. Or, ride a pre-determined number of revolutions needed to lay out a specific distance. Keep records of intermediate distances so that the whole course need not be remeasured if road alterations are made or if the course must be shortened or lengthened to bring it to a specific length.

5. Convert the total number of revolutions of the bicycle wheel into miles. Use one of the following methods:

a. Conversion tables. Figure the value for one revolution on the basis of the "constant" for that occasion. Then make a table of revolutions and values for 1 through 10 revolutions. Then tabulate in multiples of 10 through 100, and in multiples of 100 through 1,000, through 10,000 revolutions.

b. Simple arithmetic (the preferred method) as follows: multiply the calibration course distance (may be figured in feet or in yards) by the number of revolutions needed to cover the course (or lap) and divide the result by the constant (the average number of revolutions taken to cover the calibration course). The result will be in yards or feet, depending on which unit was used for the calibration course figures. Convert it to miles and yards or into kilometers as needed.

c. If measuring a specific distance, figure out the number of revolutions needed to cover one mile. If the calibration course is one mile, you will have it directly from the average number of revolutions needed to cover the mile. Figure out the value for one revolution. Then compute the total number of revolutions and fractions of a revolution (the number of spokes past the counter) needed to make up the specified course distance.

An example--Using arithmetic (proportion) to convert the revolution counter readings to actual distance. A 1,100-yard road calibration was ridden over twice and required 496 23/32 and 496 24/32 revolutions of the bicycle wheel. A road race course was ridden over, and it took 5,254 11/32 revolutions to cover the course. The bicycle was again ridden over the calibration course, and 496 25/32 revolutions were required. Adding the three constants (two before and one after the measurement of the race course) and dividing by 3 gives a "mean constant" of 496 24/32 revolutions, which equals 496.75 revolutions. So the race distance was:

$$\frac{1{,}100 \text{ yards} \times 5{,}254.34 \text{ revolutions (the measured course)}}{496.75 \text{ revolutions (mean constant)}} =$$

= 11,635.2 yards.

Then 11,635.2 yards divided by 1,760 yards (1 mile) = 6 miles 1,075 yards or 6.61 miles.

Formuli:

(1) $\frac{\text{Standard distance (calibration course)} \times \text{revs on race course}}{\text{Constant}} =$

= Distance of race course.

(2) One revolution = yds. (or ft) = $\frac{\text{Standard distance (calib. course)}}{\text{Constant}}$

(3) One spoke, in yards, = $\frac{\text{Value for one revolution}}{\text{Number of spokes}}$

The Veeder-Root Star-Wheel Counter is not being made or sold anymore. Several hundred of these counters were sold thru the RRC of America.

The JONES COUNTER ASSEMBLY

Dr. Alan Jones has taken another Veeder-Root Counter and made available an assembly which can be put on a bicycle to measure a race course. The Jones counter may be obtained by writing to ~~Mr. Clain Jones, 3717 Wildwood Drive, Endwell, New York 13760~~. Current price ~~$14.00~~

ATTACHING COUNTER to Bicycle: Installation instructions are sent with the counter. Attach the counter so that the numbers on the meter can be seen while you are on the bicycle. The device is attached on the left hand side of the bicycle. Afterwards, check to make certain that the wheels turn freely. In transporting the bicycle by car, use care and put it in the automobile with the counter side up.

USE OF JONES COUNTER: This device will record 20 counts per revolution of the bicycle wheel. You will not be concerned directly with the number of revolutions of the wheel. Use the readings from the meter. It is possible to read the counter to the nearest half a "count" on the meter, which is about two inches. To measure with the Jones Counter, the procedure is the same as described above for the Veeder-Root 5-Star Wheel Counter, except that you deal only with "counts" read from the meter. The same man should ride the bicycle to calibrate it and to use it to measure the race course. Ride the bicycle at the same speed and in the same way and with the same weight in all cases. Ride at about 10-12 miles per hour. Control the speed on steep downhills.

If the Road Calibration Course is 1 mile or 1 kilometer long, record each ride's counts from the meter and average them to get the CONSTANT for the race course measurement. If the calibration course is 1/2 mile long, double the average counts to get the CONSTANT for 1 mile.

Example: Road Calibration Course = 2640 ft (1/2 mile). Counts per ride: 1) 7857 2) 7857 3) 7856 4) 7858 = Average: 7857 counts = CONSTANT. For 1 mile CONSTANT = 15714 counts/mile. Re-Calibration: 1) 7856 2) 7858 CONSTANT for the day = 15714 counts/mile.

Once the constant is obtained, ride the bicycle over the race course. Measure along the path the runners will run, including all short cuts. Ride ~~1 meter from the curb or obstacles, vehicles, etc~~. Select courses that are safe for the runners. It is suggested that the course measurement be checked by a second method or when possible, measure the course twice by bicycle. Another possibility is to lay out the course before the actual bicycle measurement by measuring it with large scale maps, in which case you might locate the mile or kilometer points. These will serve as a check for possible errors. Large scale maps may be obtained from local sources, or use the U.S. Dept. of

or measure 12 inches from curb or 8 inches from non-curbed road, where applicable. Measure shortest path possible on available road to runners.

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Interior Geological Survey Topographic Maps. To scale the distance from the maps, use screw type adjustable divider, or ruler, or thin cord. Intermediate check points, especially in the kilometer races and the marathon, should be put in in 5 kilometer intervals--with mile points optional. Marking the first and second miles helps some runners set a proper pace.

It is advisable to take the counter off of the bicycle between measuring jobs, unless the bicycle can be kept in a safe, dry place, and will not be used much. The device is not designed for continual use in wet weather.

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STEPS IN USING THE CALIBRATED BICYCLE METHOD OF MEASURING

1.Ride the bicycle over the Road Calibration Course 4 times to obtain a Constant.

2.Measure the Race Course using the Constant obtained in Step one.

3.Ride over the Road Calibration Course two more times to obtain a revised constant. Do this the same day that you do steps one & two.

4.Make whatever changes may be necessary in the race course measurement (i.e., start, finish, or turn around points), to reflect information gained from the revised constant.

5.The race course must be measured at least twice. Take the longer measure ~~the average~~ as the distance. This may be done the same day, or on another day. In the latter case, recalibrate the bike, and then measure the race course, and re-calibrate the bicycle, all in the same day.

6. Add 1/1000 of race distance extra to course, as a "short course prevention factor."

Ted Corbitt
AAU Standards Committee
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