



USATF / Road Running Technical Council

**Course Measurement and
Certification Procedures Manual**

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- Added references in several places to the online certification portal (certifiedroadraces.com) as the place to submit courses for certification.
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- Rewrote the Correcting for Temperature subsection of the Measuring Your Calibration Course with a Steel Tape section ([go to](#)).
- Updated the information about the Jones Counter Model JR. ([go to](#))
- Expanded the Table of Contents.

INTRODUCTION

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Certification of road race courses in the United States is done under the auspices of the [USATF Road Running Technical Council \(RRTC\)](#). Courses certified by [USATF](#) are also recognized as certified by the [Road Runners Club of America](#). Runners have a right to a properly measured course. USATF certification is an assurance to the runner that times will be based on a properly measured distance. In addition, for a mark to be eligible for record consideration by USATF, it must be achieved on a USATF or World Athletics certified course and also meet the record requirements for “drop” and “separation.”

The rules and guidelines set forth in this booklet represent more than thirty years of experience in measuring road courses accurately. These procedures are now used by [World Athletics](#) and [AIMS](#) as well as USATF. Much of the pioneering work in the United States was done by Ted Corbitt, who started the certification program in 1964 after extensively researching methods of measurement. The program was initially run through the RRCA but later transferred to the AAU, which was then the US governing body for track & field, long distance running and race walking—the role now played by USATF. Corbitt served as the nation's chief course certifier until 1984.

Credit is also due to Ken Young, who oversaw the establishment of official US road running records, adopted in 1983. At the same time, he helped upgrade course certification with more rigorous standards to support the needs of record keeping, including a system of “Verification” measurements (see below) which put real “teeth” in the program. Young also served as Editor of the first edition of this manual, published in 1985.

The new certification procedures adopted in the early 1980s included important changes in measuring philosophy. Previously, the objective was simply to produce "accurate" courses. We still try to make courses as accurate as practical; however, to meet the needs of record keeping, we've added a new emphasis: Now we try to make extra sure that courses are **not short**. Specifically, we try to make sure that the **shortest possible route (SPR)** through the available roads is **at least** the stated race distance. This is intended to guarantee that every possible path a runner can take through the course is at least the stated distance.

Although there are many ways to measure a course, experience has shown that the **calibrated bicycle method** is superior to all others because of the speed and accuracy with which it can be performed. Please note that automobile odometers, aerial survey maps, electronic distance meters (EDM), and GPS devices are **not suitable for measuring road courses for certification**. An EDM may be used for measuring a "calibration course" (the course used for calibrating the bicycle), although steel tape is also entirely adequate for that purpose.

Historically, several kinds of bicycle wheel revolution counters have been used in the calibrated bicycle method. Currently, the standard counter used for this purpose is the **Jones Counter**, a remarkably simple and reliable mechanical device invented by Alan Jones in 1971 and later enhanced by Paul Oerth and by Tom and Pete Riegel. The

latest version is called the “**Jones Counter model JR**” and is available at www.jonescounter.com. Other counter devices are also available. See [Appendix J](#) for links to information about other counter devices.

The basic method of measurement is to compare the number of revolutions of the bicycle wheel needed to cover the course with the number of revolutions needed to cover a standard calibration course. Once you understand the method, it is simple and direct, but there are many important details that need to be done correctly in order to have an acceptable measurement.

In all probability, your course will not be checked. It is up to **you** to be sure it is right. Follow the instructions carefully, and you will obtain a reliable measurement. If an open record is set on your course, it will be re-measured by USATF (this is called a “Verification” re-measurement). For a mark to be accepted as an official record, the course length must be **at least** the stated distance. If your course is found to be short of its advertised length, the record will not be accepted, and certification will be withdrawn. Follow the instructions carefully and do your best.

This booklet is organized in "stand-alone" sections. Read the statement of requirements to obtain an overall picture of the procedures. Then study the particular section(s) you need for the task you have chosen to perform next, such as laying out a calibration course. Refer to the appendices as needed for clarification of points in the main text. If you are unsure of any aspect of the process, please contact your [regional certifier](#) **before** attempting the desired task. It will save both of you a lot of time.

EQUIPMENT NEEDED

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1. **Jones Course Measuring Device.** The Jones Counter is attached to the front wheel of the bicycle and displays “counts” proportional to the number of wheel revolutions. The original Jones Counters were designed so 20 counts = one revolution. Later models had different gear ratios, including 30 counts/revolution and 23.63636... (= 260/11) counts/revolution, which is also the ratio of the latest “JR” model Jones Counter. In all versions, a “count” represents approximately 7 to 10 centimeters (3 to 4 inches) on the ground. The “JR” model counter is available at www.jonescounter.com . Other counter devices that can be used for course measurement are available. See [Appendix J](#) for links to information about other counter devices.
2. **Bicycle.** A good road or commuter-type bike with high pressure tires is best, but any bicycle you are comfortable riding is OK. Refer to the section on "Use of the Calibrated Bicycle" for instructions on how to attach the Jones Counter to your bicycle.
3. **Steel Tape.** A 30 meter/100 foot or longer steel tape is best. The steel tape is used to lay out the calibration course and to make adjustments to the course.
4. **Spring Scale.** A spring scale, capable of a 50 newton (5 kilograms-force or 11 pounds-force) pull, is needed for the steel tape to be under proper tension. The spring scale need not be a precision instrument; the inexpensive variety sold at sporting goods stores for use by fishermen is OK.
5. **Thermometer.** Use a small thermometer to take temperature readings so that steel tape measurements can be corrected for temperature.
6. **Notebook and Pencils.** A small notebook that’s easy to use while cycling, and several pencils or pens are needed to record data and to sketch the more complicated sections of the course.
7. **Pocket Calculator.** A small pocket calculator or calculator phone app is useful in determining the counts needed for specific splits and for metric/English conversions. Use a calculator or phone app that carries at least 8 significant digits. **Note:** the built-in metric conversions in some inexpensive calculators are not sufficiently accurate; if in doubt, use the exact conversions in [Appendix F](#).
8. **Lumber Crayon or Chalk.** Used for temporary pavement markings.
9. **Nails & Hammer.** Used for making permanent course marks, so the nails used must be capable of penetrating asphalt without bending.

10. **Spray Paint.** For temporary course markings and to supplement permanent course marks.
11. **Duct Tape.** Used for temporary marks while laying out the calibration course. Any type of tape that will adhere to the road surface and can be marked on can be used.
12. **Bike Tools.** In the case of a flat front tire, you must recalibrate before resuming measurement.
13. **Safety Equipment.** A safety vest and helmet should be worn. Adorn your bicycle with reflective strips and reflectors in the front and rear, as well as wheel reflectors.

STATEMENT OF REQUIREMENTS

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There are eight basic steps involved in measuring a course for certification. These are:

1. **Lay out an accurate calibration course.** The calibration course must be a straight stretch of paved road that is reasonably level and relatively free of traffic and at least 300 meters in length. You may wish to check with the nearest regional certifier to determine if there is a suitable calibration course near you.
2. **Calibrate the bicycle.** Ride the bicycle over the calibration course, taking care to ride in as straight a line as possible. At least four calibration rides must be made immediately prior to measuring the race course. Rides in the same direction must be within 3 counts of each other for a 300 meter or 1000 foot calibration course. If not, additional rides are required. The “working constant” is the average number of counts/km (or per mile) **times** the short course prevention factor of 1.001.
3. **Measure the course.** Do a preliminary ride or drive of the entire course to preview the path that will need to be used in order to follow the shortest possible route (SPR) while measuring. Ride the bicycle over the course, following the shortest possible route as it will be available to the runners on race day. At least two measurements over the course are required for certification. Use the first measurement to establish tentative start and finish marks. Use the second (and any subsequent) measurement to check the distance between those **same** marks. In particular, during the second measurement, simply record counts at the points already marked during the first measurement. **Do not** make new marks on the road during the second measurement. If you measure on different days, calibrate both before and after measuring on each day.
4. **Recalibrate the bicycle.** Ride the bicycle over the calibration course at least four times immediately after the course measurement(s). After recalibrating, determine your **constant for the day**, which is the **larger** of the pre-measurement (working) constant, or post-measurement (finish) constant. (Note: Measurements calculated using the *average* of the working and finish constants will also be accepted; however, use of the **larger** constant is strongly preferred.)
5. **Determine the proper measured course length.** Recalculate each measured distance using the appropriate **constant for the day**. If you only measure the course twice, the proper measured length is the smaller value. E.g., you measure between the **same** start and finish points and obtain distances of 10,000 and 9,993.7 meters. The proper measured length is 9,993.7 meters. If you measure three times, the proper measured length is the **smallest** value. If you only measure twice, the two measurements may not differ by more than 0.08% or you must take a third measurement.
6. **Make the final adjustments to the course.** If the **proper measured length** differs from the **desired** (or advertised) **course length**, you will need to adjust either your

start, finish, or a turn-around point. These adjustments may be made with a steel tape. Once all the measurements have been completed, the proper set of marks should be made permanent and all others should be erased.

7. **Document locations of key points.** Measure and record the locations relative to permanent landmarks of the start, finish, any turn-around points, and any other points that define the length of a course such as a turn not defined by the inside edge of a road or other permanent landmarks (e.g. a tree is re not a permanent landmark). **The location of any point that defines the length of the course may not be described only by GPS coordinates.** It is recommended that the locations of mile/km points relative to permanent landmarks also be measured and recorded for inclusion on the certification map. Since the location of mile/km marks do not define the total length of the course, it is permissible, although not recommended, to describe their locations only by GPS coordinates.

8. **Submit applications and supporting documentation to your [regional USATF/RRTC certifier](#)** using the on-line certification portal at certifiedroadraces.com (see also [Appendix G](#) for the on-line certification portal information and manual version of the application forms). Carefully record all data taken and prepare a **map** showing the course layout, details of the start and finish zones and turn-around points, and any areas where the certification will require erection of barriers that restrict runners to a path longer than the shortest path available using the whole roadway (but note: for simplicity and to minimize the chance of having your course found short, it always best to lay out courses **without** any "restrictions" of this sort). In drawing the map, it is also highly desirable to include a line which displays the actual path measured through the course. For a detailed list of certification map requirements and map examples see [Appendix I](#).

Note: Maps of all certified courses are now **posted online at certifiedroadraces.com**. Measurers should be aware that their maps will be posted on the Internet for all the world to see. Runners who are thinking of running a race may view its map at this site. And race directors who are thinking of hiring a particular measurer may view maps that the measurer has produced, as evidence of the quality of this measurer's work.

LAYING OUT A CALIBRATION COURSE

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Accuracy of the calibration course is vital since any error will be multiplied when it is used for measuring a race course. A calibration course must be on a **straight, paved**, reasonably level, and lightly traveled stretch of road, and must be **at least 300 meters** in length.

Accuracy is also generally best if you can minimize the time required to transport your bike between the calibration course and race course. Therefore, you should consider laying out a calibration course close to the race course to be measured, especially when you must travel a long distance to reach the race course site.

Method of Measurement: The standard method of measuring a calibration course is to use a steel tape. Any steel tape, either surveyor's style or construction style, may be used, but to be confident of accuracy, get a tape made by one of the better-known manufacturers of surveying or construction equipment. Nylon-clad steel tapes are okay, but fiberglass tapes are definitely **not** acceptable. Electronic Distance Meters (EDM) can achieve greater accuracy than steel tapes, although that extra accuracy is **not really needed** for calibration courses used in the bicycle method.

Siting your Calibration Course: Choose a location that will be safe and convenient for calibrating a bicycle. Every time you measure a race course, you'll need to ride the calibration course at least eight times (four before and four after), and you'll want to ride it in **both directions**. Calibration courses are usually measured along the edge of a straight road—the same distance from the edge as you would ride your bike. (But on a street where vehicles may park, you may wish to measure far enough from the edge to avoid any parked vehicles.)

The marks defining the endpoints of your calibration course must be in the roadway where your bike wheel can touch them—not off to the side somewhere. In general, endpoints should be marked by nails driven into the road. Urban areas, however, often have numerous permanent objects in the street (sewers, manholes, etc.) that may serve as one or both endpoints of a calibration course.

Your calibration course will be most resistant to getting obliterated when the road is resurfaced if **both** endpoints are permanent objects such as sewers or manholes, etc. In this case, you'll have an odd-distance calibration course such as 324.54 meters—which is perfectly acceptable. You can also make your calibration course an even distance, where both endpoints are close to permanent landmarks, and where you've precisely located both endpoints relative to such landmarks.

When laying out an on-site calibration course that you will probably use only once, survivability of the calibration course is unimportant, and convenience is paramount. So just lay out a whole number of tape lengths; for example, 10 lengths of a 30-meter tape or 12 lengths of a 25-meter tape (laid out distance = 300 meters), or 10 lengths of a 100-foot tape (laid out distance = 1000 feet = 304.8 meters).

Certifying your Calibration Course: You are not *required* to submit a map for every calibration course you measure. However, when you lay out a calibration course that you think you'll want to use again in the future, or one that you think other measurers would like to use, you may draw a map for it, and you will be issued a certificate that will simplify future use of the calibration course.

Whether or not you want such a certificate, you must submit an "**Application for Certification of Calibration Course**" form, along with all your measurement data (including the "**Steel Taping Data Sheet**" if the course is measured by steel tape), whenever you lay out a new calibration course.

If you don't submit a map with your application for calibration course certification, then this calibration course, if approved, will be considered certified for only that one measuring occasion. If you want to re-use the calibration course on a later occasion, you must resubmit all the paperwork for the calibration course.

If you do submit a map for the calibration course, and are issued a certificate for it, then whenever you (or others) want to re-use this course, you will need to include the certification number of the calibration course in your road course certification application.. If you want to certify your calibration course, please use the on-line certification portal at certifiedroadraces.com

If you create a calibration course map, it must describe the endpoint positions as precisely as possible. Ideally, the endpoints should be permanent objects in the street (such as sewers or manholes), or should be referenced to such objects so precisely that you could relocate your endpoints to an accuracy of one centimeter in case the road is resurfaced and your markings obliterated. If you can't describe the positions that precisely, then the certification will be considered to expire when the road is resurfaced.

MEASURING YOUR CALIBRATION COURSE

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Equipment Needed for Taping: A steel tape, preferably at least 25 meters in length; duct tape and pen for marking tape lengths on the road; a thermometer for checking pavement temperature; possibly a spring balance for checking tape tension; Notebook and copies of the "**Steel Taping Data Sheet**" for recording data. You can tape a calibration course with just two people, but it might go more smoothly with a third person (for example, to watch for traffic and take notes).

Requirements: You must measure the course with a steel tape at least **twice**. (Normally, the second measurement will be done in the reverse direction from the first.) Use a new set of intermediate taping points (new pieces of ducttape) for the second measurement. But treat the second measurement as a check of the distance between the **same** endpoints you measured between the first time. Thus, the second measurement should result in a **number** indicating the distance between your original endpoints (not in a new set of endpoints). The two measurements of your calibration course must not differ by more than 0.01%. Note that this is 1.2 inches for a 1000 foot calibration course, or 3 centimeters for a course that is 300 meters in length.

Your final result will be based on the average of both measurements, corrected for temperature (see below). If desired, you may then adjust the course to obtain a desired even distance (such as 1 km).

Basic Taping Technique

For each tape length, the Lead and Rear tape-persons first shake out the tape until it lies straight and flat on the road. The Rear tape-person sights ahead to keep the Lead tape-person properly aligned **or** the Lead tape-person uses a ruler to maintain constant distance from the road edge or other desired (straight) line.

Intermediate taping points are marked with ballpoint pen on masking tape. *After* stretching the tape to its *approximate* position, the Lead tape-person sticks a piece of masking tape on the road, covering the position where the mark will be made. The Lead tape-person then starts pulling on the tape with proper force (see below). When the Rear tape-person has his endpoint firmly positioned over the mark (with the tape under tension), he shouts "**mark.**" At this signal, the Lead tape-person draws a fine line on the masking tape to mark the exact endpoint.

Long steel tapes are always designed so that the tape may be easily detached from the reel. You'll find that taping is easiest if you do this, and don't carry the reel along with you!

Don't panic if you see that a car is about to ride over your tape. If the Lead and Rear tapepersons hold the tape **flat** and firmly against the road, it will probably come out okay. (But a *twisted* tape will likely get broken.)

When walking from one taping position to the next, only the **Lead** tape-person holds onto the tape, which is allowed to drag freely on the road. (If Lead and Rear tape-persons attempt to hold both ends off the ground, it may drag at a spot in the middle, resulting in one extremely worn area!)

Counting the Tape Lengths

Miscounting the tape lengths in a calibration course is a disaster; the "10 km" race course you lay with it might really be 9 km or 11 km! Fortunately, it's easy to guard against such counting errors.

One handy trick is to **pre-number** your pieces of masking tape **before** you tear them off the roll as shown in Figure 1.

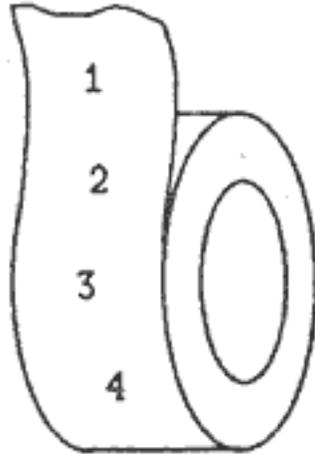


Figure 1. Duct tape with tape length numbers.

As pieces of masking tape are used, the Lead tape-person adds more numbers to the roll, so it always has at least two or three numbered segments that haven't been used yet. (Be sure to write the numbers so they won't be confused with the fine lines that will denote actual tape endpoints.)

After the taping, walk or jog the course to check the tape count. It is also helpful to do a **bike check** as follows: Ride a bike equipped with Jones Counter over the whole calibration course, and also over any one tape length. The number of counts recorded on the whole course, divided by the number of counts recorded in a single tape length, should come out very close to the number of tape lengths you laid out.

Such a bike check may not be necessary if you will be measuring with a bike that you've previously calibrated on a calibration course that you know to be accurate. Then, if you miscount tape lengths while laying out a new calibration course, you'll see that your riding constant is "way off" as soon as you start calibrating on the new course.

Know Your Tape's True Zero Point

Many steel tapes (especially construction-style tapes) don't have their zero point on the graduated portion of the tape. Misjudging the tape's zero point is harder to catch than miscounted tape lengths, but the effect can be insidious. For example, if you misjudge the zero point by 3 cm on a 30-meter tape, your measurements can come out short by about 1 meter per kilometer, entirely canceling our "Short Course Prevention Factor." The runners won't notice anything wrong with their times, but if the course ever needs to be verified, it will be found short.

Before using any tape, examine its markings carefully. If zero is not on the graduated portion of the tape, then take a ruler (or another portion of the same tape) and measure to find out where the true zero is. On construction-style tapes, it's usually at the outer edge of a "hook-ring" as shown in Figure 2.

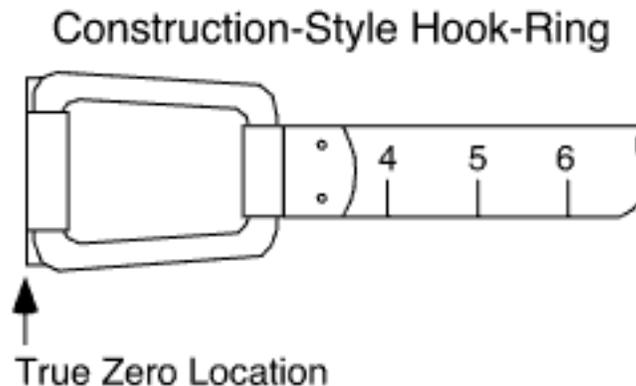


Figure 2. Typical true zero location on a steel measuring tape.

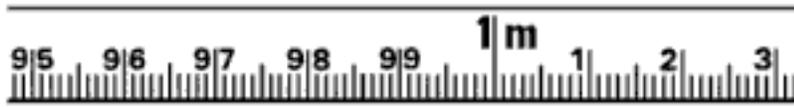
While examining your tape, make sure you also understand all its other markings. Is it a metric or Imperial tape? Metric tapes are often graduated to the millimeter, but you must check whether the numbering between meter marks denotes centimeters or millimeters. Imperial tapes may be graduated in either feet & inches or decimal divisions of a foot. Figure 3 shows some common styles of tape graduations.

Correcting for Temperature

Steel tapes are manufactured to be accurate at 20 °C (68 °F), but the tape expands when heated and contracts when cooled.

To correct your taped distance for temperature, you should take a temperature reading before you start taping, and after you finish taping. It is best to do this with a non-contact thermometer, taking the reading directly from the tape after it has been lying on the pavement for several minutes. If you are using a contact thermometer you should set it out **on the pavement and shaded from the sun** a couple minutes before taking the reading.

Metric with centimeter numbering



Metric with millimeter numbering



Imperial with feet & inch graduations



Imperial with decimal-foot graduations



Figure 3. Common steel measuring tape graduations. Drawings of tape graduations taken from Lufkin's online catalog.

Calculate the average of the pre and post temperature readings, and work out the correction to your raw taped distance by using the formulas shown below and on the "Steel Taping Data Sheet." The certifiedroadraces.com calibration course entry also shows the course adjustment formulas for the temperature.

$$\text{Correction factor} = [(\text{Temperature in } ^\circ\text{F}) - 68] \times 0.00000645$$

OR

$$\text{Correction factor} = [(\text{Temperature in } ^\circ\text{C}) - 20] \times 0.00001160$$

$$\text{Correction in inches} = (\text{Correction factor}) \times (\text{Course raw distance in feet}) \times 12$$

OR

$$\text{Correction in centimeters} = (\text{Correction factor}) \times (\text{Course raw distance in meters}) \times 100$$

After calculating the Correction, use Table 1 (or Table 2 as appropriate) to check that your value is close to the value in the table that corresponds as closely as possible to your calibration course distance and the temperature.

Table 1. Calibration course corrections due to temperature in centimeters.

Temp	Calibration Course Length			
	300 m	500 m	800 m	1000 m
40 °C	7.0	11.6	18.6	23.2
35 °C	5.2	8.7	13.9	17.4
30 °C	3.5	5.8	9.3	11.6
25 °C	1.7	2.9	4.6	5.8
20 °C	0.0	0.0	0.0	0.0
15 °C	-1.7	-2.9	-4.6	-5.8
10 °C	-3.5	-5.8	-9.3	-11.6
5 °C	-5.2	-8.7	-13.9	-17.4
0 °C	-7.0	-11.6	-18.6	-23.2
-5 °C	-8.7	-14.5	-23.2	-29.0

Table 2. Calibration course corrections due to temperature in inches.

Temp	Calibration Course Length			
	1000'	500 m 1640.42'	1/2 mi 2640'	1000 m 3280.84'
100 °F	2.5	4.1	6.5	8.1
90 °F	1.7	2.8	4.5	5.6
80 °F	0.9	1.5	2.5	3.0
68 °F	0.0	0.0	0.0	0.0
60 °F	-0.6	-1.0	-1.6	-2.0
50 °F	-1.4	-2.3	-3.7	-4.6
40 °F	-2.2	-3.6	-5.7	-7.1
30 °F	-2.9	-4.8	-7.8	-9.6
20 °F	-3.7	-6.1	-9.8	-12.2

Finally, confirm the correct direction to adjust by using the following:

If the temperature < 20 °C (68 °F)

Leave the physical course as is **and** shorten the stated distance of the course,

OR

Leave the stated distance of the course as is **and** lengthen the physical course.

If the temperature > 20 °C (68 °F)

Leave the physical course as is **and** lengthen the stated distance of the course,

OR

Leave the stated distance of the course as is **and** shorten the physical course.

How Hard to Stretch the Tape

Just as steel tapes are manufactured to be most accurate at a particular temperature, they are also most accurate when stretched with a specified amount of force. But while you may not have much control over the temperature at which you do the measurement, you **can** adjust the force you apply to the tape to match the correct force for your tape. (Unfortunately, the proper force varies from tape to tape.)

You can find out how hard you are stretching the tape by using a **spring balance** as shown in Figure 4.

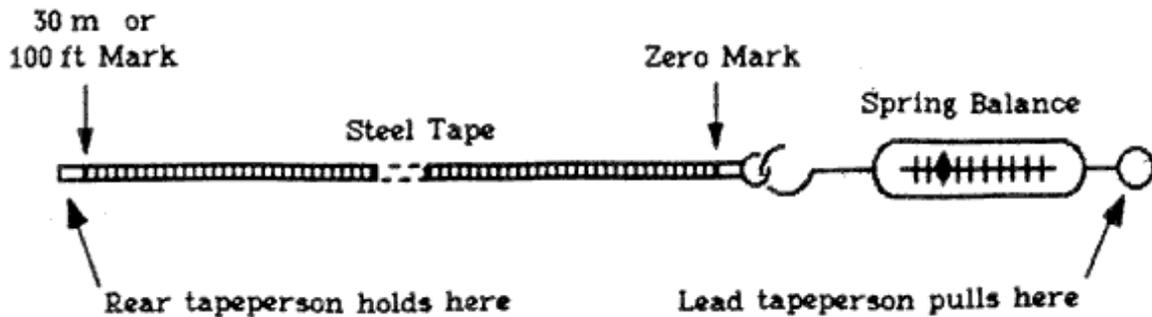


Figure 4. Schematic demonstrating the use of a spring balance to measure pull force.

You needn't actually use a spring balance this way while taping your calibration course; it is enough to do a few trials beforehand to get a feel for the correct tension. With a little experience, it will be easy to judge the proper force, and you'll be able to dispense with the spring balance entirely. Note: It is acceptable to answer question 17 on the "Application for Certification of Calibration Course" by saying you estimated the tension "by feel."

Also, since the errors due to slight variations in applied force tend to be very small, the spring balance you use for checking tape tension needn't be a precision instrument. The type sold in sporting goods stores for weighing fish is quite adequate!

The correct force for stretching a particular tape is sometimes embossed on its blade near the zero end. For example, if you find the markings "20 °C, 70 N" it means that the tape was designed to be accurate at a temperature of 20 °C and tension of 70 newtons (approximately 7 kilograms-force or 16 pounds-force). If you can't find any markings of this sort, use a value from the Table 2, shown below. The first entry in this table (for metric tapes) seems to be emerging as an international standard, so is generally a safe choice if you're not sure which one to pick.

One mistake people sometimes make is to pull with less force when using a smaller portion of the tape. For example, if a 50 m tape requires a tension of 50 N, they might apply a force of only 25 N when measuring a 25 m distance because only half of the tape is used. **That is a fallacy!** The correct tension is independent of the length of tape used. If a tape requires a

tension of 50 N, you must pull with a force of 50 N, regardless of how much or how little of the tape you are using.

Table 2. Standard tensions of steel tapes.

Standard Tension for Various Steel Tapes

Std. Metric tapes (30 m, 50 m, etc.):	50 N	≈	5.0 kgf	≈	11 lbf
Traditional U.S. 100 ft tapes:	45 N	≈	4.5 kgf	≈	10 lbf
Heavy-gauge steel U.S. 200 ft tapes:	90 N	≈	9.0 kgf	≈	20 lbf

N = newton, the modernized metric (SI) unit of force.
kgf = kilogram-force, an older (obsolete) metric unit of force.
lbf = pound-force, the unit of force in the Imperial system.

CALIBRATING THE BICYCLE

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The pre-measurement calibration is the initial step that must be performed in the measurement of a road course. The post-measurement calibration guards against systematic sources of error such as a slow leak. At least **four** pre-measurement and **four** post-measurement calibration rides are required.

1. The bicycle tires should be inflated hard, to the pressure indicated on the side of the tire.
2. Warm the tires by riding the bicycle for several minutes immediately prior to the calibration rides. This will reduce the variance in counts for the pre-measurement calibration and ensure a better measurement.
3. At one end point of the calibration course, slowly roll the front wheel forward, just through the next count. Lock the front brake and place the front wheel axle directly over the line. Record the count.
4. Ride the bicycle over the calibration course in as straight a line as possible and with the same weight and equipment on the bicycle as will be used during the actual race course measurement. A calibration ride should be one **non-stop** ride.
5. Stop the bicycle **just** before reaching the end of the calibration course and roll it slowly forward until the axle of the front wheel is directly over the line. Lock the front brake and record the count.
6. With the front wheel brake locked, turn the bicycle around and place the front wheel axle directly over the line for the next ride. Repeat steps 4 and 5.
7. Repeat the above procedure for a total of **four** rides, recording start and finish counts each time. Alternate directions on the calibration course. This will give you two rides in one direction and two rides in the opposite direction.
8. The spread among your calibration rides cannot exceed 3 counts for riding each direction of a calibration course with a length of 1000 feet or 300 meters. If your variation is greater, do more rides until your counts stabilize.
9. Add the results of each ride and divide by the number of rides. This gives the “average pre-measurement count.”
10. Divide this count by the length of the calibration course in kilometers (or in miles) to obtain the number of counts per kilometer (or per mile).

11. Multiply this by 1.001 to obtain the **working constant**. The “short course prevention factor” of 1.001 is intended to result in a course which is **at least** the stated distance, within the limits of measurement precision. It also helps ensure that (very) slight variations in the course layout on race day won't invalidate your measurement. This lengthens the course by one meter per kilometer or 5.28 feet per mile.

Now go measure the race course. When finished, return to the calibration course.

12. The post-measurement calibration must be performed as soon after the course measurement as possible. Repeat steps 3 through 11. **Four** post-measurement calibration rides are required.
13. Determine the average post-measurement count by adding all the post-measurement counts and dividing by the number of rides.
14. Determine the **finish constant** by dividing the average post-measurement count by the length of the calibration course in kilometers (or in miles) and multiply this by 1.001.
15. The **constant for the day** is **either** the working constant **or** the finish constant, whichever is larger. Although measurements using the average of the working and finish constants will be accepted, it is strongly recommended to use the larger constant.

Remember: Each day's measurement **must** be preceded and followed by calibration rides. You may measure as much as you want in a day, just as long as calibration closely precedes and follows measuring (within a few hours). This is done to minimize error due to changes in tire pressure from thermal expansion and slow leakage. Frequent recalibration "protects" the previous measurement. A smart measurer will recalibrate frequently—you never know when a flat tire is coming!

When a course is measured by **more than one cyclist**, every cyclist who rides the race course must do **his or her own pre-measurement and post-measurement calibration rides**. A separate set of calibration data must be entered into the certifiedroadraces.com on-line program using the collaborator option or a copy of the Bicycle Calibration Data Sheet must be completed for each rider, calculating individual riding constants for each rider. This procedure must be followed even when cyclists share the same bicycle, because riding constants will vary for different cyclists, depending on riders' weights and riding styles.

THE SHORTEST POSSIBLE ROUTE (SPR)

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A race course is defined by the shortest possible route that a runner could take and not be disqualified. A given runner might not follow the shortest possible route, just as a runner on a track may be forced to run further to pass another runner. The actual path of any given runner is irrelevant. The shortest possible route is a reasonably well-defined and unambiguous route that ensures all runners will run **at least** the stated race distance.

You might envision the shortest possible route as a string, stretched tightly along the course so that it comes within 30 cm (one foot) of all corners, straight through S-turns, and diagonally between corners when crossing a street. You should measure the course following the same route as that hypothetical string.

Because it is difficult to follow the shortest possible route perfectly, an extra length factor of 0.1%, called the **short course prevention factor (SCPF)**, is incorporated into the calibration procedure. Use of the factor ensures that your course will **not** be short, even if you make small errors in following the shortest possible route.

When making a turn, measure prudently close to the curb or edge of the roadway. Thirty centimeters (one foot) from the edge of the roadway is a good guide. Often manholes, storm drains, broken pavement, and other hazards render this impractical. In such cases, attempt to measure the shortest route that a runner may be expected to take. You may wish to walk the bicycle through such sections if they are relatively short.

There are three basic situations encountered in following the shortest possible route. First, if you enter a roadway by making a right turn and leave it by making another right turn as shown in , follow a path prudently close to the curb around both turns and in-between, as shown in Figure 5.

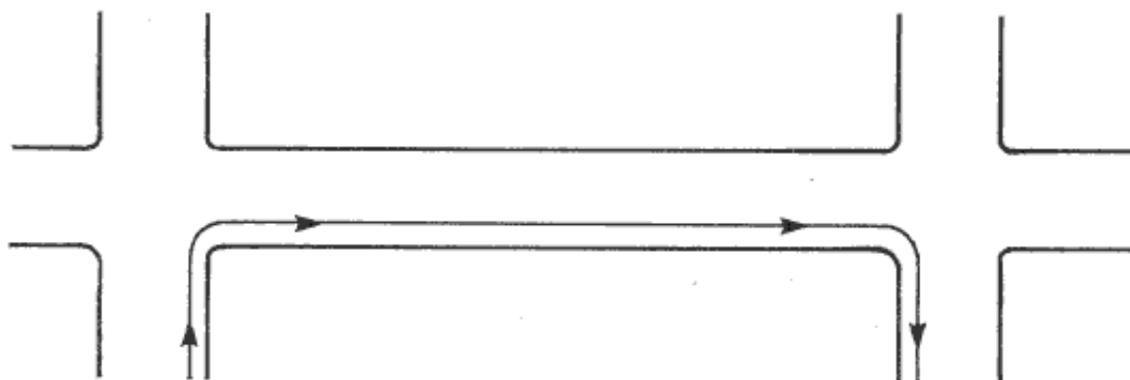


Figure 5. Right turn to right turn SPR (Shortest Possible Route).

Second, if you enter a roadway by making a right turn and leave it by making a left turn, move in as straight a line as possible, diagonally from where you entered on the right to the most extreme left position available to the runner just before making the second turn (see Figure 6). Again, make the second turn as prudently close to the curb as you can. In the case of heavy traffic, you may wish to employ the "offset maneuver" described in [Appendix A](#) (Supplementary Tips).

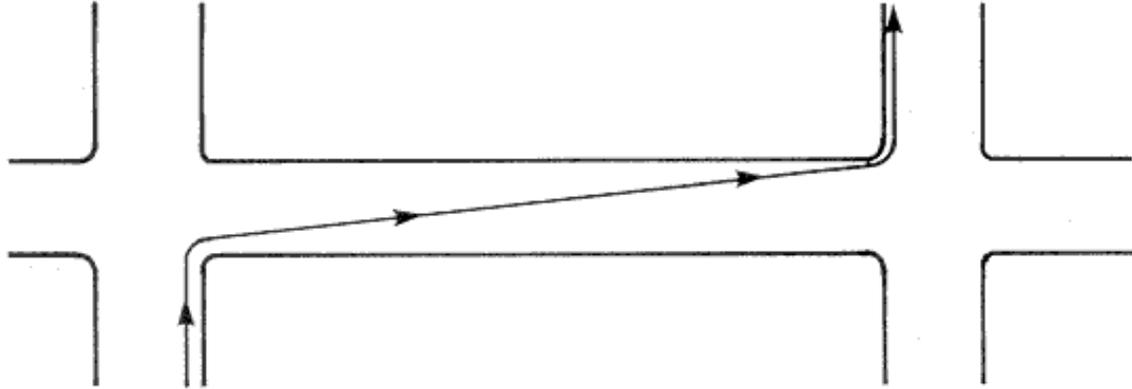


Figure 6. Right turn to left turn SPR.

Third, when measuring on a winding roadway, **do not** follow the side of the road. Unless portions of the roadway will be closed to runners by cones and/or barricades **and** will be monitored, measure the straightest and shortest path possible, moving from one side of the road to the other as necessary to follow the shortest possible route (see Figure 7 for the correct measuring path to follow in both the unrestricted and restricted cases). This may be an unsafe practice on heavily travelled roads. You may need to measure with a police escort or measure during periods when traffic is light.

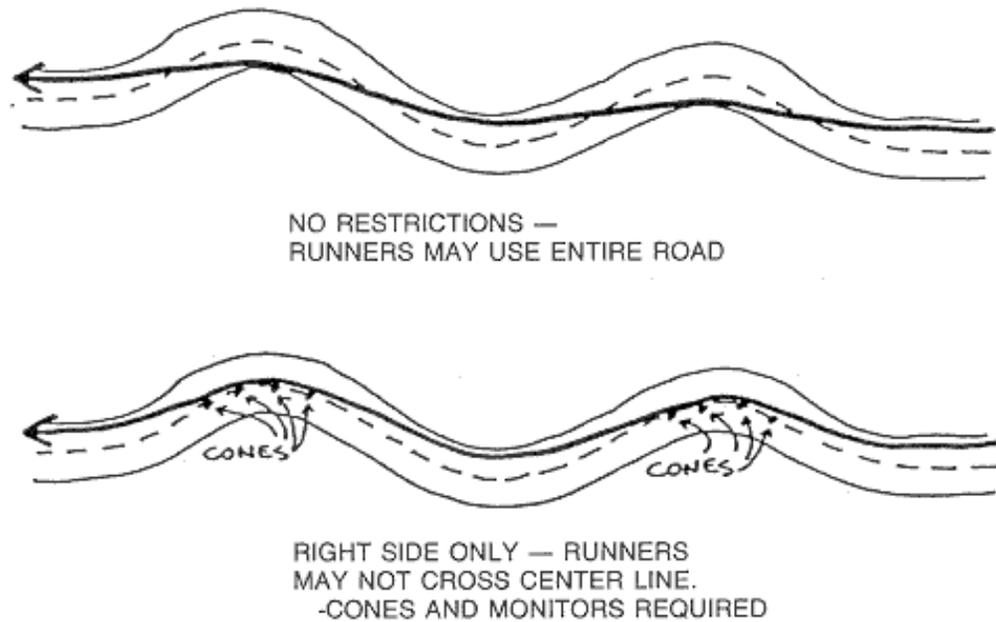


Figure 7. The SPR on a road with S-shaped turns.

When measuring a turn-around point, cycle up to the position of the turn-around point, freeze your front wheel with the brake, spin your bike 180 degrees, and continue on with the course measurement (see Figure 8 below). Even though you have measured the turn-around this way, you still have two choices for how you describe it on the map. One is to simply describe it exactly how you measured it, as a single point where a cone should be placed.

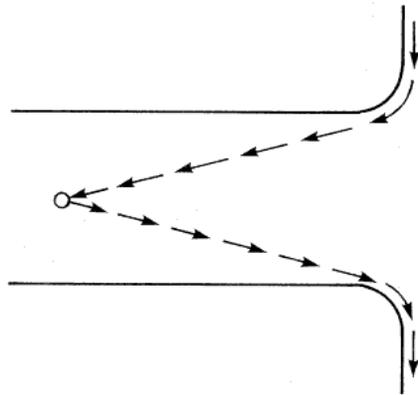


Figure 8. SPR measuring path of an out-and-back section with a turn-around.

But no runner turns instantaneously, spinning on one foot. If a course features a turnaround point, you have an option to control how runners negotiate the turn. When a course is measured to a single point, reverse direction and then back, no allowance is made for how runners actually run the turn. Marking a turnaround with a single cone ignores the semi-circle path taken. This is a trivial distance, but if enough road width is available a

larger radius turn can be employed. A radius, or semi-circular turn helps a runner maintain speed and avoids groups of runners bunching up at the turn-around.

Assume you have measured and marked a turnaround point “A” as described above. Now you want to construct a half-circle turnaround with radius “r”. Where is the center (“C”) for that circle?

The circumference of a circle is $(\pi) \times (\text{diameter})$, or $(2\pi) \times (\text{radius})$. The circumference of a half-circle is $(\pi) \times (\text{radius})$ (shown in red in Figure 9). Imagine unwrapping this half-circle arc from the circle, straightening it out, then folding it in half. When aligned with “A”, this shows that “C” should be located at a distance of $(\pi/2) \times (r)$ short of “A”. A close approximation to this is $1.57r$.

Once you have marked “C”, you can mark a half-circle coning line. The cones should be 1 foot or 30 cm inside the calculated semicircle for running. Draw a half-circle with radius of $(r - 1 \text{ ft})$; cones are to be placed along that line as shown in Figure 10. Note that the point “A” is also marked. In an emergency (e.g. there are not enough cones to construct the planned half-circle, or there is a road obstruction that makes the smooth turn impractical) you can place a cone at “A” and tell runners to go around it.

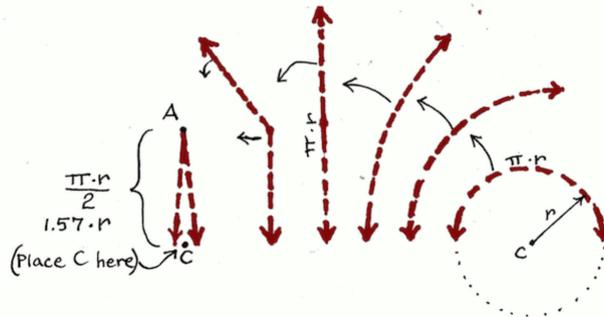


Figure 9. Unwrapping of a semi-circle turn-around to show the distance between the single-cone turn-around, A, and the center of a semi-circle turn-around, C.

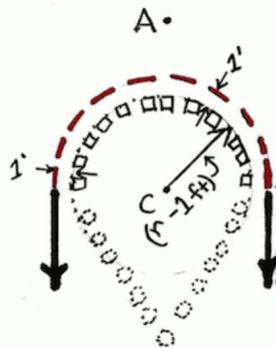


Figure 10. Cone placement for a semi-circle turn-around.

The cones along the semicircle are required and should be closely spaced. The cones “below” the semicircle (making an “ice cream cone” shape) are not required but can help the runners see where to go.

When describing the turn-around on your certification map it is best to describe the location of both turn-around alternatives. An example of how to describe the turn-around is shown in Figure 11, where the locations of the center of the semi-circle TA (point “C”), and the location of the single point TA (point “A”) are both described relative to permanent landmarks. Note that you must also include the radius length “r” on your map.

The course must be measured as it will be when the race is run. In particular, detouring around cars or other obstacles which may not be present on the day of the race will make the course short (see Supplementary Tips).

If your course is laid out to restrict the runners to a route which is longer than the shortest possible route (on pavement), traffic barricades or intensive coning is required. Course monitors are nice but often are absent, mis-positioned, or simply ignored by the runners. Instruct course monitors to disqualify and make note of the bib number on the spot, any runners they observe cutting the course as defined by the barricades and cones.

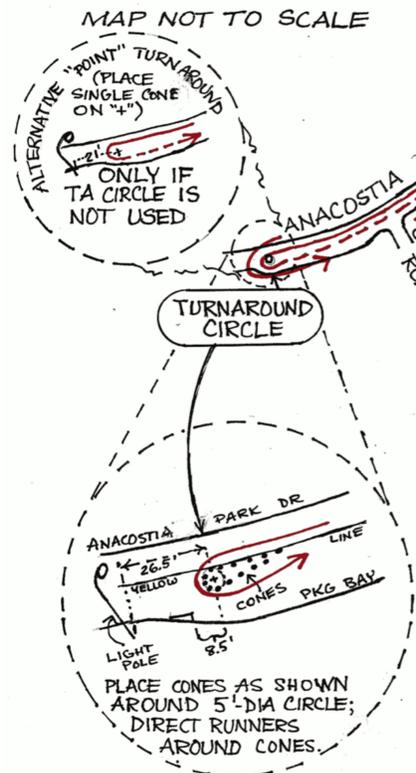


Figure 11. Turn-around description on a certification map showing both the single-cone and semi-circle options.

The locations of barriers must be marked on the road, and their exact locations put on the map. You should be prepared to document every such marker that you put in place. If this

seems like too much trouble, you should assume that runners will short-cut all they can and **measure that way**, even if the runners are instructed to run a longer route.

If you restrict the runners to one side of the road, be sure you specify how the corners are to be turned. It makes a difference. There should be no doubt of the exact measured path.

Figure 12 shows different possibilities for defining the path measured at intersection turns.

If you cannot enforce the restrictions, it's best to measure the shortest possible route and leave race-day coning as the race director wishes it.

Sometimes the paved route is likely to be ignored by the runners. Plan for this, and measure across the grass in those areas where the runners are likely to shortcut as shown in Figure 13. Be sure the route you choose is bounded by something that is permanent.

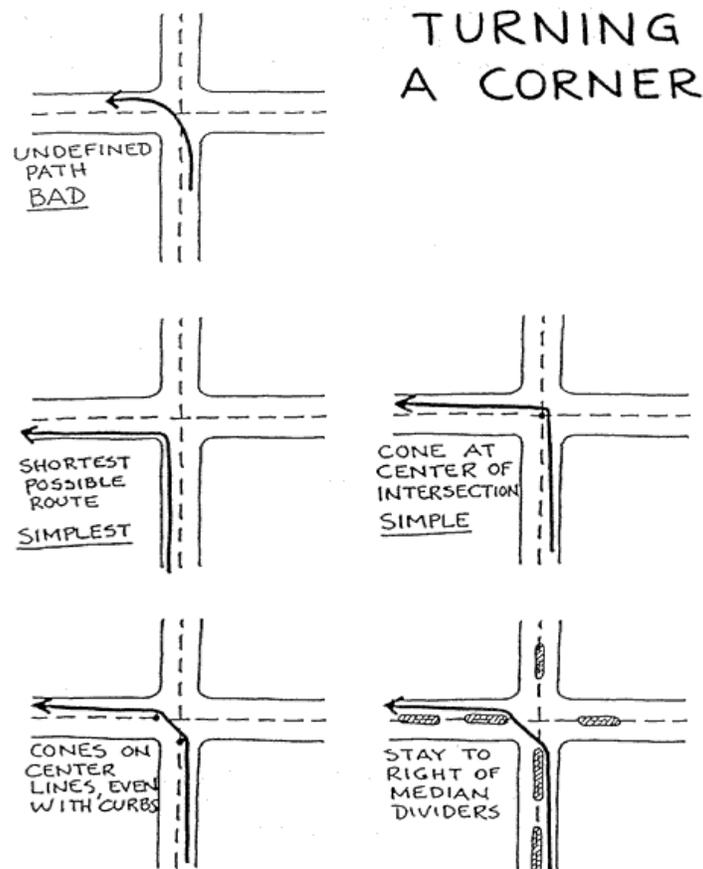


Figure 12. Possible alternatives for describing turns at intersections with and without lane restrictions.

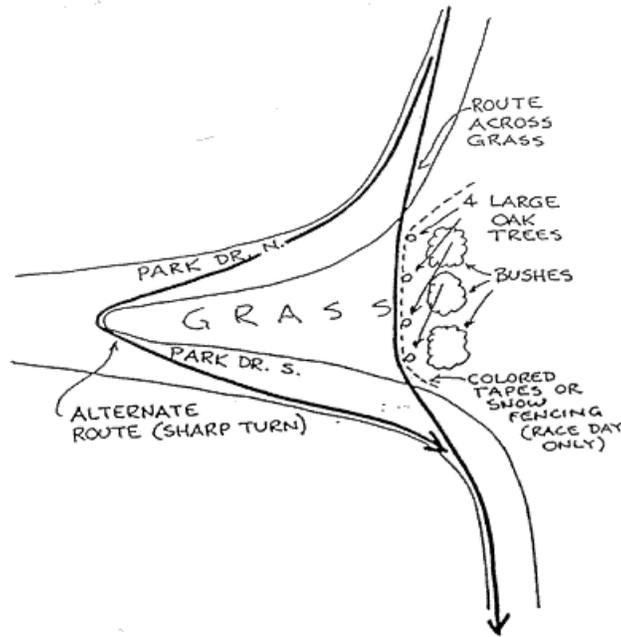


Figure 13. Planning the route to avoid likely shortcutting.

Sometimes the sides of the road are poorly defined. For example, a course may have a paved road with firm dirt shoulders that some runners prefer to run on.

Selecting the exact running/measuring route is a matter of judgment. It is probably best to remain on the pavement but as close to the dirt edge as possible **unless** the dirt route is obviously shorter. In that case, you should measure the shortest route on the dirt.

In summary, study is required to determine the shortest route that can actually be run, whether it be in the street, on the sidewalk, or on the grass or dirt.

USE OF THE CALIBRATED BICYCLE

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Mounting the Jones Counter on Your Bicycle

Note: These mounting instructions apply to the current model of the Jones Counter. This information is also available at www.jonescounter.com The standard version of the counter is mounted on the right side of the front wheel. This change from previous models allows for a disk brake equipped bike. See rrtc.net website for more information.

The Jones counter will fit on most bicycles without modification. Remove the wheel from the bicycle and slip the counter over the axle on the **Right** side. Put the wheel back on the bicycle with the counter between the fork and the wheel. Tighten the wheel securing nut or lever. A picture of a counter installed on the front axle of a bicycle is shown in Figure 14.



Figure 14. Jones Counter mounted on the front wheel of a bicycle.

Caution: Important – Do not attempt to rotate the wheel or ride the bicycle until you have checked for proper clearance. You may damage the counter.

Wiggle the wheel back and forth just a little. If the large counter gear rubs against the fork, the fit is not correct. This can sometimes be corrected by installing a washer between the outer side of the counter and the inside of the fork. Try this. If free rotation without rubbing cannot be obtained, the counter cannot be used on your bicycle. For information on modified models of the counter email JRCounter@aol.com
An installed counter with sufficient clearance is shown in Figure 15.



Figure 15. Clearances needed to avoid damage to the counter.

If there is interference between the small plastic gear and the spokes, install a washer between the inside of the counter and the adjusting nut on the wheel.

If you are unable to fit the counter to the bicycle using washers, it may not be possible to use the counter on the bike.

The counter is driven by a small metal projection (tang) and plastic extension on the inside of the large gear. This should reach between two spokes, which will cause it to rotate. The tang may also be wired to a spoke using the small hole provided on the tang after removing the plastic extension. This is shown in Figure 16.



Figure 16: Properly installed counter showing drive tang with plastic extension.

Once the counter is properly installed, and no interference is present, you can safely ride the bicycle and obtain proper counter operation.

Again – before attempting to rotate the wheel, check for interference. If you do not do this you may damage the counter.

Riding Technique

Ride in a relaxed manner, in as straight a line as possible. The basic idea behind the method is that a small amount of “wobble” while riding the course is accounted for when calibrating the bicycle. Ride the calibration course the same way you will ride the race course.

Avoid braking with the front wheel. When you brake, apply the rear wheel brake.

Failure to ride in a straight line, particularly when diagonally crossing a street, may yield a short course. Rather than watching the ground near the front wheel, aim for a distant point. Locate a point in a direct line to where you need to ride. Then ride toward that point, keeping an eye on that point.

When you encounter potholes or bad bumps, do not swerve to avoid them. Minor ones can be negotiated by slowing down and getting up off the bicycle seat. For a bad bump or hole, stop and carefully walk the bike through it. When you have to get off the bicycle and walk it (e.g., when attempting to reach an exact count or when going through a pothole), you will add roughly 1% to that portion of the course unless you push down on the handlebars to keep some weight pressing down on the front wheel.

Tires should not be checked for pressure at **any** time between calibration and recalibration. This causes a small air loss which may significantly alter your riding constant.

Avoid extreme weather conditions. Do not measure on very windy days.

Reading the Counter

Freeze the front wheel before reading the counter. This may be done by hand or by using the front wheel brake.

When reading the counter after backing up, be sure to move the bicycle forward again before taking a reading to avoid a "backlash" effect.

If you go past a count at a kilometer/mile marker, it is best to make a mark where you happen to stop, record the count there, and later adjust the split point by measuring backwards with a tape. Although it is possible to wheel the bicycle backwards, this should be avoided.

Etiquette

When measuring, you may encounter runners, other cyclists, or just people enjoying the out-of-doors. Slow down. Politely explain that you are measuring a race course and have to go in a straight line. They will usually yield to you. Except in extreme cases, avoid moving out of someone's way. If necessary, stop and wait for that person to go around you. Please be courteous at all times. You can minimize such problems by measuring when traffic of all sorts is at a minimum.

If you do a lot of measuring, you may wish to carry fore and aft signs reading "**Official Measuring**" in yellow lettering on a dark background.

COURSE MAPS

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The course map is the most important documentation of your course. Its purpose is to provide, ideally on a single sheet of paper, all the information a race director needs to set up the race using the course **as certified**. This documentation is of great value in case a record is set on the course and a “verification” measurement is needed. Current map requirements appear in [Appendix I](#) and must be followed for your course to be approved. Some maps using different styles and mapping techniques also appear in the appendix.

After a course is certified, its map and certificate are posted online at certifiedroadraces.com. These online maps may be viewed by runners who wish to run the race, by race directors staff, and volunteers who are setting up the course on race day, or by race directors who are thinking of hiring a measurer and want to see what kind of work they’ve done. Once it is posted on the website it becomes public domain.

Without good documentation for the course, mistakes could easily be made in laying out the course on race day. By the time of **next** year's race, there may be a new race director who knows nothing about the original course measurement. In addition, all the marks you've painted on the road may have faded into oblivion by the following year!

See [Appendix I](#) for course map requirements and examples.

APPENDIX A: Supplementary Tips

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Dealing with Obstacles

When measuring the course, you may encounter an obstacle, such as a parked car, that will not be present on race day. One way to deal with this problem is as follows:

- a. stop your bicycle just before the obstacle
- b. freeze your front wheel with your hand or the brake
- c. very carefully move the bicycle perpendicular to the route being measured until you are clear of the obstacle
- d. release the wheel and proceed until past the obstacle
- e. reverse the process with the wheel frozen to return to the shortest possible route

Use this procedure sparingly and report each instance in your application for certification. If you have to do this more than a few times on the course, try again on another day when most of the obstacles are gone.

Dealing with Traffic (the "Offset Maneuver")

It may not be possible to measure some sections of a road course with reasonable safety at any time. The preferred method is to arrange an "escort," which may be an official police escort or simply a large truck equipped with arrows and blinkers used for traffic control.

If the critical section requires a long diagonal run across traffic, you may wish to consider an "offset maneuver." This is performed as shown in Figure A-1.

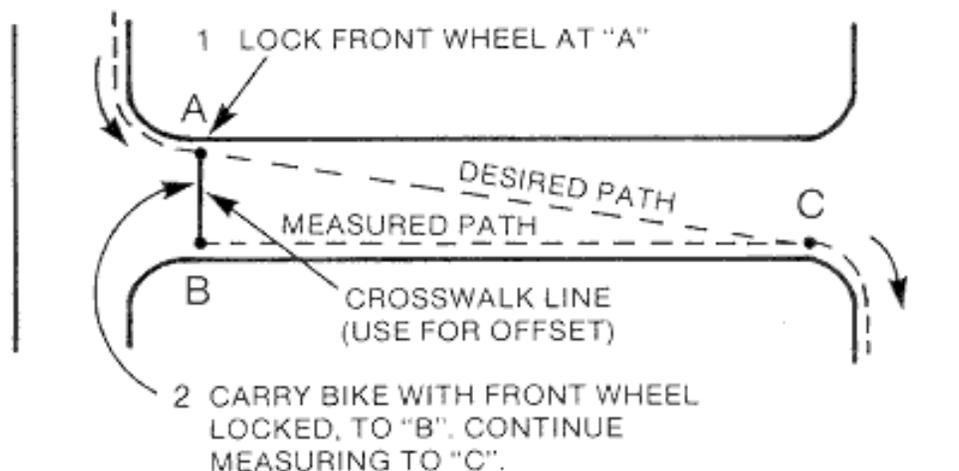


Figure A-1. Offset maneuver to use when riding a diagonal path is too dangerous.

Measure along the (straight) road edge to where a crosswalk or expansion crack lies. Using this as a guide, physically carry the bicycle across the street with the front wheel frozen.

Continue the measurement along the opposite side of the roadway. This errs on the side of making the course very slightly longer but it may save your life. When crossing the roadway, **be sure** you cross **perpendicular** to the direction of the roadway.

Two-Cyclist Riding Technique

It is often faster and more enjoyable—and possibly also more reliable—to measure with a second cyclist instead of just doing two rides of the course by yourself. It is recommended that long courses such as marathons are measured using two riders. Either way, we use the **one set of marks** technique. This means that tentative start, finish, and split marks are only painted on the road during the **first** measurement. In a two-cyclist measurement, only the **lead** rider paints marks on the road. No new marks are ever painted during the second measurement. Therefore, the second cyclist simply stops at the points already marked by the first cyclist, and records counter readings at exactly those marks. To minimize confusion during this process and subsequent data analysis, the second cyclist should **not pre-calculate** any counter readings from his/her working constant before riding.

The two cyclists should strive to make their measurements as **independent** as possible; i.e., each rider should exercise his/her own judgement as to where the shortest possible route lies. The measurements will not be truly independent if the second cyclist follows directly in the tracks of the first cyclist. Ideally, the second cyclist should follow two or three blocks behind the first cyclist; however, this may not be practical in certain situations; e.g., if you have a police escort.

Whenever a course is measured by more than one cyclist, every cyclist who rides the race course must do **his or her own pre-measurement and post-measurement calibration rides**. The certifiedroadraces.com on-line program allows for two measurers to enter their data using the Collaborator option. If submitted manually a separate copy of the Bicycle Calibration Data Sheet must be completed for each rider, calculating individual riding constants for each rider. This procedure must be followed even when cyclists use the same bicycle, because riding constants will vary for different cyclists, depending on riders' weights and riding styles.

Safety

A course measurer should always wear an orange, reflective, safety vest. A helmet is also an essential piece of safety gear. These will tend to make you look more "official," like a member of a highway crew, **and** will make you much more visible. Since the route that must be measured is often not the logical route for a cyclist, motorists may not be able to easily predict your direction and avoid you.

Even if you cannot arrange an official police escort, a friend following you in a truck with emergency lights flashing can provide considerable protection when measuring in traffic.

When steel-taping or making permanent marks, you may wish to use safety flags or stop signs to add to the protection of the measuring team.

Minimizing Stops to Check the Counter

Electronic devices are available that attach to the front wheel and provide digital readouts via a display mounted on the handlebars. Although not sufficiently accurate for certification purposes, such devices can alert you to the upcoming location of intermediate split points and measurement end points on your first measurement. Such devices are available in many bicycle stores.

You may also find it convenient to mark (with a felt-tip pen) all your intermediate stop counts on a sheet of folded 8.5x11 paper and fasten this to the front brake cables with clothes pins for easy reference.

Solid Tires and Avoidance of Flats

A flat (front) tire is a disaster! If you get a flat, **all** measurements made since the last calibration are invalid. You must fix the flat and start over with a new calibration.

Solid tires are one way of avoiding flats. Solid tires require a period of "breaking in," which you should reach after roughly 50 kilometers of riding. Solid tires have two major advantages. First, you eliminate flat tires and the wasted measurements that accompany a flat tire. This allows you to ride the shortest possible route with more confidence since glass fragments are no longer a problem.

Second, the day-to-day and within-day variations in the calibration constant are smaller. Solid tires do not eliminate the need to calibrate before and after measuring, but they do reduce differences between the working and finish constants.

Locating Intermediate Split Points

Many races have signs indicating kilometer or mile points and may have times read to the runners at several points. A "locator" guide describing how to find a painted split point quickly when driving along in a car is often useful. Very little time is available to place signs and drop off timers on race day, and such a guide helps assure the runners will get splits at the proper points. Few things are more frustrating to a serious runner than to realize mid-way through the race that the splits are all wrong!

Measuring at Night

For urban race courses on busy streets, the only time that the traffic density is light enough to permit a proper course measurement may be late at night. If you measure at night, you **must** calibrate and recalibrate during the same night under the same conditions as the

course measurement. **Do not** calibrate before sunset, measure at night, and then recalibrate after dawn.

You will need a good light system for your bicycle and a flashlight to read the Jones Counter. Many Ni-Cad battery-powered light units are available and work very well. You may also attach a flashing strobe light to your bike or person. These units are cheap, lightweight, and provide a greatly increased degree of safety. Use plenty of reflective material such as a vest and reflectors for your bicycle. Wear a helmet. Do not measure alone at night. Have a car behind you with high beams on.

Do not measure at night unless you know exactly where the shortest possible route lies. Visibility may not be good enough to sight distant corners.

Walking the Bicycle

Walking the bicycle removes weight and reduces the counts required to cover a given distance. If this is done while measuring the race course, it will tend to produce a race course that is slightly oversized (which is acceptable). The portions of the course that a bicycle is walked over will be roughly 1% longer than if the bicycle were ridden.

You may find it necessary to walk the bicycle for short distances near intermediate marks, through large potholes or other paving disasters, and occasionally up hills too steep to ride. You might consider measuring down such hills by making temporary marks at the top and bottom and measuring between them in the reverse direction.

You should **never** walk the bicycle over any portion of the *calibration course* since this will tend to produce short courses.

Measuring on Dirt, Grass, and Sand

Avoid laying out a course over non-paved surfaces. If you must, minimize the distance to be measured over such surfaces. Hard-packed dirt is OK, but avoid sand, soft dirt, and deep grass.

For certification of courses on unpaved surfaces the following conditions apply:

- 1) The bicycle tire does not cause significant deformation or movement of the road/trail surface as it rolls over the surface. Note that a grass surface is always deformed significantly by a rolling tire, and therefore it is not permissible to measure grass sections with a calibrated bicycle.
- 2) The trail/road has defined edges where there are turns.
- 3) The measurement is based on a calibration done on a similar surface.

- 4) For courses made up of paved and unpaved surfaces, Any surface that exceeds 10% of the total must be measured using a calibration on that or a similar surface.
- 5) Any length and any surface may be included in the course if it is measured with a steel tape.

The greatest accuracy is obtained by steel-taping all non-paved sections. However, measuring the entire course with a bicycle calibrated on appropriate calibration course or courses is acceptable and is, in fact, the **recommended** procedure since it reduces the chance of error.

The calculations (for start, finish, splits, etc.) can get quite complicated if you piece together a course measured partly by bicycle and partly by steel tape. If you do this, make permanent marks at those points where you change between bicycle and tape measurements.

Therefore, when unpaved sections of the course total more than 10% of the total length of the course, the recommended practice would be to calibrate the bicycle on both paved and unpaved calibration courses before starting your measurement of the course. Then measure the course making notes of the counts at the start and end of each unpaved section. After the measurement you can calculate the total length of the course by using the appropriate calibration constant on each section of the course. Finally, you might need to adjust the location of the start, finish, or turn-arounds in order to bring the course to the correct total distance.

Measuring dirt roads usually presents little problem **if** the road is well graded. If the non-paved road is not graded (usually two ruts) and is winding, it may be virtually impossible to ride the shortest possible route since the proper route would cross the ruts and intermediate ridge at angles which do not permit safe riding. If such sections are encountered and cannot be avoided, they must be steel-taped.

Minimizing Temperature Effects

In many locales, the daily temperature range may be 20 °C (36 °F) or more. Such temperature extremes usually create a greater difference between the working and finish (calibration) constants. You can reduce this difference by measuring on days when the temperature variation is small, such as on cloudy days or near dawn when the temperature changes slowly.

Another way to reduce this effect is to make more frequent re-calibration runs. If you measure over a period of five or more hours, you may wish to do a set of calibration rides mid-way through your measuring. This is feasible only if the calibration course is not too far from the race course. It does have the additional advantage that it "protects" at least some of your measurements against flat tires.

Calibration Course

Since you might be calibrating before dawn or after dusk, you may wish to make the paint marks on your calibration course with fluorescent paint for better visibility.

As a warning when approaching the end of the calibration course, an arrow 10 meters or so before the marked endpoints can be helpful. Another useful feature is to paint dots every 30 m or 100 ft to be used as reference points while calibrating.

If parked cars are a problem, you can establish the calibration course 2.5 meters from the curb as shown in Figure A-2.

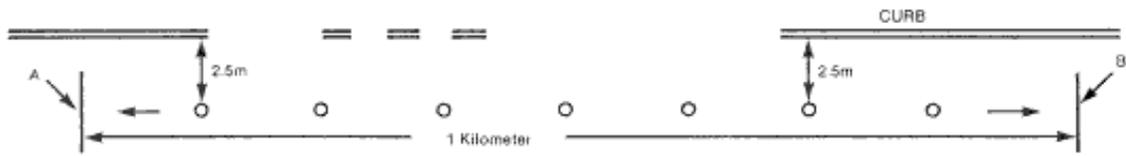


Figure A-2. Calibration course offset from the curb to avoid parked cars.

As a safety measure, you may wish to lay out **two** calibration courses—one on each side of the street—so that you are always able to ride legally with traffic. Note that **each** course must be measured and certified separately.

APPENDIX B: Course Layout

[\(Go to ToC\)](#)

If you are measuring an existing race course, consult with the race director to make sure you are measuring the correct course. Find a runner who has run the race to help determine how runners actually run the course.

If you are laying out a new course, find out what restrictions the race director and local authorities may have on where the race may be run. The finish area is especially critical since you will need a traffic-free area with enough room to set up finish chutes, medical and aid stations, results-processing areas, and often awards ceremonies. Many courses are laid out from finish to start.

The starting area must be wide enough to accommodate the maximum expected field. Trying to start more than 1000 runners on a two-lane road without shoulders creates substantial congestion and delays the back-of-the-pack runners. **Never** lay out a course with a sharp turn within the first hundred meters; the more starting straightaway you have, the better (and safer) the course. Likewise, leave at least a 100-meter straightaway leading into the finish so runners can have a decent finishing sprint.

Avoid crossing traffic where possible. During races, police prefer that runners run with the traffic. This makes it easier and safer for the police escort. If you can lay out a course that consists of mostly right turns, you avoid crossing traffic, and your measurement job is easier since you will have less traffic to contend with.

When laying out a course for a large race (more than 1000 runners), avoid multiple-loop courses and out-and-back courses. Do not lay out a course with three or more loops for large races since monitoring against cheating is nearly impossible. Likewise, a straight out-and-back course requires some type of recording at the turn-around point. This is difficult for large races and should be avoided.

Small races and ultra-marathons are conveniently held on small loop courses, with each loop being from one to ten kilometers (one-half to six miles) in length. Certify the loop itself as a **closed loop** course. Once the closed loop is certified, **all** integral multiples of the loop are automatically certified. Thus, you may be able to certify a 100 km course with 10 km of measurement (twice over a 5 km loop).

If the closed loop course can be made an exact standard distance such as 5 km or 5 miles, races of several different lengths may be held on it. Intermediate splits which are integral numbers of loops are also certified and considered valid for record purposes. To set up a closed loop course which is an exact standard distance, refer to the discussion below on laying out a course with fixed start and finish points.

It is important to lay out a reasonably accurate course before doing the actual measurement.

An approximate measurement with your (uncalibrated) bicycle is a good idea since it will give you a rough idea of start and finish points and will familiarize you with riding the shortest possible route. If your chosen course is way off, this is the time to make alterations.

Once you have a tentative course, consult with the race director and local authorities to determine how much of the roadway will be available to the runners. If the runners are to be restricted to following a longer route when a shorter one is available, it is necessary to include temporary barriers to keep them along the correct path. Instructions such as "stay on the right side" are universally ignored, unless enforcement exists. Note that it is easier to let them run wherever they want on the road and measure the shortest path they can take.

If you measure a restricted route, **it must be coned and monitored**, or the certification will be invalid. The restricted route must be marked in such a manner that cones and/or barricades may be properly placed on race day. The positions of barricades and cones must be clearly specified on the course map. Usually, painted lane markings are used as the basis for a restricted route.

If you need to adjust the course, small adjustments can be made by moving the start, finish or turn-around points. If the needed adjustment is large, you may need to reroute the course and make additional bicycle measurements. Making changes in the middle of a course is usually awkward.

If both the start and finish must be at fixed points, you should have a turn-around point somewhere on the course. The position of the turn-around may be varied to get exactly the desired length. Remember when you move a turn-around, the runners will run twice the distance you move the turn.

Mark all important points on the final course carefully and permanently. Determine their locations relative to fixed landmarks so they can be found again in case of repaving or other changes in the road surface. Make sure provisional marks are not confused with final marks. Provisional marks may be obliterated by spraying over them with black spray paint (on asphalt) or simply "block" them out in the original color.

The entire race course should be inspected just before the race by someone who knows the course as it was measured. Be sure the start, finish, and turn-around points are correctly located. Check the positions of course monitors and marshalls as well as the positions of cones and barricades. If there is a lead car, someone who knows the route should be in the lead vehicle. This person should also have a map of the course. In any complicated undertaking involving lots of people, there are likely to be errors. Anticipate them. Check and double check.

APPENDIX C: Example of Course Measurement

[\(Go to ToC\)](#)

Setting Up the Calibration Course

It is 7:15 a.m. on 7 October 1982 in Elysium, OH. You arrive at your pre-selected site for the calibration course on Fargo Road with your two trusty helpers, Ralph Doe and Susan Marker. This section of Fargo Road is straight and level, recently paved, with no cross-traffic and little traffic of any kind. You have checked your equipment list and everything is accounted for.

You have decided to set up a 300 meter calibration course, which will be convenient for measuring metric race courses (and you are, in fact, planning to measure a 10 kilometer race course). You couldn't find a metric tape in your local hardware store so you are using a 100-foot tape instead. Since 300 meters = 984.25 feet, you will be laying out 9 and a fraction lengths of the 100-foot tape.

[Note: You probably **can** find a metric tape by checking stores that sell to the surveying profession, companies that sell equipment for track meets, educational supply houses, or by visiting any hardware store outside the United States.]

Locate the start. There is a storm drain just south of the intersection of Fargo Road with Turtle Road. This will make a nice permanent reference. You drive a PK nail into the pavement, 18 inches west of the east edge of Fargo Road and exactly 2.0 feet south of the south edge of the storm drain located in front of 2317 Fargo Road. This will be the permanent northern endpoint of your calibration course (point A).

You lay the measuring tape on the pavement with a short section exposed to any sunlight on the calibration course. After a couple minutes you use your non-contact thermometer to take a temperature reading directly from the exposed tape. In the case where you have only a contact type thermometer, you lay the thermometer on the pavement, standing so that you shade the thermometer. After three minutes, the temperature seems to have stopped changing. It reads 53 °F. In either case, Susan records the start time and temperature.

Ralph holds the 100 ft mark of the tape over the PK nail at point A. You grab the “zero” end and extend the tape (southward) while walking it out to its full extension of 100 feet. You are using the zero end because that is the end with a ring to which you can attach a spring balance. You and Ralph jiggle the tape as needed until it lies straight and flat, and you check that your end is still 18 inches from the curb. Then you start pulling on the spring balance until it reaches 50 newtons (5 kilograms-force, or 11 pounds-force), moving the tape slowly forward.

In the meantime, Susan tears off a piece of masking tape (which she has already pre-numbered with numeral “1”) from her roll and sticks it on the roadway at your end of the tape. When you have the tape steadily under tension and Ralph signals that his end is

over the mark, Susan puts a thin black mark on the masking tape alongside the zero mark of the measuring tape.

You continue in this manner until you have marked 9 one-hundred-foot sections. At this point, you mark an 84-foot section. The procedure is exactly as before except that Ralph uses the 84-foot mark instead of the 100-foot mark on the tape. You still pull the spring balance with the full force of 50 newtons (**do not** use less force, even though you're using a smaller portion of the tape). The marked point (point "B") is now 984 feet south of point A. It isn't necessary to get exactly 984.25 feet at this step since a final adjustment will be made later. Susan enters 9 tape lengths \times 100 feet each, with a "partial" tape length of 84 feet.

You now start measuring back (northward) from point B, in 100-foot lengths, using new pieces of masking tape which will each be intermediate to the previous marks. You use a **red** pen this time, to clearly distinguish these marks from the old ones. Note that you had to turn the tape around at point B since only the zero end has a ring where you can attach the spring balance.

As before, you lay out 9 full 100-foot tape lengths. However, you measure the last interval to the PK nail at point A. This is found to be 83 feet 11¼ inches. Thus, according to your second measurement, the distance between the permanently marked point A and your temporary point B is ¾ inch short of 984 feet. The second measurement is 983 feet 11¼ inches or 983.94 feet in decimal form.

You repeat the temperature reading as before and find it to be 59 °F. Susan records this datum.

You now calculate the temperature-corrected average measured distance between points A and B, as instructed on the Steel Taping Data Sheet. The corrected measurement is 983.89 feet. Since your desired calibration course length is 300 meters or 984.25 feet, you must now lengthen the tentative course by 0.36 feet which is equal to 4¼ inches. You do this by moving point B to a point 4¼ inches further south. Using the tape measure once more, you find that the corrected point B is 17 ft 4¼ inches north of the north edge of the manhole in the center of the intersection of Fargo Road and Parrot Lane.

You are now almost finished. But, before permanently marking point B, you check to make sure you haven't missed a whole tape length somehow. You take your bicycle off of the rack and ride it around for a few minutes to warm up the tires. You place the bicycle's front axle over the north endpoint and record a count of 12546. You then ride southward one 100 foot tape length (being careful to use a 100 ft interval rather than the 84 ft interval!), and stop with the front axle over the mark. You record a count of 12833. The difference, corresponding to one tape length, is 287 counts.

You now return to the northern endpoint (point A) and, pointing the bike southward again, note a counter reading of 13217 with the front axle over the mark. You ride the bicycle over the full calibration course, stopping with the front axle over the corrected southern

endpoint. You record a count of 16036. The difference is 2819 counts. Dividing the full course count of 2819 by the 100 ft count of 287 yields a course length of 9.82 tape lengths which, for such a rough check, is in excellent agreement with the intended course length of 9.8425 tape lengths.

Finally, you put a PK nail at the corrected endpoint (point B) of your 300 meter course. You thank Ralph and Susan and head home to create your certification map (example shown in Figure C-1) and fill out the forms necessary to obtain certification of your new calibration course (example shown in Figure C-2).

You use the on-line certification program certifiedroadraces.com to enter your calibration course. If there is a reason that you cannot use the on-line program you can use the manual method with the forms shown below (available in [Appendix G](#)).

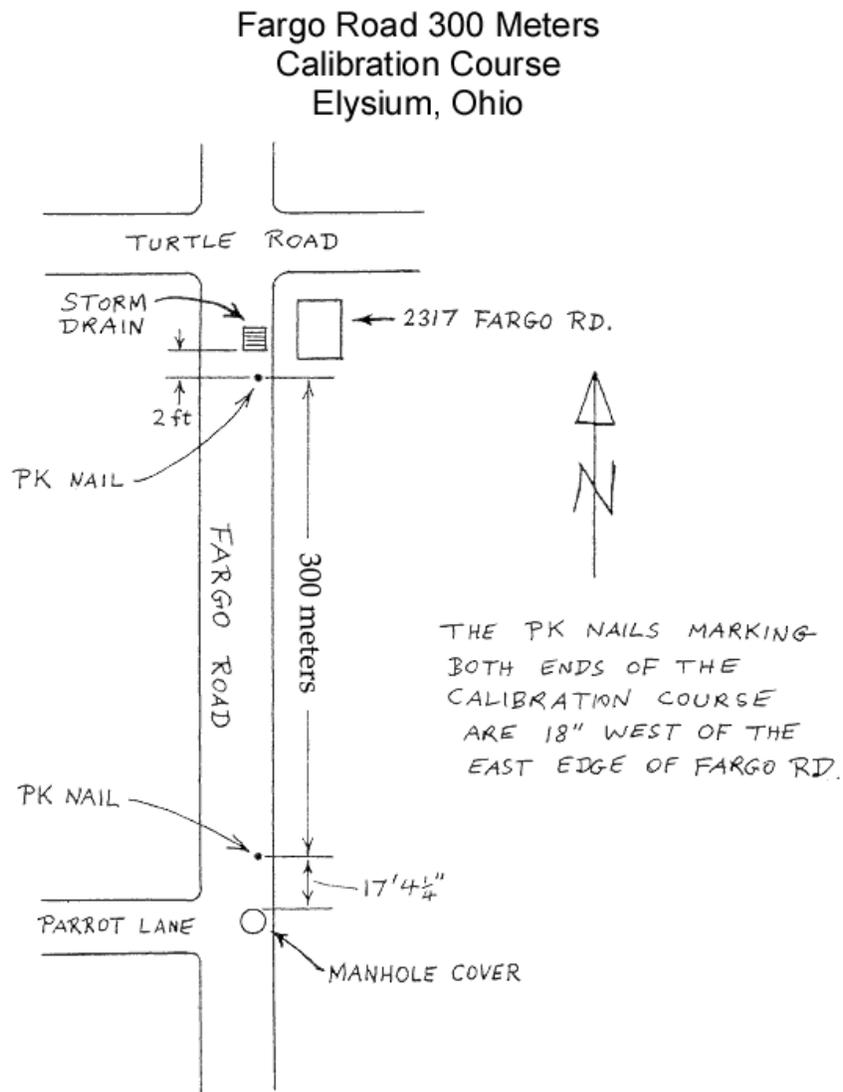


Figure C-1. Calibration course map example.

STEEL TAPING DATA SHEET
(for measuring a calibration course or track)

Name of Calibration Course Fargo Road 300 Meters

City and State Elysium, Ohio Date 7 Oct 1982

Start Time 7:15 am Finish Time 9:00 am

Pavement Temperature: Start 53 F Finish 59 F Average 56 F
(Thermometer shaded from direct sun)

Measurements and Calculations:

1. First Measurement. This establishes tentative start and finish marks which should not be changed until the final adjustment on line 6 below.

$$\frac{9}{\# \text{ tape lengths}} \times \frac{100'}{\text{distance per tape length}} + \frac{84'}{\text{partial tape length}} = \frac{984.00 \text{ ft}}{\text{measured distance}}$$

2. Second Measurement. This checks the distance between the SAME tentative start and finish points marked in the first measurement, but use new intermediate taping points.

$$\frac{9}{\# \text{ tape lengths}} \times \frac{100'}{\text{distance per tape length}} + \frac{83'11\frac{1}{4}''}{\text{partial tape length}} = \frac{983.94 \text{ ft}}{\text{measured distance}}$$

3. Average Raw (uncorrected) Measurement of Course 983.97 ft

4. Temperature Correction. Use the average pavement temperature during measurement in whichever formula is appropriate (for Celsius or Fahrenheit temperature). Work out answer to at least seven digits beyond the decimal point.

$$\begin{aligned} \text{Correction factor} &= ([\text{Temp}(\text{°C}) - 20] \times .0000116) + 1.0000000 \\ \text{Correction factor} &= ([\text{Temp}(\text{°F}) - 68] \times .00000645) + 1.0000000 \\ \text{Correction factor} &= ([56 - 68] \times .00000645) + 1.0000000 \\ &= (-.0000774) + 1.0000000 = 0.9999226 \end{aligned}$$

NOTE: For temperatures below 20 °C (68 °F), factor is less than one
For temperatures above 20 °C (68 °F), factor is greater than one

5. Multiply the temperature correction factor by the average raw measurement of the course (line 3)

$$\frac{0.9999226}{\text{correction factor}} \times \frac{983.97 \text{ ft}}{\text{avg. raw measurement}} = \frac{983.89 \text{ ft}}{\text{corrected measurement}}$$

(Desired length 984.25' - 983.89' = 0.36' = 4¼")

6. If you wish, you may now adjust the course to obtain an even distance, such as 300 meters (not applicable if measuring a track). This is not necessary as you may choose instead to use an odd-distance calibration course whose endpoints are pre-existing permanent objects in the road to guard against hazards such as repaving. If you adjusted the course, explain what you did.

Added 4¼" to south end of course
Final Adjusted Length of Calibration Course 984.25 ft = 300 meters

CONVERSION FACTORS: 1 foot = 0.3048 meters
300 meters = 984.25 feet
1 kilometer = 1000 meters = 3280.84 feet

APPLICATION FOR CERTIFICATION OF CALIBRATION COURSE

1. Name of Calibration Course Fargo Road 300 Meters

2. Length of Calibration Course 300 meters

3. City and State Elysium, Ohio

4. Date(s) Measured 7 Oct 1982

5. Method Used to Measure Calibration Course Steel Tape

6. How many times did you measure the calibration course? 2

7. Measuring Team Leader: John Doe , 614-123-4567
 (Name) (Telephone #)
123 Accurate Rd, Perfection OH 43807 john.doe@example.com
 (Address) (E-mail address)

8. List Names and Duties of Team Members:
John Doe - lead tapeman Ralph Doe - rear tapeman
Susan Marker - marked tape lengths
and kept notes

9. Submit a **map** of this calibration course, showing direction of north, the name of the road (and relevant cross streets), and the exact locations of start and finish points, including taped distances from nearby permanent landmarks. Enclosed

10. Is this calibration course: STRAIGHT? Yes PAVED? Yes

11. How are the start and finish points marked? Nails & Paint

12. Are the start and finish points located in the road where a bicycle wheel can touch them or elsewhere?
In the road

13. Approximate altitude of calibration course (meters or feet – specify which) 700 ft

Mark endpoints in a permanent way (concrete or P-K nails). Paint will fade. The calibration course, once certified, can be used to measure many courses. TAKE CARE OF IT!

14. If the calibration course was measured by **Electronic Distance Meter (EDM)**, describe on a separate sheet the exact procedures used; also include a copy of the original field notes from the measurement.

15. If the calibration course was measured by **steel tape**, fill out a copy of the **steel taping data sheet** and complete the following:

16. How much tension (force) was applied to the tape while measuring? 50 newtons = 11 pounds

17. How was this tension maintained? Spring scale

18. Was the tape free of any kinks, crimps or splices? Yes

19. Bicycle Check. This is a check against miscounting the number of tape lengths. (If you used a gross measurement check other than a bicycle, please explain.)

A. Counts for full calibration course	<u>2819</u>	(16036 - 13217)
B. Counts for one tape length	<u>287</u>	(12833 - 12546)
C. Divide A by B	<u>9.82</u>	<- Close enough to
D. Number of full tape lengths	<u>9.8425</u>	show number of
		tape lengths
		is correct

Figure C-2. Calibration course measurement data sheet and certification application example.

APPENDIX C: Example of Course Measurement (continued)

[\(Go to ToC\)](#)

Calibrating the Bicycle

You take your bicycle with tires fully inflated and your pack of equipment out to the calibration course you previously submitted for certification. It is 7:15 a.m. You determine the temperature as before (53 °F) and ride the bicycle around for roughly five minutes to warm up the tires. You record the time and temperature.

You position the front axle of the bicycle over the start point on the calibration course. You record the start count as 116091. You ride the calibration course, carrying your equipment. You carefully stop the bicycle with the front axle positioned directly over the end point. You record the finish count as 118914.

You then repeat this procedure three more times, recording the start and finish counts. Each time you reverse direction, you freeze the front wheel with the handbrake before turning the bike around. In this way, your finish count for one ride is your start count for the next ride. This isn't required, but simplifies the arithmetic and helps ensure accuracy of your average count, even if there are errors in intermediate counter readings.

You now sit down and fill in the first part of the **Bicycle Calibration Data Sheet**. The average pre-measurement count works out to 2822.25 counts on your 300 meter calibration course. To figure the counts in one kilometer (i.e., 1000 meters), you multiply by the ratio 1000/300. Then multiply by the 1.001 **safety factor**. Your resulting **working constant** is 9416.9075 counts per kilometer. You round this upwards to 9417 and will use this value for preliminary course markings.

Since you also intend to mark some mile splits, you multiply the 9416.9075 figure by the conversion factor of 1.609344 (see [Appendix F](#)) to obtain a mile constant of 15155.04, which you round to 15155 counts/mile. (It's safest to round constants **upwards**; however the rounding here is minor, and you weren't planning to certify the mile splits anyway).

You now measure the course (see next section).

After you have completed your two measurements of the race course, you return to the calibration course. It is now 10:30 a.m. You check the temperature and record 63 °F.

You calibrate the bicycle just as you did for the pre-measurement calibration with four rides. Your resulting **finish constant** works out to 9409.40 counts/km, which you round upwards to 9410 counts/km.

Since the **finish constant** is smaller than the **working constant**, the **constant for the day** is taken to be the **working constant** or 9417 counts per kilometer. If you start your

measurements in the early morning, you will generally find your working constant to be larger than your finish constant. This means that the preliminary course marks will not need to be adjusted for the change in the bicycle calibration. You should use the on-line certification program at certifiedroadraces.com to enter your course. If there is a reason that you cannot use the on-line program (See [Appendix G](#) for why you might not be able to use the on-line certification program) you can use the manual method with the forms shown below in Figure C-3 (and available in [Appendix G](#)).

BICYCLE CALIBRATION DATA SHEET

Date of Measurement 16 Oct 1982
 Name of Measurer John Doe
 Length of calibration course 300 meters

1. Ride the calibration course 4 times, recording data as follows:

Ride	Start Count	Finish Count	Difference	
1.	116091	118914	2823	Pre-measurement
2.	118914	121734.5	2820.5	Average Count <u>2822.25</u>
3.	121734.5	124557	2822.5	Time of Day <u>7:15 am</u>
4.	124557	127380	2823	Temperature <u>53 F</u>

WORKING CONSTANT = Number of counts in one kilometer or one mile, calculated from Pre-measurement average count, and multiplied by 1.001 "safety factor."

$$\text{Working Constant} = 2822.25 \times \frac{1000 \text{ m}}{300 \text{ m}} \times 1.001 = 9416.9075 \text{ counts/km} \quad (\text{use } 9417 \text{ for layout})$$

Also $9416.9075 \times 1.609344 = 15155.04/\text{mile}$ (use 15155 for mile splits)

2. Now, measure the course, including all intermediate distances, using the working constant. Enter data on the "Course Measurement Data Sheet."

3. Recalibrate the bicycle by riding the calibration course 4 times, recording data as follows:

Ride	Start Count	Finish Count	Difference	
1.	342567	345387	2820	Post-measurement
2.	345387	348206.5	2819.5	Average Count <u>2820</u>
3.	348206.5	351026	2819.5	Time of Day <u>10:30 am</u>
4.	351026	353847	2821	Temperature <u>63 F</u>

FINISH CONSTANT = Number of counts in one kilometer or one mile, calculated from Post-measurement average count, and multiplied by 1.001 "safety factor."

$$\text{Finish Constant} = 2820 \times \frac{1000 \text{ m}}{300 \text{ m}} \times 1.001 = 9409.40 \text{ counts/km} \quad (\text{round up to } 9410)$$

CONSTANT FOR THE DAY = Either the Working Constant or the Finish Constant, whichever is the larger*.

Constant for the Day = 9417 counts/km

Remember, each day's measurement must be preceded and followed by a calibration run. You may measure as much as you want in a day, just so calibration precedes and follows it in the same 24 hour period. This is done to minimize error due to changes in tire pressure from thermal expansion and slow leakage. Frequent calibration "protects" the previous measurement. A smart measurer will recalibrate frequently—you never know when a flat tire is coming!

CONVERSION FACTOR: 1 mile = 1.609344 kilometers

* You may, if you wish, define your "Constant for the Day" as the average of Working and Finish constant instead of the larger. However, if you use the average, you will produce a shorter race course, which will face a greater risk of being found short if it ever needs to be validated. Therefore, use of the larger constant is strongly recommended.

Figure C-3. Calibration course measurement data sheet example.

APPENDIX C: Example of Course Measurement (continued)

[\(Go to ToC\)](#)

Measuring the Race Course

The race course has already been defined in terms of the route and desired start and finish points. The course is to be a 10-kilometer course. The start may be adjusted but the finish line is fixed.

You have completed your pre-measurement calibration rides and have determined your working constant to be 9417 counts per kilometer (15155 counts per mile). You have decided to lay out mile splits and splits for one and five kilometers (splits at every multiple of 5 km are recommended for all metric races and the half and full marathons).

You mark the finish line in the pavement on Turtle Road and note its location as 37 feet west of the "No Parking" sign by the Weed Shoe Store. You place the front axle of the bicycle over the Finish line and rotate the wheel *forward* until you reach an even thousands of counts (154000 counts). This simplifies the arithmetic but is not required. In your notebook, you record the initial count and calculate the count for each intended split, working backwards from the finish to the starting line.

These counter readings are calculated as follows. First you work out the metric splits:

Finish				=	154000 counts
5 km	154000	+	5 x 9417 cnt/km	=	201085 counts
1 km	154000	+	9 x 9417 cnt/km	=	238753 counts
Start	154000	+	10 x 9417 cnt/km	=	248170 counts

Knowing what the count will be at the starting line, you then work backwards to figure out what the count will be at each mile split:

Start				=	248170 counts
1 mile	248170	-	15155 cnt/mi	=	233015 counts
2 miles	233015	-	15155 cnt/mi	=	217860 counts
3 miles	217860	-	15155 cnt/mi	=	202705 counts
4 miles	202705	-	15155 cnt/mi	=	187550 counts
5 miles	187550	-	15155 cnt/mi	=	172395 counts
6 miles	172395	-	15155 cnt/mi	=	157240 counts

After computing all these counts, you arrange them in a single list, in the same order as you will come to them in the measurement, from finish to start.

[Note: If these calculations for inserting mile splits into a metric course seem complicated, perhaps you can avoid them by laying out the course entirely with kilometer splits. An

increasing number of races are moving to an all-metric format; e.g., see the Tulsa Run example in the next section on examples of course maps.]

You should use the on-line certification program at certifiedroadraces.com to enter your course. If there is a reason that you cannot use the on-line program (See [Appendix G](#) for why you might not be able to use the on-line certification program) you can use the manual method with the forms shown in this section and available in [Appendix G](#).

You check the temperature and record the time and temperature. You mount the bicycle and ride, checking the count periodically. You make a sharp right-hand turn onto Fargo Road, staying close to the right-hand curb as you round the corner. Since the next turn will be a left, you sight a straight diagonal that will take you to the curb at the northeast corner of the intersection of Fargo and James Roads. Following this shortest course, you ride until you reach a count of 157240. You dismount and paint a short line and a small "6" on the pavement at the position of the front axle, indicating the tentative six-mile mark. You record the mark as located opposite the center of the driveway at 2180 Fargo Road.

You continue the diagonal path to the James Road intersection. At this point, you know that the next turn will also be a left turn. You find the corner to be gravelly and realize that runners could cut here. You note that a cone and monitor must be placed at this corner to keep the runners on the pavement. You measure following a path close to the curb on the north side of James Road. As you reach your count of 172395, you dismount and mark the tentative five-mile point.

Your next turn is left onto a winding bike path. You carefully follow the shortest route, crossing from one side of the path to the other as needed to follow the shortest route. You note and mark the four-mile, 5-kilometer, and three-mile marks.

Your next turn is a left onto River Street. As soon as you can see a straight path for the southwest corner of River Street and the bike path, you head for it. The next turn will be a right, heading north onto Joy Street. You sight the diagonal and ride the shortest route to the northeast corner of Joy and River Streets. You note and mark the two-mile mark.

Your tentative turn-around point on Joy Street is adjacent to a high-voltage tower. You head for the middle of the street adjacent to the tower. When you are opposite the tower, you stop and "freeze" the front wheel. You mark the turn-around with a line and a "T." You record the count. You then carefully reverse the direction of the bicycle while holding the front wheel frozen. You now sight for the northwest corner of Joy Street and Turtle Road where you will make a right turn, noting and marking the tentative one-mile and one-kilometer marks enroute.

You round the last corner and stay to the north side of Turtle Road. When the counter reaches 248170, you have reached your tentative starting line. You mark as before and paint a small "S" on the pavement next to the line. You then locate and record that the tentative starting line is 1.0 feet west of the telephone pole #3014-6C in front of Mergor Hardware Store at 2717 Turtle Road.

Now you are ready for the return measurement. This time, you've decided to ride from Start to Finish so you can make independent judgments of the shortest possible route. You hold the front axle of the bicycle over the tentative starting line that you marked in the first measurement, and rotate the wheel *forward* until the counter reads an even number of hundreds (248200). You mount and ride the course in the direction the race will be run. This time, you do not need to make any calculations before riding, and you **do not** make any new marks on the road. You simply stop at each of the marks you painted on the road during your first measurement (start, splits, turn-around, finish). At each such mark, you record exactly what your counter reads when the front axle is directly over the previously painted mark. You continue in this manner all the way to the (previously fixed) finish line.

Your count at the previously painted finish line is 342326. You calculate the start-to-finish counts for measurement #1 as 94170 and for measurement #2 as 94126. You divide each start-to-finish count by the working constant to obtain the preliminary course length for each measurement. You record these as 10,000 meters and 9,995.33 meters. Their difference is 4.67 meters. You then divide this difference by course length #1 (10,000 m) and note that the two measurements differ by 0.0467% which is within the 0.08% maximum allowable tolerance.

You now return to the calibration course and recalibrate the bicycle.

After recalibrating, you find that your post-measurement "finish" constant is smaller than your pre-measurement "working" constant, which means that your "constant for the day" (defined as the larger of the working constant or finish constant) is identical to the working constant. This allows you to avoid recalculating your measurements using the constant for the day. You need only adjust the race course for the difference between the lesser of the two measurement rides and the desired race distance.

The lesser of the two measured distances is 9,995.33 meters, based on ride #2. (Very likely, you did a better job of riding the shortest possible route during your second ride over the course; it is often easier to concentrate on riding the shortest route during the second ride because you don't have to worry about making new marks on the road this time.) This is the "official" measured length of the tentative course. To bring the course up to the full desired distance of ten kilometers, it must be lengthened by 4.67 meters.

At this point you must convert back to the Imperial system since you are (unfortunately) using a non-metric tape. You check [Appendix F](#) and note the conversion between meters and feet is 0.3048 meters = one foot. Dividing the 4.67 meters by 0.3048 meters per foot gives you 15.32 feet or 15 feet 4 inches, which is the distance by which you must lengthen your course to bring it up to the full 10 kilometers.

Rather than adjust the starting line, you opt to adjust the turn-around point. Using your steel tape, you measure 7 ft 8 inches north from your tentative turn-around point and make a

permanent mark, using concrete nails pounded into the pavement. You also mark the turn-around with spray paint and a "T" for turn-around.

Since the difference between the marked intermediate split points and the split points that would result from using the lesser measurement value would not be greater than 5 meters (the overall adjustment was 4.67 meters), you opt to leave the intermediate split point marks where they are and mark them with concrete nails and spray paint.

You return to the start/finish area and make permanent marks for the start and finish lines.

You now return home and have lunch before sitting down to fill in the blanks in the forms for certification (see Figures C-4 and C-5 for an example). You are satisfied with the morning's work.

You should use the on-line certification program at certifiedroadraces.com to enter your course. If there is a reason that you cannot use the on-line program (See [Appendix G](#) for why you might not be able to use the on-line certification program) you can use the manual method with the forms shown below (and available in [Appendix G](#)).

COURSE MEASUREMENT DATA SHEET

Name of Course or Race Name ELYSIUM 10K
 Name of Measurer #1 JOHN DOE Working Constant #1 9417 $\frac{CTS}{KM} = 15155$ $\frac{CTS}{MI}$
 Date 16 OCT 1982 Start: Time 7:45 AM Temperature 53 F
 Finish: Time 9:00 AM Temperature 57 F
 Name of Measurer #2 JOHN DOE Working Constant #2 9417
 Date 16 OCT 1982 Start: Time 9:10 AM Temperature 57 F
 Finish: Time 10:15 AM Temperature 62 F

Measurement Data. Use the first measurement ride to lay out the start/finish points and all intermediate split points. Use the second ride to check the location of those same points. Do not use two sets of marks!

Measured Point	Counts for Measurer #1			Counts for Measurer #2	
	Recorded	Elapsed		Recorded	Elapsed
FINISH	154000	> 3240	FIN	342326	> 3237
6 MI	157240	> 15155	6	339089	> 15145
5 MI	172395	> 15155	5	323944	> 15139
4 MI	187550	> 13535	4	308805	> 13528
5 KM	201085	> 1620	5KM	295277	> 1620
3 MI	202705	> 15155	3	293657	> 15151
2 MI	217860	> 15155	2	278506	> 15149
1 MI	233015	> 15155	1	263357	> 15157
START	248170		START	248200	

Preliminary Course Length	start-to-finish counts	divide by	working constant	=	measured length
Measurer #1	<u>94170</u>	/	<u>9417</u>	=	<u>10.000 KM</u>
Measurer #2	<u>94126</u>	/	<u>9417</u>	=	<u>9.99533 KM</u>
Difference between lengths #1 and #2	divide by	length #1	=	Measurement comparison (less than 0.0008?)	
<u>0.00467 KM</u>	/	<u>10.000 KM</u>	=	<u>.000467</u>	<u>YES</u> () [yes or no]

IMPORTANT. Before you leave the course, compare the two measurements. They should agree to within 0.08%. If the two preliminary measurements do not agree to within 0.08%, something is wrong. Fix it! Then go to the calibration course and recalibrate.

If either of the Constants for the Day (for measurements #1 and #2) are not the same as the Working Constant, recalculate the length of the course here.

Final Course Length	start-to-finish counts	divide by	constant for day	=	length of course
Measurer #1	_____	/	_____	=	_____
Measurer #2	_____	/	_____	=	_____

NOT NEEDED SINCE WORKING CONSTANT = CONSTANT FOR DAY

The length of the race course as measured by the calibrated bicycle is the lesser of the two lengths calculated above.

Measured course length 9995.33 METERS Desired course length 10,000 METERS
 Use a steel tape to add or subtract distance as required to bring the minimum length to the same value as the desired course length. 4.67 METERS / .3048 m/FT = 15.32 FT
 How much did you add or subtract, and where (start, finish, turn-around point)?
ADDED 4.67 m (15.32 FT) BY MOVING TURNAROUND 7'8" TO NORTH

Note: You need not adjust intermediate split points unless certification is desired for those points as well. Did you adjust the intermediate points and, if so, how?
NO

Figure C-4. Race course measurement data sheet example.

APPLICATION FOR CERTIFICATION OF A ROAD COURSE
The Calibrated Bicycle Method.

1. Name this Course will be Known By ELYSIUM 10K
2. Advertised Race Distance 10 KILOMETERS Race Date 23 Nov 82
3. Location of Start ELYSIUM, OH Finish (if different) SAME
city, state city, state
4. Person in Charge of Measurement:
JOHN DOE, 123 ACCURATE RD, PERFECTION 614-123-4567
(name) (address) OH 43807 (telephone)
5. Race Director (if course is measured for a specific race):
M. OFFOT, 82 JALOUSIE LN, ALTIBOR, OH 614-555-6602
(name) (address) 44167 (telephone)
6. Is this an application for recertification of a previously certified course? If so give the reason(s) for recertification. NO

CALIBRATION OF BICYCLE

7. Did you calibrate the bicycle on a calibration course previously certified by the Road Running Technical Committee? NO (YES or NO)
If YES, enclose a copy of the letter or certificate, and map, verifying RRTC certification of the calibration course.
If NO, you must enclose an Application for Certification of Calibration Course. ENCLOSED
8. Is your bicycle calibration data sheet attached? YES (YES or NO)
9. Did you include the factor of 1.001 in your calibration constant? YES (YES or NO)

SUMMARY OF MEASUREMENTS

10. Date(s) of measurements 16 OCT 1982
11. How many measurements of the course were made? 2
12. Name(s) of measurer(s) JOHN DOE
13. Exact length of course 10.000 KM
14. Difference between longest and shortest measurements 4.67 METERS
15. Which measurement was used to establish the final race course and WHY?
2ND RIDE - YIELDED SHORTER MEASURED VALUE
16. Is your course measurement data sheet attached? YES (YES or NO)

COURSE LAYOUT AND MARKING

17. Is your course map attached? YES (YES or NO)

NOTE: The course map need not be to scale but must indicate direction of north. It must be in one color and fit on 8.5x11 paper. Descriptions of the exact positions on the start, finish, and all turn-arounds relative to permanent landmarks must be included on the map. Details of any restricted portions where cones and monitors are required must be detailed. Include a line representing the actual measured path.

18. List all intermediate splits (attach list describing the position of each relative to permanent landmarks). EVERY MILE PLUS 5 KM
19. How far from the curb (edge of pavement) did you measure on curves? 30 CM (1 FOOT)
20. If your course contains pairs of opposite turns (right-to-left or left-to-right) did you follow the shortest diagonal path? YES (YES or NO)
If NO, attach a detail of the measured path.

APPLICATION FOR CERTIFICATION OF A ROAD COURSE
The Calibrated Bicycle Method (continued)

21. Does your course contain any turn-around (double-back) points? YES (YES or NO) If YES, attach a detail of the measured path. SEE MAP.
22. Does your course include any winding or "S" curved sections? YES (YES or NO) If YES, show, by attached example, how you chose the route you measured. SEE MAP
23. Are the runners to be restricted to a route longer than the shortest possible route for any portion of the race course? NO (YES or NO) If YES, attach a description of how you plan to insure that the runners follow the measured course.
24. Type of course (check one):
 one loop _____ time(s) same out/back _____ time(s)
 figure-8 _____ time(s) several out/back sections
 partial loop keyhole (out/loop/back)
 complex of different loops point-to-point
25. Straight-Line Distance (as the crow flies) between Start and Finish 69 FT (21 METERS)
26. Altitude of Race Course (above mean sea level):
start 778 FT finish 778 highest 787 lowest 738
27. Total Climb (summation of all up-hill altitude changes) _____ (optional)
28. Type of surface (give percentages):
45 curbed streets graded dirt road
25 uncurbed streets/roads ungraded dirt road
 concrete sidewalk gravel road
 concrete/brick streets/roads undefined paved surface
30 paved bike path undefined dirt surface
 unpaved bike path undefined grass surface
 trail (single file) track (curbed or uncurbed)
- If your course includes any unpaved sections, please attach a detail of the method(s) used to measure such sections.
29. Is a description of the exact starting and finishing points (and any turn-around points, if any) attached? This description should include diagrams, including street names and taped distances from the start/finish points to near-by prominent landmarks, so that a stranger could find them. SEE MAP YES (YES or NO)
30. How did you mark the start and finish points (and turn-around points)?
PAINT, NAILS & WASHERS
31. Did the same person ride the bicycle on both the calibration course and the race course for any given measurement? YES (YES or NO)
32. Were both the calibration and the race courses DRY during the calibration and measurement rides: YES (YES or NO)
33. Did you perform both the pre-measurement and post-measurement calibrations and the measurement of the race course on the same day? YES (YES or NO)

Figure C-5. Race course certification application example.

APPENDIX C: Example of Course Measurement (continued)

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Course Maps

One of the most valuable results of your paperwork will be your course map. Not only should it demonstrate to the certifier the manner in which you measured your course, but it should document **exactly** how the course is laid out and where the crucial start, finish, and turn-around points are located. Once the course is certified, your map will be posted online at certifiedroadraces.com.

In order to have your submission and map approved you must follow the map requirements as shown in [Appendix I](#).

APPENDIX D: Adjusting an Existing Certified Course

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It is sometimes the case that a race director will want or need to make a small change to his existing certified course for various reasons, such as construction on part of the course or a desire for a different location of the start or finish line. If this change is relatively small, it is permissible to do a course adjustment rather than completely remeasure the course. Course Adjustments should be entered into the certifiedroadraces.com on-line certification program by sending the manual forms to the State Certifier for entry into the program.

Adjustments should preferably be made by the person who originally measured the course. However, if someone else is going to make the adjustment, they must be approved by the Regional Certifier. When doing a course adjustment there are two very different situations that have different measurement requirements:

- **Case 1:** When the race organization wishes to re-route part of the course but the previous path is still available to measure.
- **Case 2:** When the course must be re-routed because part of the previous path has been obliterated by construction or other events.

Case 1 is the simpler situation, as the measurer need only make arbitrary marks before and after the portion to be re-routed, then measure between those marks along both old and new paths (two measurements along each path), and then calculate the difference.

Case 2 is trickier because the adjustment requires having suitable previously measured “reference points” before and after the portion that’s being re-routed. By “reference points,” we mean intermediate points along the race course whose positions have been documented with the same care as required for a race course start or finish, and where the distances between successive reference points have been measured twice and are known to the same accuracy as required for a certified course length. Reference points aren’t necessarily split points, and in fact, ordinary split points often don’t satisfy the criteria to serve as reference points. This is where involvement of the original measurer is especially helpful, because only the original measurer will, in general, know if reference points are available. If no suitable reference points are available, the course must be remeasured completely.

If a portion of a certified course is modified without remeasuring the whole course, the course will **not** be given a new 10-year life. Instead, assuming adjustments are done properly, a new certificate will be issued containing the same expiration date as the original certification. There is no limit on the number of times a course may be adjusted, but adjustments made without remeasuring the whole course will not extend the course’s expiration date.

If it is desired to extend the course’s expiration date, then, after applying the adjustment procedure indicated above (including addition/subtraction of distance with intention of keeping the course length unchanged), the entire course must be remeasured at least once. Thus, all portions of the course not involved in the current modification must be given at

least one new measurement. This will result in a remeasured length for the full course, calculated the same way as for any normal certification measurement (including the SCPF in riding constants). If portions of the course have been remeasured only once, the remeasured length must be within 0.08% of the intended race distance, and if it comes out shorter than the intended length, distance must be added to the course to bring it to the intended length. If agreement isn't obtained within 0.08%, or if the measurer thinks the course should be shortened, then a second measurement is required, as for a new certification.

The rules on eligibility for USATF and World Athletics records make a distinction between courses with start-to-finish separation less than or greater than 50% of the race distance (such as 2.5 km for a 5 km race). If it appears that your course is close to this threshold, try to determine its separation more accurately. Your course can be certified either way; however, if the separation exceeds 50%, official records cannot be set on the course.

Altitude of the Race Course

The Application for Certification of a Road Course asks for four elevations: start, finish, highest and lowest. Of these, the start and finish elevations are most important. To find the high and low elevations, you'll need to trace over your course route, as shown on the map, and check elevations at many points along the course. Elevations of points on race courses can easily be obtained from Google Earth or other on-line mapping programs.

The drop of a course is defined as the difference between the start and finish elevations and cannot be more than 1 meter per kilometer for a course to be USATF record eligible. If the finish elevation is higher than the start elevation, the drop is shown as a negative value. Negative drops are always record eligible.

Type of Surface

The various classifications are, for the most part, self-explanatory. Enter the percentage of the course that is comprised of each type of surface. Note that if a significant percentage of the course is unpaved, then it will be necessary to do additional calibrations as described in the "[Measuring on dirt, grass, and sand](#)" sub-section of [Appendix A](#).

APPENDIX F: Metric-Imperial Conversions

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Courses may be measured in Imperial or English units such as miles, feet, and inches. Courses may also be measured in Metric units such as Kilometers and Meters. All distances must be shown as metric unless the course is an exact mile distance. For example, marathons must be 42.195 kilometers, half marathons must be 21.0975 kilometers, a 10 mile distance may be shown as 10 miles. Calibration courses may be in either metric or imperial units, e.g. 300 meters or 1000 feet are both acceptable calibration course lengths.

There are many on-line conversion programs that can be used to get exact conversions. If you are using an on-line conversion program be sure that the program does not round off the conversion or you may have a short course. The following are standard conversions.

The easiest such definition to remember is that of the inch:

$$\text{one inch} = \mathbf{2.54} \text{ centimeters } \textit{exactly}^*$$

*Throughout this appendix, all conversion values in **boldface** are *exact*.

From the above, one can derive the equivalents of other units of length, e.g.:

$$\begin{array}{lclclcl} \text{one foot} & = & 12 \times 2.54 \text{ cm} & = & \mathbf{30.48} \text{ cm} & = & \mathbf{0.3048} \text{ meters} \\ \text{one yard} & = & 3 \times 30.48 \text{ cm} & = & \mathbf{91.44} \text{ cm} & = & \mathbf{0.9144} \text{ meters} \\ \text{one mile} & = & 5280 \times 0.3048 \text{ m} & = & \mathbf{1609.344} \text{ m} & = & \mathbf{1.609344} \text{ km} \end{array}$$

Doing Conversions in the Working Constant

If both mile and kilometer distances must be marked when laying out a race course, the conversion is most easily done in the **working constant**:

- Determine the working constant in counts/km or counts/mile.
- Multiply** constant in counts/km by **1.609344** to obtain the constant in counts/mile, or:
- Divide** the constant in counts/mile by **1.609344** to obtain the constant in counts/km.

Conversion Table for Standard Distances

The following table shows how kilometer and mile distances are related but is not intended for routine measuring. It is much easier to do the conversion **once** in your measuring constant, as described above, than to do repeated conversions for each split. The table does show, for example, that 10 km is not exactly 6.2 miles. Courses measured to exactly 6.2 miles **will not** be certified as 10 kilometers!

$$\begin{array}{lcl} 1 \text{ km} & = & 0.62137119 \text{ miles} \\ 5 \text{ km} & = & 3.1068560 \text{ miles} \\ 8 \text{ km} & = & 4.9709695 \text{ miles} \end{array} \qquad \begin{array}{lcl} 1 \text{ mile} & = & \mathbf{1.609344} \text{ km} \\ 5 \text{ miles} & = & \mathbf{8.04672} \text{ km} \\ 10 \text{ miles} & = & \mathbf{16.09344} \text{ km} \end{array}$$

10 km =	6.2137119 miles	20 miles =	32.18688 km
12 km =	7.4564543 miles	30 miles =	48.28032 km
15 km =	9.3205679 miles	40 miles =	64.37376 km
20 km =	12.427424 miles	50 miles =	80.4672 km
25 km =	15.534280 miles	100 miles =	160.9344 km
30 km =	18.641136 miles		
50 km =	31.068560 miles		
60 km =	37.282272 miles		
100 km =	62.137119 miles		
150 km =	93.205679 miles		
200 km =	124.27424 miles		

half marathon = **21.0975** km = 13.10938 miles
marathon** = **42.195** km = 26.21876 miles

The marathon is **defined as **42.195 km** *exactly*.

Conversions for Steel Taping

1 foot	=	0.3048 meters
300 meters	=	984.25 feet
1 kilometer	=	3280.84 feet
degrees Celsius (°C)	=	[degrees Fahrenheit (°F) - 32] ÷ 1.8
1 pound-force	=	4.448 newtons

APPENDIX G: Application Forms & Online Application System

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The RRTC has developed an online, web browser based system for submitting USATF race course certification applications. This online system is available at certifiedroadraces.com and it should be used whenever possible. The on-line certification system will help you expedite your submission through the system. Using this new online system is fairly straight-forward, however, it would probably be a good idea to watch some instructional videos beforehand to make the process go more smoothly. See [Appendix J](#) for a list of instructional videos for the new online submission system.

While this new online submission system can handle most of the courses you have measured, there are several situations regarding the methods you may have used to measure the course that it cannot handle. Before you attempt to submit your course through the online system you should check the lists below to determine if your course measurement is eligible or not for online submission. Note that the online submission system continues to be developed and enhanced. The lists below describe its capabilities as of the publication date of this document (January of 2022).

Below is a list of the type of course measurements that CAN currently be handled by the new online submission system:

- Road course that was measured by one rider in continuous rides from start to finish and/or finish to start
 - Single set (pre and post) of calibration rides was used
 - Maximum value of the pre-calibration and post calibration constants was used
- Road course that was measured by two riders in continuous rides from start to finish and/or finish to start
 - Each rider used a single set (pre and post) of calibration rides
 - Each rider used the maximum value of their pre-calibration and post-calibration constants
- Calibration course that was measured in multiple complete tape lengths (except for the last tape length, which can be a partial tape length)

Below is a list of the type of course measurements that CANNOT currently be handled by the new online submission system. If your course measurement falls into one of these categories you should not attempt to use the online system. Instead you should complete the PDF version of the application and email that, along with your measurement data and your map, to your state certifier.

- Road course that was measured in segments, rather than in continuous rides from start to finish or finish to start.
- Pure out and back road course that was measured by making a single ride “out” and a single ride “back.”

- Road course that was measured by one rider using multiple calibrations (for example, when the two rides were on different days)
- Any road course measurement that used the average, rather the maximum, of the pre and post calibrations
- Adjustments of an existing certified course
- Single ride certification of an expired course
- Road course with certified splits
- Course submissions made to change the name or make corrections to an existing certified course
- Calibration course that was measured in multiple partial tape lengths

If you determine, based on the description above, that your course measurement cannot be handled by the online certification portal, then you should complete the PDF version of the application and email it and your course map to your state certifier. The PDF version of the application forms needed for USATF course certification are provided in a single file named “appforms.pdf” which you can download in Adobe PDF format. The forms contained in this file are as follows:

- Steel Taping Data Sheet
- Application for Certification of Calibration Course
- Bicycle Calibration Data Sheet
- Course Measurement Data Sheet
- Application for Certification of a Road Course

[Download appforms.pdf file](#)

Note: You'll probably have to include a **processing fee** when sending the completed application forms to your regional certifier. The exact amounts of these fees vary from state to state. Therefore, check with your certifier **before** sending the application forms.

[View current list of USATF/RRTC certifiers](#)

APPENDIX H: Summary of Recent RRTC Rule Decisions

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Over the past several years the RRTC has modified or added to its rules for the certification process. While some of these changes have been reflected in changes to the Procedures Manual, several have not. The purpose of this appendix is to document all rule modifications agreed to by the RRTC over the past several years that are not yet included in the main body of the Procedures Manual. For a complete history of RRTC rule changes dating back to 1996 check the [RRTC website](#).

Temperature corrections of steel tape measurements of calibration courses (Dec. 2021)

Temperature correction for steel tape measurements of calibration courses is always required, even when it results in the course being longer (i.e., temperature > 68F). Previously it was optional for the measurer to do a temperature correction if the temperature was greater than 68F.

Temporary calibration course use (Dec. 2018)

A temporary calibration course may be used as part of a race course application submission if it is measured the same day as the race course, and measurement data for it is also submitted. If the calibration course is not submitted and approved for certification, it may not be used for future race course measurements.

Inclusion of intermediate marks (miles or kilometers) on certification maps (Dec. 2018)

It is strongly recommended that intermediate points along the course, mile or kilometer marks, be included and their locations described on certification maps.

One measurement for renewals (Dec. 2016)

For a certified course that has expired and has never been changed/adjusted, a single measurement that results in a measured distance within 0.08% of the original measured distance is sufficient to re-certify the course with a new 10-year life. This can be done repeatedly as long as the course is never changed/adjusted. If the re-measurement is short (but within the 0.08%) it should be lengthened to the correct distance. For a course that has been adjusted since it's original measurement, once it's 10-year life has expired it must be measured twice for re-certification.

Certified splits (Dec. 2016)

If the certified distance(s) is(are) from the start to the intermediate split, then they can go on the same map (intermediate point to intermediate point, or intermediate point to finish) must go on a separate map/certification.

Calibration course location should go on the map (Dec. 2016)

It is highly recommended that a street address, cross roads, or GPS coordinates be included on a calibration course map so that it can be easily located by measurers.

GPS coordinates not to be used to define length of course (Dec. 2016)

Should not be used as the only description of a point that defines the length of a course. That includes start, finish, turn-around, and any point that defines a turn on the course. The only exception to this is in high-profile races where GPS coordinates and a nail in the road are used to define a certified split. In this case the approximate location of the nail must be described, and the nail must be located in the road..

Calibration only measurer not listed on USATF website (Dec. 2015)

A person who has measured only calibration courses will no longer be listed on the USATF website as a measurer.

Calibration course steel taping measurement tolerance (Dec. 2013)

The two steel tape measurements of a calibration course must be within 0.01% of each other. If they are not, additional measurements must be made until there are two measurements that are within 0.01% of each other, and the length of the course should be established by averaging those two measurements.

De-listing a measurer from the USATF site (Dec. 2013)

A policy was established for the situation where a Certifier feels a measurer should be removed from USATF/RRTC site. It's posted on the USATF web site at:
<http://www.usatf.org/Products--Services/Course-Certifications/USATF-Certified-Courses/Additional-Tools/Listed-Measurer-Standards.aspx>

Courses must be certified to actual measured distance (Jul. 2013)

All courses must be certified at the actual measured distance. For example, it is not permissible to certify a course as 5km if the actual measurement of the course is, say, 5007 meters. In that case the distance of the course must be listed on the certificate as 5007 meters. The actual distance of the course must also appear somewhere on the map. This can be in the name of the race at the top of the map if the actual measured distance of the course is the distance stated in the race name.

Calibration ride tolerance (Dec. 2012)

Calibration rides in the same direction can be no more than 1 count per 100m of cal course length different. For example, on a 300m calibration course, two rides in the same direction can't be more than 3 counts different. If the calibration rides are not within this tolerance, the measurer must continue to make rides until he/she has at least 2 rides in each direction that are within this tolerance. In this case, the rides that are not within this tolerance should be dropped when calculating the calibration constant.

Unusable courses (2012)

When a new course for a race is measured and submitted for certification, the certifier should ask the measurer if the old course used by the race is still "usable." If it's unusable then a statement should be made as to why this is the case. Next, the certifier should notify the registrar that the status of that course should be changed.

APPENDIX I: RRTC Course Map Requirements and Examples

[\(Go to ToC\)](#)

An RRTC course certificate consists of a course measurement and course map. The course map is used to show runners, race directors, race staff and others the exact course as it was measured and includes details on the start, finish, critical turns and restrictions. The map does not need to be drawn to scale or include every single cross-street or landmark. Some maps enlarge sections where more detail is needed to show how the course is to be run, and shrink sections where less detail is needed.

A course map consists of a **primary map page** and an optional set of **supplemental map pages**. The primary map (required) is a single page. It is used to show an overview of the entire course and includes the system generated USATF Certified Course map stamp. The supplemental map file (optional) may contain multiple pages that may include additional detail maps, mile or kilometer descriptions, route and other notes required to set up the course.

The primary map page may be a JPG, PNG or PDF file format and is limited to a maximum file size of 7 megabytes (7 MB.) The supplemental map pages are a PDF file and are also limited to a maximum file size of 7 megabytes (7 MB.)

The primary map and supplemental map pages should be printable on a standard 8.5" x 11" paper. They should have a file resolution of 300 dots per inch (300 dpi) or greater. Margins on all four sides should be $\frac{3}{8}$ ". A PDF should be 2550 x 3300 pixels. Additional white space must be provided on the primary map to accommodate the USATF Certified Course map stamp.

Additional map requirements:

1. The full course map must appear on the primary map page. If additional pages are required it must be stated on the primary map page. (E.g. *See additional pages for details.*)
2. Digital or hand drawn maps must be neat and representative of the actual course streets and paths. Maps shall be created so they are clear when printed or reproduced.
3. The measurer's name, contact email and/or phone number shall be listed on the primary map page.

4. A *Compass rose* or *North designation* is required for map drawings.
5. A text description of the start, finish, turnarounds or any other critical points that define the course distance is required.
6. Drawings of the start, finish, and turnarounds must be shown with reference to permanent structures and, if space allows, should be displayed on the primary map page. If space is not available on the primary map page, details must be noted on the primary map page and must be shown in the supplemental map page(s).
7. All roads of the running route and those listed in the descriptions shall be shown and labeled on the map. Intersecting roads that are not part of the running route may be included but are not required to be shown unless they are referenced in the mile or kilometer split descriptions.
8. Sidewalks and paths must be labeled.
9. Non-paved surfaces shall be labeled with the surface type.
10. The course name on the primary map shall be the same as the course name on the certificate.
11. The course city and state for the start and finish must appear on the primary map page. The course start city and state is required if different from the finish.
12. The following statement must appear on the map unless otherwise noted:
“This course was measured using the full width of the road and the Shortest Possible Route (SPR).”
13. Course Restrictions must be indicated on the primary map, e.g., *one lane only or must stay on the shoulder or cross over in crosswalk*. If there is not enough space on the primary map page, this information must be noted on the primary map page and detailed in the supplemental map page(s).
14. The map must include any special notes that impact how the course is set up, e.g., where cones and/or delineators must be placed. If there is not enough

space on the primary map page, this information must be noted on the primary map page and detailed in the supplemental map page(s).

15. Course Distance.

- a. Distances are stated in kilometers unless the certified distance is in whole miles or is a very specific mile distance (e.g., 10 miles, 3.5 miles).
- b. The certified distance must be shown on the primary map and must match the course distance on the certificate.
- c. If the certified distance exceeds the advertised distance, the certified distance must be shown on the certificate and primary map.

16. A calibration course distance may be listed in either meters and/or feet. The calibration course distance must be listed on the primary map and must match the certified distance on the certificate.

17. To avoid ambiguity and for consistency, dates must be listed using the Mth d, yyyy or Month d, yyyy format, using an alpha month and 4-digit year, e.g., Mar 4, 2019, March 4, 2019.

18. A course entirely on a track shall include the following statement on the primary map. *“This is not a certification of the track itself.”*

The following are required unless an acceptable reason is given. Reviewers have the discretion to accept maps and data based on the information provided by the measurer.

19. Whenever possible, the start, finish, and turnarounds should be defined by at least two permanent mark locations. In the example in Figure I-1 below, the red arrow shows the runners path. A single location may be used if the mark is at an exact distinct permanent location. (E.g. monument, building foundation.)

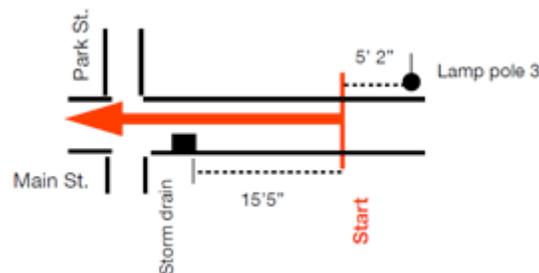


Figure I-1. Race course start defined by the distance to two permanent landmarks.

20. All intersections that are turns on the course should be detailed in full, e.g., four way, three way or T intersection. The map only needs to show that a street continues past the turn. The example in Figure I-2 below, the red arrow illustrates the runners path through a four way intersection.

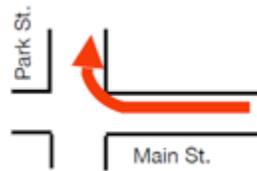


Figure I-2. Course path shown through a fully defined intersection.

21. The running direction should be shown on the map unless the course was designed to be run in either direction and includes mile or kilometer marks for both running directions.
22. *Mile or kilometer mark* descriptions should be included on the primary map page or supporting map pages. Other splits should be shown if they assist in the measurement or course set up and are especially important if all of the mile or km marks cannot be provided. GPS coordinates may be listed as a secondary location. GPS coordinates should not be used as the only description unless permanent marks cannot be found. Mile or kilometer mark descriptions should be included on the primary map page. If there is insufficient space on the primary map page they should be added to the supporting map page(s).
23. Adjusted courses should list the relevant previous certificate number on the primary map page. This is in addition to the new certificate number that will appear when the certifier adds the USATF Certified Course map stamp.

Recommendations

24. A text description of the course route is optional, if the route is clearly defined by the map. On complex maps or maps covering large areas, the course route text description is recommended.

25. Digitally drawn maps are preferred.

26. The following naming convention is suggested in order to avoid identical course names for events with multiple courses:

- Add the year of the race to the course name to distinguish between active courses with the same name. E.g., The Big Marathon - 2020, The Big Marathon - 2019
- Add the name of the option to a course name with multiple start, finish or intermediate route options. E.g., The Big Marathon Main St Start, The Big Marathon Flood Route
- Add the race distance to the race name for multiple races with the same event name. E.g., The Big Marathon, The Big Half Marathon, and The Big 5K.

Examples of Maps

Figures I-3 through I-7 show examples of maps that meet the map requirements. They also show different styles and have been created with different mapping tools.

2021 FCA 5K Chattanooga, TN

Measured by Matthew Studholme
August 29, 2021
sheddingcat@comcast.net
(276) 206-7202

This course was measured using the full width of the road / TN Riverwalk and the shortest possible route (SPR), except on Amnicola Hwy (emergency lane only).



USATF Certificate
TN21056MS
Effective: 09/05/2021
Through: 12/31/2031

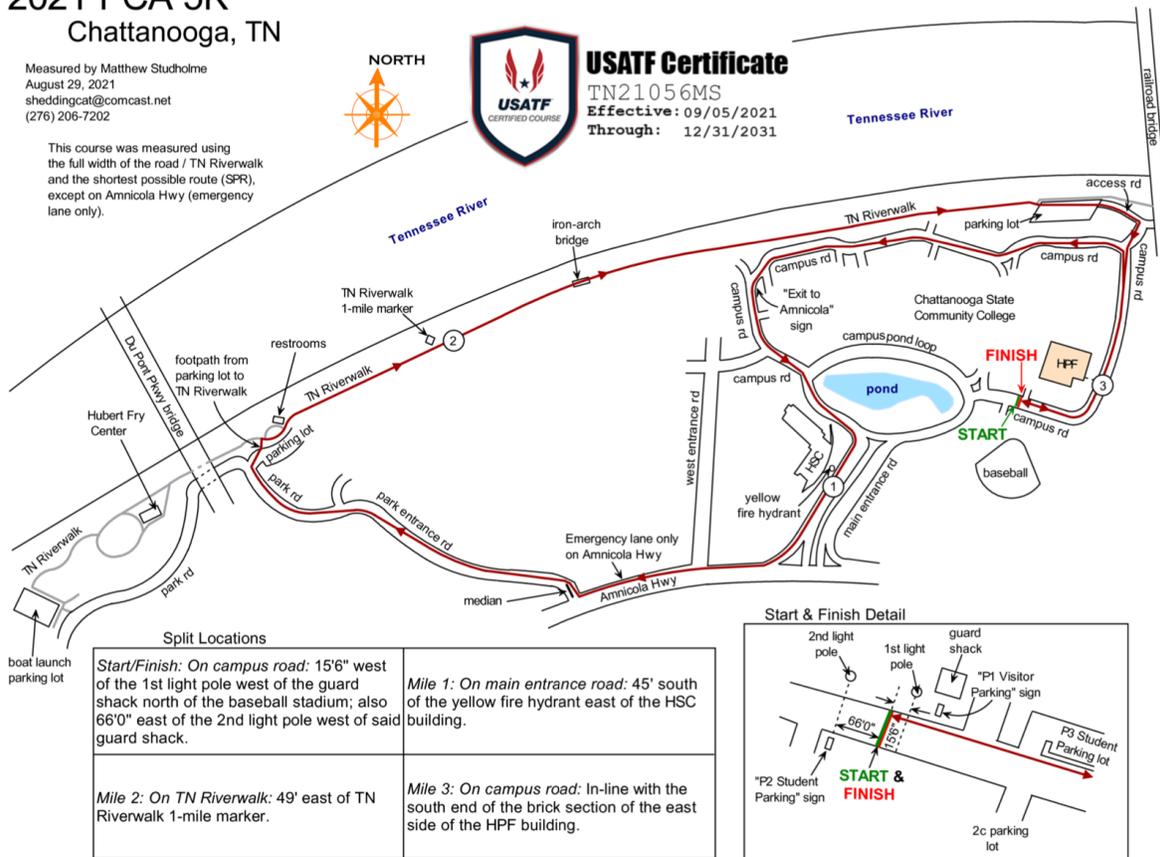
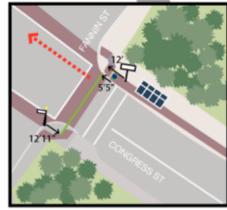
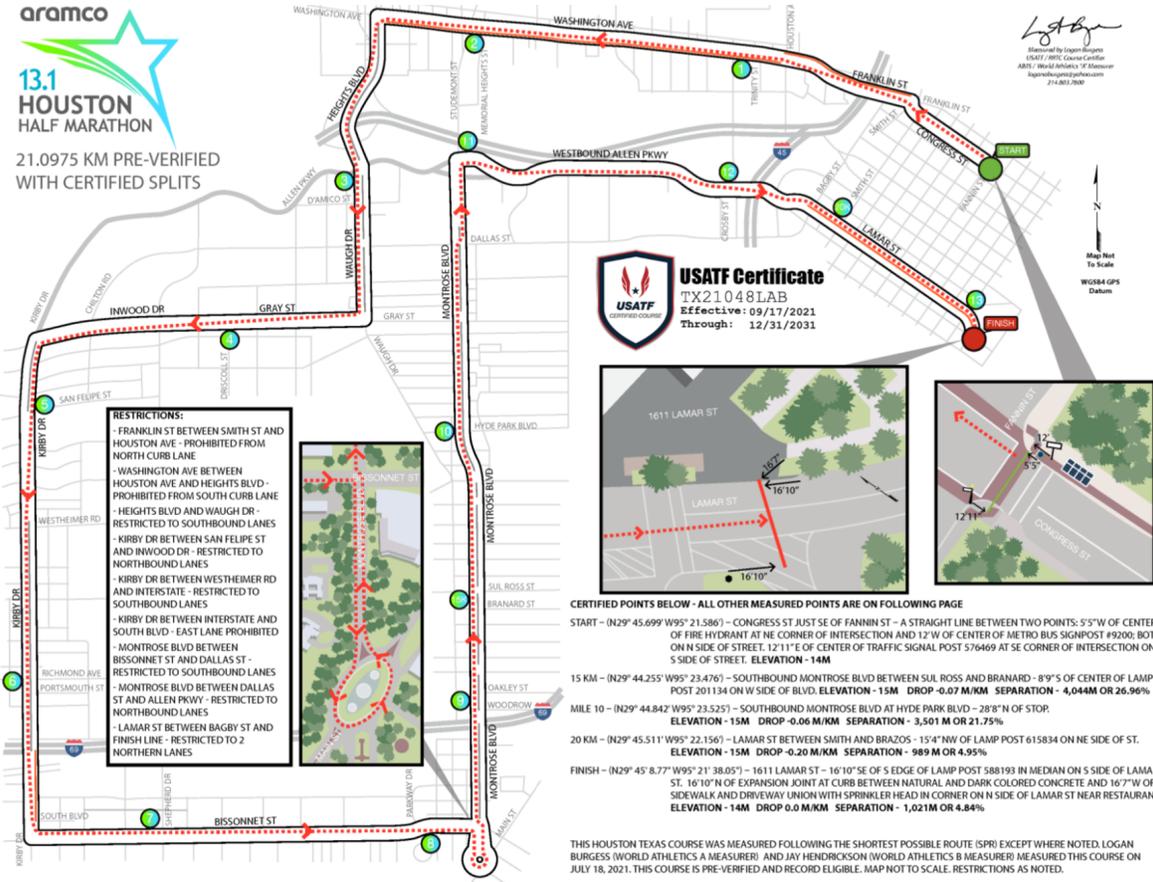


Figure I-3. This map is an example of a mostly black and white digital line drawn map using SmartDraw for PCs. Color is not required but is useful to add clarity to the route. This map shows the SPR on the curves, and provides two distinct reference points for the Start/Finish so that if one is lost over time the course can still be used.



21.0975 KM PRE-VERIFIED WITH CERTIFIED SPLITS



CERTIFIED POINTS BELOW - ALL OTHER MEASURED POINTS ARE ON FOLLOWING PAGE

START - (N29° 45.699' W95° 21.586') - CONGRESS ST JUST SE OF FANNIN ST - A STRAIGHT LINE BETWEEN TWO POINTS: 5'5" W OF CENTER OF FIRE HYDRANT AT NE CORNER OF INTERSECTION AND 12' W OF CENTER OF METRO BUS SIGNPOST #9200; BOTH ON N SIDE OF STREET. 12'11" E OF CENTER OF TRAFFIC SIGNAL POST 576469 AT SE CORNER OF INTERSECTION ON S SIDE OF STREET. ELEVATION - 14M

MILE 10 - (N29° 44.842' W95° 23.525') - SOUTHBOUND MONTROSE BLVD AT HYDE PARK BLVD - 28'8" N OF STOP. ELEVATION - 15M DROP - 0.06 M/KM SEPARATION - 3,501 M OR 21.75%

20 KM - (N29° 45.511' W95° 22.156') - LAMAR ST BETWEEN SMITH AND BRAZOS - 15'4" NW OF LAMP POST 615834 ON NE SIDE OF ST. ELEVATION - 15M DROP - 0.20 M/KM SEPARATION - 989 M OR 4.95%

FINISH - (N29° 45' 8.77" W95° 21' 38.05") - 1611 LAMAR ST - 16'10" SE OF S EDGE OF LAMP POST 588193 IN MEDIAN ON S SIDE OF LAMAR ST. 16'10" N OF EXPANSION JOINT AT CURB BETWEEN NATURAL AND DARK COLORED CONCRETE AND 167" W OF SIDEWALK AND DRIVEWAY UNION WITH SPRINKLER HEAD IN CORNER ON N SIDE OF LAMAR ST NEAR RESTAURANT. ELEVATION - 14M DROP 0.0 M/KM SEPARATION - 1,021M OR 4.84%

THIS HOUSTON TEXAS COURSE WAS MEASURED FOLLOWING THE SHORTEST POSSIBLE ROUTE (SPR) EXCEPT WHERE NOTED. LOGAN BURGESS (WORLD ATHLETICS A MEASURER) AND JAY HENDRICKSON (WORLD ATHLETICS B MEASURER) MEASURED THIS COURSE ON JULY 18, 2021. THIS COURSE IS PRE-VERIFIED AND RECORD ELIGIBLE. MAP NOT TO SCALE. RESTRICTIONS AS NOTED.



21.0975 KM PRE-VERIFIED WITH CERTIFIED SPLITS



- Start – (N29° 45.699' W95° 21.586') – Congress St just SE of Fannin St – A straight line between two points: 5'5" W of center of fire hydrant at NE corner of intersection and 12' W of center of Metro Bus signpost #9200; both on N side of street. 12'11" E of center of traffic signal post 576469 at SE corner of intersection on S side of street.
- 1 KM – (N29° 45.959' W95° 22.119') – Franklin St just E of Artesian Rd – 2' W of lamp post 201686 on S side of St
- Mile 1 – (N29° 46.049' W95° 22.478') – Washington Ave at Colorado St – 3' W of STOP sign at SE corner of intersection
- 2 KM – (N29° 46.073' W95° 22.721') – Washington Ave just W of White St – 62' W of METRO Bus Stop 477 signpost on S side of Ave
- 3 KM – (N29° 46.124' W95° 23.339') – 2911 Washington Ave – 22' E of E edge of gate to cemetery
- Mile 2 – (N29° 46.132' W95° 23.474') – Washington Ave at Memorial Heights Dr – 21' W of NO PARKING HERE TO CORNER SIGN immediately W of intersection
- 4 KM – (N29° 46.061' W95° 23.834') – Waugh Dr just S of Raymond St – 112' S of STOP sign at SW corner of intersection
- Mile 3 – (N29° 45.638' W95° 23.896') – 510 Waugh Dr – even with S edge of northernmost vehicle entry to retail center at address
- 5 KM – (N29° 45.545' W95° 23.894') – Waugh Dr just S of Damico St – 32' S of lamp post 20587_ on W side of Dr
- 6 KM – (N29° 45.193' W95° 24.116') – W Gray St just E of Dunlavy St – 4' W of lamp post 205982 on N side of St
- Mile 4 – (N29° 45.185' W95° 24.386') – W Gray St at 1400 Driscoll St – 20' W of STOP at SE corner of intersection
- 7 KM – (N29° 45.171' W95° 24.735') – 2136 Inwood Dr – 6" W of address marker at E edge of driveway
- 8 KM – (N29° 44.904' W95° 25.125') – Kirby Dr at San Felipe St – even with yellow center stripe of San Felipe on E side of Kirby Dr
- Mile 5 – (N29° 44.880' W95° 25.130') – Kirby Dr at San Felipe St – 88' S of Metro Bus Stop 5572 signpost on E side of Dr
- 9 KM – (N29° 44.361' W95° 25.128') – Southbound Kirby Dr at Steel St – 21' S of lamp post 660047 on W side of Dr
- Mile 6 – (N29° 44.007' W95° 25.119') – Southbound Kirby Dr at retail exit directly W of Portsmouth St – 13' N of N edge of retail building and at N edge of storm sewer cap
- 10KM – (N29° 43.815' W95° 25.120') – Southbound Kirby Dr under Southwest Freeway – 10' N of S edge of concrete median edge, marked on median
- 11 KM – (N29° 43.535' W95° 24.815') – 2322 Bissonnet St – 1' W of lamp post 446667 on N side of St
- Mile 7 – (N29° 43.537' W95° 24.651') – 2206 Bissonnet St – 4' E of E edge of house at address
- 12 KM – (N29° 43.544' W95° 24.196') – 1728 Bissonnet St – even with E edge of front door of house at address
- Mile 8 – (N29° 43.564' W95° 23.661') – 1205 Bissonnet St – 18' E of NO PARKING sign at W edge of property
- 13 KM – (N29° 43.568' W95° 23.575') – Bissonnet St just W of Yoakum Blvd – 2' W of Metro Bus Stop 3656 signpost
- 14 KM – (N29° 43.714' W95° 23.468') – Southbound Montrose Blvd at Barkdull St – 18' N of STOP sign at SW corner of intersection
- Mile 9 – (N29° 43' 58.59" W95° 23' 28.24") – 4444 Montrose Blvd – 43' N of center of fire hydrant 3735379 on W side of road
- 15 KM – (N29° 44.255' W95° 23.476') – Southbound Montrose Blvd between Sul Ross St and Branard St – 8'9" S of center of lamp post 201134 on W side of Blvd. **SPLIT IS VERIFIED.**
- 16 KM – (N29° 44.792' W95° 23.520') – Southbound Montrose Blvd at Missouri St – 104' N of STOP sign at SW corner of intersection
- Mile 10 – (N29° 44.842' W95° 23.525') – Southbound Montrose Blvd at Hyde Park Blvd – 28'8" N of STOP sign at SW corner of intersection. **SPLIT IS VERIFIED**
- 17 KM – (N29° 45.334' W95° 23.535') – Southbound Montrose Blvd at W Clay St – 44' N of STOP sign in SW corner of intersection
- Mile 11 – (N29° 45.705' W95° 23.525') – Ramp between Montrose Blvd and Westbound Allen Pkwy – 54' E of crosswalk lamp post at NE corner of intersection
- 18 KM – (N29° 45.654' W95° 23.353') – Westbound Allen Pkwy just E of Montrose Blvd / Studemont St exit ramp – 56' E of "Thru Traffic Merge Left" sign post
- 19 KM – (N29° 45.657' W95° 22.737') – Westbound Allen Pkwy – 26' E of lamp post H100071 in median
- Mile 12 – (N29° 45.611' W95° 22.554') – Westbound Allen Pkwy – 209' E of W end of median nose at onramp from Sabine St
- 20 KM – (N29° 45.511' W95° 22.156') – Lamar St between Smith St and Brazos St - 15'4" NW of lamp post 615834 on NE side of St. **SPLIT IS VERIFIED.**
- Mile 13 – (N29° 45.224' W95° 21.686') – 1440 Lamar St – 10' S of center of double doors at address
- Finish – (N29° 45' 8.77" W95° 21' 38.05") – 1611 Lamar St – 16'10" SE of S edge of lamp post 588193 in median on S side of Lamar St. 16'10" N of expansion joint at curb between natural and dark colored concrete and 16'7" W of sidewalk and driveway union with sprinkler head in corner on N side of Lamar St near restaurant.

Figure I-4. This map was made using Adobe Illustrator. It shows a pre-verified course with certified intermediate splits. Color details are added for clarity. GPS is used as a secondary reference for the splits. The primary references are based on permanent marks.



Union Home Mortgage
Cleveland Marathon
10K

Measured by Jane H. Parks, World Athletics Grade A Measurer
 973-349-0033 janehp3@gmail.com
 and Terri Speck September 11, 2021



USATF Certificate
 OH21005JHP
 Effective: 09/28/2021
 Through: 12/31/2031

Route

- Start on W Superior
- Right turn onto West 9th Street
- Right turn onto West Saint Clair Avenue
- Left turn onto West 3rd Street
- Right turn onto Alfred Lerner Way/Erieside Ave.
- Right our onto East 9th Street
- Left turn onto Lakeside Avenue East
- Right turn onto East 13th Street
- Right turn onto Saint Clair Avenue
- Left turn onto West 9th Street
- Right turn onto Detroit Avenue
- U turn between W 50th and W51st Sts
- Right turn onto West 45th St.
- Left turn onto Franklin Boulevard
- At roundabout, left West 28th St against traffic
- Right turn onto Detroit Avenue
- Finish on W Superior



All marks are given relative to the running direction. This course was measured using the shortest possible route using the full width of the roads with the following exception. Runners will run in the direction of traffic on Detroit Avenue. At the turnaround runners will move from the westbound lanes to the eastbound lanes. All GPS and mile marks are approximate.

Start/Finish: On West Superior Ave., 11 feet 8 inches west of the center of the Stop Light Pole and 2 feet 6 inches west of the Superior Ave. Warehouse District sign. Both are on the northwest corner of the intersection with West 3rd. St.

Mile 1: On Alfred Lerner Way, 3 feet 4 inches before the fire hydrant on the right and 76 feet 8 inches before the Stop Sign on the right at the east end of First Energy Stadium.

Mile 2: On Saint Clair east of E 9th St., 4 feet 5 inches west of lamp post B124 24 25 on the right.

Mile 3: On Detroit Ave. Bridge, 56 feet after lamp post 1 vm 5 on the right.

Mile 4: On Detroit Ave in line with the fire hydrant on the northwest corner of the intersection with 45th St.

Turnaround: On Detroit Ave. between West 52nd and W50th, 10 feet 3 inches before (east of) telephone pole 398103. The turnaround point is in the middle of the double yellow lines. (41 29 48N 81 41 59 W)

Mile 5: On Franklin in the center of the driveway to #2905 on the right and at the leading edge of the door to the unnumbered Gray house on the left.

Mile 6: On Detroit Ave at the eastern end of the bridge between the 6th and 7th metal fence posts on the right side of the bridge starting from the easternmost fence post on the bridge.

Figure I-5. This map uses a base map from the event or a screenshot from Google Maps can be used as a base map. Microsoft Word or Apple Pages can be used to add the details, route, and mile marks on a single page before converting to a PDF. The Start/Finish lists two distinct permanent reference points. The primary reference point for the turnaround is an exact measurement from a permanent structure. The turnaround has a GPS point for the secondary reference point.

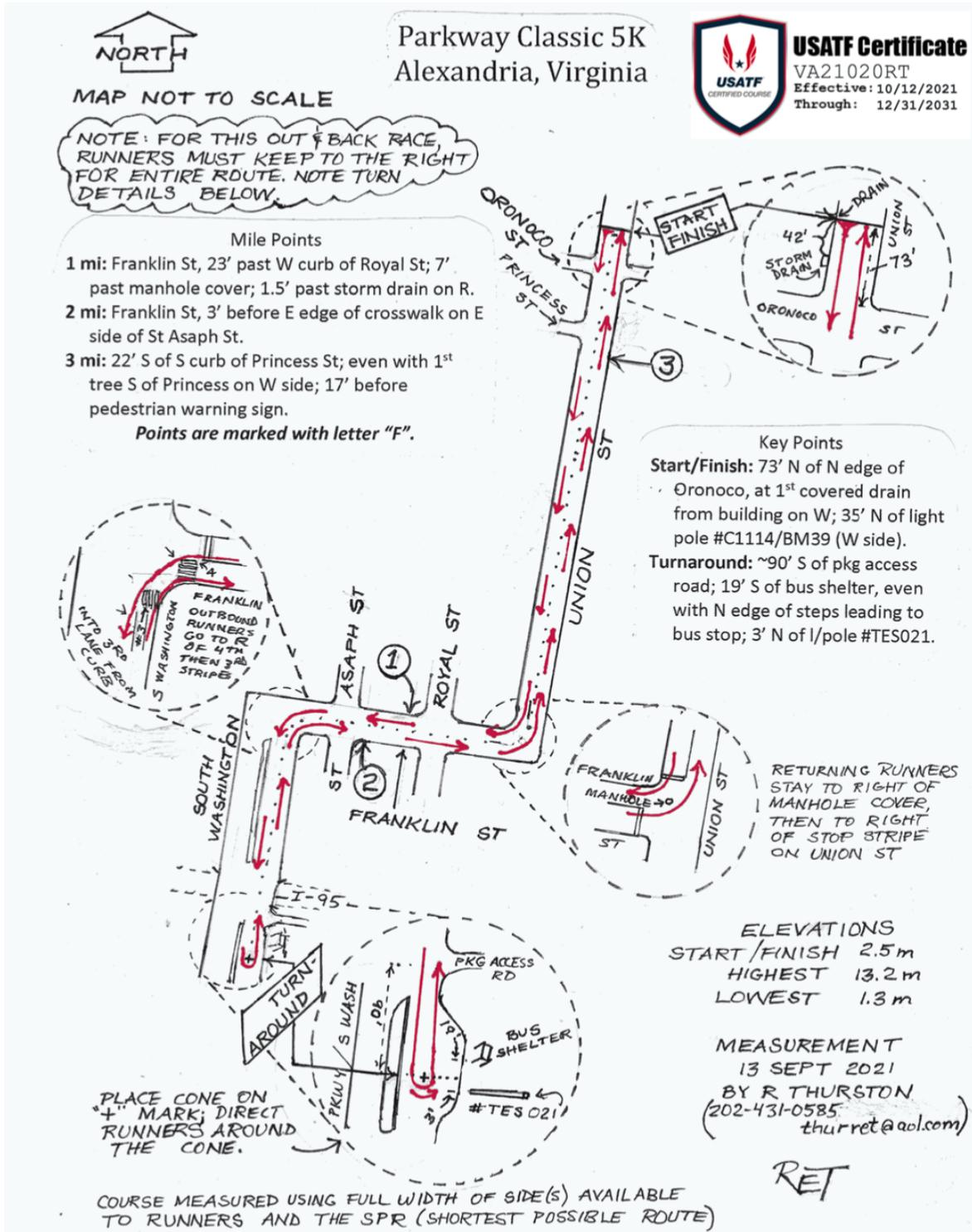


Figure I-6. This is an example of a hand-drawn map with typed descriptions. It shows details and restrictions as needed. The map is clear and easy to read.

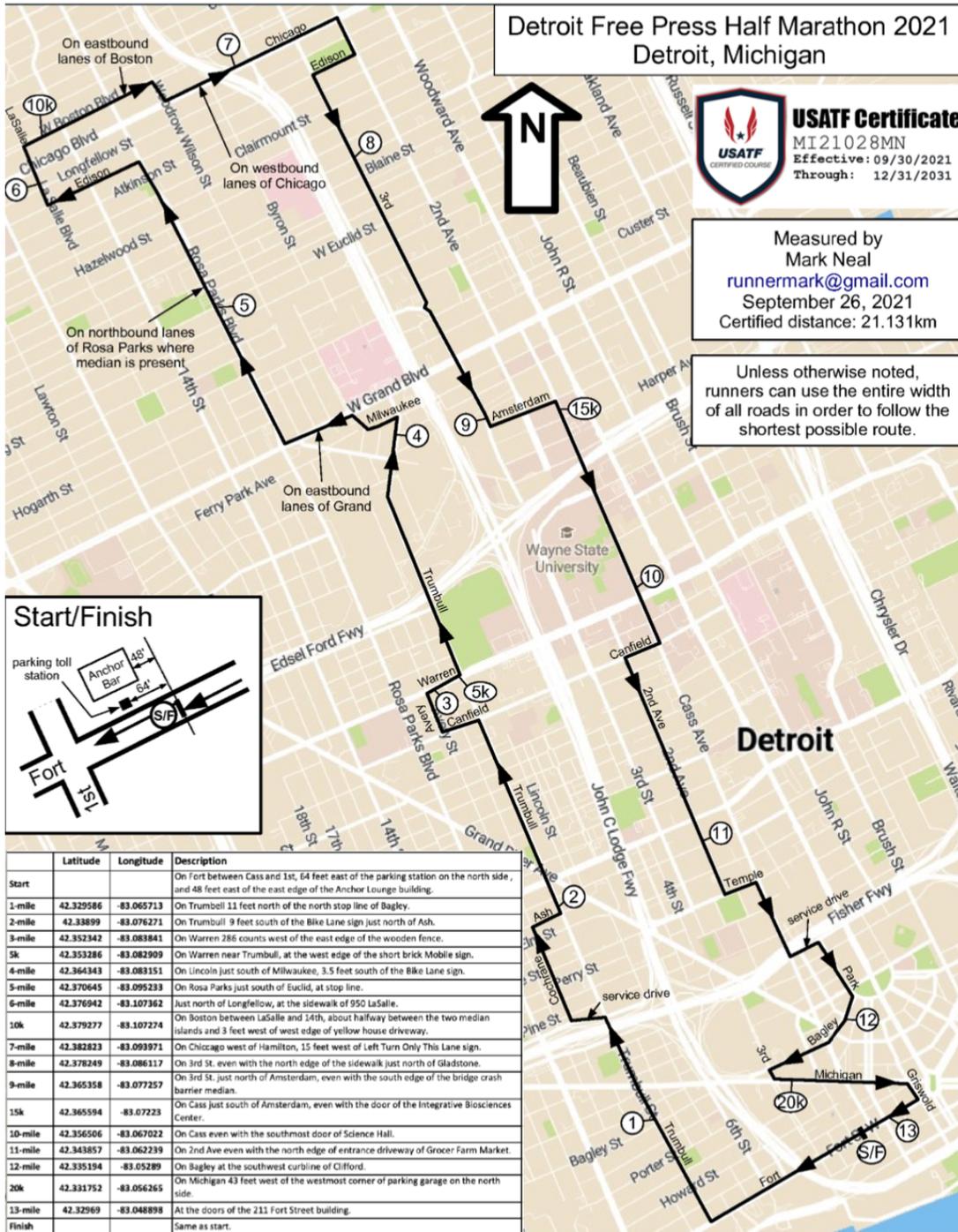


Figure I-7. This map uses a screenshot from a mapping program as the background street map. The software package OpenOffice Draw was then used to draw the race course route, street names, mile mark locations, etc. Note that since the course path within the widths of the streets is not shown, a note is included that the full width of the roads may be used except where indicated otherwise. Then, several callouts on the map show where the runners are restricted to one side of the road.

APPENDIX J: Useful Links and References

[\(Go to ToC\)](#)

Information for Course Measurers

- [Search for Certified Courses and Maps](#)
- [Course Certification Application Forms](#)
- [The RRTC Regional Certifiers](#)
- [RRTC Course Measurement Bulletin Board](#)
 - [Bulletin Board List of Interesting Topics](#)
- [The McBrayer Course Measurement Video](#) (on YouTube)
- **Tools for Course Measurers (Equipment, Mapping, etc.)**
 - [OpenOffice Draw Basics Tutorial](#) by Mark Neal (YouTube video)
 - [OpenOffice Simple Map Drawing Tutorial](#) by Mark Neal (YouTube video)
 - [OpenOffice Map Drawing Tutorial](#) by Nathan Porch (YouTube video)
 - [The "Jones Counter model JR"](#)
 - [Cook Jones counter](#)
 - **Jones Lucas counter** - contact Kevin Lucas(lucasmeasurement@gmail.com) for more information
 - [Certifier's Drop & Separation Calculator](#)
- **Online Course Certification Submission System**
 - [Link to Online Course Certification System](#)
 - [Introduction](#)
 - [Introductory video](#)
 - [Instructional videos](#)
 - [Online Course Certification Learning Site](#)
 - [FAQ](#)
 - [Online Certification System Discussion on Measurement Forum](#)

RRTC Rules/Policies/Guidance

- [Certified Course Expiration/Renewal Policy](#)
- [USATF/RRTC Position on GPS used by runners](#)
- [Policy on Changing Name of a Certified Course](#)
- [Policies on Pre-race & Post-race Verification Measurements](#)
- [Effective Date of Course Certification](#)
- [Standards for Listing Measurers on Website](#)
- [Policies on Pre-race & Post-race Verification Measurements](#)
- [Policy on Adjustments to Certified Courses](#)
- [Policy on Certification Numbering of an Adjusted Course](#)
- [USATF Rules and Regulations Relevant to the RRTC](#)
- [Rulebooks](#)
- [USATF Insurance Policy as it applies to a measurer](#)
- [Complete listing of recent rule changes](#)

About the Road Running Technical Council

- [What RRTC Does](#) (Scope & Activities)
- [The RRTC Officers](#)
- [The RRTC Regional Certifiers](#)
- [Final Signatory Measurers](#)
- [World Athletics Measurers](#)
- **Roles of RRTC Officers**
 - [RRTC Chair](#)
 - [Vice Chairs](#)
 - [Course Certifiers](#)
 - [Course Registrar](#)
 - [Validation Chair](#)
 - [Education & Training Chair](#)
 - [Members at Large](#)
- [The RRTC Ted Corbitt Award](#)
- **RRTC Annual Meeting Minutes**
 - [2020](#)
 - [2019](#)
 - [2018](#)
 - [2017](#)
 - [Older](#)

Historical Course Measurement Information

- [Archive of Historical Documents collected by Pete Riegel](#)
- [Historical Certified Course Lists](#)
- [Foreign Course list](#)

Measurement Seminar Material

- [Measurement Seminar 2014 ed2.pdf](#)

See the rrtc.net website for a more updated and complete list of links.