ROAD COURSE MEASUREMENT

INTERNATIONAL SEMINAR

Columbus, Ohio – 1990

The TAC/IAAF International Measurement Seminar was held on June 16-17, 1990. People came from many places to participate. Left to right, standing in street: John Disley (Great Britain), Sally Nicoll, Tom McBrayer, Joan Riegel, Bernie Conway (Canada), Bob Baumel, Tom Knight, Amy Morss (holding Hannah Morss-Fish), Pete Riegel. Standing on curb, left to right: Scott Hubbard, Mike Wickiser, George Tillson, Jay Wight, Bob Thurston, Doug Loeffler, Wayne Nicoll, David Fish.

REPORT OF PROCEEDINGS

National Governing Body for Athletics in the United States

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July 12, 1990

EDITOR'S NOTE

This report, except for the appendix, was organized and compiled by me, and I am responsible for any errors, miscalculations, misinterpretations and omissions in it.

The individual reports contained in the appendix to this report are the work of the measurers who participated in the seminar. I strongly suggest you take the time to examine each one. None is perfect, yet not one is lacking in measurement perception. In the appendix, you will find many ways to approach the problem of course measurement, and many ways to present the resulting data.

I elected to produce this initial report as a solo effort because of my experience with the Olympic Marathon Measurement report of 1983. That report took 6 months of hard work by three people, and I was not anxious to repeat the process. In addition, I felt it was desirable to get the report into the hands of the participants as soon after the event as possible.

Commentary is welcome; indeed, it is invited. Perhaps someone else will step forward to organize and produce another document to supplement this one. It's certain I have not mined all the gold out of this lode of measurement data. The readers of Measurement News will benefit from commentary and criticism.

IAAF has conducted several international seminars, aimed at different levels of measurer. This one was intended to test the abilities of experienced people, to see how they would do under realistic conditions. It was the toughest test of any group of measurers I've heard of, outside of real-life situations. It may be that the test fell short in some ways. If it did, we'd love to find a way to do it better next time.

The expenses of many of the US participants were funded by TAC, while IAAF took care of John Disley's travel expenses. These contributions are greatly appreciated, since it is unlikely that we could have obtained such a broad spectrum of participants without them.

Finally, I'd like to thank everybody who came to the seminar and contributed to this report. There's a lot of meaningful and useful data here, and it's your work that made it possible. Special thanks to John Disley for giving up 5 days for his quick in-and-out visit to the US. We all benefited from his presence.

Pete Riegel

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INTERNATIONAL ROAD COURSE MEASUREMENT SEMINAR

International Amateur Athletic Federation (IAAF)
The Athletics Congress (TAC)

Columbus, Ohio - June 16-17, 1990

INTRODUCTION

Thirteen North American course measurers (12 Americans and one Canadian) came to Columbus this June to be examined for elevation to "IAAF approved measurer" status. The seminar, organized by Joan and Pete Riegel of TAC (the US member of IAAF), was centered around a 5 kilometer race course laid out in West Jefferson, Ohio, on roads at the recreational facility of Battelle Memorial Institute.

About two months before the seminar Pete went to the site and laid out a slightly inaccurate 5 km course, using an uncalibrated bicycle, judging the constant from past experience. He estimated the course to be about 5020 meters in length. He added a "construction zone" (actually two painted lines) through which the participants could not ride, having to tape across it instead. The course was laid out on mostly uncurbed asphalt roadways, free of vehicular traffic. Several security gates were present, which could be walked around but not ridden through.

Pete laid out the course to include some deliberate errors. The measurers' job was to act as though an important record had been set on the course, and to determine its length. When they were done with that, they had to figure out what should be done to fix the course, so it would be correct for the next race.

Several IAAF seminars have been held abroad, and the capabilities of many foreign measurers are already known. This seminar was the first to be held in the United States, and its purpose was to demonstrate to IAAF that US measurers are proficient in the art.

Evaluating the measurers was John Disley, IAAF road course technical coordinator. Disley earned an Olympic steeplechase bronze in the 1952 games, and set the world record in that event in 1952 and 1955. He has since been active in British mountaineering, and also organized the sport of orienteering there. A competitive orienteer (Welsh over-60 champion) and road racer, he is co-director of the London Marathon, and has been active in establishing course measurement techniques within IAAF, traveling the world to instruct member federations in the techniques of accurate course measurement.

For a while it looked like the event would have to be held without Disley. Air conditioning equipment in his plane exploded during takeoff from Heathrow, and the plane had to be stopped while passengers evacuated via a large inflated rubber chute. No serious injuries resulted, but John had to work hard to get to Columbus in time, arriving late Friday night.

Saturday morning, at the site, John and Pete gave a brief introduction to the event. The measurers were then given an answer sheet, and told they would

have to hand it in by the end of the day. The idea of having to submit on-site irrevocable answers seemed to make some participants nervous. They were also expected to submit a course map and a written report of what they did later, to Pete and John. This was intended to simulate the situation a validator often encounters. He arrives at the site with little time, measure the course once, and makes same-day recommendations as to what to do. Later he submits a written report to IAAF (or Sally Nicoll, Validations Chairman, in the USA). In that report he can discuss any mistakes he might have made on the day.

Pete conducted an orientation ride of the race course. Because some corners were uncurbed and crumbling, he put down curved paint marks and pronounced them curbs, to be sure everybody measured with the same perception of the course. Splits were already marked with paint and nails.

Wayne Nicoll was assigned to lay out a 300 meter calibration course on one side of the road, and Bob Baumel on the other. Bob Thurston checked Nicoll's course and got 300.01 meters. Tom Knight's check of Baumel's course yielded 299.98 meters. Thus it both calibration courses were about right.

Once the calibration courses were done, people calibrated, and started measuring the race course. They were allowed to ride around the course to check it out all they wanted, but to only obtain measurement data on one single ride. The idea here was that if it was a marathon course, there would be no time for a second ride. Thus they had to get it right the first time.

In the weeks following the seminar, participants mailed their data, maps and reports to Pete and John. A copy of each measurer's submitted material will be found in the appendix to this report.

ACCURACY OF THE METHOD

The true length of the test course (like all courses) is unknown. However, standard measurement practice is to assume that true length is best approximated by the average of all measurements. Some statisticians prefer the median value, since this eliminates variation caused by wildly different measurements. In this report, the average value is taken to be correct. In our case there is little difference, since they are virtually the same.

Overall Accuracy

All 14 measurements of the course fell within 0.1 percent of the average value. This reinforces the common belief that the bicycle method is accurate to 1 m/km or better.

Calibration Variation

Average range of calibration for 4 rides of the 300 meter calibration course was 1.27 counts (maximum = 4, minimum = 0). Because of nearly constant temperature, little variation was seen between the precalibration and postcalibration values. Those using solid tires averaged a precal-to-postcal change of -0.056 counts per kilometer, while those using pneumatic tires averaged -1.719 counts per kilometer.

Documentation of Critical Points

The end result of a layout measurement is a road course. Critical points that affect the length of the course are supposed to be well-documented and accurate. Our measurers had widely-varying opinions as to where these points lay, as can be seen below.

The "TA TO POLE" distance is something I calculated based on each measurer's map dimension and his recommended amount that the course be shortened. Every measurer used pole 359 A64 as his reference point. The START-FINISH REFERENCE is that shown on the submitted map. There were two poles to choose from there.

There is a lot of variation in these measurements, considering that all three distances were only 25 meters or so. The principal cause may be that we vary in our ability to eyeball accurately when we are exactly opposite something.

	TA TO POLE	START-FINISH REFERENCE
PR	22.8	25.9 S OF NB10
SH	22.6	24.38 S OF NB 10, ALSO 23.47 N OF NB9
JD		
MW	22	23.5 E OF NB9 (E? SHOULD BE N)
ETM	21.3	25.75 S OF NB 10
GT	23	25.74 S OF NB 10
DL	22	23.5 N OF NB9
RT	22.8	23.5 S OF NB 10
WN	22.5	23.5 S OF NB 10
AM	23.1	24.4 S OF NB 10, ALSO 23.5 N OF NB9
BC	22.6	25.7 S OF NB 10, ALSO 23.56 N OF NB9
JW	(a)	23.9 N OF NB9
BB	22.3	23.56 N OF NB9
TK	22.47	23.52 N OF NB9

	TA-TO-POLE	S OF NB10	N OF NB9
Average Measurement	22.45	24.86	23.56
Standard Deviation	0.50	1.03	0.14
Number of Measurements	12	8	8
High	22.8	25.9	23.9
Low	21.3	23.5	23.47

(a) Wight used a diagonal measurement from the pole to the nail, not readily convertible for comparison purposes, but quite acceptable.

Course Curvature

Both courses used for comparative measurements were winding, with a high proportion of curvature requiring staying close to a road edge. Most road courses do not have such curvature, and thus measurement error tends to become exaggerated on winding courses.

The Columbus course had about 2030 degrees of curvature, or 35 radians. Given a measurement span of 8.1 meters for all measurements, and assuming that all differences came from differences in riding, this means that all measurers rode within ± 11 cm of the intended 30 cm from road edges, or 4.5 inches. Put another way, all measurers rode within a path that was 22 cm, or 9 inches, wide.

The Los Angeles Olympic Marathon measurement of 1983, performed by 13 US measurers, had a variation of only 12.9 meters in a bike-measured distance of 30.9 km. This course, however, was a "normal" marathon course, with only the "average" amount of curvature. The presence of long, straight stretches, which everybody measures alike, masked the differences that appear on short, twisting test courses.

Effect on Validation Procedures

One measurer lays out a course, and it is checked by another, if a record is set. Out of our 14 measurements, Nicoll's would have been found short of the nominal distance by Hubbard, Conway, Wight and Loeffler. Morss's would have been found short by Loeffler.

There are 91 possible paired combinations of 14 measurers. We have 5 cases where shortness was found. This represents a failure rate of 5.5 percent.

In the US we apply an extra allowance of 0.5 m/km to validations, to allow for possible measurement error. If this is applied, there is only one shortness found, representing a failure rate of 1 percent.

In Measurement News, November, 1989, the comparative measurements done by British measurers, accompanied by Pete Riegel, were discussed. In this gathering, 8 people measured a 2600 m test course. All measurements fell within 1 m/km of the nominal length. However, two of those measurements would have been found short by a third. There are 28 possible paired combinations of 8 measurers. Thus we have here a 7.1 percent failure rate.

Use of the 0.5 m/km negative allowance would have reduced the British fail rate to zero.

COMMENTARY ON THE RESULTS

Before launching into the benefits and deficiencies, it should first be made clear that almost everybody produced the correct answers in their reports. The test was a stringent one, in spite of its apparent simplicity. I hope that participants will study their methods, and work to improve them where they fall short. After all, in a real situation of this kind you could well face the same exercise, only it won't be a test. It will be the real thing, and you'll be judged by your work.

Observed Benefits

1) All measurers rode within reasonable limits, given the nature of the test course. Riding skill was thus seen to be reasonably good.

2) All measurers reached the proper conclusions, based on the data each obtained. Calculation skill was apparent, and on-site conclusions contained few errors.

3) Maps were adequate to define the measured course.

4) Narrative accounts varied, but were generally acceptable.

Observed Deficiencies

1) Premature or incorrect rounding-off of calibration values. Retain at least 6 significant figures in calculations, and do not round off until the final answer is reached.

2) Using "counts" as a unit of measurement. Several measurers converted their taped distances into counts, and rolled the front wheel until a new count was reached. This is inexact, since the proper number of counts is unknown, since recalibration has not yet been performed. Generally only a small error is involved, but it can be a big one if taped distances are large.

Recommended approach: When checking an existing course, forget you have a calculator. Calibrate, measure the course, stopping at all points and recording counts, and recalibrate. Tape between points you cannot ride between, recording the both the points and the taped distance between them. Then convert everything to meters (or miles or whatever you're working in). Once you have done that you are done with counts, and should not think of them again. All adjustments can be easily figured by using the measured lengths of the intervals.

Some measurers carried the "count" approach to extremes, treating them as though they were as valid as meters. A count is merely a tool we use to find out a distance. It is not itself a distance.

There is nothing inherently wrong with using counts in your own figuring. However, the presentation to others who may have to follow your work is greatly clarified if distances are converted to meters at the earliest opportunity.

3) Did not record a count at either side of the construction area. In general this was done by those who thought in "counts." On the whole, few were very clear just exactly how they measured across the construction zones.

4) Premature calculation. In a validation involving already-established split points, first measure the course as it is. Do not get involved in trying to figure out where everything ought to be as you ride. You do not know this anyway, since, until you recalibrate, you do not know your correct constant. Once you have all the data in the bag, then get out the calculator and figure out what you have and how things ought to be. If you stopped at all the splits, you will have enough information to adjust them later. This is not a job that needs to be done as the ride proceeds.

5) Using feet and inches as reference dimensions. IAAF and almost all of its member federations use the metric system. The US is practically alone in the world in its adherence to the Imperial system.

6) Landmarks on map shown on the wrong side of the road.

7) Adjusted turnaround shown on the map with adjustment made in wrong direction.

8) Use of improper constant in figuring distance. IAAF uses the average constant, not the precalibration constant or the larger constant.

9) Closed gates: Few reported how they negotiated closed gates. One report made no mention of gates or construction areas at all, instead reporting the measurement as though it was an uninterrupted ride. Lack of this information makes it difficult or impossible to trace exactly what was done by the measurer.

10) Inaccurate documentation of reference points. It is impossible to know how another group would have performed, since we are the only ones to do this, but it appears that our reference point documentation could use work.

SEMINAR ATTENDEES

John Disley CBE
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ENGLAND TW12 2DW

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Wayne/Sally Nicoll
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Pete & Joan Riegel
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SUMMARY OF MEASUREMENTS - IAAF SEMINAR

Battelle-West Jefferson Recreational Facility - June 16, 1990

Weather - clear, sunny, 27-32 (C), 80-90 (F)

Calibrations were all performed on twin 300 meter on-course baselines.

One was laid out by Wayne Nicoll. It was checked by Bob Thurston, who obtained 300.01 meters.

The other was laid out by Bob Baumel. It was checked by Tom Knight, who obtained 299.98 meters.

These calculations assume the calibration courses were 300.00 meters.

All calculations are based on average constant without extra 1.001.

MEASURED LENGTHS OF VARIOUS SEGMENTS OF COURSE BASED ON RAW DATA

These lengths were calculated by Pete Riegel, using Lotus 1-2-3 spreadsheet program, and are based on raw measurement data submitted by each participant in a post-seminar report. In doing these calculations, it was Pete's intent to get the most exact answers that the data would support. Data is presented in the order it was received by Pete Riegel.

Here are the measured lengths of the full course, as determined by exact calculation, as well as the abbreviations that will hereafter be used for the measurers:

ABBREV	MEASURER	OVERALL LENGTH
PR	RIEGEL	5018.31
SH	HUBBARD	5017.46
JD	DISLEY	5018.51
MW	WICKISER	5019.75
ETM	MCBRAYER	5019.11
GT	TILLSON	5020.34
DL	LOEFFLER	5015.16
RT	THURSTON	5019.24
WN	NICOLL	5023.29
AM	MORSS	5021.20
BC	CONWAY	5016.95
JW	WIGHT	5016.42
BB	BAUMEL	5020.18
TK	KNIGHT	5019.10

			MEASURED LENGTHS				
	OVERALL LENGTH	ADJUST TO TURN	START 1 KM	1 KM 2 KM	2 KM 3 KM	3 KM 4 KM	4 KM FINISH
PR	5018.31	-6.66	1007.41	1003.31	1002.46	989.39	1015.74
SH	5017.46	-6.23	1007.80	1003.06	1001.88	989.01	1015.71
JD	5018.51	-6.76	1007.62	1004.05	1002.12	988.95	1015.78
MW	5019.75	-7.38	1008.10	1003.87	1002.38	989.19	1016.21
ETM	5019.11	-7.05	1008.19	1003.28	1002.08	989.28	1016.29
GT	5020.34	-7.67	1007.90	1003.60	1003.02	989.52	1016.30
DL	5015.16	-5.08	1007.07	1002.58	1001.80	988.65	1015.06
RT	5019.24	-7.12	1008.54	1003.73	1002.20	988.94	1015.83
WN	5023.29	-9.15	1009.62	1004.47	1002.75	989.59	1016.85
AM	5021.20	-8.10	1009.82	1003.94	1002.37	988.63	1016.44
BC	5016.95	-5.98	1007.21	1003.35	1001.84	988.85	1015.70
JW	5016.42	-5.71	1007.38	1003.20	1001.91	988.73	1015.20
BB	5020.18	-7.59	1008.56	1003.81	1002.25	989.24	1016.32
TK	5019.10	-7.05	1008.24	1003.34	1002.52	989.17	1015.82
HIGH	5023.3		1009.8	1004.5	1003.0	989.6	1016.9
LOW	5015.2		1007.1	1002.6	1001.8	988.6	1015.1
SPAN	8.1		2.7	1.9	1.2	1.0	1.8
AVERAGE	5018.93		1008.10	1003.54	1002.26	989.08	1015.95
STD DEV	1.995		0.797	0.462	0.344	0.299	0.469

MEASURED LENGTHS - CONTINUED

	1 KM 1 MI	1 MI 2 KM	3 KM TURN	TURN 4 KM
PR	588.57	414.74	220.27	769.12
SH	588.88	414.18	221.02	767.98
JD	589.02	415.03	219.99	768.96
MW	589.12	414.76	220.25	768.94
ETM	589.04	414.23	220.47	768.81
GT	589.09	414.52	220.19	769.33
DL	588.54	414.04	220.22	768.43
RT	589.23	414.50	220.22	768.73
WN	589.83	414.65	220.33	769.26
AM	589.33	414.61	220.16	768.47
BC	588.78	414.57	220.39	768.46
JW	588.80	414.40	*	*
BB	589.17	414.64	220.25	768.99
TK	589.05	414.30	220.30	768.88
HIGH	589.8	415.0	221.0	769.3
LOW	588.5	414.0	220.0	768.0
SPAN	1.3	1.0	1.0	1.3
AVERAGE	589.03	414.51	220.31	768.80
STD DEV	0.314	0.254	0.233	0.364

* Wight reported no data for turnaround point.

DEVIATION FROM AVERAGE MEASURED VALUE, METERS

	OVERALL LENGTH	START 1 KM	1 KM 2 KM	2 KM 3 KM	3 KM 4 KM	4 KM FINISH	SPAN OF KM DEVS
PR	-0.619	-0.689	-0.232	0.200	0.310	-0.208	0.999
SH	-1.473	-0.299	-0.488	-0.374	-0.076	-0.237	0.412
JD	-0.416	-0.486	0.511	-0.137	-0.135	-0.169	0.998
MW	0.824	-0.008	0.332	0.127	0.110	0.263	0.339
ETM	0.177	0.083	-0.268	-0.178	0.200	0.340	0.608
GT	1.409	-0.208	0.059	0.759	0.441	0.359	0.968
DL	-3.772	-1.033	-0.962	-0.457	-0.431	-0.890	0.602
RT	0.311	0.434	0.188	-0.055	-0.139	-0.117	0.573
WN	4.361	1.518	0.931	0.494	0.512	0.906	1.024
AM	2.268	1.715	0.399	0.118	-0.454	0.490	2.169
BC	-1.979	-0.890	-0.196	-0.412	-0.233	-0.247	0.694
JW	-2.512	-0.726	-0.345	-0.345	-0.354	-0.743	0.398
BB	1.250	0.454	0.269	-0.008	0.158	0.378	0.462
TK	0.171	0.136	-0.199	0.268	0.092	-0.125	0.467

Average km span for 14 measurers = 0.765

CALIBRATION DATA AND CALCULATIONS

	AVERAGE CONSTANT	POSTCAL MINUS PRECAL CT/KM	PRECAL VARIATION COUNTS	POSTCAL VARIATION COUNTS	AVG VARIATION COUNTS	TIRE TYPE	BIKE
PR	9261.25	0	0.5	1.5	1	SURETRAK	MOTOBECANE
SH	9474.17	-1.67	1	0	0.5	PNEU	TREK
JD	9261.88	0.42	1	0.5	0.75	SURETRAK	MOTOBECANE
MW	9475.42	-2.50	0	0.5	0.25	GOODFOAM	NASHBAR
ETM	9924.38	-1.25	1	2.5	1.75	SOLID	FUJI
GT	9782.50	1.67	2	2	2	PNEU	RALEIGH
DL	9354.17	0	1	3	2	PNEU	FUJI
RT	9465.67	-0.33	1.5	1.1	1.3	GOODFOAM	NASHBAR
WN	9272.50	3.33	1	1	1	GOODFOAM	SUTEKI
AM	9529.38	-3.75	1.5	4	2.75	PNEU	PEUGEOT
BC	9310.83	-1.67	1	2	1.5	PNEU	RALEIGH
JW	9329.17	-5.00	1	0	0.5	PNEU	VISCOUNT/SEB
BB	9377.92	-3.33	1.5	1	1.25	PNEU	TARGA
TK	9344.17	0	2	0.5	1.25	PNEU	FUJI

AVG SOLID CHANGE -0.056 COUNTS/KM 1.27 COUNTS AVERAGE
AVG PNEU CHANGE -1.719 COUNTS/KM RANGE FOR 4 RIDES

REPORTED DISTANCE VS CALCULATED DISTANCE

Exact distances are those calculated by this program, based on the original data of the measurer. Other distances are those reported on measuring day and later.

MEASURER	COURSE LENGTH	ADJUSTMENTS TO SPLITS 1 KM	1 MI	2 KM	3 KM	TURN	4 KM
RIEGEL (Exact)	5018.311	-6.41	14.97	-8.73	-10.18	-6.66	14.74
Reported on Site	5018.3	-6.4	15	-8.7	-10.2	-6.6	14.6
Reported Later	5018.3	-6.4	15	-8.7	-10.2	-6.6	14.7
HUBBARD (Exact)	5017.457	-6.80	14.27	-8.86	-9.74	-6.23	14.71
Reported on Site	5017.5	-6.9	14.1	-9.2	-11.2	-6.3	0 *
Reported Later	5017.6	-6.9	14.1	-9	-9.8	-6.3	14.7
DISLEY (Exact)	5018.514	-6.62	14.32	-9.67	-10.79	-6.76	14.78
Reported on Site	5018.5	-6.6	14.3	-9.6	-10.7	-6.65	25.4 *
Reported Later	5018.43	-6.6	14.3	-9.6	-10.7	-6.7	14.2
WICKISER (Exact)	5019.754	-7.10	13.74	-9.97	-11.35	-7.38	15.21
Reported on Site	5019.754	-7.1	13.7	-10	-11.4	-7.4	-15.2 *
Reported Later	5019.8	-7.1	13.7	-10	-11.4	-7.4	15.2
MCBRAYER (Exact)	5019.107	-7.19	13.72	-9.46	-10.54	-7.05	15.29
Reported on Site	5019.107	-7.186	13.724	-9.462	-10.540	-7.054	15.286
Reported Later	5019.107	-7.187	13.724	-9.462	-10.534	-7.054	15.286
TILLSON (Exact)	5020.339	-6.90	13.97	-9.50	-11.51	-7.67	15.30
Reported on Site*	5014.499	-6.74	14.29	-9.18	-11.03	-7.25	-13.89 *
Reported Later	5019.513						
LOEFFLER (Exact)	5015.158	-6.07	15.34	-7.65	-8.45	-5.08	14.06
Reported on Site*	5015.158	-5	15.282	-5.6	-5.4	-2.5	13
Reported Later	5015.158	-6.087	15.265	-7.700	-8.490	-5.1	14.042
THURSTON (Exact)	5019.241	-7.54	13.18	-10.27	-11.47	-7.12	14.83
Reported on Site	5019.2	-7.6	13.2	-10.3	-11.5	-7	14.5
Reported Later	5019.24	-7.6	13.2	-10.3	-11.5	-7	14.5
NICOLL (Exact)	5023.291	-8.62	11.51	-12.10	-13.85	-9.15	15.85
Reported on Site	5023.162 *	-8.416	11.633	-11.972	-13.661	-9.081	15.827
Reported Later	5023.162 *	-8.416	11.633	-11.972	-13.661	-9.081	15.827
MORSS (Exact)	5021.198	-8.82	11.81	-11.76	-13.13	-8.10	15.44
Reported on Site	5021.1	-9.8	11.8	-11.77	-13.15	-8.1	15.44
Reported Later	5021.21	-8.8	11.8	-11.8	-13.1	-8.08	15.43
CONWAY (Exact)	5016.951	-6.21	14.96	-8.56	-9.40	-5.98	14.70
Reported on Site	5016.5 *	-6.11	15.13	-8.37	-9.12	-5.74	3.11 *
Reported Later	5016.5 *	-6.12	15.13	-8.37	-9.12	-5.74	14.7

WIGHT (Exact)	5016.418	-6.38	14.78	-8.58	-9.49	-5.71	14.20
Reported on Site	5016.42	-6.38	14.77	-8.58	-9.49	-5.71	14.21
Reported Later	5016.42	-6.38	14.77	-8.58	-9.49	-5.71	14.21
BAUMEL (Exact)	5020.180	-7.56	13.23	-10.37	-11.62	-7.59	15.32
Reported on Site	5020.18	-7.56	13.22	-10.37	-11.62	-7.59	15.32
Reported Later	5020.18	-7.56	13.22	10.37	11.62	-7.59	15.32
KNIGHT (Exact)	5019.101	-7.24	13.67	-9.58	-11.11	-7.05	14.82
Reported on Site	5019.1	-7.2	13.7	-9.6	-11.1	-7.05	14.8
Reported Later	5019.10	-7.24	13.66	-9.59	-11.11	-7.05	14.82

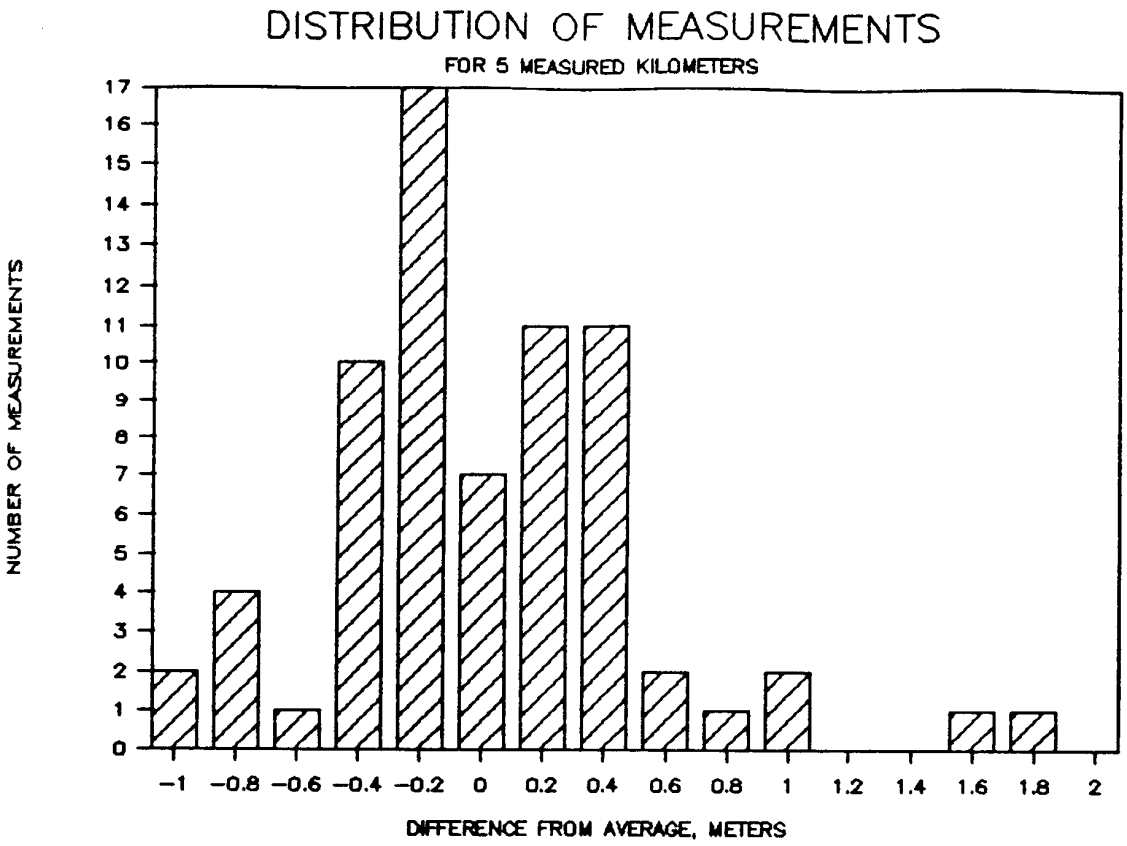
* George Tillson included 1.001 in his constant when he figured his on-site length.

* Doug Loeffler used an extra 1.001 when figuring his on-site turn adjustment.

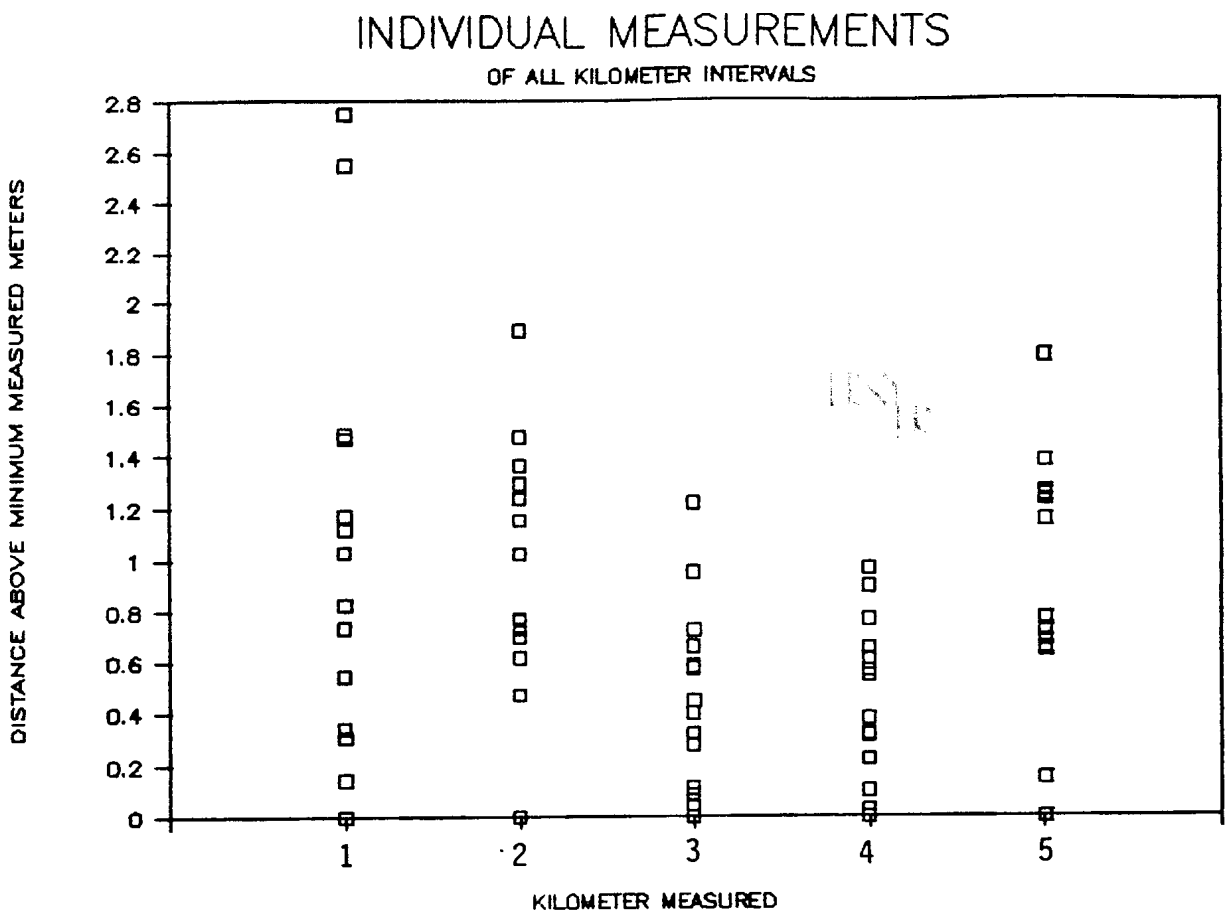
* Wayne Nicoll obtained counts on both a standard Jones counter and a Jones II counter. He reported his lengths based on the Jones II. Riegel has calculated his distances based on the standard counter here. Using Wayne's Jones II data, his exact length is 5023.11 meters. Both sets of data produced virtually identical results.

* Bernie Conway figured out his course length based on his precalibration constant rather than his average constant.

Other differences reflect other simple errors made on site, with no clear explanation of the reason.



Here is how the 70 measurements of five individual kilometers by 14 riders break down. It is seen that the distribution is one-sided, toward longer measurements. This is consistent with common sense, since one cannot measure significantly shorter than the legal course without leaving it. On the other hand, swerving and measuring wide on corners can produce a higher value for a measurement.

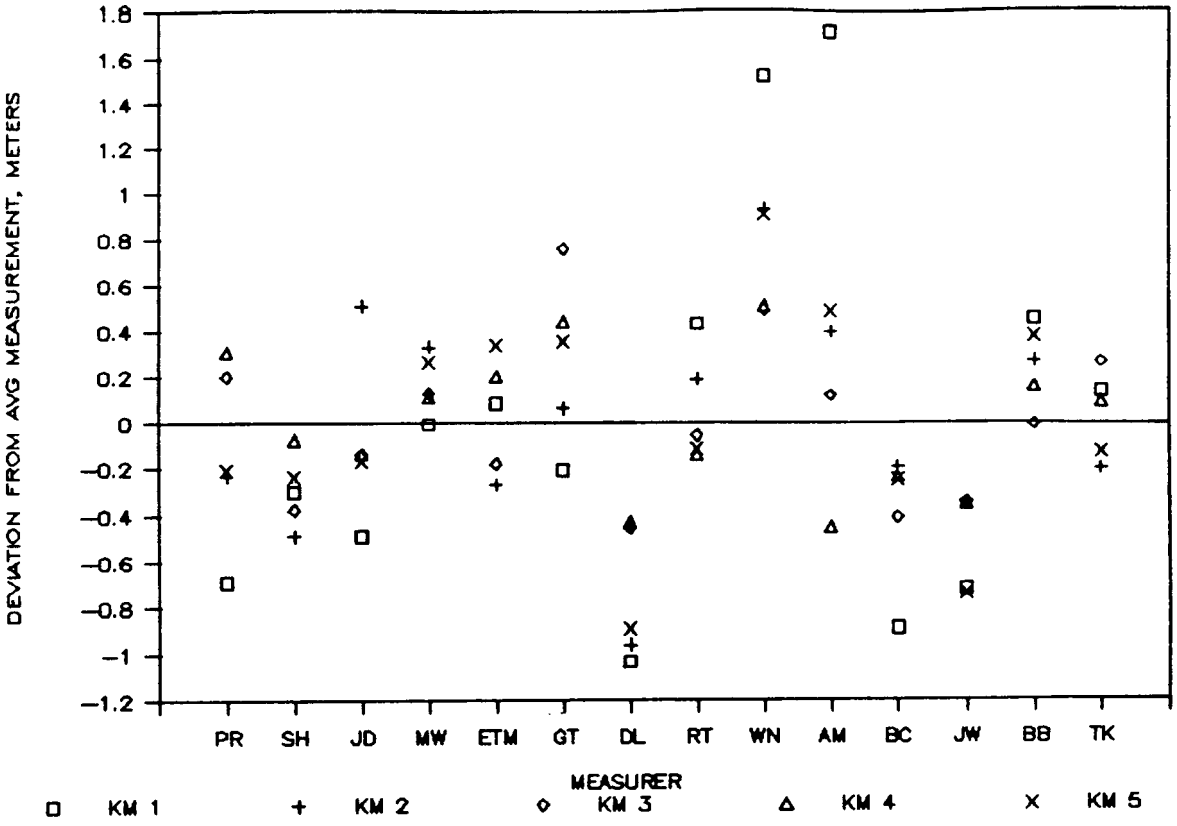


This graph shows the measurement spread on each individual kilometer of the course. The lowest measured interval for each kilometer was taken as zero.

For example, the lowest measurement of km 2 was Loeffler's 1002.6 meters. The highest was Nicoll's 1004.5. The difference is 1.9 meters. This is the highest point in the distribution for the km 2 length. All other values fell between these extremes as shown.

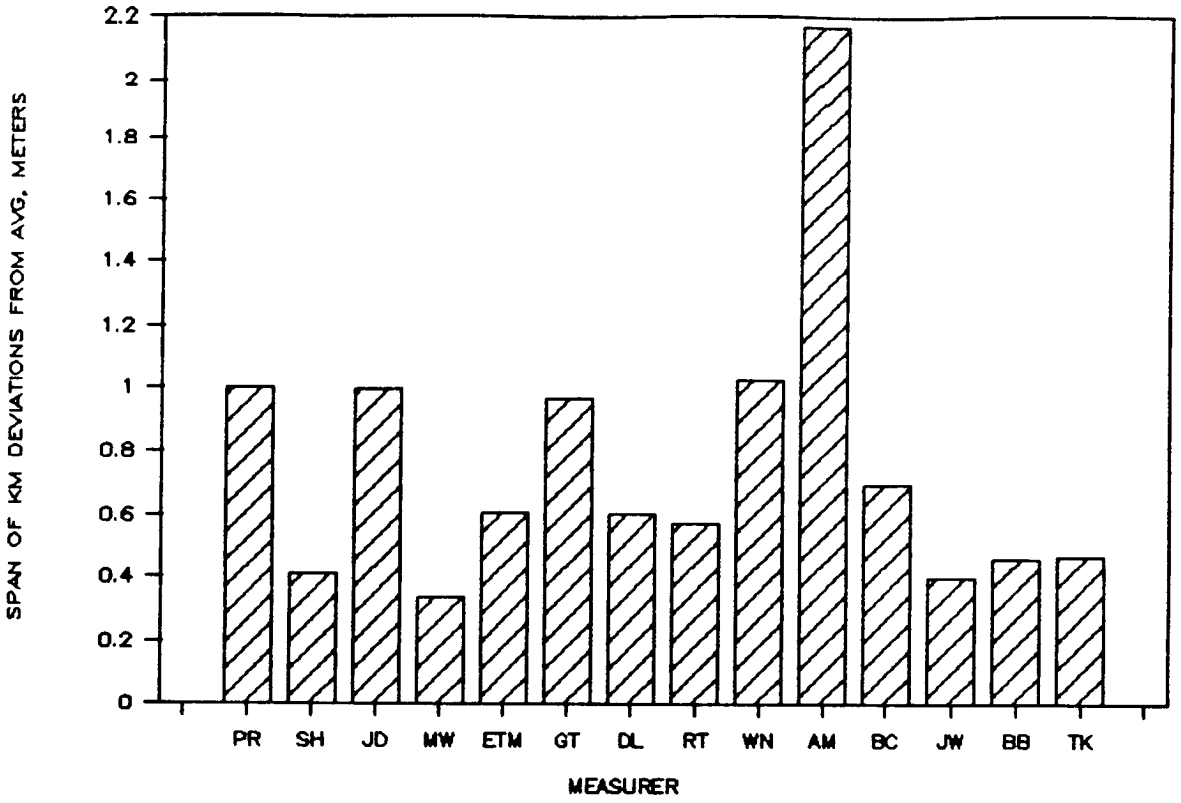
Since each "kilometer" of the course was only slightly different from 1 km, the above results show differences in m/km.

Note that those intervals with the widest variation are those that have the greatest amount of curvature. The first and second kilometers have many curves, while the third and fourth have few.



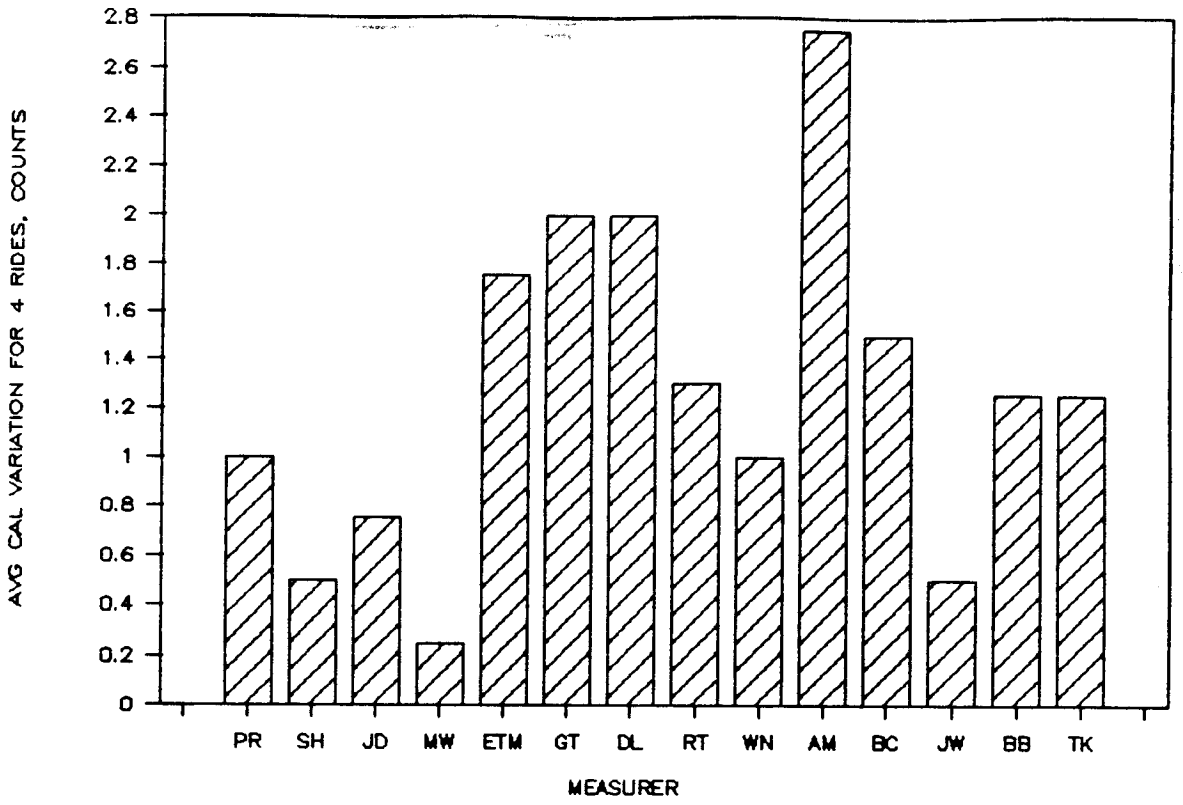
Here is how each measurer's value for each kilometer compared with the average. For example, on km 1-2, Pete Riegel's measurement was 0.619 meters below the average measured value. On km 3-4 Pete was 0.310 meters above the average. All others were calculated the same way.

Consistency and precision of measurement is related to the span of the points for each measurer. The narrower the span, the more precise the measurement.

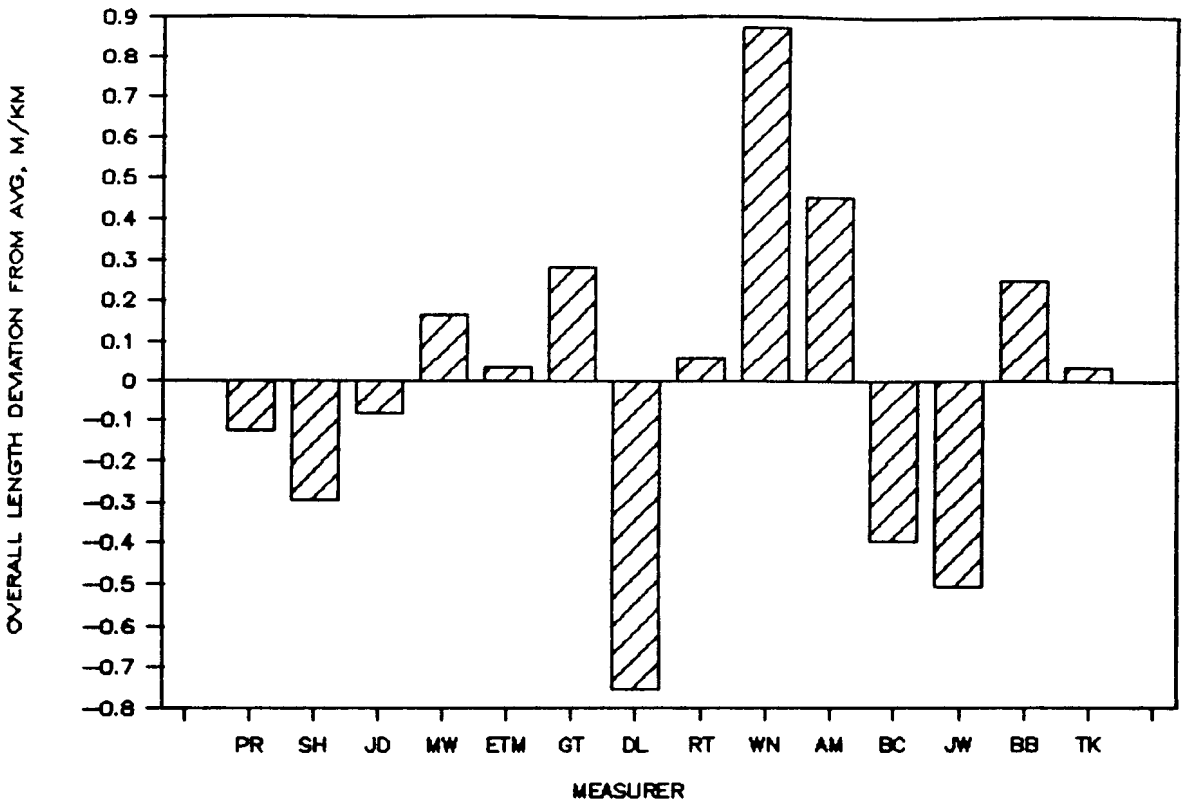


Every measurer measured five individual kilometers. On each, his measurement differed from the average by some value. The maximum span of these differences is shown in this graph. For example, on km 1-2, Pete Riegel's measurement was 0.689 meters below the average measured value. On km 3-4 Pete was 0.310 meters above the average. His span for the five intervals was thus .689 + .310 = .999 meters. All other values were calculated in the same way.

The best riding will produce the least span.



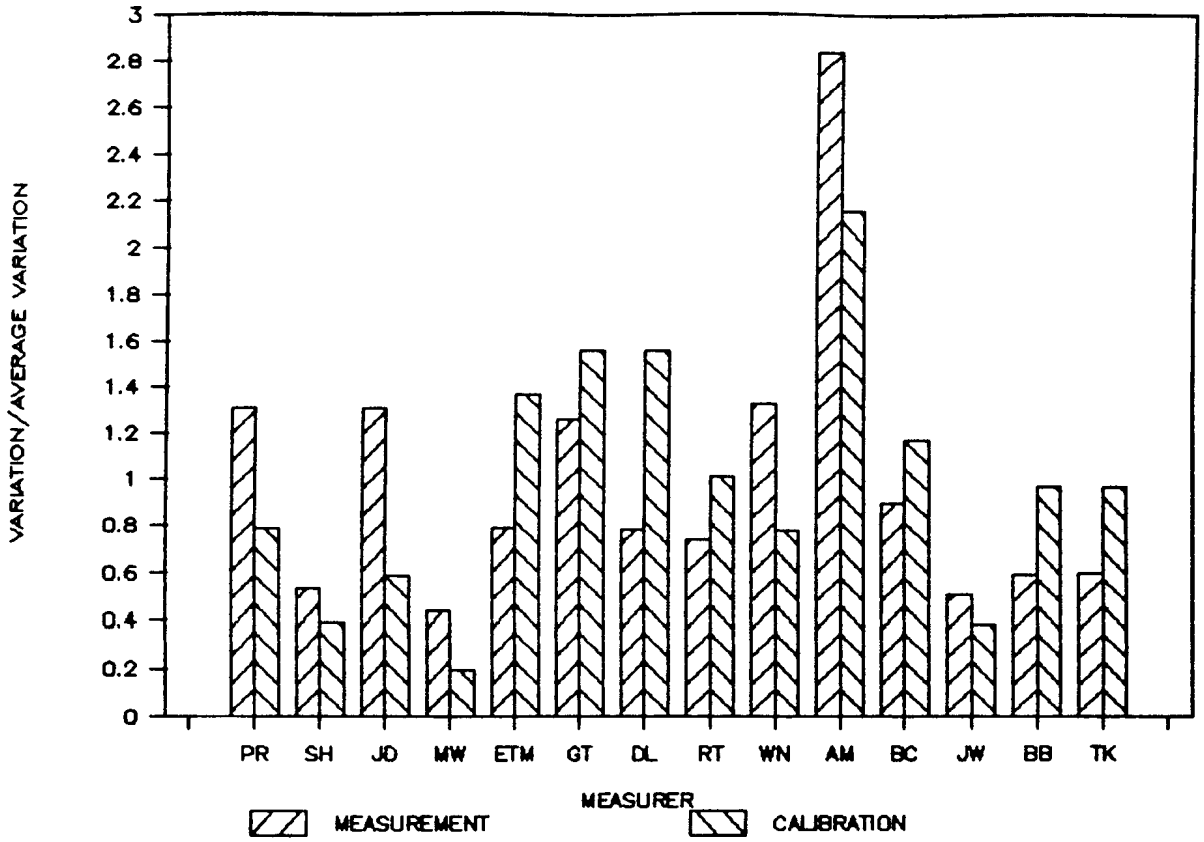
This shows how calibration varied. For example, John Disley had precalibration rides of 2778.5, 2778, 2778.5, 2779, for a precal span of 1 count. On postcal he had 2779, 2778.5, 2778.5, 2778.5 for a span of 0.5. His average was thus (1 + .5)/2 = 0.75.



Here is how the 14 individual measurements of the entire course compared with the average measured value of 5018.93 meters. For example, George Tillson obtained a length of 5020.34 meters. His length is 1.409 meters higher than the average. Since the course was 5 km long, his deviation was 1.409/5 = 0.28. All other values were obtained in a similar way.

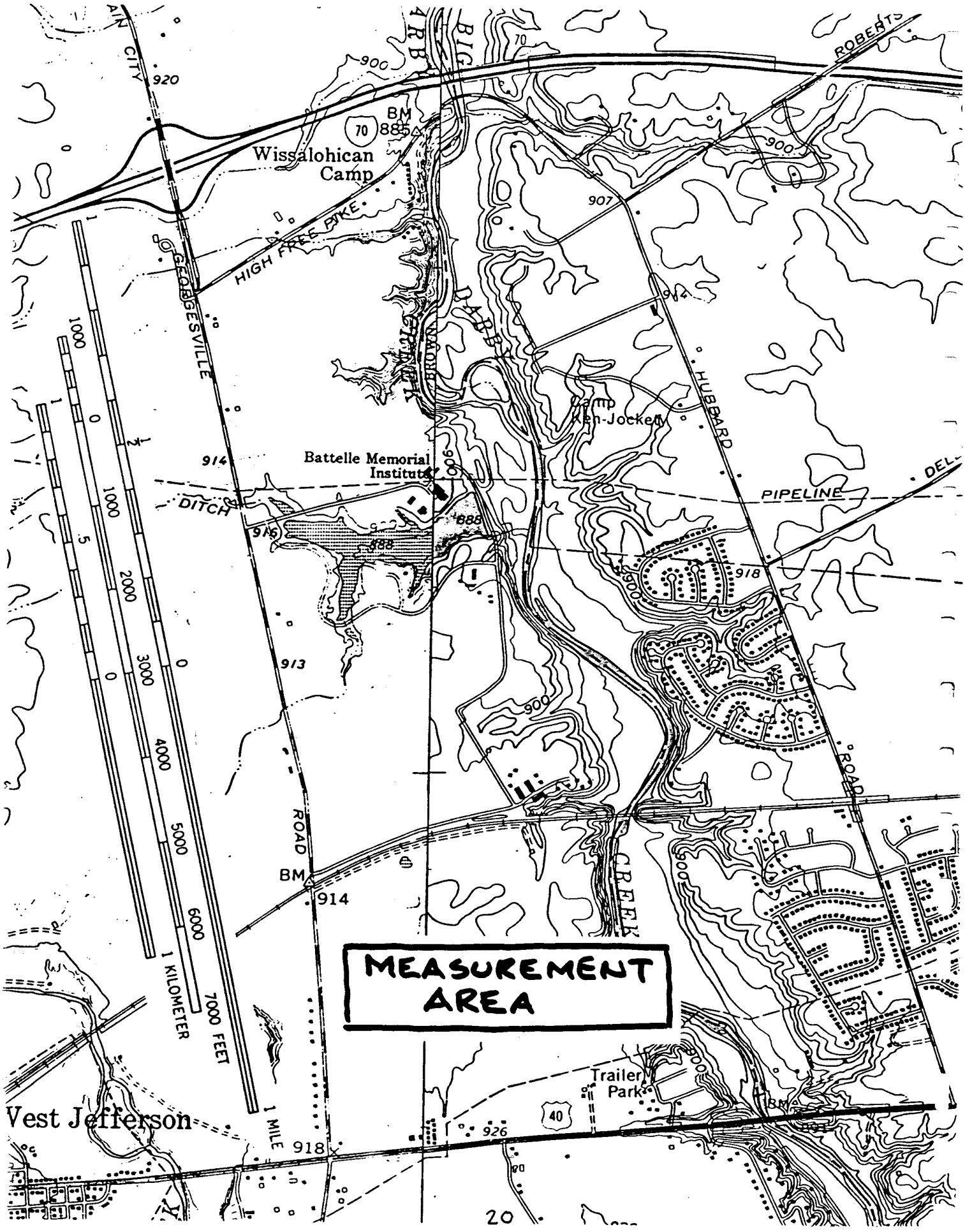
Note that all values are less than 1 m/km from the average. This reinforces the belief that bicycle measurement has an accuracy of better than 1 m/km.

In an exercise to ride the exact route as accurately as possible, the best riding will produce the least deviation from the average, assuming that the course length is indeed represented by the average.



Do we measure as we calibrate? Is there a relationship between calibration variation and measurement variation? Here we see each measurer's calibration variation shown next to his measurement variation, for the five measured intervals. It appears that, in general, steady calibrators produce steady measurements.

For example, Mike Wickiser had an average calibration variation of 0.25 counts. The average variation of all measurers was 1.27 counts. Mike's calibration ratio was .25/1.27 = 0.20. Mike's measurement variation over the 5 intervals was 0.339, while the average was .765. His measurement ratio was thus .339/.765 = .44. All others were calculated the same way.


Wissalohican Camp
HIGH FREE PIKE
GEORGESVILLE
BIG DARBY CREEK
BARBY CREEK
Camp Ken-Jockety
HUBBARD
PIPELINE
DITCH
Battelle Memorial Institute
ROAD
ROAD
CREEK
BM 885
BM 914
Trailer Park
MEASUREMENT AREA
1 KILOMETER
7000 FEET
1 MILE
Vest Jefferson
20

APPENDIX

The following pages are copies of reports of the measurement activity, submitted by each participant.

Note that they all differ slightly in format and method of presenting the data. This was an intentional result, since there is presently no universally accepted format for data presentation. It was hoped that asking each person to use his own judgment would give a spectrum of ways it could be done.

No editing of the material has been done, aside from reducing some of the pages. What you see is what was received. At the end of each person's section is a check of the measurement as Pete Riegel saw it, based on the submitted data. He is responsible for the accuracy of the check, not the measurer involved. On the check page is the date that each person's report was received by Pete Riegel.

PR

MEASUREMENTS OF IAAF TEST COURSE - JUNE 16, 1990

ALL CALCULATIONS USE AVERAGE CONSTANT WITHOUT EXTRA 1.001.

PRECAL			POSTCAL		
71940			31220		
74718.5	2778.5	2778.375	33998.5	2778.5	2778.375
77496.5	2778	9261.25	36777	2778.5	9261.25
80275	2778.5		39554.5	2777.5	
83053.5	2778.5		42333.5	2779	

CONSTANT FOR DAY = 9261.25 CTS/KM = 9.26125 CTS/METER

	RECORDED COUNTS	INTERVAL COUNTS	INTERVAL METERS	ADJUST TO TURN	NEW INTERVAL	DIS FROM START	DESIRED DIST	ADJUST
START	12077							
BEG CON	12903	826	89.19		89.19	89.19		
		TAPED	15.00		15.00	104.19		
END CON	12903							
1K	21268	8365	903.23		903.23	1007.41	1001.00	-6.41
END CON	25804	4536	489.78		489.78	1497.20		
		TAPED	15.00		15.00	1512.20		
BEG CON	25804							
1M	26580	776	83.79		83.79	1595.99	1610.95	14.97
2K	30421	3841	414.74		414.74	2010.73	2002.00	-8.73
2K	83800							
3K	93084	9284	1002.46		1002.46	3013.18	3003.00	-10.18
TA	95124	2040	220.27	-6.6	213.67	3226.86		
TA	95547							
4K	102670	7123	769.12	-6.6	762.52	3989.37	4004.00	14.63
FINISH	112077	9407	1015.74		1015.74	5005.11	5005.00	-0.11
TOTAL			5018.31		5005.11			
DESIRED LENGTH			5005					
DIFFERENCE			13.31					

I DID NOT RECOMMEND THIS CHANGE

REMOVE AT TURNAROUND 6.66 (Recommended moving the turn 6.6 m to shorten course by 13.2 m.)

Because the 2 km split was right by the calibration course, I began and ended my ride there. Before I rode I taped two sets of reference points across the construction zone with John Disley, at 15 m each. I stopped at all of the split points, at the turn, and at the construction reference points, obtaining a count at each point.

Upon conclusion of the ride I figured up the data, and recommended a 6.6 meter adjustment to the turn, and various adjustments to the split points as shown above. I concluded that the length of the course, as measured, was 5018.3 meters. I calculate its adjusted length at 5005.1 meters.

Pete Riegel

PR

NARRATIVE ACCOUNT OF MEASUREMENT

Because the 2 km split was right by the calibration course, I began and ended my ride there. Before I rode I taped two sets of reference points across the construction zone with John Disley, at 15 m each. I stopped at all of the split points, at the turn, and at the construction reference points, obtaining a count at each point.

At locked gates, I rode to the gate until the front wheel touched it. I locked the wheel and moved the bike back one wheel diameter, which I had marked temporarily with my toe. I then rolled forward until the wheel again touched the gate. This had the effect of adding 6.3 counts (1 wheel diameter) to my total. Again locking the wheel, I picked up the bike, walked around the gate, and put the bike down sideways so the back of the front wheel was against the gate. I carefully rolled it forward until there was room to straighten out the bike, and rode on. I did this at each of the 4 large gates I encountered. On the lift gates on the curbed island, one opened automatically as I approached it. On the other one, I tipped the bike sideways with the wheel in contact with the ground, and rolled it until I could once again get it upright, and rode on. I did not record counts when doing these various gate maneuvers.

I did no calculating at all from first calibration ride until I was finished. I only rode and recorded data.

Upon conclusion of the ride I figured up the data, and recommended a 6.6 meter adjustment to the turn, and various adjustments to the split points as shown above. I concluded that the length of the course, as measured, was 5018.3 meters. I calculate its adjusted length at 5005.1 meters. The above calculations and recommendations are the same as those I recommended on measuring day.

Note that I recommended moving the turn 6.6 m, rather than the exact value of 6.66 m. I did this because I don't believe it makes sense to imply accuracy down to the centimeter, and because someone else will be doing the marking. I doubt they would get it that close. In the same way, I never document a split to anything closer than the nearest 0.5 foot when working in Imperial distances.

Pete Riegel

PR

4/28/90 - layout of test course at West Jeff

63

Splits - S, 1K, 1M, 2K, 3K, 4K, 5K

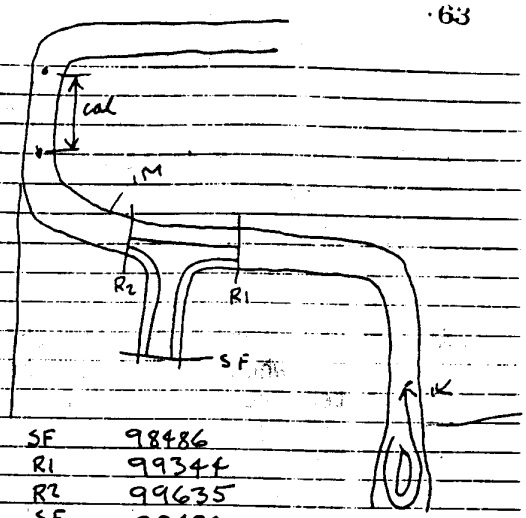
also a 300 500 m cal course.

- go for 400. tougher math

- Use 9264 c/km as true cal

ASSUMED

	INTENDED, M
S	0
1K	1008
@ 1M	1597
2K	2000
3K	3014
4K	4004
5K	5020

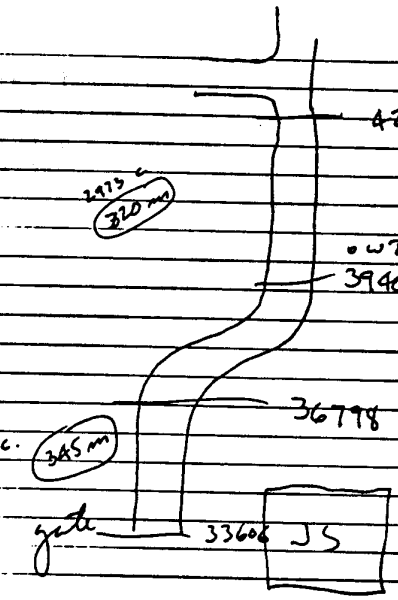


SF	00490	ODO
1008 =	9338 + 490 = 9828	.62
1597 =	14795 + 490 = 15285	.98
?~~2000~~ =	~~+4014~~ 19125	1.25
3014 =	28412	1.87
TA =	~~30063~~ 30456	2.01
4004 =	37583	2.49
5020 =	~~46995~~ 46998	3.12

SF	98486
R1	99344
R2	99635
SF	00490
VIA GATE R1	01348
R1	14480
R2	14771

SF - R1 =	858
R1 - R1 =	13132
R1 - R2 =	291
R2 - SF =	855
	15136
5020 ~~5K~~ =	~~46320~~ 46505
add to TA	~~+5598~~ 15684
+	~~14971~~
	~~30063~~ 30456

64



65

ORIGINAL LAYOUT OF TEST COURSE 4/28/90

PR

2778.5
2778.5
2778
2778.5

Precal = 2778.375

2778.5
2778.5
2777.5
2779

Postcal = 2778.375

} AV = 9261.25 c/km

PETE RIEGEL

ON-SITE CALCULATIONS

S ——— 826

X 15m

TA in Z11C = 22.8 m E of TP 359 A64

8365

1K ——— 4536

X 15m

SF in 25.9 m S of TP.

776

1M ——— 3841

2K ——— 9284

3K ——— 2040

TA ——— 7123

4K ——— 9407

F

m	original adj	new length	cum
89.2 ✓		89.2	89.2
15		15	104.2
903.2 ✓		903.2	1001 1007.4
489.8 ✓		489.8	1497.2
15		15	1512.2
83.8 ✓		83.8	1611 1596.0
414.7 ✓		414.7	2002 2010.7
1002.5 ✓		1002.5	3003 3013.2
220.3 ✓	6.6 ~~9.1~~	213.7 ~~211.2~~	3226.9 ~~3224.4~~
769.1 ✓	6.6 ~~9.1~~	762.5 ~~760.0~~	4004 3989.4 ~~3984.4~~
1015.7 ✓		1015.7	5005.1 ~~5000.1~~

5018.3

Desired length = 5005

diff 13.3

Remove 9.1 m from TA

6.6 m from TA

TA - ~~move 6.6~~ m TF/TS ✓
1K - move 6.4 TS
1M - move 15 TF
2K - move 8.7 TS
3K - move 10.2 TS
4K - move ~~+8~~ 19.6 TF

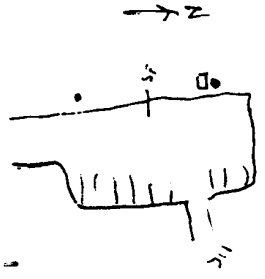
11:40 85°

71940 6.5
74716.5 6.5 cal
77496.5 6.5
80275 6.5
83053.5

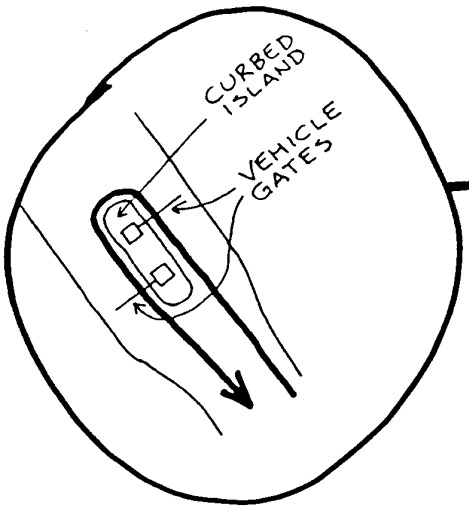
2K - 83800 .62
3K - 93064 .13
TA - 95124
TP 359 A64 95335.5
TA 95547 .47
4K - 02670 .62
F - 12077 .05
BC/EC - 12903 .56
1K - 21268 .30
BC/EC - 25804 .05
1M - 26580 .25
2K - 30421

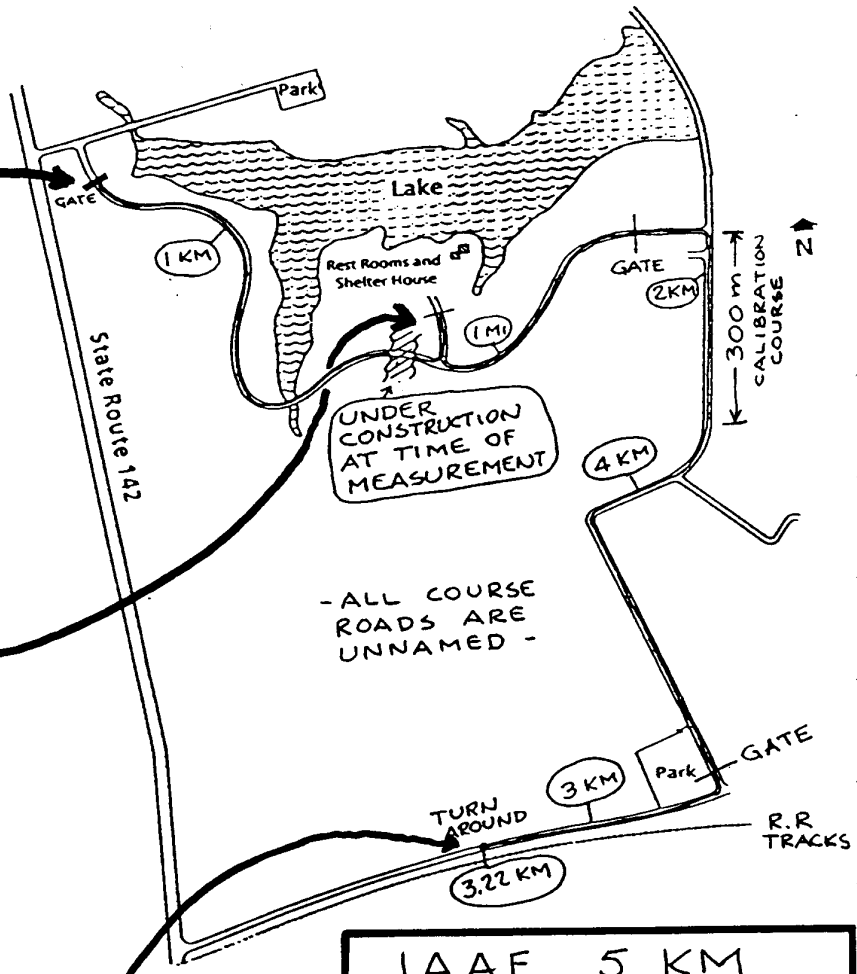
31220 36777 11:45 85°
33998.5 39554.5 42333.5

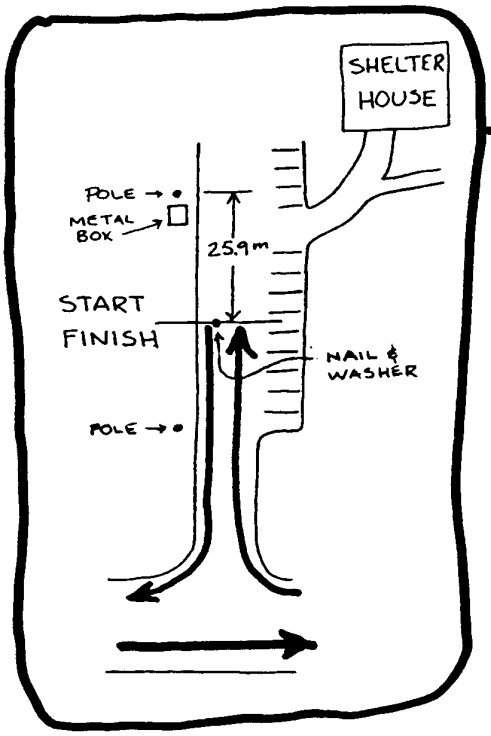
ORIGINAL DATA

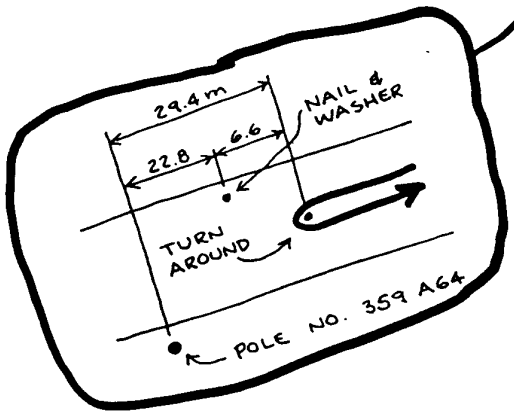


ORIGINAL DATA





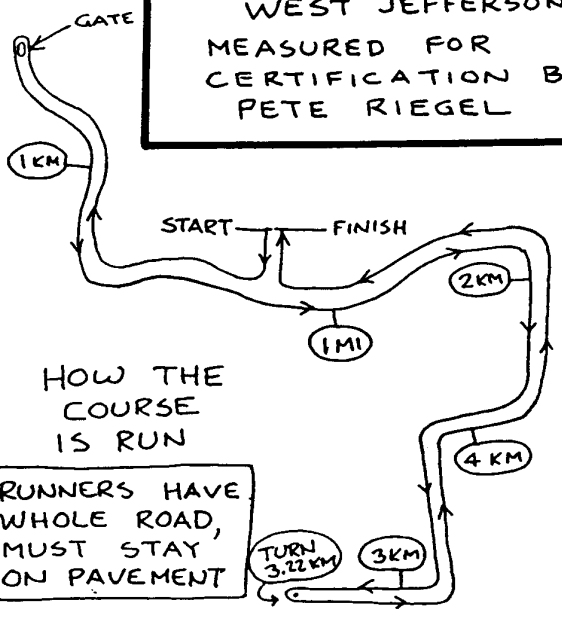




IAAF 5 KM TEST COURSE

WEST JEFFERSON, OH

MEASURED FOR CERTIFICATION BY PETE RIEGEL



HOW THE COURSE IS RUN

- RUNNERS HAVE WHOLE ROAD, MUST STAY ON PAVEMENT

SH

great lakes sports publications, inc.
[redacted]
921 Bath
Ann Arbor, MI
48103
313 662 9851

Dear John & Pete,

My final field notes and adjustment figures differ from those I turned in on 'measuring day'. I was adding the wrong number of counts each time I went past a gate and, although I caught this and adjusted my final total, I failed to adjust figures for 2-4K marks. Plus, I finally discovered the error of my ways in calculating the adjustment of the 4K mark!

It was a most enjoyable experience, learning, meeting everybody, measuring and all. Pete, I trust you'll pass along my regards to TAC for covering so much of our costs. Joan, of course, deserves much credit for working out many of the details for the weekend. You can bet I'll wear the sweatshirt with pride.

John, it was a pleasure to at last meet the fellow I'd read about for so long. I hope you found the trip worthwhile to offset the difficulties of the trip over here.

I hope we can do something like this again. To all, thanks.

6/18/90

Regards,

Scott Hubbard

SH

THE ATHLETICS CONGRESS
VALIDATION REPORT
Scott Hubbard, Michigan Regional Certifier

June 18, 1990

Dear John & Pete,

I arrived at the Battelle Park grounds at 9:30 am on 6/16. I was shown around the course by the race director who recommended an area to lay out a calibration course. After reviewing the course, I proceeded to lay out a 300 meter cal course along the east edge of the park road system.

There were three gates to negotiate and a construction zone that required taping. A turn-around point had been established on the south entrance service road. The start/finish line and all intermediate marks were clearly marked. After a bite to eat, I headed out to the cal course. The day was hot, sunny and humid.

I rode the course forward, stopping at each kilometer and one mile mark. This was done in case the marks would need adjustment. The roads were traffic-free and except for the gates which required special care, the ride was clean.

After finishing, I returned to the cal course and re-calibrated. I then returned to the shelter in the park to calculate course length. Following this, I went back on the course and re-located the turn-around and intermediate marks.

Results of my measurement:

1. Course length is 5017.6 meters.

2. Recommended shortening course by 12.6 meters.

Other findings are found in field notes.

Best,

Scott Hubbard

PS I should also note that I was provided lodging and free meals at race expense.

SH

BATTELLE PARK VALIDATION June 16, 1990

Laid out a 300 meter cal course in Battelle Park.

PRECAL 12:30 PM 82 F, Dry

FIGURES

7000		
9843	2843	
12685	2842	AVE CONSTANT: 2842.5
15527	2842	
18370	2843	

POSTCAL 1:30 PM 83 F, Dry

FIGURES

2000		
4842	2842	
7684	2842	AVE CONSTANT: 2842
10256	2842	
13368	2842	

AVERAGE FOR DAY: 2842.25
9474.1665 per KILOMETER

CALCULATIONS DO NOT INCLUDE .1% SCPF

FIELD NOTES

START	49000
1 KM	58549
1 MI	64129
2 KM	68053
3 KM	77545
TA	79639
4 KM	86915
FINISH	96538

TOTAL COUNTS: 47538 divide by 9474.1665= 5.0176445 KM
COURSE LENGTH: 5017.6 meters

**I MEASURED FROM FIXED POINTS ON EACH SIDE OF THE CONSTRUCTION ZONE. THE DISTANCE WAS 15 METERS. I CALCULATED THAT THIS WAS WORTH 143 COUNTS. I JUST ADDED THIS TO MY TOTAL AFTER CARRYING MY BIKE TO THE OTHER SIDE OF THE CONSTRUCTION ZONE.

SH

CALCULATE ADJUSTMENT OF MARKS USING SCPF .1%

One kilometer= 9484 counts

	HAD	NEED
START	49000	
1 KM	58549	58484 (65)
1 MI	64129	64262 (133)
2 KM	68053	67968 (85)
3 KM	77545	77452 (93)
4 KM	86915	86936 (See adjustment below)

SINCE COURSE WAS 12.6 METERS OVERSIZE, I SUBTRACTED THIS DISTANCE FROM THE TURN-AROUND POINT AS IT WAS THE BEST PLACE TO DO SO. I MOVED THE TURN-AROUND POINT 6.3 METERS TOWARD THE START/FINISH LINE, (2 x 6.3= 12.6). 12.6 meters EQUALED 119 counts. I SUBTRACTED THIS VALUE (119 counts) FROM THE FIGURE FOR THE 4K MARK TO DETERMINE A NEW VALUE FOR 4K.

THEREFORE, NEW FIGURES FOR 4K:

	HAD	NEED
4 KM	86796	86936 (140)

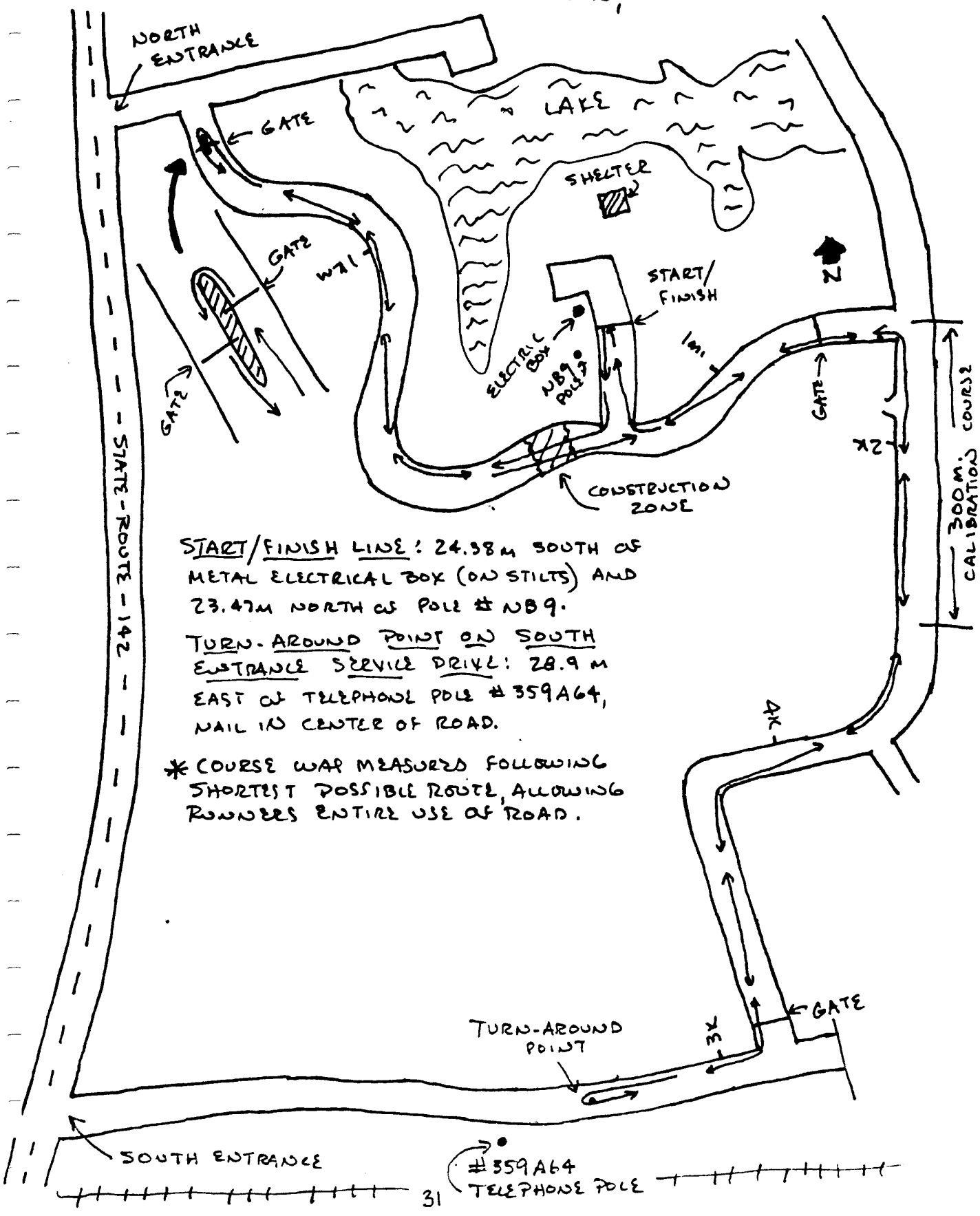
EACH COUNT IS WORTH .10544 meters

ADJUST MARKS ACCORDINGLY:
Move 1 Km 6.9 meters toward start (65 x .10544)
Move 1 Mi 14.1 meters toward finish (133 x .10544)
Move 2 Km 9.0 meters toward start (85 x .10544)
Move 3 Km 9.8 meters toward start (93 x .10544)
Move 4 Km 14.7 meters toward finish (140 x .10544)

NOTE ABOUT THE TURN-AROUND POINT: ALTHOUGH THE TA WAS LOCATED ALONG THE NORTH EDGE OF THE ROAD, I PLACED IT IN THE MIDDLE BECAUSE I FELT THAT WAS A MORE NATURAL RUNNING PATH.

BATTELLE PARK
WEST JEFFERSON, OH.

SH



START/FINISH LINE: 24.38 m SOUTH OF METAL ELECTRICAL BOX (ON STILTS) AND 23.47m NORTH OF POLE # NB9.

TURN-AROUND POINT ON SOUTH ENTRANCE SERVICE DRIVE: 28.9 m EAST OF TELEPHONE POLE # 359A64, NAIL IN CENTER OF ROAD.

* COURSE WAS MEASURED FOLLOWING SHORTEST POSSIBLE ROUTE, ALLOWING RUNNERS ENTIRE USE OF ROAD.

SH

MEASUREMENT CHECK BY LOTUS 1-2-3 USING SUBMITTED DATA

SCOTT HUBBARD - RECEIVED 6-21-90

PRECAL			POSTCAL		
7000			2000		
9843	2843	2842.5	4842	2842	2842
12685	2842	9475	7684	2842	9473.333
15527	2842		10526	2842	*
18370	2843		13368	2842	

CONSTANT FOR DAY = 9474.166 CTS/KM = 9.474166 CTS/METER

	RECORDED COUNTS	INTERVAL COUNTS	INTERVAL METERS	CORRECTED INTERVAL METERS
START	49000			
1K	58549	9549	1007.90	1007.80
1M	64129	5580	588.97	588.88
2K	68053	3924	414.18	414.18
3K	77545	9492	1001.88	1001.88
TA	79639	2094	221.02	221.02
4K	86915	7276	767.98	767.98
FINISH	96538	9623	1015.71	1015.71
TOTAL			5017.64	5017.46

ON TAPED DISTANCES, 15 METERS EACH, HUBBARD ADDED 143 COUNTS TO WHAT HE HAD WHEN HE ENTERED THE CONSTRUCTION ZONE, THEN RESUMED MEASURING.

143/(DAY'S CONSTANT) = 15.094 METERS

CORRECTED INTERVAL REFLECTS THE USE OF 15 M INSTEAD OF 15.094 METERS IN START-1K AND 1K-1M.

* SCOTT REPORTED 10256 AS THIRD POSTCAL COUNT. LIKELY TRANSPOSITION.

76 JD

JOHN DISLEY C.B.E.
DIRECTOR
Hampton House
Upper Sunbury Road
Hampton
Middlesex TW12 2DW

Tel: 081 979 1707
Fax: 081 941 1867

F A C S I M I L E

TO : Pete Riegel
FROM : John Disley
DATE : 22 June 90 NUMBER OF PAGES 4
(including this one)

M E S S A G E

Here are the figures for my measurements

1) Validation
2) Lay-out

Tom

JD

(1)

Battelle Park
5Km Course
Calibration Course - 300m

Pre Cal

2778.5
2778
2778.5
2779

Av. 2778.5
= 9261.666 cts per 1 km.

Post Cal

2779
2778.5
2778.5
2778.5

Av. 2778.625
= 9262.0883

Average for Day = 9261.87 cts for 1 km.

CERTIFICATION - VALIDATOR

Point	Count	Section Count	Section Metres
Start	68600		
Hole (west)	69427	827	89.3
Hole (east)	69567.5	—	15 m
1 Km	77934	8366.5	903.3
Hole (east)	82478.5	4539.5	490.1
Hole (west)	82613	—	15 m
1 mile	83390	777	83.89
2 Km	87234	3844	415.03
3 Km	96515.5	9281.5	1002.1
Turn	98553	2037.5	219.98
4 Km	1) 05675	7122	768.96
Finish	1) 15083	9408	1015.77
			5018.43m

JD

①

LAY OUT

Av. constant for day 9261.87 Obs/Km
× 1.001 = 9271.13
Av constant including 1:1000 = 9271.13

	Recorded Digits	Elapsed Counts	Interval metres	Interval mile	Cumulative metres	
Start	68600					
Hole	69427	827	89.2			
Holt	69567.5	—	15			
1 Km	77934	8366.5	902.4		1006.6	
Hole	82473.5	4539.5	489.6			
Holt	82613	—	15			
1 Mile	83390	777	83.8	−14.3m.	1595	1609.3
2 Km	87234	3844	414.6		2009.6	
3 Km	96515.5	92815	1001.1		3010.7	
Turn	98553	2037.5	219.7		3230.4	
4 Km	105675	7122	768.2		3998.6	
Fin.	115083	9408	1.014.7		5013.3	

②

Lay Out

Move	1 Km	6.6 TS
Move	1 ml	14.3 TF
Move	2 Km	9.6 TS
Move	3 Km	10.7 TS
Move	Turn	6.7 TS/TF
Move	4 Km	14.2 TF

Finish + Start remain as before.

Ian Dickey

JD

MEASUREMENT CHECK BY LOTUS 1-2-3 USING SUBMITTED DATA

JOHN DISLEY - RECEIVED 6-22-90

PRECAL		POSTCAL	
2778.5	2778.5	2779	2778.625
2778	9261.666	2778.5	9262.083
2778.5		2778.5	
2779		2778.5	

CONSTANT FOR DAY = 9261.875 CTS/KM = 9.261875 CTS/METER

	RECORDED COUNTS	INTERVAL COUNTS	INTERVAL METERS		
START	68600				
BEG CON	69427	827	89.29		
			15.00	TAPED	15.17 BY BIKE
END CON	69567.5				
1K	77934	8366.5	903.33		
END CON	82473.5	4539.5	490.13		
			15.00	TAPED	15.06 BY BIKE
BEG CON	82613				
1M	83390	777	83.89		
2K	87234	3844	415.03		
3K	96515.5	9281.5	1002.12		
TURN	98553	2037.5	219.99		
4K	105675	7122	768.96		
FINISH	115083	9408	1015.78		
TOTAL			5018.51		

MW

The Athletics Congress of the USA

The Governing Body for Athletics in the United States including Track and Field, Long Distance Running and Race Walking for men and women and boys and girls at all age levels.

MIKE WICKISER
2939 Vincent Road
Silver Lake, Ohio 44224
(216) 929-1605

6-20-90

V A L I D A T I O N R E P O R T

TO WHOM IT MAY CONCERN :

This report details the IAAF validation measurement seminar conducted June 15 & 16, 1990 in Dublin, Ohio. It was arranged by Pete Reigel with agenda, accommodations, and preliminary informational mailings handled by Joan Riegel. Arriving at the Courtyard by Marriot in Dublin, Ohio on Friday, June 16, 1990, room reservations had been made and I was informed of other attendees having already arrived. An informal discussion took place adjacent to the lobby area of the hotel prior to the 7:00 PM scheduled dinner meeting where various members of the seminar were able to become acquainted with one another. This informal group meeting worked very well and continued on thru dinner when plans were set to meet in the lobby at 8:00 AM the following morning.

A caravan led by Pete Riegel left at that time proceeding to Battelle Park were the actual 5 kilometer course was located.

Upon arriving at the race course site, Pete Riegel & John Disley outlined the day's schedule and passed out course maps and answer submittal sheets to be completed and turned in by the day's end. I have included an answer sheet in this package with a correction made with regards to adjustment of the 4K split.

With opening remarks concluded, Pete Riegel then led two groups over the race course, marking a construction area which could not be measured by bicycle, and painting artificial curbs along poor edges of some turn areas. During the course tour, Pete answered questions regarding available race course areas and pointed out a suitable 300+ meter section for a calibration course.

This done, Wayne Nicoll and Bob Baumel conducted separate measurements and remeasurements of parallel 300 meter calibration courses on opposite sides of the road. Enclosed course map indicates area used for this purpose. The only problem in this seminar came about from using different steel tapes, in both 30 meter and 200 foot lengths and numerous Celcius and Fahrenheit thermometers.

Only after much discussion with regards to tension and temperature effects on the two different tapes, was the exact 300 meter length agreed upon and each course was marked with PK nails and paint at the terminal points. A cure for this snag would be to limit future seminars to one thermometer and one tape measure. Teams could measure and recheck length with much less lost time in that manner.

Calibration courses completed, measurers were instructed to make only one measurement ride of the course. Familiarization rides were allowed so long as no measurement data was taken. I chose to ride the course one time to help get a mental picture and work out some of the obstructions involved. This appeared to be a common method used by various others.

I then returned to the calibration course, calibrated, and proceeded to measure. Beginning at the start/finish location, I made one complete ride of the course with the bike being carried (wheel locked) around the aforementioned construction area in each direction. The construction area was less than 15 meters across and two sets of marks were made at points on each end in line with the S.P.R. These were set and measured at 15 meters in length for ease of figuring purposes. Immediately after measuring the race course, I recalibrated and returned to the shelter house where data was reviewed and Pete's question sheet was completed. No discussion of results was permitted prior to turning in the information sheets so as to give no advantage.

After all measurers had completed gathering data and most had submitted answers, Pete Riegel led the way back to the hotel.

Another dinner meeting was held at 7:00 PM where Pete passed out result tabulations showing all participants data and replies. Much discussion ensued over the results with regards to the longest, shortest, and average distance and numerous ways of looking at these results.

My personal results show the course to be 5019.8 meters. All other measurers show it to be in excess of 5000 meters. It is therefore quite safe to say that this course exceeds advertised length and should support any records.

After the meeting concluded, I said my "goodbyes" and left for home. I was very pleased to be involved in such a seminar. The experience has been invaluable.

MW

Not to mention that I am now able to connect names with faces and made the aquaintance of a number of fellow measurers. Congratulations to Pete and Joan Reigel on a very enjoyable seminar with excellent accomadations.

Also find enclosed with this report are a course map as measured, a copy of the answer sheet with my corrected data, field data notes, a TAC validation form, and a race course validation measurement data report of my own configuration.

Respectfully submitted,

Mike Nichols

cc: Pete Riegel
John Disley

MW

RACE COURSE VALIDATION MEASUREMENT DATA REPORT

MEASURER : MIKE WICKISER 2939 VINCENT RD. SILVER LAKE, OHIO 44224

CALIBRATION COURSE LENGTH : 300 METER (ON SITE) DATE : JUNE 16, 1990

PRECALIBRATION TEMP. 88 F. TIME : 12:30 PM.		POSTCALIBRATION TEMP. 89 F. TIME : 1:27 PM.	
COUNTS	ELAPSED	COUNTS	ELAPSED
65500		34100	
68343	2843	36942	2842
71186	2843	39784	2842
74029	2843	42626.5	2842.5
76872	2843	45469	2842.5
TOTAL	AVERAGE	TOTAL	AVERAGE
11372	2843	11369	2842.25

AVG. PRE/POST CAL. COUNTS = 2842.625 * (300/100) = 9475.4166 COUNTS/KILOMETER

RACE COURSE MEASUREMENT DATA

COURSE NAME or I.D.# BATTELLE PARK 5 KILOMETER

START TIME = 12:45 PM. TEMP. = 87 F. FINISH TIME = 1:23 PM. TEMP.= 90 F.

WEATHER CONDITIONS : CLEAR + SUNNY

		ELAPSED	
START :	82000		
1 K/M :	91410	9410	ADD 15 METERS STEEL TAPED DISTANCE
1 MILE:	96850	5440	ADD 15 METERS STEEL TAPED DISTANCE
2 K/M :	100780	3930	
3 K/M :	110278	9498	
4 K/M :	119651	9373	
5 K/M :	129280	9629	
		TOTAL	
		47280 COUNTS	PLUS 30 METERS DUE TO CONSTRUCTION WHICH REQUIRED STEEL TAPE MEASUREMENT.

TOTAL ELAPSED COUNTS : 47280

AVG. COUNTS PER KILOMETER : 9475.4166

CALCULATED COURSE LENGTH : 4989.7542 METERS

STEEL TAPED DISTANCE : 30 METERS

TOTAL RACE COURSE LENGTH : 5019.7542 METERS

NOTES / COMMENTS : COURSE EXCEEDS STATED DISTANCE BY CONSIDERABLE AMOUNT. ADJUSTMENT OF 14.7 METERS ACCEPTABLE

MW

Field Notes

COURSE NAME : Buttelle DATE 6-16-90

PRECALIBRATION 300 meter Course
TEMP. 88°F TIME : 12:30 PM

POSTCALIBRATION
TEMP. 89°F TIME : 1:27 pm

COUNTS	ELAPSED
65500	
68343	2843
71186	2843
74029	2843
76872	2843

COUNTS	ELAPSED
34100	
36942	2842
39784	2842
42626.5	2842.5
45469	2842.5

TOTAL 71372 AVG. 2843 = TOTAL 11369 AVG. 2842.25

AVG. Pre/Post cal counts = 2842.625 = 9475.4166 counts/km

MEASUREMENT DATA

START TIME 12:45pm TEMP. 87°F FINISH TIME 1:23pm TEMP. 90°F
WEATHER CONDITIONS : Clear Sunny

START : 82000 +15m count.
1K 91410 +15m count..
1m 96850
2K 00780
3K 10228 TO-12365
4K 19651
5K 29280

TOTAL ELAPSED COUNTS 47280 = 4.9897542 km + 30 meters =

AVG. COUNTS PER KILOMETER 9475.4166
AVG. COUNTS PER MILE 15249.204

COURSE LENGTH 5019.7542 meters.

1k = 94100 + .9930961 + 15m = 1008.0916 meters.
1m = 14850 + .9738213 Miles = 30m = .0186411 = .9924624 miles
2k = 18780 1.9819709 + 30m = 2011.9709 meters
3k = 28278 2.9843542 + 30m 3014.3542 meters
4k = 37651 3.9735456 + 30m 4003.5456 meters
5k = 47280 + 4.9897542 + 30meters = 5019.7542 meters

MW

The Athletics Congress of the USA

The Governing Body for Athletics in the United States including Track and Field, Long Distance Running and Race Walking for men and women and boys and girls at all age levels.

SALLY H. NICOLL
Ragged Mountain Club
Potter Place, New Hampshire 03265

VALIDATION REPORT

Name of Race BATTELLE PARK 5 kilometer Location WEST JEFFERSON , OHIO

Date(s) of Race N/A Course ID # N/A

Advertised Race Distance 5 kilometers

Describe how you determined the exact route used by the race in question
route as shown by map & by ride around course with Pete Riegel

Validation Measurement Data (if such measurement is required or necessary)

Calibration Course two parallel on site courses laid out for validation Length 300 meter

Is the calibration course a previously certified course? YES (NO)

Did you check the length of the calibration course? (YES) NO

If you did check, please indicate the method used and the results

Two parallel cal courses - laid out + Double measured by 3 teams of measurers under Direction of Wayne Nicell + Bob Baumel

1. Pre-measurement calibration

Time of Day 12:30 pm Temperature 88° F.

	Finish Count	-	Start Count	=	Difference
#1	68343	-	65500	=	2843
#2	71186	-	68343	=	2843
#3	74029	-	71186	=	2843
#4	76872	-	74029	=	2843

Average Pre-Measurement Count 2843

2. Course Measurement. Note that a single ride, following the SPR as available to the runners on race day, is required. You may wish to attach descriptions of deviations from the SPR, uncertainties in the exact route available for the race, or other sources of measurement variability. An analysis of sources of error and findings of concomitant non-validation measurements may also be appended to this report.

Time of Day at Start of Measurement 12:45 pm Temperature 87° F.

Finish Count 129280 (minus) Starting Count 82000

Counts on Course 47280 · plus 30 meters steel taped due to construction area

Time of Day at End of Measurement 1:23 pm Temperature 90° F.

MW

3. Post-measurement calibration

Time of Day 1:27 pm Temperature 89° F.

	Finish Count	-	Start Count	=	Difference
#1	36942	-	34100	=	2842
#2	39784	-	36942	=	2842
#3	42626.5	-	39784	=	2842.5
#4	45469	-	42626.5	=	2842.5

Average Post-Measurement Count 2842.25

4. Calculation of Length of Course

a. Pre-Measurement Count 2843 -

b. Post-Measurement Count 2842.25

c. Average Count ((a+b)/2) 2842.625

d. Length of Calibration Course 300 meter

e. Validation Constant (c/d) 9.4754166

f. Counts on Course (from #2) 47280 plus 30 meters

g. Calculated Course Length (f/e) 4989.7542 plus 30 = 5019.7542 meters

h. Advertised Course Length 5000 meters

i. Percent Difference (100(g-h)/h) 0.39508

I, the undersigned, hereby attest that the foregoing report is a fair and unbiased examination of the length of the race or races conducted on the road race course in question. All numerical information reported herein was gathered or directly witnessed by me and is a true statement of my findings.

Mike Wickiser
(signed)

Date of Validation 6-16-90

Name and Address of Validator MIKE WICKISER 2939 Vincent rd. Silver Lake, Ohio 44224

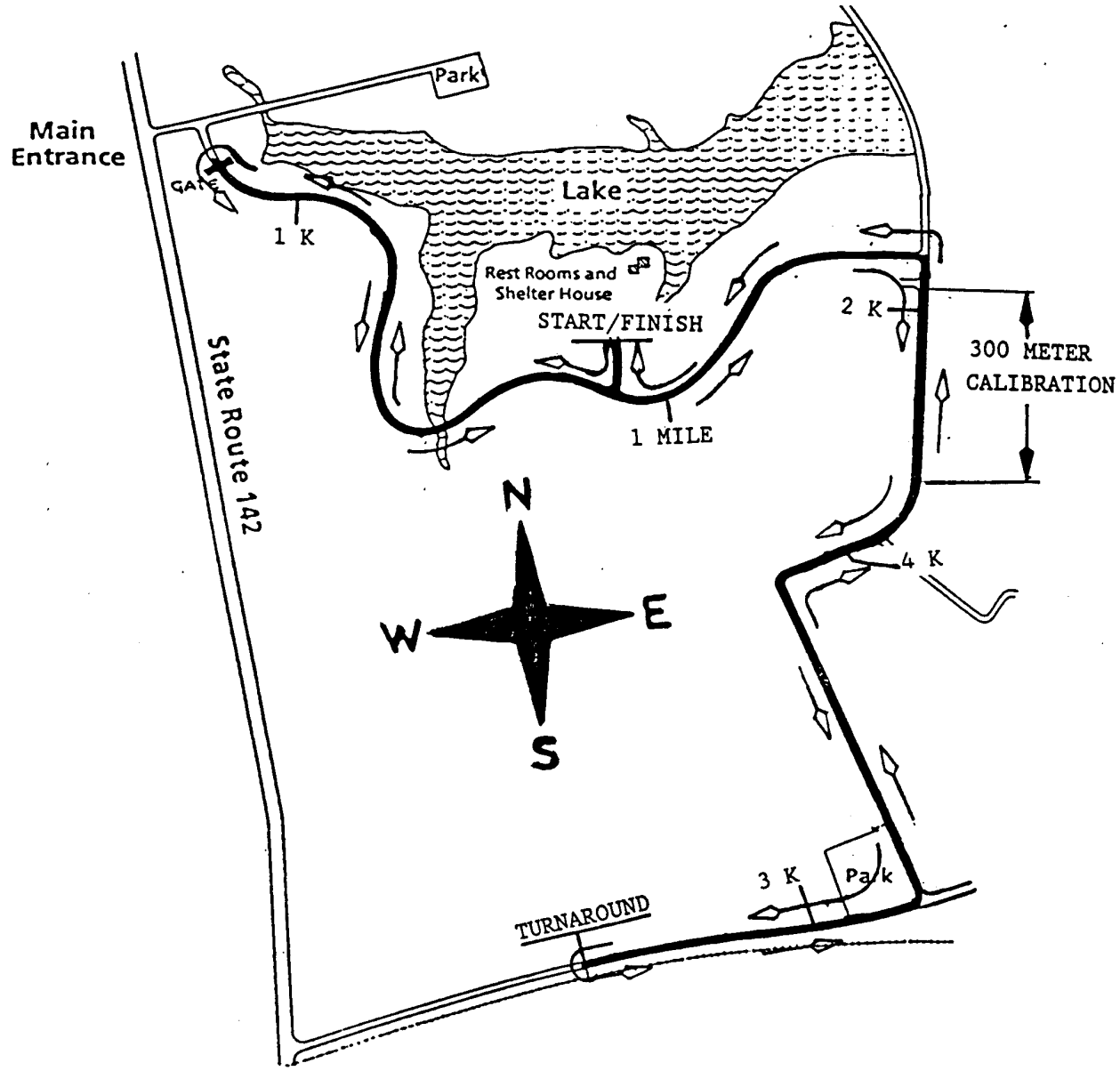
(216) 929-1605

Please Attach: Copy of Course Certificate
Copy of Detailed Map of the Course
Narrative Report of Validation Activity

MV'

B A T T E L L E P A R K 5 KILOMETERS
WEST JEFFERSON, OHIO

START / FINISH : BATTELLE PARK SHELTER HOUSE PARKING AREA
23.5 METERS EAST OF UTILITY POLE # NB9
GATE TURNAROUND : RUNNERS PROCEED THRU EXIT GATE,
AROUND CONCRETE ISLAND,
AND BACK THRU ENTRANCE GATE
TURNAROUND : BATTELLE PARK SOUTH ENTRANCE RD.
22 METERS EAST OF UTILITY POLE #359A64



START / FINISH, TURNAROUND AND
ALL INTERMEDIATE SPLITS MARKED
WITH PK NAILS AND WHITE PAINT

RUNNERS HAVE FULL USE OF PAVED ROADWAY THROUGHOUT

MW

MEASUREMENT CHECK BY LOTUS 1-2-3 USING SUBMITTED DATA

MIKE WICKISER - RECEIVED 6-22-90

PRECAL			POSTCAL		
65500			34100		
68343	2843	2843	36942	2842	2842.25
71186	2843	9476.666	39784	2842	9474.166
74029	2843		42626.5	2842.5	
76872	2843		45469	2842.5	

CONSTANT FOR DAY = 9475.416 CTS/KM = 9.475416 CTS/METER

	RECORDED COUNTS	INTERVAL COUNTS	INTERVAL METERS	CORRECT METERS	
START	82000				
1K	91410	9410	993.10	1008.10	FOR CORRECT METERS, ADD 15
1M	96850	5440	574.12	589.12	METERS TO START-1K AND
2K	100780	3930	414.76	414.76	1K-1M.
3K	110278	9498	1002.38	1002.38	
TURN	112365	2087	220.25	220.25	
4K	119651	7286	768.94	768.94	
FINISH	129280	9629	1016.21	1016.21	

TOTAL 5019.754

ETM

INTRODUCTION

The first IAAF course measurement seminar to be conducted in the United States was held in Columbus, Ohio on June 15-17, 1990. Peter Riegel, Chairman of the Road Running Technical Committee of The Athletics Congress, and his wife, Joan, were hosts. Attendees included John Disley of Great Britain, the IAAF representative, and twelve U.S. measurers. The purpose of the seminar was to evaluate the measurers for possible acceptance as an approved IAAF measurer.

REPORT

Friday (06.15.90) – The first evening was spent socializing and preparing for the activities scheduled for the next day.

Saturday (06.16.90) – The group left headquarters (Marriott Courtyard) promptly at 8 am and drove to the Battelle Recreation Facility in West Jefferson, Ohio. This facility is a private park for the use of Battelle employees only and on this day was virtually traffic free.

Following a brief orientation and a conducted tour of the 5 km road course (previously laid out), the measurers divided into two groups for the purpose of establishing two temporary 300 meter calibration courses by steel taping. Bicycle calibration followed using the standard Jones counter.

Each rider then independently measured the 5 km course in the validation manner, i.e. one ride without the SCPF. The course included an "impassible construction site," full road width barriers and a turn-around.

The post calibration ride was performed immediately after the course ride. A steel taping of the construction site was also performed.

Using data collected from the calibration and course rides, questionnaires concerning the course were then completed. These questions were of two types: 1) the validation of an existing course on which a record had been set; and 2) the adjustment of this same course to IAAF standards including accurately placed splits. Answers were evaluated by Peter Riegel and John Disley.

CONCLUSIONS, THOUGHTS, SUGGESTIONS, ETC.

How exciting it was to be associated with a group that is learning the way in its field. and spreading the word. Road course measurement is an export we can be proud of.

The only for improvement that I could see was in the taping of the temporary cal courses. Pete was right about our being uptight when it comes to cal courses. We do need to put things in perspective.

All in all, Pete, it was an extraordinary weekend. The coming together, the sharing of ideas, the camaraderie – it was all there. You and Joan made it happen, and I thank you.

ETM

E. T. (Tom) McBrayer

06.22.90

Validation Course Length - Work Sheet

- Pre Cal 9925 cts/km
  Post Cal 9923.75
  Total 19848.75
  Avg 9924.375

- Val Ride
  Finish Count 98095 Δ = 49595 cts
  Start Count 48500

49595 cts / 9924.375 cts/km = 4.997292 km = 4997.292 m

Add Taped Distances 10.845
10.870

Total Course Length 5019.107 m

IAAF - Quality Course

Course Length as Validated 5019.107 m
Length Required for IAAF 5005.0
Δ = 14.107 m

Distance to be removed from existing course

Adjustment: Move Turn Around $\frac{14.107}{2}$ m

Toward Start/Finish = 7.0535 m

Relocation of Splits

Split	cts	m	+ Taped Distance	Total
1 km	9897	997.2416	10.945 m	1008.1866
1 Mile	15635	1575.4141	10.945 + 10.870	1597.2291
2 Km	9849	992.405	10.870	1003.275
3 km	9945	1002.0782	—	1002.0782
T-A				
4 km	9818	989.2814	—	989.2814

ETM

RELOCATION OF SPLICES (CON'T)

SPLIT	MEASURED SPLIT DISTANCE m	CUMULATIVE m	REQ'D m	ADJUSTMENT (m) TOWARD	
1 km	1008.1866	1008.1866	1001	7.1866	S
1 MILE	1597.2291	1597.2291	1610.953	13.7239	F
2 km	1003.275	2011.4616	2002	9.4616	S
3 km	1002.0782	3013.5398	3003	10.5398	S
T-A				7.0535	S/F
4 Km	989.2814	4002.8212*	4004	15.2858	F

* SUBTRACT TURN AROUND ADJUSTMENT (TOTAL DISTANCE)

4002.8212 - 14.107 = 3988.7142 m

BICYCLE CALIBRATION DATA SHEET

Date of Measurement 06·16·90

Name of Measurer E T McBRAYER

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

Ride	Start Count	Finish Count	Difference
①	30400	33378	2978
②	33378	36355	2977
③	36355	39332	2977
④	39332	42310	2978

Pre-measurement Average Count 2977.5

Time of Day 11 37 A

Temperature 85°F

Length of Calibration Course 300 m

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

Working Constant = $\frac{2977.5 \text{ CTS}}{300 \text{ m}} = 9925 \frac{\text{CTS}}{\text{Km}}$

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	03200	06177.5	2977.5
②	06177.5	09155.5	2978.0
③	09155.5	12131	2975.5
④	12131	15108.5	2977.5

Post-measure Average Count 2977.125

Time of Day 12 35 PM

Temperature 87°F

FINISH CONSTANT = Number of counts in one kilometer or one mile, calculated from Postmeasure average count, and multiplied by **1.001 "safety factor"**

Finish Constant = $\frac{2977.125 \text{ CTS}}{300 \text{ m}} = 9923.75 \frac{\text{CTS}}{\text{Km}}$

Constant for the Day = **Either** the Working Constant **or** the Finish Constant, whichever is the **larger**. $(9925 + 9923.75) \div 2 = 19848.75 \div 2 = 9924.375 \frac{\text{CTS}}{\text{Km}}$

CONSTANT FOR THE DAY = _____

NOTE: FOR VALIDATION RIDE, AVERAGE PRE & POST RIDES

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 recalibration "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

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COURSE MEASUREMENT DATA SHEET

Name of Course or Race Name BATTELLE PARK 5 km

Name of Measurer #1 E T McBRAYER Working Constant #1 _____

Date 06·16·90 Start: Time 12 NOON Temperature 86°

Finish: Time 12 52 P Temperature 87°F

Name of Measurer #2 _____ Working Constant #2 _____

Date _____ Start: Time _____ Temperature _____

Finish: Time _____ Temperature _____

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 Recorded	Elapsed	~~Counts for Measurer #2 Recorded~~	~~Elapsed~~
START	48500			
CONST	49420	9897		
1km	58397			
CONST	63297			
1MILE	64135	9849		
2km	68246	9945		
3km	78191			
T-A	80379	9818		
4km	88089			
FINISH	98095	10086		

TAPED DISTANCES FOR CONSTRUCTION SITE

1. 10,945 m

2. 10.870 m

Preliminary Course Length	start-to-finish counts	divide by	~~working~~ constant	=	measured length
Measurer #1	49535	/	9924.375	=	4997.292 m
Measurer #2		/		=	

Difference between lengths #1 and #2	divide by	length #1	=	Measurement comparison (less than 0.0008?)	
	/		=		(___) [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		/		=	

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

Measured course length _____. Desired course length _____

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.

How much did you add or subtract, and where (start, finish, turn-around point)?

_____

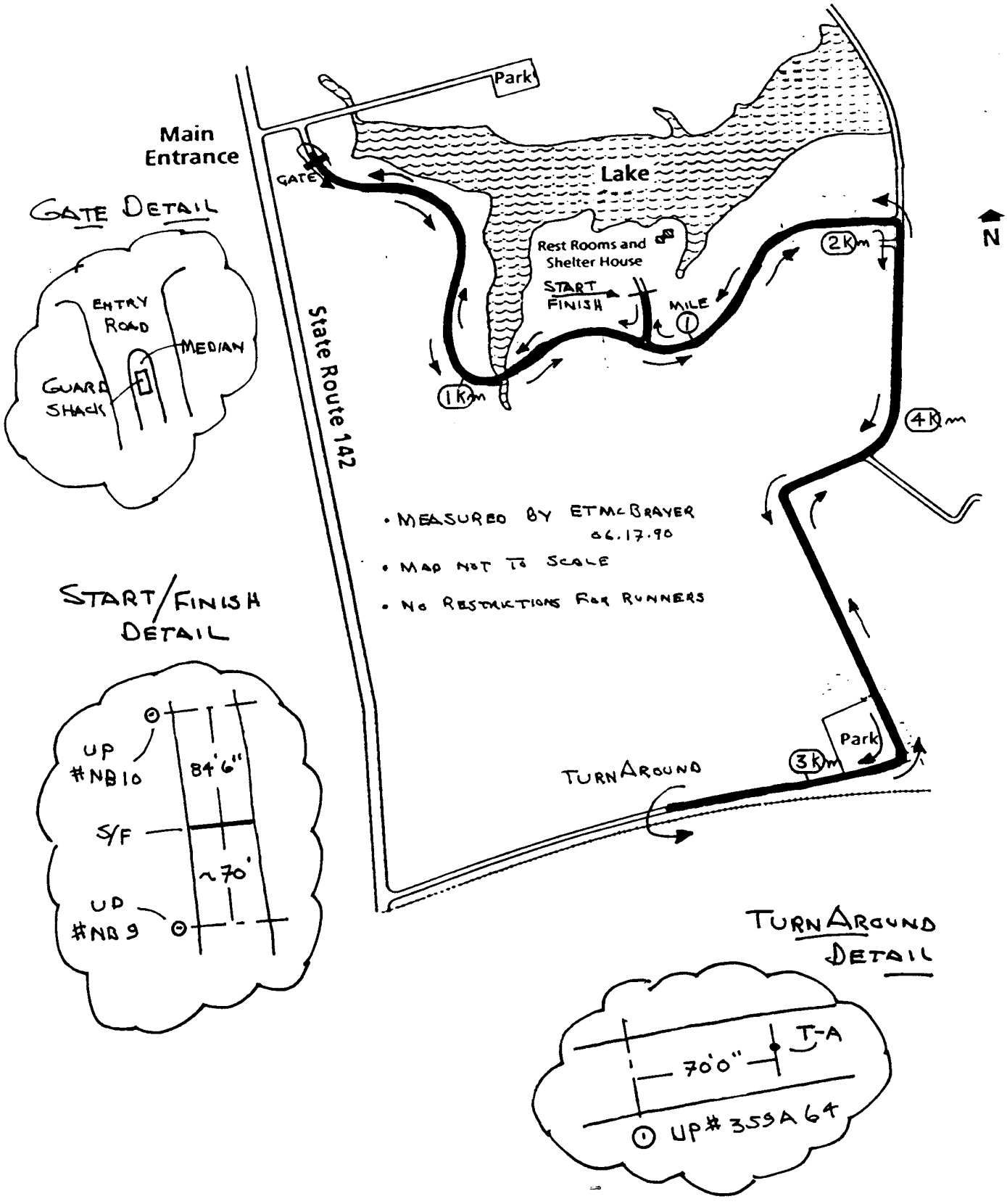
Note: You need not adjust intermediate split points unless certification is desired for those points as well. Did you adjust the intermediate points and, if so, how?

_____

ETM

ETM

BATTELLE PARK
WEST JEFFERSON, OHIO



PRECAL 06.16.90

11²⁷ 85°F

F 33378 11910
S 30400 AVG 2977.5
2978

F 36355 9925 ≤75 Km
S 33378
2977

F 39332
S 36355
2977

F 42310
S 39332
2978

ETM

IL 32

F 6177.5 11908.5
S 05200
2977.5 2977.125

F 9855.5
S 06177.5 9923.75 <70/km
2978.0

F 12131.0
S [illegible]
2977.5

F 15162.5
S 12131
2977.5

06.16.90

CONTINUED
1. 10.945 m
2.

06.16.90

ET RIKF
12 Noon [illegible]

S 4 48506
CONST 49420 9897

1 Km 58397
CONST 6[illegible] 9849
1 Mi 64[illegible]
2K 68246 9945
3K 73191
T-A 80279 9818
4K 8[illegible]
F 90695 10086

49595

FIELD NOTES 06.16.90
(51) ET McBRAYER

ETM

MEASUREMENT CHECK BY LOTUS 1-2-3 USING SUBMITTED DATA

TOM MCBRAYER - RECEIVED 6-25-90

PRECAL			POSTCAL		
30400			3200		
33378	2978	2977.5	6177.5	2977.5	2977.125
36355	2977	9925	9155.5	2978	9923.75
39332	2977		12131	2975.5	
42310	2978		15108.5	2977.5	

CONSTANT FOR DAY = 9924.375 CTS/KM = 9.924375 CTS/METER

	RECORDED COUNT	INTERVAL COUNT	INTERVAL METERS
START	48500		
BEG CON	49420	920	92.70
		TAPED	10.945
END CON	49420		
1K	58397	8977	904.54
END CON	63297	4900	493.73
		TAPED	10.87
BEG CON	63297		
1M	64135	838	84.44
2K	68246	4111	414.23
3K	78191	9945	1002.08
TA	80379	2188	220.47
4K	88009	7630	768.81
FINISH	98095	10086	1016.29
TOTAL		48675	5019.107

GT

Wiborn Road
Shortsville, NY 14548
June 20, 1990

Dear Pete

The weekend was a superb experience for me-the challenges that you presented to us, the opportunity to discuss measuring situations with so many experts and the fellowship. Many many kind thanks for inviting me.

Enclosed is my paperwork. If time permits, any negative comments that you might have would be appreciated. I truly love the challenge of measuring courses and I hope that I have the opportunity to do many.

Thanks to Joan for making all of the arrangements, and for putting together for us on Saturday a very enjoyable lunch as we diligently toiled in the "library". And the lovely green shirt with our message, very nice to have, and I wore it last night to a track meet. Several people commented on it.

I did not toil sufficiently for I readily noted my errors in using the safety factor for validating the course and in moving the 4K adjustment in the wrong direction. Also I woke up early Sunday morning and realized that I should have been much more conservative in measuring the course, I hugged the turns too much, not staying out a foot. I rode the course too tightly.

Pete, I wish that we could have had more time: chat about Colorado as I climbed many mountains in the Climax area including several times the one so visible to the area, Holy Cross, and learn more about the nature of projects undertaken by Battelle. And I wish that we could have had as a group a discussion with general questions and observations. One item that I wanted to bring up, race courses that have 90 Deg turn within a 100' of the finish despite the recommendation on page 37 of Course Measurement Procedures. I realize that we can only suggest changes but it works. I measured a course two weeks ago in Rochester and the finish line was going to be in a parking lot just 50' after a 90 D turn. I got the race director to have the finish on a straightaway.

I sure appreciate your hospitality. And I enjoyed the meals at the comfortable hotel. Was also nice to be close to the excellent Dublin HS track. Thanks so much.

Best Regards George

And I am pleased to be able to see so much valuable information in Measurement News. Thanks for your fine efforts

53

I've used my car's odometer for laying out a couple of courses - checked it on the NY Thruway - I'm about 1.4 miles / 100 miles along the Thruway, the Thruway is quite accurate I have been advised. I've also measured

BICYCLE CALIBRATION DATA SHEET

(1) GT

Date of Measurement June 16 1990

Name of Measurer George Tillson (Use Separate Data Sheet ~~for 2nd Measurer~~)

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

Ride	Start Count	Finish Count	Difference
1	10,000	12,933	2,933
2	12,933	15,868	2,935
3	15,868	18,803	2935
4	18,803	21,738	2935

Pre-measurement Average Count 2,935

Time of Day 11:30 am

Temperature 88° F

11,738 ÷ 4 = 2934.5 = 2,935

Length of Calibration Course: Name and ID Code # - 300 metres

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

NOTE: NEVER round down, ALWAYS round up.

Working Constant = 2,935 x 1.001 safety factor = 2,937.935

Rounded up = 2,938 = 300 metres, 1,000 metres = 9,793.3 C

Working constant = 9,794 counts

1,000m = 3280.84' = 9794 Counts

∴ 1 mile (5,280') = 15,762.463 = 15,763 counts

Without safety Factor = 9,794

300 x 2,935 = 880,500 ÷ 1000 = 9,793.333 = 9,794 rounded up

NOTE: Read page 9 of Manual, "How to take temp. readings". Check tire air pressure before calibration rides. DO NOT touch it until AFTER re-calibration rides.

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	91,000	93,934	2,934
2	93934	96,869	2935
3	96,869	99,804	2,935
4	99,804	2,740	2936

Post-measure Average Count 2,935

Time of Day 2.00 pm

Temperature 90° F

11,740 ÷ 4 = 2,935 = 300 metres

FINISH CONSTANT = Number of counts in one kilometer or one mile, calculated from Postmeasure average count, and multiplied by **1.001 "safety factor"**

300 metres = 2,935 c. x 1.001 = 2,937.935 = 2,938

Finish Constant = 2,938 = 300 metres 1,000 metres = 9,793.3 =

Finish constant = 9,794 counts

Constant for the Day = **Either** the Working Constant **or** the Finish Constant, whichever is the **larger**. (circle one) Both the same

CONSTANT FOR THE DAY = 9,794 counts

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 recalibration "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

Battelle Park - 5 K Race Course
West Jefferson, Ohio

(2) GT

Validation of Race Course conducted on June 16, 1990

Measured Point	Calculated Counts		Recorded Counts	Long by	Short by	Adjustment
Start	0	35,000	35,000			
Obstacle - Temporary Ditch	15 metres wide *		35,974 + 147 = 36,021			
1 K	9,794	44,794	44,860	66		Shorten 66c = 6.74m
Ditch			49,656 − 147 = 49,803			
Imid	15,763	50,763	50,623		140	Lengthen 140c = 14.29m
2 K	19,588	54,588	54,678	90		Shorten 90c = 9.19m
3 K	29,382	64,382	64,490	108		Shorten 108c = 11.03m
Turnaround			66,644			Adjust by 142c shorten 71 counts
4K	39,176	74,176	74,170		6	Lengthen 6c + adjustment in finish (see page 3)
Finish	49,970	83,970	94,112	142		For validation purposes course is long by 192 counts = 19.6 metres
without safety factor	48,920	83,920	94,112	192		

1000 m = 9,794c 1 metre = 9.794 c

* 15 metres wide ditch - carried bicycle across the ditch

300 m = 2,938c, 15m = 147 Counts (55) G. Tillson June 18/90

Bathelle Park 5K Race Course

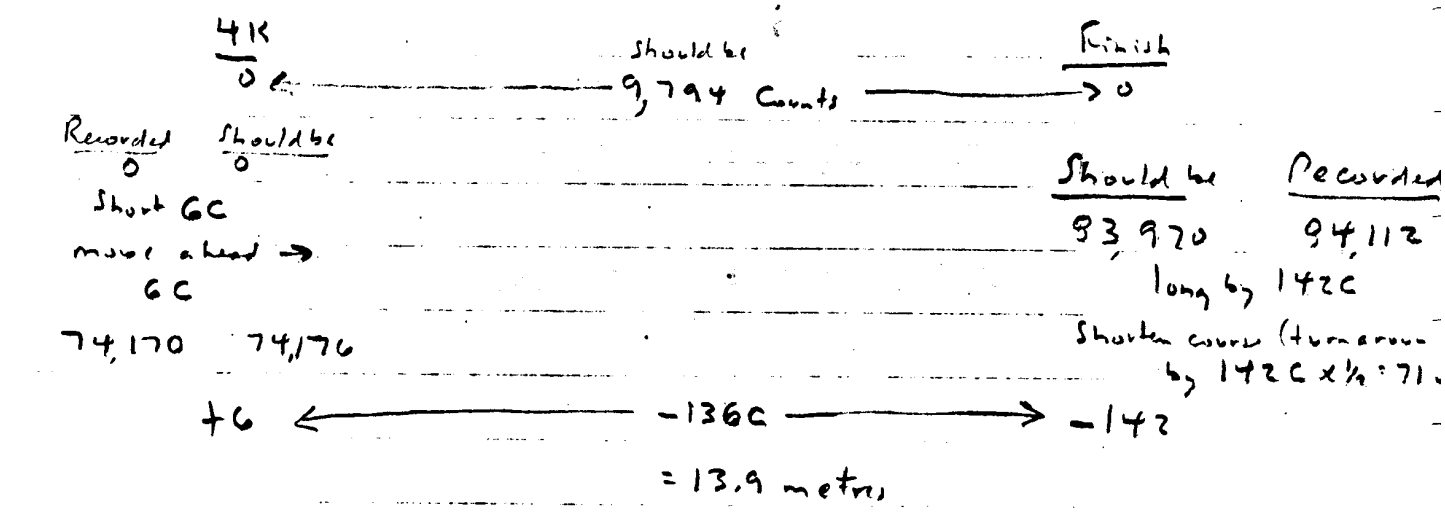
(3) GT

Adjustments in South Turnaround and 4K points

Finish: Calculated Counts with safety factor 48,970
Found course to be 142C = 14.5 metres too long

Turnaround needs to be moved
As runners should run 142C less (14.5 m),
the S. turnaround should be moved towards the start and finish
by 1/2 of 142C = 71 Counts = 7.25 m

4K split



4K
Should be 74,176 Counts

Recorded
9,936

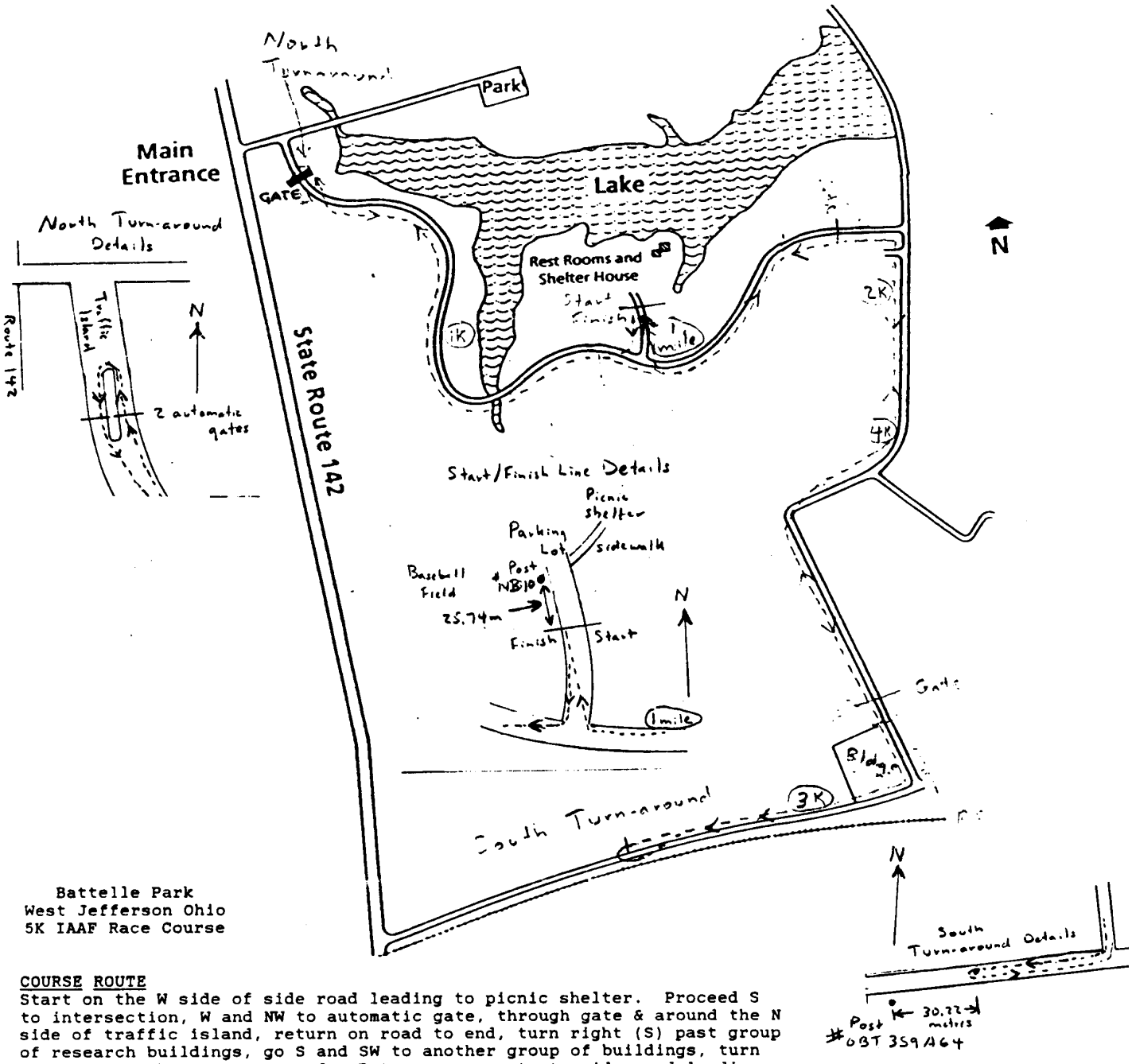
Finish
Recorded 84,112

Therefore move 4K toward finish by
136 (142-6) counts = 13.9 meters

George Tillson June 19/90

GT

BATTELLE PARK
WEST JEFFERSON, OHIO
5K IAAF Race Course



Battelle Park
West Jefferson Ohio
5K IAAF Race Course

COURSE ROUTE
Start on the W side of side road leading to picnic shelter. Proceed S to intersection, W and NW to automatic gate, through gate & around the N side of traffic island, return on road to end, turn right (S) past group of research buildings, go S and SW to another group of buildings, turn right and go W to turn-around. Return same route to side road leading to shelter and the finish. Start/Finish Line are at the same point.

START: On W side of road leading to picnic shelter. Start is 25.74m S of pole #NB10. Pole is opposite pathway entrance to shelter.
South Turn-around: On N side of E-W road which is the next road S of main entrance road. 30.22m E of pole #OBT 359A64. Pole on S side of road adjacent to RR track.
Finish: Same as the start.

Turnaround description includes the final course adjustment.

Shortest Possible Route was measured.
Measured by George Tillson June 17, 1990

GT

MEASUREMENT CHECK BY LOTUS 1-2-3 USING SUBMITTED DATA

GEORGE TILLSON - RECEIVED 6-25-90

PRECAL			POSTCAL		
10000			91000		
12933	2933	2934.5	93934	2934	2935
15868	2935	9781.666	96869	2935	9783.333
18803	2935		99804	2935	
21738	2935		102740	2936	

CONSTANT FOR DAY = 9782.5 CTS/KM = 9.7825 CTS/METER

	RECORDED COUNT	INTERVAL COUNT	INTERVAL METERS		
START	35000				
BEG CON	35874	874	89.34		
			15.00	TAPED	TILLSON ADDED 147 COUNTS
END CON	36021				TO ACCOUNT FOR 15 METERS
1K	44860	8839	903.55		AT CONSTRUCTION AREAS
END CON	49656	4796	490.26		
			15.00	TAPED	15 METERS IS USED
BEG CON	49803				IN THIS CALCULATION
1M	50623	820	83.82		
2K	54678	4055	414.52		
3K	64490	9812	1003.02		
TA	66644	2154	220.19		
4K	74170	7526	769.33		
FINISH	84112	9942	1016.30		
TOTAL			5020.339		

DL

Validation Report

16 June 1990

Battelle Park 5K, Columbus, Ohio

A group of TAC measurers met to measure a road course for the purpose of validating its length. Two calibration courses were measured by the group. Cal Course measurement was headed by Wayne Nicoll and Bob Baumel who each measured a 300 meter course. The two cal courses were checked by Tom Knight and Bob Thurston respectively. I participated in the layout of the Baumel cal course. Our measurement was made with a 60 meter steel tape. I personally inspected the length of the tape for kinks or breaks or splices and found no abnormalities. We used standard TAC procedures to conduct the measurement. I held the tail end of the tape on each mark starting with the PK nail at the north end of the course. Mike Wickiser held the other end of the tape, stretching it with a spring scale to the appropriate force. Baumel placed tape on the road surface and marked each length. Marking tape was pre-marked and I counted the number of segments and subsequently checked the segments via counts on the Jones Counter. After a check measurement by Thurston the course was adjusted for temperature. Temperature at the beginning of the measurement (10:57 AM) was 31° C and at the conclusion (11:30) was also 31° C.

The second Cal Course was adjusted and each participant proceeded with his/her measurement. (59)

DL

My validation measurement began at 1:45 pm after calibrating my bicycle at 1:35 pm. The course was in a double out-and-back configuration. There was a construction area in the first kilometer which was encountered again in the second kilometer on the first out and back section. This area could not be traversed by bike. A mark was placed on one side of the construction area on the outgoing tangent and a tape was stretched tight across the area to a point 15 meters away and on the other side of the area. A mark was placed at this point. The process was repeated on the return tangent. I rode the course in the direction from start to finish, skipping over the two construction areas then adding the taped 15 meters after the measurement was completed. The course was quite winding and several gates were encountered. These were compensated for by displacing the bicycle backward by a bike length then moving to the far side of the gate. (The race director advised that the gates were open during the race and also that the runners had access to the entire roadway throughout the race). Details of the measurement are summarized on the attached sheets. The course was found to be 5015.2 meters in length.

Following the measurement and determination of the course length I calculated changes to be made to the course to adjust it to the proper length and to relocate intermediate splits to accurate locations (They were mostly mislocated as originally layed out).

DL

In calculating these changes to the course I made an error by using the SCPF twice. I added the proper percentage to the RAW constant that was used to validate the course but then advised adjusting to 5005 meters total length. This resulted in a course whose total length is 5010 meters. I have prepared a revised recommendation which is ~~also~~ attached.

Report submitted by:

Doug Loeffler

18 June 1990

Revised Results 6/19/90 DL

ANSWER SHEET TO BE SUBMITTED JUNE 16, 1990

Acting as a Validator of an Existing Course
A race was held on this course yesterday. You are an IAAF validator sent to check the course. How long was the course on race day?

5015.158129 metres

Acting as an IAAF Measurer Laying Out a New Course
A race will be held tomorrow on this course. What adjustments should be made to the course so that the runners will have an IAAF-quality course with accurate splits?

Move the 1 km split 6.08689 metres toward the (start? ~~finish?~~) along the running path.

Move the 1 mile split 15.265438 metres toward the (~~start~~? finish?) along the running path.

Move the 2 km split 7.69667 metres toward the (start? ~~finish~~?) along the running path.

Move the 3 km split 8.495514 metres toward the (start? ~~finish~~?) along the running path.

Move the turnaround 5.1 metres (toward? ~~away from~~?) the start and finish along the running path.

Move the 4 km split 14.041727 metres toward the (~~start~~? finish?) along the running path.

Name of measurer Doug Loeffler

Tire size SEE ORIG. SHEET Pneumatic or solid? Pneumatic

Bicycle brand or ID Fuji

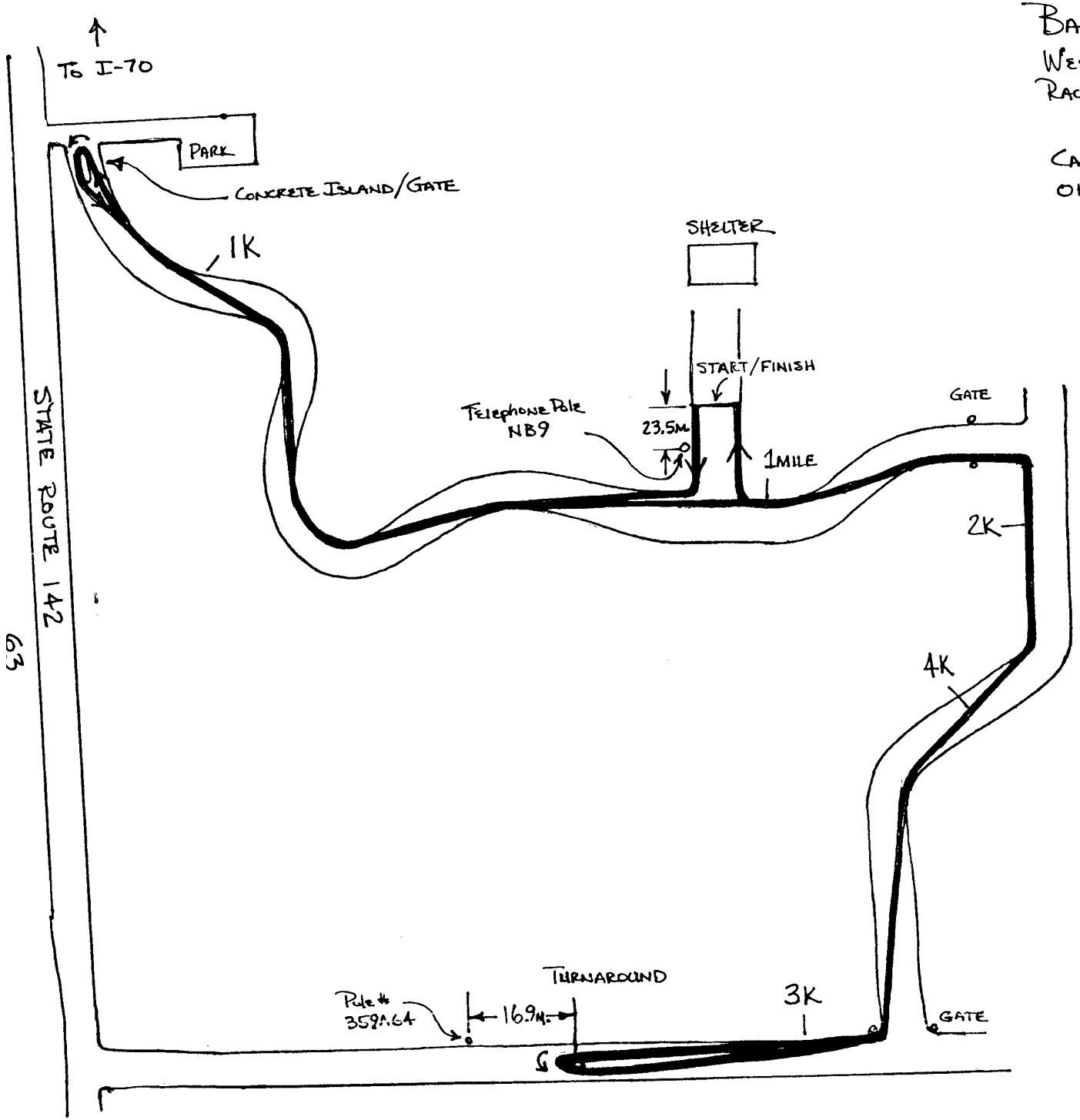
After you get home, send a narrative account of your validation of the course, and recommended adjustments for the next race, to John Disley and Pete Riegel. Include copies of your original data and any calculations you made, using a format you deem most satisfactory to convey the information. Also submit a course map.

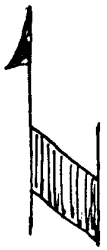
BATTELLE PARK 5K

West Jefferson, Ohio

RACE DIRECTORS: Pete Riegel
John Disley

CAL COURSE: ON SITE, 300M.
OH90001DL





START/FINISH: ON ROAD TO SHELTER HOUSE, 23.5MT. N. of telephone pole NB9

TURNAROUND: ON FIRST ROAD SOUTH OF MAIN PARK ENTRANCE, 16.9M. EAST OF TELEPHONE POLE 359A64

DL

DL

1' = .3048 M
1M = 1609.349005 M

Const Area 15M each

Cal. Const 6-16-90 10:57 31°C pre; 88°F post

89°F 89°F
Calibrate 1:35p 300M Reeal 2:29

S	67100	S	38500
1	69907	1	41306
2	72713	2	44114
3	75519	3	46919
4	78325	4	49725
	11225		11225

S	87000	
C_1	87835 ← +15M	
1K	96280	15M = 140 - 31249 counts
C_2	00862 ← +15M	
1M	01645	
2K	05518	
3K	14889	
TA	16949	
4K	24137	
F	33632	

Validation of Course Length
D. Loeffler

DL

Pre-Measurement Calibration
6-16-90 300M. 1:35pm 31°C.

	Recorded	Elapsed
S	67100	-
1	69907	2807
2	72713	2806
3	75519	2806
4	78325	2806
		11225

Post-Measurement Calibration
6-16-90 300M. 2:29 pm 31°C

S	38500	-
1	41306	2806
2	44114	2808
3	46919	2805
4	49725	2806
		11225

11225 + 11225 = 22450 ÷ 8 = 2806.25 = Avg. Count for 300M.

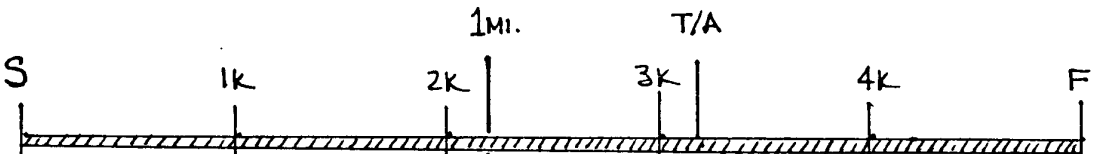
2806.25 x 3.3333 = 9354.1666 counts per 1 KM.

Validation Measurement
6-16-90 1:45 pm 31°C

	Recorded	Elapsed
Start	87000	-
C_1	87835	7835*
1K	96280	9280
C_2	00862	13862*
1 Mile	01645	14645
2K	05518	18518
3K	14889	27889
T.A.	16949	29949
4K	24137	37137
Finish	33632	46632

* Taped Measurement of Construction Area @ 15M each

Total Length 133632 - 87000 = 46632 ÷ 9354.1666 = 4985.158129 meters
+30.00000 meters taped
5015.158129 meters



	S–1K	1K–2K	2K–1MI.	1MI.–T/A	T/A–3K	3K–4K	4K–F	TOTAL
A. COUNT	9280	9238	9371	2060	7188	9495		
B. LENGTH IN METERS (A÷(K*1.001)	991.080277	986.594784	1000.798844	220.002734	767.660025	1014.041727		4980.178394
C. TAPED DISTANCE X 1.001	15.0150	15.0150						30.03000
D. TOTAL LENGTH	1006.095277	1001.60978	1000.798844	220.002734+767.660025		1014.041727		5010.208387
E. DESIRED LENGTH	1000	1000	1000	1000		1000		5000.00000
F. ADJUSTMENTS:								- 10.208387
F_1 ADJUST TOTAL COURSE LENGTH				-5.1	-5.1			
				214.902734+762.560025				
F_2 ADJUSTED SPLITS	1006.095277	1001.60978	1000.798844	977.462759		1014.041727		5000.008387
F_2 ADJUST 4K				+ 14.041727		- 14.041727		
(6)				991.504486		1000.0000		
F_3 ADJUST 3K			- 8.495514	+ 8.495514				
			992.30333	1000.0000		1000.0000		
F_4 ADJUST 2K		- 7.69667	+ 7.69667					
		993.91311	1000.0000	1000.0000		1000.0000		
F_5 ADJUST 1K	- 6.08689	+ 6.08689						
	1000.008387	1000.0000	1000.0000	1000.0000		1000.0000		5000.008387 ~ 5000.0000

F_6 ADJUST 1MILE

COUNT	14645
LENGTH IN METERS	1564.048562
TAPED DISTANCE +SCPF	+ 30.030000
TOTAL LENGTH	1594.078562
DESIRED LENGTH	1609.344000
ADJUSTMENT	+15.265438 M

DL

DL

MEASUREMENT CHECK BY LOTUS 1-2-3 USING SUBMITTED DATA

DOUG LOEFFLER - RECEIVED 6-27-90

PRECAL			POSTCAL		
67100			38500		
69907	2807	2806.25	41306	2806	2806.25
72713	2806	9354.166	44114	2808	9354.166
75519	2806		46919	2805	
78325	2806		49725	2806	

CONSTANT FOR DAY = 9354.166 CTS/KM = 9.354166 CTS/METER

	RECORDED COUNTS	INTERVAL COUNTS	INTERVAL METERS
START	87000		
BEG CON	87835	835	89.27
		TAPED	15.00
END CON	87835		
1K	96280	8445	902.81
END CON	100862	4582	489.84
		TAPED	15.00
BEG CON	862		
1M	1645	783	83.71
2K	5518	3873	414.04
3K	14889	9371	1001.80
TA	16949	2060	220.22
4K	24137	7188	768.43
FINISH	33632	9495	1015.06

TOTAL	5015.16
DESIRED LENGTH	5005
DIFFERENCE	10.16
REMOVE AT TURNAROUND	5.08

RT

13 Kennedy St., NW
Washington, DC 20011
June 27, 1990

To: John Disley, Pete Riegel

Subject: Report on IAAF Road Course Seminar, Columbus, Ohio, June 15 & 16, 1990

Dear John and Pete,

I am sending my tabulated results from measurement of the 5K course, along with a copy of my field notes and a map indicating the course as measured and the direction to move the marks.

My first official duty was to check calibration course #1, i.e. the one on the east side of the road, extending 300 meters south from utility pole NA-10. I used Bob Baumel's 30m tape to do this. Amy Morss was rear tapeperson and George Tillson gave line.

Using the tape method, we measured 9 segments of 30 meters, and found that the 10th segment measured 29.959 meters, giving a raw total of 299.959m. Using 96 degrees F as the temperature, I found the temperature conversion to be 28 degrees x 0.00000645 x 300m = 0.054m. Added to the raw measurement between nails, this gives 300.013m. When I got back to the start and read the thermometer, it was reading 101. Another calculation using 98 as ave. temp yields an adjusted measurement of 300.017m.

I did not know the proper tension to use for Bob's tape; Wayne suggested 5 pounds, so I used about 2.5 kg. WRONG as I found out; it says right on the tape to use 5 kg. So a better measurement would surely have found the course to be somewhat shorter than this one. However, my conclusion was that the remeasurement showed the calibration course to be accurate with an acceptable tolerance (+/- 2 cm).

A different problem with that cal. course bothered me a little more; namely, how far from the edge of the road it was (approximately 1.5m). I believe in keeping a cal course closer to a visible line or edge whenever possible, unless there is good reason not to. Sometimes I stay out for parked cars, but then usually you have a few parked cars to gauge by. On the other hand, if there is a prominent "target" to ride towards in both directions, a course almost anywhere in the road can work. Despite all this, I could detect no difference in the numbers from the 2 cal courses.

The measuring numbers speak for themselves. This was a good exercise, and called for a variety of problem-solving and measuring techniques. Measuring something only once goes against the grain, but that's fair enough in this situation.

I would like for us, at some point, to discuss more fully the technique for riding when doing a validation ride. This has been left a bit vague in most discussions I have had within our "system". I remember that Ken Young said to just measure the way you always do, and other measurers have said they can really only measure in one way. But I feel that if the rules allow you to be 30 cm from the curb or edge, then a validator should make a

determined effort to be very close to 30 cm from the edge. That's quite tricky but it seems only fair. RT

It is interesting to note from the results submitted on June 16 that the average measurement is 5018.8, the median is 5019.1, and the total spread is 0.16%. We'd like to think our spread would be < 0.1%. (I took the liberty of translating Tillson's number to 19.5 by using the "straight" constant). In other words, had Wayne measured the course, would Doug have found it short by 3 meters? The catch is that we were measuring "as validators", probably interpreting that differently in each case. What would happen if we took the same or a similar group of people, gave them a well-defined course, and told them to lay out a course. Would we have the same spread?

In conclusion, I am trying to point out that the excuses for gatherings like this one are almost endless, and that's good because it was great fun. Many thanks to Joan for a great job with all the arrangements; to Pete for a great "problem course layout"; and to John for giving us the excuse this time and for sliding down a chute to get there.

Best regards to all,

Bob Thurston

Bob Thurston

TA Calibration - 300m Course

PRE 1.52pm - 2.00pm 87°F

59710	
62550.5	2840.5
65389.5	2839
68229.5	2840
71069.0	2839.5
9465.83	

POST 2.43 - 2.50pm 90°F

27980	
30819.3	2839.3
33659.5	2840.2
36499.5	2840.0
39338.6	2839.1
9465.50	

AVE FOR SESSION: 9465.67/KM

MEASUREMENT		ADDING IN CONSTRUCTION:		POINT SHOULD BE	DIFFERENCE
START	76.000	76.000		76 000	—
(STOP AT CONSTRUCT)	76 845				
END ISLAND (TA)	83444				
1 KM	85404.5	85 546.6	9546.5	85475	+71.6
(STOP/CONSTR)	90046				
1 MI	90840	91124 [15124]		91249	-125.
2 KM	94763.5	95047.5	9501	94950	+97.5
3 KM	104 250	104534	9486.5	104 425	+109.0
T/A	106 334.5	106 618	—	106551	+67.0
4 KM	113611	113 895 *	9361	113900.5	(-5/-142) *
FINISH	123 226.5	123510.5	9615.5	123376	+134.5

TOTAL COUNTS: 47226.5
[47510.5]

4.98924
+30 meters
5.01924 km.

1 CT = 0.10564 m

15 meters = 142 counts

4 KM EQUIVALENT ONCE T/A SHORTENED: 113763

Need 47,376 COUNTS
Course is 134.5 CTS ~~LONG~~ LONG.
(14 meters)
TA #2 SHOULD MOVE BACK ~7 meters

* AFTER T/A ADJUSTMENT, PRESENT "4K" WILL BE AT 113 761 CTS

CHECKING CAL CURVES

Cal Course

840 cts - 3K

(1)

96

-68

96°F 28°F

29.959

29995 Rawl

.00000645

.00000

299.

300.013

0.054

End 101°F

(2) T — 6/16/90

59710 — 1.52 pm

62550.5 start W side

65389.5

68229.5

71069.0 2.00

T 87°

ST. 76000 2.04 PM

76845 15 km

76845

83444 end of island

85404.5 1K

90046 ← 15 km

90840 1 mile

94763.5 2 Km

'04250 3K

'06334.5 TA

'13611 4K

'23226.5 FINISH 2.38

41K - ~560 CTS to CORNER

FIELD NOTES (3)

6/16

POST-CAL 2.43

27980

30819.3

33659.5

36499.5

39338.6 2.50

TURNAROUND IS NOW

22.8m E of TP 359 464

OBTelco Pole 359A64

21 counts E of

75' by tape

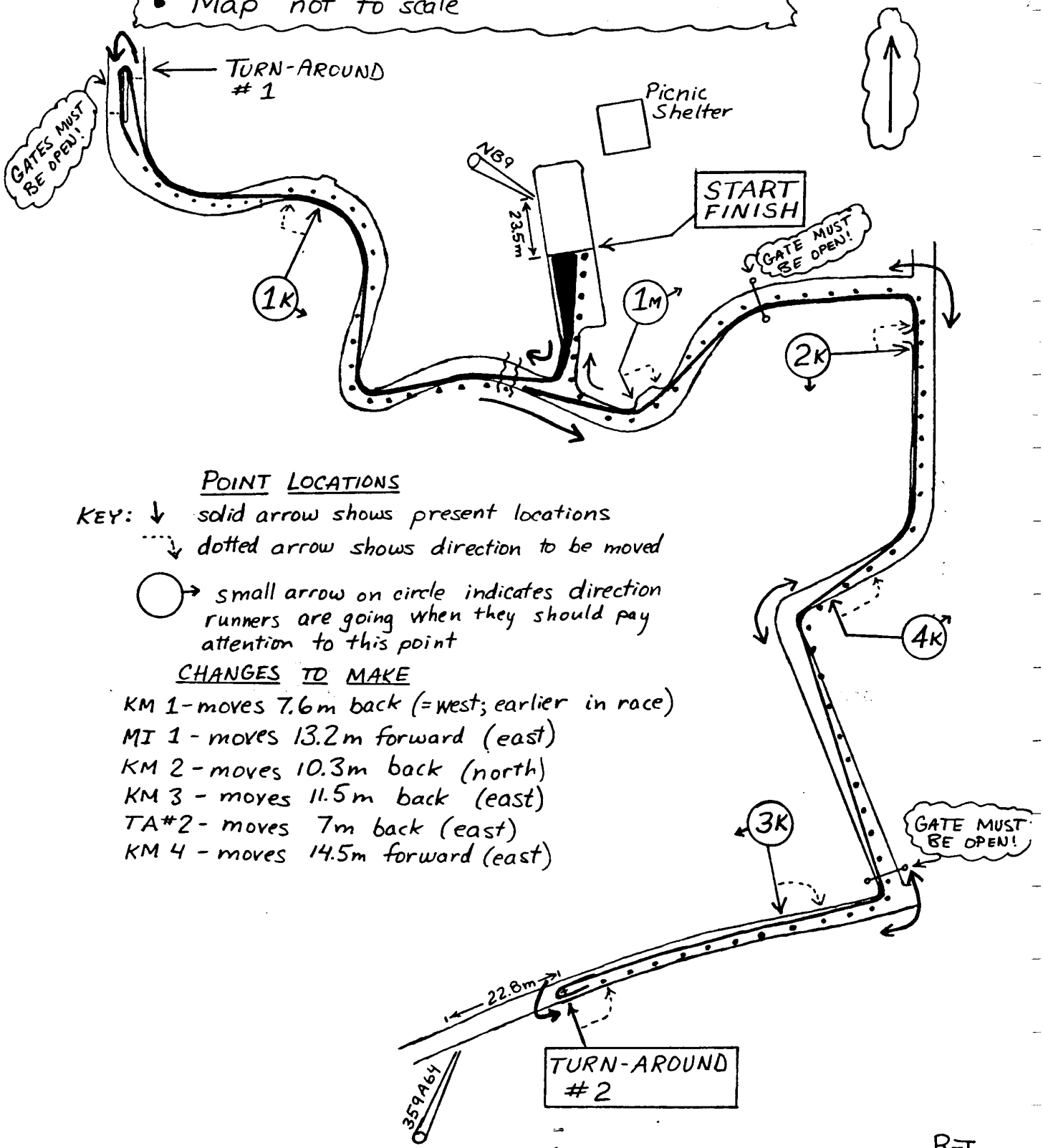
61735 LOC UST ON RP

61778 present TA

RT

BATTELLE PARK 5K
West Jefferson, Ohio

- Showing present locations of timing points and direction each should be moved
- Map not to scale



POINT LOCATIONS

KEY: ↓ solid arrow shows present locations

⋯↓ dotted arrow shows direction to be moved

○→ small arrow on circle indicates direction runners are going when they should pay attention to this point

CHANGES TO MAKE

KM 1 - moves 7.6m back (=west; earlier in race)
MI 1 - moves 13.2m forward (east)
KM 2 - moves 10.3m back (north)
KM 3 - moves 11.5m back (east)
TA#2 - moves 7m back (east)
KM 4 - moves 14.5m forward (east)

RET

MEASUREMENT CHECK BY LOTUS 1-2-3 USING SUBMITTED DATA

BOB THURSTON - REC'D 6-28-90

PRECAL			POSTCAL		
59710			27980		
62550.5	2840.5	2839.75	30819.3	2839.3	2839.65
65389.5	2839	9465.833	33659.5	2840.2	9465.5
68229.5	2840		36499.5	2840	
71069	2839.5		39338.6	2839.1	

CONSTANT FOR DAY = 9465.666 CTS/KM = 9.465666 CTS/METER

	RECORDED COUNTS	INTERVAL COUNTS	INTERVAL METERS
START	76000		
BEG CON	76848	848	89.59
		TAPED	15.00
END CON	76848		
1K	85404.5	8556.5	903.95
END CON	90046	4641.5	490.35
		TAPED	15.00
BEG CON	90046		
1M	90840	794	83.88
2K	94763.5	3923.5	414.50
3K	104250	9486.5	1002.20
TA	106334.5	2084.5	220.22
4K	113611	7276.5	768.73
FINISH	123226.5	9615.5	1015.83

TOTAL	5019.24
DESIRED LENGTH	5005
DIFFERENCE	14.24
REMOVE AT TURNAROUND	7.12

The Athletics Congress of the USA

The Governing Body for Athletics in the United States including Track and Field, Long Distance Running and Race Walking for men and women and boys and girls at all age levels.

WN

WAYNE B. NICOLL
Ragged Mountain Club
Potter Place, New Hampshire 03265
~~(603) 224-0413~~
~~(603) 735-5884~~

(603)735-5721

26 June 1990

Peter S. Riegel 3354 Kirkham Road, Columbus, OH 43221
John I. Disley CBE Hampton House, Upper Sunbury Rd, Hampton
Middlesex, England TW12 2DW

Dear Pete and John,

Enclosed is the information Pete requested from the seminar. I thought it went very well and was a good learning experience for all of us.

A few thoughts on validations. Having performed a considerable number of validations since Pete introduced me to the process in 1985, I developed a validation philosophy which I felt was a means of applying fairness to the measurement. I am now beginning to question that approach.

In our revised TAC/USA measurement manual, we describe the path to be along the shortest possible route, coming within 30 centimeters of edges and curbs. In practice, most knowledgeable measurers ride closer than 30 cm to be assured their measurement would have little possibility of coming up short. On a validation, however, it seems unfair for a validator to ride inside of the 30 cm line. On most validations where I have been accompanied by skilled measurers, my results will reflect the longest distance achieved by any of the riders. I have made a special effort to ride what I felt was a path at or outside of the 30 cm line when riding close to curbs, barriers, and road edges. For example, on 28 October 1989 I validated the Robert Moses 2K racewalk loop in Niagara Falls, NY. I was accompanied by Bob Edwards (PA certifier) and David MacPhee, a measurer of proven skills (not the measurer of record of this course). The results were: Bob - 1.9998K, Dave - 1.9991K, Wayne - 2.0010K. Had Bob been the validator, the validation would have had to be reviewed by the board consisting of Riegel, Baumel, and Nicoll. If Bob had been performing an IAAF validation, the course could have been considered short.

The results at the recent IAAF Measurement Seminar reflect my approach of not riding within the 30 cm line. I found myself measuring during the lunch hour alone. I was able to concentrate on achieving a fair measurement. As I finished up I felt I had perhaps negotiated the course a little too tightly. Yet the group results reflect my ride as the longest. It is my opinion that most certifiers performing as validators have become so conditioned to tight riding that they are unable to ride with a 30 cm limit in mind. They are imbued with the

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competitive notion that the best rider is the one with the shortest measurement. The wide disparity between my figures (longest) and that of Doug Loeffler's (shortest) really concerns me. There should not be a difference between two skilled measurers of 8 meters on a 5K measurement. When Doug and I have measured together we have not had that significant a difference.

It does not appear to be a problem for USA domestic validations since we are already willing to consider acceptance of a US record run on a course that may reflect as being up to .05% short. It may present problems on an IAAF measurement if validators typically ride tighter than 30 cm. The IAAF rules, to my knowledge, would not find a record acceptable from a course that validated at less than the advertised distance.

I am questioning whether or not I should continue my attempts to ride "fairly" on USA validations. If it has not already been accepted, I would suggest that IAAF validation review policies might also allow for .05% shortness and no attempt be made to condition validators to ride at the 30 cm limit as I have been attempting to do. I would appreciate your thoughts on this subject.

Sincerely,

Wayne B. Nicoll
Vice Chair, East
RRTC

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26 June 1990

Validation Report - Battelle Park

This is a report of the IAAF validation of the 5 kilometre road race course in Battelle Park, Battelle Stadt, West Germany, site of the 1990 IAAF Mens and Womens 5K Road Race Championships.

I flew to Battelle Stadt Flughaven on 15 June where I was met by Frau Joan Riegel, wife of Herr Peter Riegel, the race director of both events. She escorted me to the Battelle Stadt Hilton, where I met Herr Riegel, Helmut Hesser (the course manager), and other race staff members, and attended a short meeting to plan the validation measurement for the next morning. That evening Helmut and I reviewed a videotape of the mens race held earlier in the day. The womens event was scheduled for Sunday 17 June, allowing us to conduct the validation on Saturday.

Early on Saturday Herr Riegel and I drove to Battelle Park, a huge corporate park in a rural setting of forest, fields, and lakes. The area has a network of flat, traffic free, smoothly paved roads on which the races were held. The start/finish was a common point located on an entrance drive to a recreational complex. The race course consisted mainly of two out/back sections, one of which had a turnaround point created with a nail and paint on the road surface. The calibration course, located on the race course, consisted of two parallel 300 meter courses laid the year before by a team of US, British, and Canadian measurement experts. Since I was present at the seminar the year before and was the team leader for the laying of one of the calibration courses, it was not deemed necessary to check the calibration course lengths. A copy of my report on the calibration course tapings is included.

When we arrived at the start/finish area Herr Riegel discovered a short section of race course in the first mile had been torn up for culvert repairs and was rendered impassable by bike or auto. Herr Riegel was assured by the construction supervisor that the repairs would be complete by the following morning. It was necessary to steel tape the construction zone, taking care to align the tape with the projected path of the runners who would cross the zone twice. The figures of 10.97 and 10.91 metres shown in the calculations represent the construction zone lengths.

There were three locked auto barrier gates on the course. The park security supervisor could not be convinced by Herr Riegel to leave the gates open during the validation. Two of the gates could be negotiated by tilting the bike and rolling under the bar. The

WN

other required carrying the bike around the gate, both outbound and inbound on the course. The figures of 2.03 and 1.7 metres represent the taped distances between the stop and start locations of the front bike wheel. (used some old marks on the first pass, made my own marks on the second pass). In retrospect, it would have been much simpler to have taped even metre distances for both obstacles, i.e., 15 metres for the construction, and 3 metres for the gate.

Herr Riegel was concerned the splits might not be accurately located, since he had just learned they were not laid during the original measurement but had been laid later using an auto odometer. He asked that I check the split locations and move them if necessary. The bike calibration and recalibrations were carried out without difficulty. A slight rise in counts on recalibration is probably due to fatigue caused by the unusually hot and humid conditions of the day. I measured the course and found the distance to be 5023.2 metres, which will support any national or world records set at either event. The kilometre splits were each too long at varying lengths and the one mile split was short. The course length was shortened to 5005 metres by moving the turnaround point back toward the start/finish and each of the splits were adjusted to the appropriate mile or kilometre distance with the SCPF included. Herr Riegel seemed pleased with the adjustments. A copy of the revised course map and the calculations are included.

Due to another pressing commitment, I was unable to stay for the womens race on Sunday but Helmut Hesser assured me a videotape of the race would be available if needed to support any records. I am most appreciative of the splendid cooperation and warm hospitality shown by Herr Riegel, Frau Riegel, and the race staff, contributing to a smooth and successful validation.

Respectfully submitted,

Wayne B. Nicoll
IAAF Validator, (USA)

WN

Report On Calibration Course Taping

1990 IAAF Measurers Seminar

At the seminar two 300 meter calibration courses were laid along a straight section of the race course used by the participants of the seminar. I was assigned to supervise one of the two course layings.

When I arrived at the site, I found I had seven people. Rather than utilize only three to lay the course I elected to employ two teams, one using a standard 200 foot steel tape and the other measuring with a 30 meter nylon clad "skinny" tape. Temperatures were taken and averaged at 80 degrees Fahrenheit. Each crew used masking or duct tape to mark their pulls and record the number of the pull. Tension devices were utilized on both tapes. The 200 foot tape crew moved along quickly, converted from feet to meters, and laid their 300 meter mark. The second crew then laid their mark, 4.5 centimeters short of the first crew's mark.

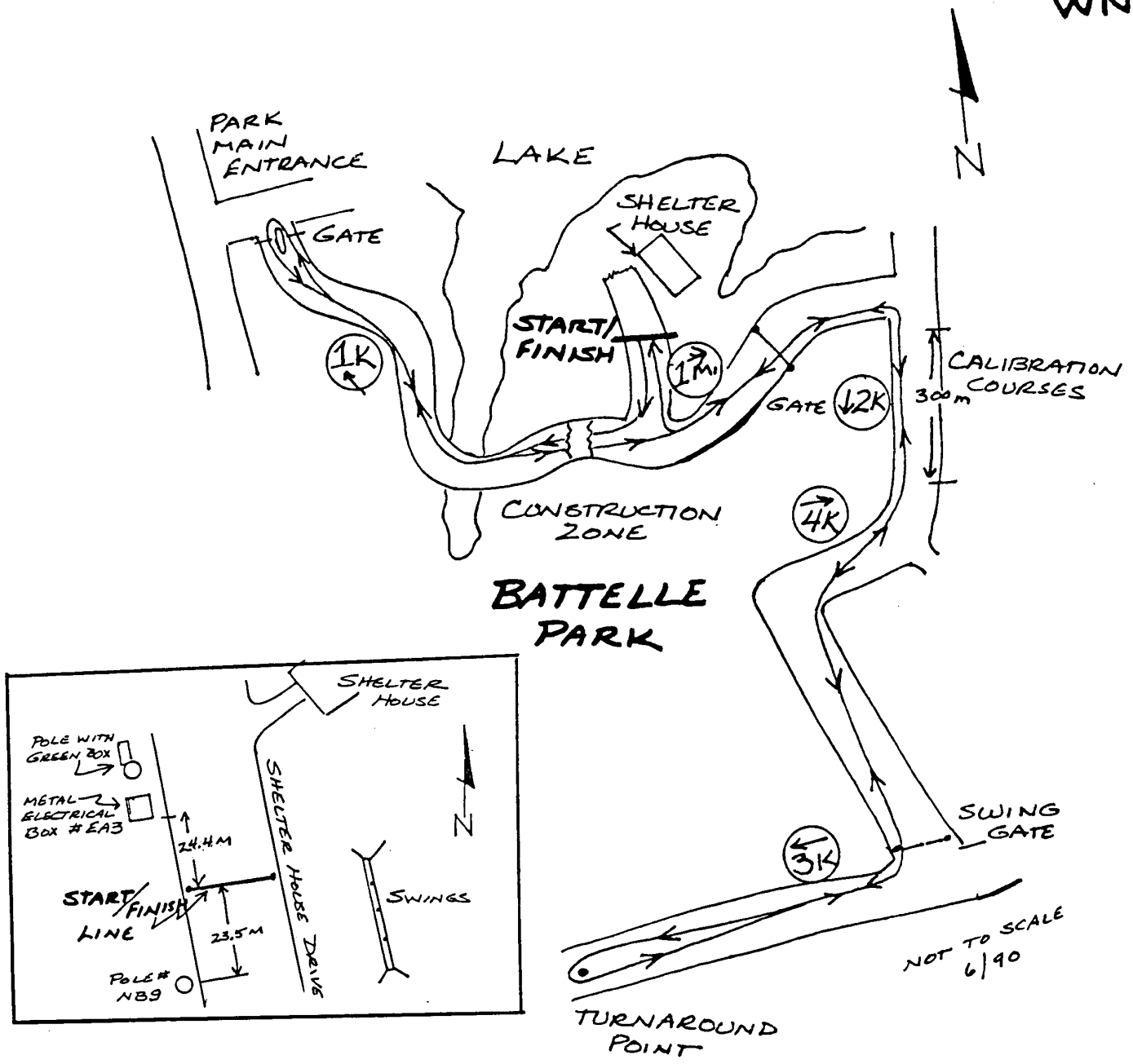
The next task was to compute the final location of the point, taking into consideration the expansion of the tape. A discussion ensued over the difference in the coefficient of expansion of the two tapes and whether the proper amount of tension had been applied to two tapes of different lengths and materials. With seven experts talking at once, complete confusion reigned. The first crew elected to re-tape their course and came up with the same length. When the discussion subsided and Bob Thurston had begun his assigned task of checking our course with a 60 meter tape, I elected to average the raw measurements and placed a nail halfway between the two "300 meter" marks. Bob finished his measurement, applied the formula for thermal expansion for his tape, and proclaimed the course to be 300.13 meters in length. I have included some figures on a steel taping data sheet that I believe represents the calculations that should have taken place at the time of the initial measurements. I have not addressed the possibility that the "skinny" tape has a different coefficient of expansion. Had the second team measured to the first team's mark, there would have been less confusion as how to calculate the distance. In planning similar exercises for the future, I would utilize two teams but only one tape and follow the procedures as outlined on the steel taping data sheet. Also I feel that a tension device is not necessary to obtain acceptable measurements.

Despite the confusion we were never in danger of being unacceptably long or short with the measurement. We must be careful, however, not to create a calibration course that is long when performing a validation.

Submitted by,

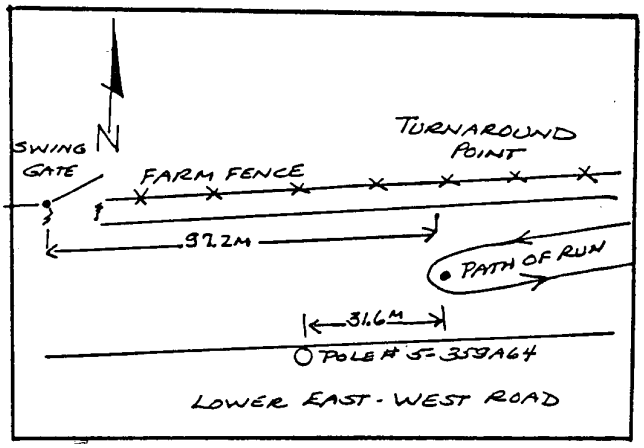
Wayne B. Nicoll
VC East, RRTC

WN



Course Measurement By:

Wayne B. Nicoll



Battelle Park 5K Measurements
6-16-90

(1) WN

CALIBRATION 12:05 PM 84°F

JONES II		JONES I	
28000	4170	65767	2871
32170	4172	68548	2781
36342	4173	71329	2781
40515	4172	74110	2782
44687		76892	

RECALIBRATION 12:58 PM 88°F

29000	4172	33101	~~4172~~ 2782
33172	4173	35883	2782
37345	4175	38665	2783
41520	4174	41448	2782
45694		44230	

MEASOREMENT 12:22 PM 84°F

	II	I
S -	52000	81766
1K -	65887	91026
1 MILE -	73940	96394
2K -	79679	00220
3K -	93625	09518
T -	96689	11561
4K -	07390	18694
5K -	21509	28107

WN

CALIBRATION AVERAGE: (JONES II)

44687 − 28000 = 16687 } Average 16690.5
45694 − 29000 = 16694 }

16690.5 ÷ 4 = 4172.625

1000 ÷ 300 = 3.3333 × 4172.625 = 13908.61 counts per 1

CONSTRUCTION DISTANCES:

36' × .3048 = 10.97 meters (outbound) (BETWEEN 5+1K)
35.8' × .3048 = 10.91 meters (inbound) (BETWEEN 1K+1M)

MIDDLE GATE DISTANCES:

2.03 m (outbound between 1M+2K)
1.70 m (inbound " 4K+F)

CALCULATED COURSE LENGTH:

121509 − 52000 = 69509 ÷ 13908.61 = 4.9975518K
4997.5518 + 2.03 + 1.7 + 10.97 + 10.91 = 5023.1618 METERS

1K - 65887 − 52000 = 13887 ÷ 13908.61 = 998.4462
998.4462 + 10.97 = 1009.4162 METERS

2K - 79679 − 52000 = 27679 ÷ 13908.61 = 1990.0622 METERS
1990.0622 + 10.97 + 10.91 + 2.03 = 2013.9722 METERS

3K 93625 − 52000 = 41625 ÷ 13908.61 = 2992.7505
2992.7505 + 10.97 + 10.91 + 2.03 = 3016.6605 meters

CALCULATED LENGTHS (CONT.) WI

107360 − 52000 = 55360

4K − 55390 ÷ 13908.61 = 3982.4252 meters

3982.4252 + 10.97 + 10.91 + 2.03 = 4006.3352 meters

1 MILE − 73940 − 52000 = 21940 ÷ 13908.61 = 1577.4401 m

1577.4401 + 10.97 + 10.91 = 1599.3201 METERS

1 MILE = 1609.344 m 1.001 MILE = 1610.9533 meters

(1610.9533 − 1599.3201 = 11.6332 meters to be added)

TURNAROUND 96689 − 52000 = 44689 ÷ 13908.61 = 3213.0457

~~96684~~ 3213.0457 + 10.91 + 10.97 + 2.03 = 3236.9557 meters

ADJUSTMENTS:

1K: 1009.4162 − 1001 = 8.4162 m Towards.

2K: 2013.9722 − 2002 = 11.9722 m Towards

3K: 3016.6605 − 3.003 = 13.6605 m " "

1 Mi: 1610.9533 − 1599.3201 = 11.6332 m Toward P

T: 5023.1618 − 5005 = 18.1618 ÷ 2 = 9.0809 meters Toward S/P

4K: 4006.3352 − 18.1618 = 3988.1734

4004 − 3988.1734 = 15.8266 meters Toward P.

JONES I SUMMARY:

11125 + 11129 = 22254 ÷ 2 = 11127 ÷ 4 = 2781.75 x 3.3333 = 9272.4072

128107 − 81766 = 46341 ÷ 9272.4072 = 4997.7313 + 25.61 =

5023.3413 meters

1K − 1009.6319

2K − 2014.1159

3K − 3016.2066

4K − 4006.4788

1 Mi − 1599.4638

WN

ADJUSTMENT OF TURNAROUND POINT LOCATION:

ORIGINAL LOCATION:

P06 #5-359A64 - 66496 } 209 counts (JONES I)
TURN POINT - 66705 } 209 ÷ 9.272 = 22.54 meters

SWING GATE ON FENCE WEST OF POINT: 81911 } 1225 counts (JONES II)
TURN POINT: 80766 } 1225 ÷ 13.9 = 88.13 meters

TURN WAS ADJUSTED TOWARD S/P 9.08 meters
FINAL ~~pole~~ LOCATION to pole: 22.5 + 9.1 = 31.6 meters
" " " GATE POST: 88.13 + 9.1 = 97.2 meters

(1)

Construction 6-16-90
36' out
35.8' in

1st BARRIER out 2.03 meters (middle check)
1.7 meters
5K test calibration 1205PM 84°F

II		I	
28000		65767	2871
32170	4170	68548	~~2781~~
	4172		
36342	4173	71329	2781
40515	4172	74110	2782
44687		76892	(11125)

~~290~~ 1258PM 86°F

29000	4172	33101	2782
33172	4173	35883	2782
37345	4175	38665	2783
41520	4174	41448	2782
45694		44230	(11129)

(2)

START MEASURE 5K
12:22PM

	II	I
S	52000	87766
1K	65887	91026
1M	73940	96394
2K	79679	00220
3K	93625	09518
T	96689	11561
4K	07390	18694
5K	21509	28107

16687 ÷ 4 = 4171.75
16694 ÷ 4 = 4173.5 } average 4172.625

44687 − 28000 = 16687
45694 − 29000 = 16694 } average 16690.5
16690.5 ÷ 4 = 4172.625 average
1000/300 = 3.3333 × 4172.625 = 13908.61

Construction
36 × .3048 = 10.97 m (out) (S − 1K)
35.8 × .3048 = 10.91 m (in) (1K − 1mi)
BARRIER 2.03 (out) (1M − 2K)
1.7 m (in) (4K − F)

3

121509 − 52000 = 69509

69509 ÷ 13908.61 K = 4.997538

4997.6618 + 2.03 + 1.7 + 10.97 + 10.91 =

5023.1618

1K = 65887 − 52000 = 13887 ÷ 13908.61

998.4462 + 10.97 = 1009.4162

(I 998.619)

1mi = 73940 − 52000 = 21940 ÷ 13908.61 =

1577.4401M + 10.97 + 10.91 = 1599.3201

(5 TT, 5838 D
mile = 1609.344 M
TACMILE = 1610.9533)

short 10.0123 meters
add 11.6332 meters

2K = 79679 − 52000 = 27679 ÷ 13908.61

1990.0632 Meters + 10.97 +

I(1990.2059)

10.91 + 2.03 = 2013.9722 M

3K = 93625 − 52000 = 41625 ÷ 13908.61 =

2992.7505 M + 10.97 + 10.91 + 2.03 =

I(2992.2966)

3016.6605 mm

73.91

4K = 55390 ÷ 13908.61 = 3982.4252 M

3982.4252 + 10.97 + 10.91 + 2.03

(I 3982.8688)

= 4006.3352 M

5K = 5023.1618

DALS I: 11125 + 11129 average = 11127

11127 ÷ 4 = 2781.75 average

2781.75 × 3.3333 = 9272.4072

128107 − 81766 = 46341

46341 ÷ 9272.4072 = 4.997313

4997.7313 + 25.61 = 5023.341

10.97
10.91
2.03
1.7
25.61

T = 44689 ÷ 13908.61 = 3213.0457

3213.0457 + 10.91 + 10.97 + 2.03 =

3236.9557 = Talmadge

1mi add 10.0123 + (.001 × 1609.344)

(5)

4K before adjustment T was:
4006.3352

4006.3352 − 18.1618 = 3988.1734

4K after T adjustment = 3988.1734
add (4004 − 3988.1734) = 15.8266 meters

5/1F − 77' (23.47m) W.? of Pole #B9
(24.38m) 80' E.? of METAL ELECTRICAL BOX # CA3
(25.9M) 85' to pole w/ green box

□ ○ 1 GREEN BOX

Turnpoint 5-359864
JONES I − 66496 − pole T = 66705
T = 22.5399 meters JONES II 50766 8799, 1225

FIREARM B GATE POSI

1225 ÷ 139.8861 = .0880749 = 88.07 meters

PAVILION

WN

STEEL TAPING DATA SHEET
(for measuring a calibration course)

Name of Calibration Course BATTELLE PARK 300 #1

City and State WEST JEFFERSON, OH Date 6/16/90

Start Time 10:00 AM Finish Time 11:00 AM

Pavement Temperature: Start 78° Finish 82° Average 80°
(if you do not use a bimetallic thermometer, the thermometer must be shaded)

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.

4	x	200'	+	184.252	=	984.252' or 300M.
# tape lengths		distance per tape length		partial tape length		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.

10	x	30 METERS	+	.045	=	300.045 METERS
# tape lengths		distance per tape length		partial tape length		measured distance

(THE NAIL WAS PLACED AT 300.0225. THURSTON FOUND DISTANCE TO BE 300.013.) (RAW MEASUREMENT)

3. Average Raw (uncorrected) Measurement of Course 300.0225

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.

Correction factor	=	1.0000000	+	.0000116	x	[Temp (°C) - 20]
Correction factor	=	1.0000000	+	.00000645	x	[Temp (°F) - 68]
Correction factor	=					
	=	1.	+	.00000645 x (80-68)		
	=	1.0000774				

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).

1.0000774	x	300.0225	=	300.0457 meters
correction factor		avg. raw measurement		corrected measurement

6. If you wish, you may now adjust the course to obtain an even distance (such as one kilometer). This is not necessary as you may choose instead to use an odd-distance course whose end-points are pre-existing permanent objects in the road to guard against hazards such as repaving. If you adjusted the course, explain what you did.

Final Adjusted Length of Calibration Course 300 METERS

CONVERSION FACTORS: 1 foot = 0.3048 meters THURSTONS CHECK - 300.13 METERS
1 kilometer = 1000 meters = 3280.84 feet

WN

MEASUREMENT CHECK BY LOTUS 1-2-3 USING SUBMITTED DATA

WAYNE NICOLL - RECEIVED 6-28-90

USING JONES 1 COUNTER

PRECAL			POSTCAL		
65767			33101		
68548	2781	2781.25	35883	2782	2782.25
71329	2781	9270.833	38665	2782	9274.166
74110	2781		41448	2783	
76892	2782		44230	2782	

CONSTANT FOR DAY = 9272.5 CTS/KM = 9.2725 CTS/METER

	RECORDED COUNTS	INTERVAL COUNTS	INTERVAL METERS	ADD TO INTERVAL	CORRECT INTERVAL	OVERALL ADJUST	NEW INTERVAL LENGTHS	CUM INTERVAL LENGTHS	DESIRED LENGTHS	REQ'D ADJUST
START	81766									
1K	91026	9260	998.65	10.97	1009.62		1009.62	1009.62	1001	-8.62
1M	96394	5368	578.92	10.91	589.83		589.83	1599.45	1610.95	11.51
2K	100220	3826	412.62	2.03	414.65		414.65	2014.10	2002	-12.10
3K	109518	9298	1002.75		1002.75		1002.75	3016.85	3003	-13.85
TA	111561	2043	220.33		220.33	-9.15	211.18	3228.03		
4K	118694	7133	769.26		769.26	-9.15	760.12	3988.15	4004	15.85
FINISH	128107	9413	1015.15	1.7	1016.85		1016.85	5005.00	5005	0.00
TOTAL			4997.68		5023.29		5005.00			
DESIRED					5005.00					
REMOVE FROM TURN - HALF IN 3K-T, HALF IN T-4K.					9.15					

WN

WAYNE NICOLL

USING JONES 2 COUNTER

PRECAL			POSTCAL		
28000			29000		
32170	4170	4171.75	33172	4172	4173.5
36342	4172	13905.83	37345	4173	13911.66
40515	4173		41520	4175	
44687	4172		45694	4174	

CONSTANT FOR DAY = 13908.75 CTS/KM = 13.90875 CTS/METER

	RECORDED COUNTS	INTERVAL COUNTS	INTERVAL METERS	ADD TO INTERVAL	JONES 2 CORRECTED METERS	JONES 1 METERS
START	52000					
1K	65887	13887	998.44	10.97	1009.41	1009.62
1M	73940	8053	578.99	10.91	589.90	589.83
2K	79679	5739	412.62	2.03	414.65	414.65
3K	93625	13946	1002.68		1002.68	1002.75
TA	96689	3064	220.29		220.29	220.33
4K	107390	10701	769.37		769.37	769.26
FINISH	121509	14119	1015.12	1.7	1016.82	1016.85
TOTAL			4997.50		5023.11	5023.29

TOTAL JONES II COUNTS 117694
TOTAL JONES 1 COUNTS 78463

JONES 1 * 1.5 117694.5 GOOD AGREEMENT!
JONES II / 1.5 78462.66

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AM

Amy Morss
4131 Bussey Rd.
Syracuse NY 13215
(315) 492-2486

6/19/90

Dear Pete & Joan,

Again, let me thank you for letting me be a participant in your clinic. It was a wonderful experience and I enjoyed meeting you all. I appreciate you letting me bring my family, Hannah wasn't at her best, but y'all were so kind.

Enclosed is my data. I enclosed two sets of calculations, Wayne's way and my way, just for curiosity sake. Also, you'll find a newsletter that I'm sending out to my NY measurers describing the trip and giving them the opportunity to 'compete' in the measurement. Should be fun.

You asked for suggestions and it may be bold of me as your most inexperienced certifier to give any, but it is because of that that I do so. Only 2 things: I would have liked to see a bit more formal exchanging of ideas, methods etc. I guess I supposed because it was called a clinic that we'd actually have some formal teaching going on. For instance, I hardly got to speak to John Disley and I was hoping he would shed his vast knowledge on me... The other thing, I personally would have benefited from a break between the ride and the number crunching. I realize this may not exactly simulate validation conditions, but I would hope even an international race director would let you go back to the hotel to freshen up and revitalize. I work better when my head isn't so full...

Thanks again. It was a priviledge to meet you both.

Sincerely,

Amy

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AM

Amy Morss
4131 Bussey Rd.
Syracuse NY 13215
(315) 492-2486

VALIDATION REPORT FOR BATTELE PARK 5K

The ride took place on the afternoon of 6/16/90 on a very hot (90-95°F) day around 2PM in W. Jefferson, Ohio. The race director took us on one ride of the course and I took one ride by myself before starting the validation. The calibration was laid on the course sight that morning as a group project of all the measurers present for the IAAF International Measuring Clinic. It was a 300 meter course (actually 2 courses on either side of the road) and took about 3 hours of deliberation to get straight. My bike was a 12 speed with pneumatic tires. There was a slight wobble to my front wheel, but I consulted with Wayne Nicoll, and he felt it wouldn't effect my ride.

The course was flat and very curvey and closed to motor vehicles. There were 2 gates to ride up to, one turnaround, a construction sight that we could not ride over and a gate area where the bars could be raised up. The actual construciton area was less than 15 meters, but in order to fit the bike past it, the steel taping turned out to be 15 meters for easy figuring.

I did have to get off my bike a number of times because other measurers were riding directly in my path because of the out/back nature of the course. There were really no other hitches (except I dropped my calculator once and had to go back to get it). I found the course to be 5021.21 meters long.

BICYCLE CALIBRATION DATA SHEET

AM

Date of Measurement 6-16-90

Name of Measurer Amy Morss

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

Ride	Start Count	Finish Count	Difference
1	93770	96629	2859
2	96629	99489	2860
3	99489	02347.5	2858.5
4	02347.5	05207.5	2860

Pre-measurement Average Count 2859.375

Time of Day 1:20 pm

Temperature 90° F

Length of Calibration Course 300 meters

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

Working Constant =

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	62930	65786	2856
2	65786	68645	2859
3	68645	71503	2858
4	71503	74363	2860

Post-measure Average Count 2858.25

Time of Day 2:38

Temperature 95°

FINISH CONSTANT = Number of counts in one kilometer or one mile, calculated from Postmeasure average count, and multiplied by **1.001 "safety factor"**

Finish Constant =

Constant for the Day = **Either** the Working Constant **or** the Finish Constant, whichever is the **larger**.

CONSTANT FOR THE DAY = 2859.375 + 2858.25 = 2858.8125

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 recalibration "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 (92)

Battele Park Calculations

AM

① $\frac{2858.8125 \text{ cnts}}{300 \text{ meters}} = \frac{x}{1000 \text{ meters}} \Rightarrow 9529.375 \text{ cnts/K}$

$9529.375 \times 1.609344 = 15336.042 \text{ cnts/mile}$

② CONSTRUCTION:

$\frac{2858.8125 \text{ cnts}}{300 \text{ m}} = \frac{x}{15 \text{m}} = 142.94062$ cnts for construction sight (rounded to 143)

③ Correction for construction

SPLITS	COUNTS RECORDED	CORRECTION	FINAL COUNTS
START	10170	0	10170
1K	19650	143	19793
1mile	25123	286	25409
2K	29074	286	29360
3K	38626	286	38912
TA	40724	286	41010
4K	48047	286	48333
Finish	57733	286	58019

④ Length of course

$58019 - 10170 = 47849$

$47849 \div 9529.375 =$ 5021.21 meters

AM

⑤ Movement of splits: part 1 (SEE BELOW)

SPLITS	COUNTS FROM START	KILOMETERS FROM START	DIFFERENCE FROM IAAF SPLIT	METH 2 MOVE
1K	19793 - 10170 = 9623	9623 / 9529.375 = 1.0098	1.0098 - 1.001 = 1.0088	8.8 *
1mile	15239 (9469.075)	9469.075 / 9529.375 = .99367	(.99367)(1.609344) = 1.5991568 − 1.6109533	11.8 TF
2K	19190	2.01377	.01177	11.8 T
3K	28742	3.01615	.01314	13.2 S
5K**	47849	5.0212	.01621	16.2.
TA =>	16.21 ÷ 2 =	8.1 Toward S/F		
4K ***	38163	4.0048	.00077	16.21 - .77 = (15.44) SF

* MISTAKE ON ORIGINAL CALCULATIONS: SHOULD BE 8.8 M

** SINCE 5K IS FIXED, MUST DETERMINE THIS BEFORE FIGURING ON HOW TO MOVE TA

*** 4K IS DETERMINED AFTER CALCULATIONS FOR TA

NOTE: THIS IS THE WAYNE SUGGESTED THAT I DO IT WHEN WE WERE RIDING HOME IN THE CAR. I ADMIT IT IS NOT THE WAY I WAS TRYING TO DO IT. THE NEXT PAGE SHOWS MY WAY...

⑥ MOVEMENT OF SPLITS: PART 2 **AM**

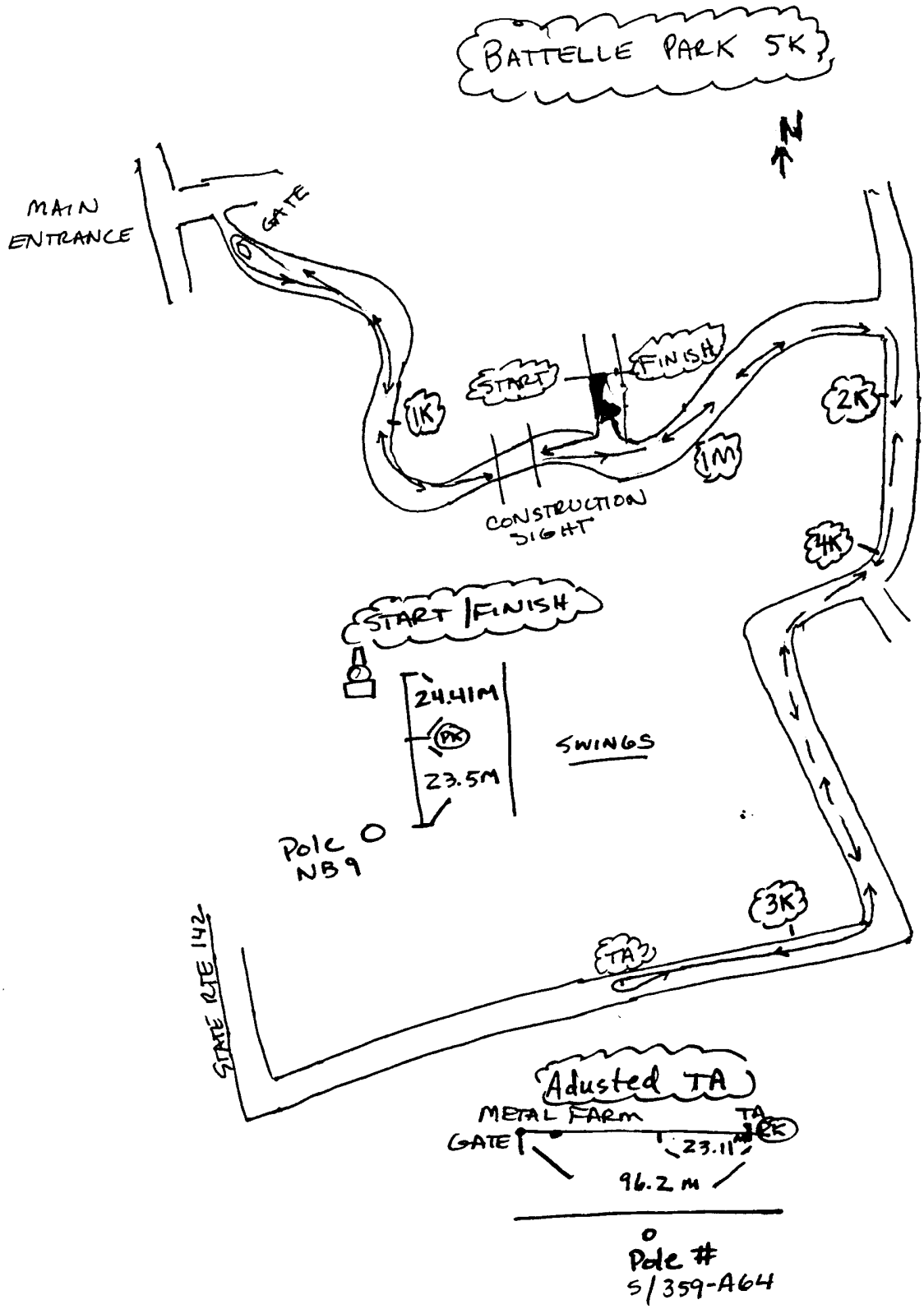
SPLITS	WHAT SPLITS SHOULD HAVE BEEN W/ SCPF	DIFFERENCE IN COUNTS FROM ACTUAL	METERS MOVED
S	—	—	—
1K	10170 + 9538.9043* = 19709	19793 - 19709 = +84	2858.825cnt/300m = 84/x = 8.8m TS
1M	10170 + 15351 = 25521	-112	11.8 T F
2K	10170 + 2(9538.9043) = 29248	+112	11.8 TS
3K	10170 + 3(") = 38788	+125	13.1 TS
5K	10170 + 5(") = 57865	+154	16.16
TA	16.16 ÷ 2 = 8.08 TOWARD S/F		
4K	10170 + 4(9538.9043) = 48326	+7	15.43 TF

16.16 - .73 = 15.43 TF

* THIS NUMBER IS CNTS/K WITH SCPF IN.

GRANTED THIS WAY MAY BE MORE CUMBERSOME, BUT IT WAS THE WAY MY BRAIN WAS THINKING AFTER ALL THE STUFF IN MY HEAD. GLAD TO SEE, AT LEAST, THAT THE NUMBERS CAME UP THE SAME. I'M DISAPPOINTED THAT I GOT SO CONFUSED + IT TOOK SO LONG FOR ME TO DO THE FIGURES. I WOULD HAVE BENEFITED FROM A BREAK INBETWEEN THE NUMBER CRUNCHING + THE MEASUREMENT ☺.

AM


BATTELLE PARK 5K
N
MAIN ENTRANCE
GATE
1K
START
FINISH
2K
1M
CONSTRUCTION SIGHT
4K
START/FINISH
24.41M
PK
23.5M
SWINGS
Pole NB9
3K
TA
STATE RTE 142
Adusted TA
METAL FARM
TA
2K
GATE
23.11M
96.2 M
Pole #
S/359-A64

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AM

Amy Morss
4131 Bussey Rd.
Syracuse NY 13215
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6/19/90

NY Measuring Newsletter 2

This past weekend I was fortunate enough to be able to attend the IAAF International Measurement Clinic in Columbus, Ohio. David, Hannah and I drove out there to meet with 14 other certifiers from around the country, Canada and even London, England. John Disley, London's long-time measurer, flew in to work with our group. Pete Riegel, RRTC's Chairman and one of TAC's premier measurer and his wife hosted the event. We all stayed at a local hotel where we enjoyed meals together.

The actual clinic was set up like a test. We went to a park on Saturday, where Pete played race director and took us on a 'ride' of his 5K course. We were to validate his marks (according to IAAF rules) and then determine how to move intermediate split points for a race held at a later date on the same course. It all sounds easy, but the problem was actually quite complicated as there was a simulated construction sight we could not ride over, several gates in our way and all the answers were required to be in meters (sadly my brain still works in feet).

We all laid a 300 meter cal course (actually a few of them) in the morning--a project that took hours. It seems pulling all the great mathematical measuring minds (and egos) together caused for much conflict. When those were finally completed, it was almost lunch and while some where anxious to ride immediately, most of us ate lunch. Sally Nicoll and Joan Riegel brought us a beautiful spread to the park and I was able to take a break and visit with my family.

The riding wasn't too bad, except by the time I went out I was sunburned. The course was flat and contained in the park, so there was no traffic--a pleasant experience. There was, however, traffic amoung the measurers as the out/back course had us each riding the SPR in each other's way. I usually got off the course to make way for the more experienced riders.

I was one of the least experienced there and the only woman. My inexperience showed up during the number crunching time and while my numbers turned out fine, it took me a long time to obtain them. Being the only woman proved to be interesting and many of my fellow certifiers commented that it was a refreshing change.

At the end of the day Pete compiled all the numbers and it was quite interesting to compare notes. It was a comfort to learn that even the 'big boys' make mistakes, but for the most part we were all within meters of each other. Wayne Nicoll, our most experienced validator, had the longest ride, with me next. This is ok for a validation ride where the measurer isn't suppose to cheat the course.

(OVER)

AM

I most enjoyed meeting everyone and putting faces with names I've seen for years. While I'm still much too green to be considered for an international measuring team, the exchange of information and ideas was wonderful and made the 8 hour trip worthwhile. Most everyone there was a runner too, so we all talked shop and even got to run together. All in all, a valuable experience.

For fun I thought I'd give y'all a taste of what it was like for me. I got the sunburn for you, but I'm going to give you a chance do some number crunching of your own. I'll give you all my raw data, the map, some rules of IAAF measurement and the answer sheet to fill in. The first one to come up with the correct answers will win one of my old T-shirts! Lucky you! I did the calculations 2 ways and came up with the same results, so I'm fairly certain I've got the correct answers. YOu can do it any way you like and don't have to send your calcs if you don't want to, but I'd be interested to see what you did. If you want my calcs after, I'll send them off. I'll print the winner in the next newsletter. Good luck! (by the way, George Tillson also attended the conference and may know too much to participate...!)

Two other notes:

We are scheduling an informal measuring workshop on July 7th. We will be going over the Phelps 20K course in Shortsville, NY. This is the race that our own George Tillson is both race director and measurer. Wayne Nicoll will lead the group, so you'll have a chance to pick his brain, and we can get a chance to meet each other. If you are interested in attending, call and I'll give you details.

Since the money for these newsletters comes out of the fees you send me, I want to update my list of measurers and weed out any of you that are no longer active. There are a few from my original list that I've never heard from...if you don't measure anymore, I'd appreciate a call so I can take you off of my list. Thanks.

GET OUT AND MEASURE!!!

My data:
Pre-cal: 93770, 96629, 99489, 02347.5, 05207.5
Post cal: 62930, 65786, 68645, 71503, 74363
Counts recorded:
Start: 10170
1K: 19650
1 Mile: 25123
2K: 29074
3K 38626
TA: 40724
4k: 48047
finish: 57733

Rules:
1. Cal course length: 300 meters
2. IAAF rules use <u>average</u> of pre and post cal constants.
3. Validation rides do NOT include SCPF.
4. Construction length: 15 meters
5. HINT: A validator only checks total length of the course. There are 2 parts to the answer sheet--be sure to 'change hats' for the 2 parts.

AM

MEASUREMENT CHECK BY LOTUS 1-2-3 USING SUBMITTED DATA

AMY MORSS - RECEIVED 6-28-90

PRECAL			POSTCAL		
93770			62930		
96629	2859	2859.375	65786	2856	2858.25
99489	2860	9531.25	68645	2859	9527.5
102347.5	2858.5		71503	2858	
105207.5	2860		74363	2860	

CONSTANT FOR DAY = 9529.375 CTS/KM = 9.529375 CTS/METER

	RECORDED COUNTS	INTERVAL COUNTS	INTERVAL METERS	ADD TO INTERVAL	CORRECT INTERVAL	OVERALL ADJUST	NEW INTERVAL LENGTHS	CUM INTERVAL LENGTHS	DESIRED LENGTHS	REQ'D ADJUST
START	10170									
1K	19650	9480	994.82	15.00	1009.82		1009.82	1009.82	1001	-8.82
1M	25123	5473	574.33	15.00	589.33		589.33	1599.15	1610.95	11.81
2K	29074	3951	414.61		414.61		414.61	2013.76	2002	-11.76
3K	38626	9552	1002.37		1002.37		1002.37	3016.13	3003	-13.13
TA	40724	2098	220.16		220.16	-8.10	212.06	3228.20		
4K	48047	7323	768.47		768.47	-8.10	760.37	3988.58	4004	15.44
FINISH	57733	9686	1016.44		1016.44		1016.44	5005.00	5005	-0.00
TOTAL			4991.20		5021.20		5005.00			
DESIRED					5005.00					

REMOVE FROM TURN - HALF IN 3K-T, HALF IN T-4K. 8.10

BC

67 Southwood Cres.,
London, Ontario,
N6J 1S8,
June 19/90

Pete Riegel,
3354 Kirkham Rd.,
Columbus, Ohio,
43221

Dear Pete,

It was so good to meet you and the other measurers in person at the IAAF Course Measurement Workshop in Columbus, Ohio. The experience was even better than I hoped it would be. I learned a lot and had a very enjoyable weekend as well. I also finally figured out where I went astray in calculating out the 4 km point. Very tricky but understandable when I thought about it. I finally got a distance of 14.70 m as the distance toward the finish that the 4 km should be moved. In the past when I had a race with a turnaround I always measured once to get a fairly accurate turnaround and then made two more rides, the first placing the km/mile intervals and the second to these same points. This way the final adjustment to the turnaround was very minor and didn't require any movement of the km/mile points just the turnaround. I wasn't looking for a problem at the 4 km and so didn't see one which was there.

Concerning the measurement of Battelle Park in West Jefferson, Ohio. The course has passed validation and any World or National records that are ever set on this course would pass validation. I measured the course to be 5016.5 m and so the course is at least long enough by 16.5 m. My calculations for validation are covered in my letter to John Disley so I have just made a copy of it for you.

I have noticed a few variations between the TAC and IAAF method of certification and I wanted to just list them and make sure I have them correct and perhaps if I have missed some others you would let me know?

	TAC	IAAF
Calibration Course	300 m	500 m
Number of rides	TWO	ONE (2nd recommended)
Pre & Post Calibration	Take larger	Take average
Forms	Copy from Course Measurement Booklet.	Write up on your own in a letter explaining your steps.

Well once again thank you for including me in the IAAF Road Race Measurement Course. I strongly recommend that anyone who has the chance to attend one of these does so. I would like to attend more of these if they are offered. I also appreciated seeing some of the inovations other measurers have developed to help in their measuring such as the pointer attached to the Jone's counter and seeing the Jones Counter 2. I hope this works because it certainly makes seeing the counts easier. By the way if anyone is interested in getting a 30 m steel tape I have a contact at Stanley Tools in New Hamburg, Ontario. I will contact him and see if they have a U.S. distributer or if they have to deal directly.

yours truly,

Bernie Conway

BC

67 Southwood Cres.,
London, Ontario,
N6J 1S8,
June 19/90

John Disley CBE,
Hampton House - Upper Sunbury Rd.,
Hampton, Middlesex,
England, TW!12 2DW

Dear John,

It was so good to meet you and the other measurers at the IAAF Course Measurement Workshop in Columbus, Ohio. I hope your trip back to England went better than your trip to the U.S. It would have been anticlimactic if after climbing so many mountains and mesuring in so many busy cities around the world that you would have suffered broken bones in a descent down the shute from an aircraft.

Concerning the measurement of Battelle Park in West Jefferson, Ohio the course has passed validation and any World or National records that are ever set on this course would pass validation. I measured the course to be 5016.5 m and so the course is at least long enough by 16.5 m. My calculations for validation are listed below:

Pre-calibration Measurement of 300m Calibration Course

Ride # 1	# 2	# 3	# 4
10794	13587	16380	19174
08000	10794	13587	16380
2794	2793	2793	2794

Average is $\frac{2793.5 \text{ counts}}{300 \text{ m}} \times 1000 \text{ m} =$ 9311.66 counts for 1 km
or 46558 counts for 5 km.

These are the numbers for validation and they do not include the 0.1 % spr.

The distance for the entire course was calculated to be 5016.5 m as shown below:

Finish Counts 79712
Start Counts 33000
Difference of 46712 counts or $\frac{46712 \text{ counts}}{9311.66 \text{ counts/km}}$ = 5.0165 km
= 5016.5 m

Measurement to Lay Out a New 5 km Course

Using the precalibration rides listed above I have calculated my Working Constant as shown:

Working Constant = $\frac{2793.5 \text{ counts}}{300 \text{ m}} \times 1000 \text{ m} \times 1.001$ = 9321 counts/km
or 15001 counts/mile
or 46605 counts/5 km

Nominal Distance Measured	Number of Counts	Interval Counts	Comments
0 km (start)	33000	0	
1 km	42378	9378	long, should be 42321
1 mile	47860	14860	short, should be 48001
2 km	51720	9342	long, should be 51642
3 km	61048	9327	long, should be 60963
Turn Around	63100		
4 km	70255	9207	short, should be 70284
5 km	79712	9457	long, should be 79605

BC

Post Calibration Measurement of 300 m Calibration Course

Ride # 1	# 2	# 3	# 4
87794	90586	93379	96172
85000	87794	90586	93379
2794	2792	2793	2793

Average $\frac{2793 \text{ counts}}{300 \text{ m}} \times 1000 \times 1.001 = 9319.31$ counts per km

Before adjusting the turnaround and the km and mile split(s) we must average the pre and post calibrations to calculate the measured distances.

Average of pre and post calibrations = $\frac{9320.9782 + 9319.31}{2}$

Constant for the day = 9320.144 counts/km

For Correct Distance of	Adjust as follows:
Start	leave as is.
1 km	42378 Shorten by 57 x 1000 m / 42321 9320.144 counts / 57 which is 6.12 m
1 mile	48001 Lengthen by 141 x 1000 m / 47860 9320.144 counts / 141 which is 15.13 m
2 km	51720 Shorten by 78 x 1000 m / 51642 9320.144 counts / 78 which is 8.37 m
3 km	61048 Shorten by 85 x 1000 m / 60963 9320.144 counts / 85 which is 9.12 m
Turn Around	To adjust so that the 5 km is at the same position as the start it is necessary to adjust the turnaround. Since this is an 79712 out and back section the actual 79605 adjustment is only half. 107 Shorten by 1 x 107 x 1000 m / 2 x 9320.144 counts which is 5.74 m
4 km	The moving of the turnaround would have an affect on the measurement of the 4 km point if we used the counts from the start. Instead we could more easily calculate the movement of the 4 km point by measuring back from the finish of the 5 km point.
	79712 counts at the 5 km point 70255 counts at the 4 km point 9457 counts difference. The difference should be less by 9457 9320 137 counts x 1000 m / 9320.144 counts which is 14.70 m. Therefore move the 4 km towards the finish by this distance.
5 km	Same as the Start. Leave where it is.

yours truly,

Bernie Conway

BICYCLE CALIBRATION DATA SHEET

BC

Date of Measurement JUNE 16/90

Name of Measurer BERNIE CONWAY

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

Ride	Start Count	Finish Count	Difference
1	08000	10794	2794
2	10794	13587	2793
3	13587	16380	2793
4	16380	19174	2794

Pre-measurement Average Count 2793.5

Time of Day 12:30 PM

Temperature 29°C

Length of Calibration Course 300 m

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

Working Constant = $\frac{2793.5 \text{ counts}}{300 \text{ m}} \times 1000 \times 1.001 =$ 9321 counts/km

= 15001 counts/mile

= 46605 counts/5km

103

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	85000	87794	2794
2	87794	90586	2792
3	90586	93379	2793
4	93379	96172	2793

Post-measure Average Count 2793

Time of Day 3:30 PM

Temperature 29°C

FINISH CONSTANT = Number of counts in one kilometer or one mile, calculated from Postmeasure average count, and multiplied by **1.001 "safety factor"**

Finish Constant = $\frac{2793 \text{ counts}}{300 \text{ m}} \times 1000 \text{m} \times 1.001 =$ 9319 counts/km

Constant for the Day = **Either** the Working Constant **or** the Finish Constant, whichever is the **larger.**

CONSTANT FOR THE DAY = 9321. 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 recalibration "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

COURSE MEASUREMENT DATA SHEET

Name of Course or Race Name BATTELLE IAAF 5 km

Name of Measurer #1 BERNIE CONWAY Working Constant #1 _____

Date JUNE 16/90 Start: Time 1 PM Temperature 29°C

Finish: Time 3 PM Temperature 29°C

Name of Measurer #2 _____ Working Constant #2 _____

Date _____ Start: Time _____ Temperature _____

Finish: Time _____ Temperature _____

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 Recorded	Elapsed (TOTAL)		Counts for Measurer #2 Recorded	Elapsed
START	33000	0			
1 km	42378	9378	(out)		
1 mile	47860	14860	(short)		
2 km	51720	18720	(out)		
3 km	61048	28046	(out)		
T.A.	63866				
4 km	70255	37255	(short)		
5 km	79712	46712	(out)		

Preliminary Course Length	start-to-finish counts	divide by	working constant	=	measured length
Measurer #1	46712	/	9321.	=	5011.5 m
Measurer #2		/		=	

Difference between lengths #1 and #2	divide by	length #1	=	Measurement comparison (less than 0.0008?)	
	/		=		(____) (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		/		=	

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

Measured course length 5011.5 m Desired course length 5000 m

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.

How much did you add or subtract, and where (start, finish, turn-around point)?

SUBTRACT ½ of 11.5 m from TURNAROUND

RK

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?

YES, PACED OUT SO WITHIN 1 m.

APPLICATION FOR CERTIFICATION OF A ROAD COURSE
The Calibrated Bicycle Method

1. Name this Course will be Known By BATTELLE IMAP 5k
2. Advertised Race Distance 5 km or 5000m
3. Location of Start WEST JEFFERSON, OHIO (city, state) Finish (if different) — (city, state)
4. Person in Charge of Measurement:
   BERNIE CONWAY (name) 67 SOUTHWOOD CRES, LONDON ONTARIO, CANADA (address) (519) 641-6889 (telephone)
5. Race Director (if course is measured for a specific race):
   PETE RIEGEL (name) 3354 KIRKHAM RD, COLUMBUS, OHIO (address) (—) — - — (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? N A (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. N A
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)

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SUMMARY OF MEASUREMENTS

10. Date(s) of measurements JUNE 16 / 90
11. How many measurements of the course were made? ONE
12. Name(s) of measurer(s) BERNIE CONWAY
13. Exact length of course 5 km or 5000m
14. Difference between longest and shortest measurements —
15. Which measurement was used to establish the final race course and WHY?
    1ST - ONLY ONE ALLOWED.
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).
19. How far from the curb (edge of pavement) did you measure on curves? 30cm.
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)

NO, a detail measur ... ace c... n the s... y? ... (YES or NO)

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.
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.
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 —
26. Altitude of Race Course (above mean sea level):
    start ___ finish ___ highest ___ lowest ___ ?
27. Total Climb (summation of all up-hill altitude changes) — (optional)

28. Type of surface (give percentages):

100 curbed streets	___ graded dirt road
___ uncurbed streets/roads	___ ungraded dirt road
___ concrete sidewalk	___ gravel road
___ concrete/brick streets/roads	___ undefined paved surface
___ 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. YES (YES or NO)
30. How did you mark the start and finish points (and turn-around points)?
    S/F - NAIL & PAINTED . TA - NAIL
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 ...ement ...ace c... n the s... y? ... YES (YES or NO)

8K

BC

June 16/90 IAAF Measured Columbus Ohio

300m cal. course Temp Corrected

10794	13587	16380	19174
08000	10794	13587	16380
2794	2793	2793	2794

AV 2793.5 counts / 300 m = 46558.3 counts / 5 km

for Validation (no 0.1% added)

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Measurement of 5 km Course

2793.5 counts / 300 m × 1.001 × 1000 = 9321 counts / km

= 15 00[illegible] counts / mile

= 46 605 counts / 5 km

Distance	My Splits	Pete's Orig. Splits	Dif.
0	33000		
1 km	42321	42378 (over)	Shorten by 1000 m / 6.11 m; 57 counts × 1000 m / 9321 [illegible]
1 mile	48001	47860 (short)	141 counts × 300 m / 2793.5 = 15.1
2 km	51642	51720 (long)	78 × 300 / 2793.5 = 8.38

× 1000 m / 9321 count

BC

	mine	orig.	dif
3 km	60963	61048 (long)	85 × 300 / 2793.5 = 9.13
T.A.	~~[illegible]~~	~~63100~~	
4 km	70284	70255 (short)	29 × 300 / 2793.5 = [illegible]
5 km	79605	79712 (long)	107 × 300 / 2793.5 = 11.49

∴ Move turnaround ½ × 11.49 m = 5.75 m short

~~Length of Course race day 79712~~
~~33000~~
~~46712 counts~~

~~46712 / 46558 = 154 counts over × 300 m / 2793.5 counts = 16.5 m long~~
See next page.

Post ?

87794	90586	93379	96172
85000	87794	90586	93379
2794	2792	2793	2793

AV 2793 counts / 300 m Slightly shorter count than pre.

~~AV~~ ∴ Use Pre ~~[illegible]~~ for course measurement.

BC

BC

1 km	57 counts	Shorter by 6.11 m
1 mile	141 counts	lengthen by 15.13 m
2 km	78 counts	shorter by 8.37 m
3 km	85 counts	shorter by 9.12 m
T.A		
4 km	29 ~~107~~ counts	lengthen by 3 ~~11~~ m
5 km	107 counts	shorter by 11.48 m

by shortening at T.A. by ½ x 11.48 m

~~Step on 5.74 m~~

Description Start/Finish & T.A. for Map.

23.56 m W. of T.P. NB29 W ~~E~~ of Swings at Pavilion

25.76 m ~~E~~ of T.P. NB10 in front of Pavilion W side of road.

T.A. 264 counts (28.35 m) E ~~W~~ of T.P. 359964 T.P. is 3rd T.P. W of white block Bldg across from Parking lot.

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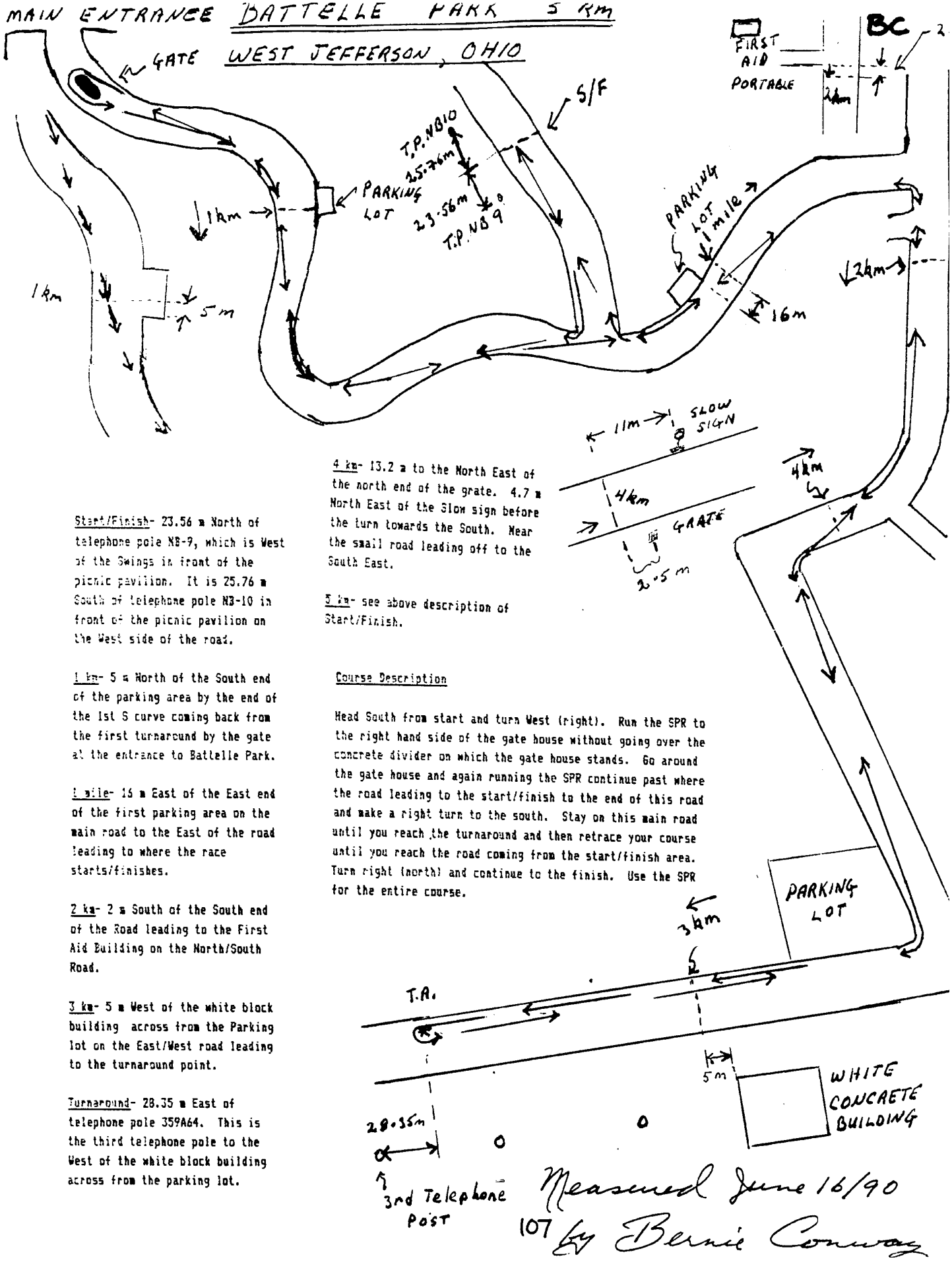
BC

1 km	8 m N ~~from~~ of ~~S~~ (see map) 8 m end of Parking area by 5 cars from 1st T.A. After going thru ground concrete base of gate.
1 mile	16 m E of E end of 1st Parking Area & E of road leading to S/F area.
2 km	2 m S of S edge of Road leading to First Aid Building
3 km	5 m W of White block Build across from Parking Lot.
4 km	2.5 m S of Sand of gate 11 m S of Slow sign before turn toward the ~~South~~ (Water tower to South.)
T.A.	See 2 pgs earlier.

BC



Start/Finish- 23.56 m North of telephone pole NB-9, which is West of the Swings in front of the picnic pavilion. It is 25.76 m South of telephone pole NB-10 in front of the picnic pavilion on the West side of the road.

1 km- 5 m North of the South end of the parking area by the end of the 1st S curve coming back from the first turnaround by the gate at the entrance to Battelle Park.

1 mile- 16 m East of the East end of the first parking area on the main road to the East of the road leading to where the race starts/finishes.

2 km- 2 m South of the South end of the Road leading to the First Aid Building on the North/South Road.

3 km- 5 m West of the white block building across from the Parking lot on the East/West road leading to the turnaround point.

Turnaround- 28.35 m East of telephone pole 359A64. This is the third telephone pole to the West of the white block building across from the parking lot.

4 km- 13.2 m to the North East of the north end of the grate. 4.7 m North East of the Slow sign before the turn towards the South. Near the small road leading off to the South East.

5 km- see above description of Start/Finish.

Course Description

Head South from start and turn West (right). Run the SPR to the right hand side of the gate house without going over the concrete divider on which the gate house stands. Go around the gate house and again running the SPR continue past where the road leading to the start/finish to the end of this road and make a right turn to the south. Stay on this main road until you reach the turnaround and then retrace your course until you reach the road coming from the start/finish area. Turn right (north) and continue to the finish. Use the SPR for the entire course.

Measured June 16/90
by Bernie Conway

BC

MEASUREMENT CHECK BY LOTUS 1-2-3 USING SUBMITTED DATA

BERNIE CONWAY - RECEIVED 6-30-90

PRECAL			POSTCAL		
8000			85000		
10794	2794	2793.5	87794	2794	2793
13587	2793	9311.666	90586	2792	9310
16380	2793		93379	2793	
19174	2794		96172	2793	

CONSTANT FOR DAY = 9310.833 CTS/KM = 9.310833 CTS/METER

	RECORDED COUNTS	INTERVAL COUNTS	INTERVAL METERS
START	33000		
1K	42378	9378	1007.21
1M	47860	5482	588.78
2K	51720	3860	414.57
3K	61048	9328	1001.84
TURN	63100	2052	220.39
4K	70255	7155	768.46
FINISH	79712	9457	1015.70
TOTAL			5016.951

BERNIE USED HIS PRECAL AS CONSTANT FOR THE DAY, RATHER THAN AVERAGE.
PRECAL WAS THE LARGER, BUT INCORRECT FOR IAAF.

TOTAL COUNTS = 46712
DISTANCE BASED ON PRECAL = 5016.502

DID HE TAPE THE 15 M INCREMENTS, AND SUBSTITUTE COUNTS? HIS REPORT
MAKES NO MENTION OF ANY TAPED DISTANCES.

JW

4419 Thornbark Court
Hoffman Estates, Illinois 60195

June 26, 1990

Mr. Peter S. Riegel, Chairman
Road Racing Technical Committee
The Athletics Congress of the USA
3354 Kirkham Road
Columbus, Ohio 43221

Dear Pete,

Below please find my report of the validation ride of the Batelle Park 5000 meter course. I apologize for witing so long. After leaving Columbus I drove out to Kansas and spent a couple of days with family and friends, then came back to work after missing three days. I've finally caught up, so here goes.....

Validation of the Batelle Park 5K course in West Jefferson, Ohio was conducted on Saturday, June 16, 1990. The course was accessible and generally free of traffic, with the exception of two closed gates, one operating access control gate that interfered twice with the Shortest Possible Route (SPR), and one area that was impassible due to construction. Each of these obstacles was encountered twice along the course with the exception of the access gate which as described interfered twice although it was encountered only once.

Prior to beginning the actual measurement of the race course a calibration course was laid out along both sides of the north-south road along the east side of Batelle Park. Both courses were 300 meters in length. After completion of four calibration rides, the bicycle was ridden back to the start of the race course and the validation measurement begun. The construction area was measured by establishing points on the SPR in both directions on each side of the construction area 15 meters apart. Using the layout constant, 15 meters were equal to 140 counts; the counter was stopped at the first mark, the reading noted, the bicycle walked across the construction area, the counter advanced 140 counts from the noted reading, the front tire centered on the second mark, and the measurement continued.

The closed gates were measured by stopping the bicycle with the front tire in contact with the gate, moving the bicycle around or under or over the gate, placing the rear tire against the other side of the gate, advancing the counter to compensate, and continuing the measurement. The length of the bicycle is 5.65 feet or 16 counts. The access gate that served as a turnaround point was measured by lifting the gate slightly and walking the bicycle along the SPR around the concrete island and underneath both gates.

The course was measured using the SPR across the full paved width of the roadways in accordance with the course map and the instructions. After completion of the validation ride the bicycle was recalibrated and the course length calculated. Results are shown on the attached calibration and course measurement report. The total length of the course as measured was calculated at 5016.4 meters. The weather was perfect; the course was dry and there was no wind to speak of.

Should the race director wish to adjust the course to the proper length for a 5000 meter course (5005 meters including short course prevention factor), 11.4 meters must be removed from the course. The most convenient place to do this would be at the turnaround point at the south end of the course. Because the runners actually make a 180 degree turn at this point, any distance by which the point is moved is reflected twice in the course distance. Thus to remove the 11.4 meters, the turnaround point should be moved 5.7 meters toward the start/finish line. If the intermediate splits were properly located, only the 4K split would be moved as a result of the TP adjustment. However because the measurement showed that all of the intermediate splits were incorrectly located, all should be adjusted in accordance with the attached Split adjustment recommendations.

I appreciated the opportunity to attend the seminar and meet the other measurers. My reaction to the weekend was much the same as yours. Count me in on the next one.

Respectfully Submitted,

Jay W. Wight
Regional Certifier
TAC/RRTC

JW

CALIBRATION AND COURSE MEASUREMENT REPORT

PRE-CALIBRATION

11:35 AM 6-16-90 84°F

START	FINISH	ELAPSED
45453	48252	2799
48252	51052	2800
51052	53852	2800
53852	56651	2799

AVERAGE = 2799.5

$\frac{2799.5 \times 1000}{300} = 9331.67$ counts/km

$\times 1.609344 = 15017.86$ counts/mile

POST-CALIBRATION

12:30 PM 6-16-90 85°F

START	FINISH	ELAPSED
16374	19172	2798
19172	21970	2798
21970	24768	2798
24768	27566	2798

AVERAGE = 2798

$\frac{2798 \times 1000}{300} = 9326.67$ counts/km

$\times 1.609344 = 15009.82$ counts/mile

AVERAGE CONSTANT = $\frac{9331.67 + 9326.67}{2} = 9329.17$ counts/km

COURSE VALIDATION MEASUREMENT

START: 12:00 NOON 84°F FINISH 12:25 PM 85°F

POINT	READING	ELAPSED COUNTS	ELAPSED METERS
START	62000	0	0
1K	71398	9398	1007.38
1M	76891	14891	1596.18
2K	80757	18757	2010.58
3K	90104	28104	3012.49
4K	99328	37328	4001.21
FINISH	08799	46799	5016.42

ELAPSED METERS WERE CALCULATED AFTER THE POST-CALIBRATION RIDE USING THE AVERAGE CONSTANT.

JW

SPLIT ADJUSTMENT RECOMMENDATIONS

POINT	ELAPSED METERS TO EXISTING POINT (CORRECTED 5000M COURSE)	PROPER ELAPSED DISTANCE	SUGGESTED ADJUSTMENT IN METERS ("+" = TOWARD FINISH)
START	ZERO	ZERO	NONE
1K	1007.38	1001	-6.38
1 MILE	1596.18	1610.95	+14.77
2K	2010.58	2002	-8.58
3K	3012.49	3003	-9.49
4K	3989.79	4004	+14.21
FINISH	5005.00	5005	NONE

NOTE: THIS TABLE ASSUMES THAT THE SOUTH TP HAS BEEN MOVED 5.71 M TO THE EAST AND THE COURSE THUS SHORTENED BY 11.42 METERS.

BATTELLE PARK

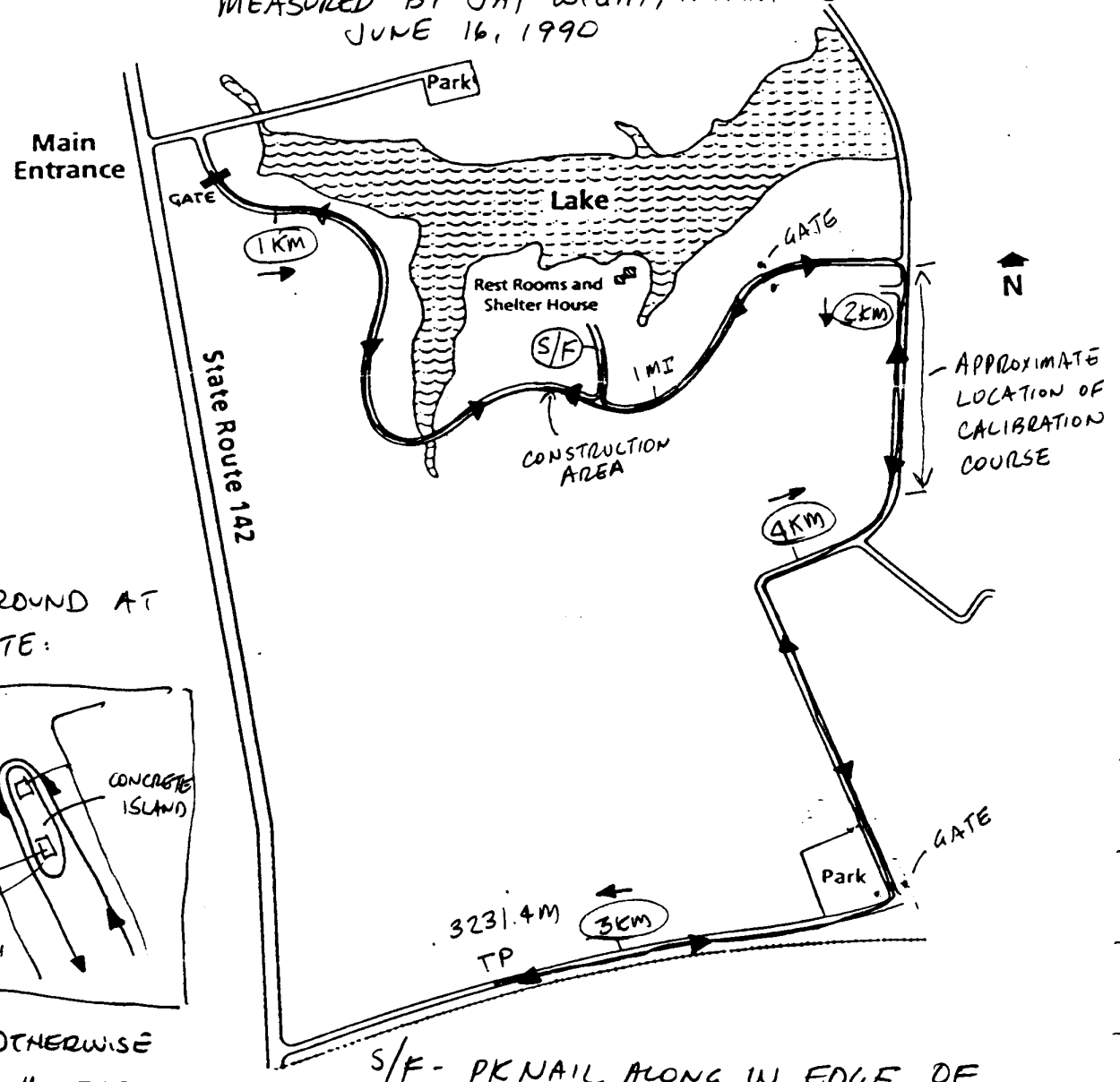
JW

WEST JEFFERSON, OHIO

5000 METER ROAD RACE COURSE

MEASURED BY JAY WIGHT, HOFFMAN ESTATES, IL, USA

JUNE 16, 1990



TURNAROUND AT GATE:

COURSE OTHERWISE DEFINED AS THE FULL PAVED SURFACE OF ALL ROADS. RUNNERS NOT OTHERWISE RESTRICTED.

S/F - PK NAIL ALONG W EDGE OF PARKING LOT DRIVE, 23.5M N ALONG EDGE OF PAVEMENT FROM ℄ OF UTILITY POLE "NB-9" which is the middle of 3 poles along the W side of the drive

TP - (as located) - along N edge of road, 83' NE across road from utility pole 359464 just N of fence between road and RR tracks to the south, approximately .312 M E of intersection.

JW

MEASUREMENT CHECK BY LOTUS 1-2-3 USING SUBMITTED DATA

JAY WIGHT - RECEIVED 7-2-90

PRECAL			POSTCAL		
45453			16374		
48252	2799	2799.5	19172	2798	2798
51052	2800	9331.666	21970	2798	9326.666
53852	2800		24768	2798	
56651	2799		27566	2798	

CONSTANT FOR DAY = 9329.166 CTS/KM = 9.329166 CTS/METER

	RECORDED COUNTS	INTERVAL COUNTS	INTERVAL METERS
START	62000		
1K	71398	9398	1007.38
1M	76891	5493	588.80
2K	80757	3866	414.40
3K	90104	9347	1001.91
4K	99328	9224	988.73
FINISH	108799	9471	1015.20
TOTAL			5016.42

140 COUNTS = 15.00669 I WILL NOT BOTHER CORRECTING FOR THE DIFFERENCE

THE ATHLETICS CONGRESS
OF THE USA

Road Running Technical Committee
Bob Baumel, Vice-Chairman West

129 Warwick Road
Ponca City, OK 74601
405-765-0050 (home)
405-767-5792 (work)

1990-07-02

John Disley CBE — Hampton House-Upper Sunbury Rd
— Hampton, Middlesex — ENGLAND TW12 2DW
Pete Riegel — 3354 Kirkham Rd — Columbus, OH 43221 — USA

Measuring Report for IAAF Seminar

I attended the IAAF Course Measuring Seminar in Columbus, OH on 90/06/16, and measured the Battelle Park test course. Interpreting my measurement as a validation for a previously held race, I determined the length of the existing course as 5020.18 metres. (Stated more correctly, I found the length to be somewhere between 5019.3 m and 5021.1 m, according to the range between pre-measurement and post-measurement calibration.) Based on this measurement, following standard IAAF procedure, the course should be shortened 15.18 m before using it for future races. The race director wishes to apply this adjustment at the Turnaround, which should therefore be pulled in 7.59 m.

The enclosed calculation sheet shows all my data and numerical results, including the calculated adjustment for each split. The enclosed map describes the course, including key points (Start/Finish and Turnarounds), as it should be adjusted for future races. (Regrettably, there was not enough time to document the intermediate split positions.)

A detailed description of my measurement activity (in chronological order) follows:

Measuring Activity

The fourteen seminar participants (organizers Pete Riegel and John Disley, and the twelve other measurers including myself) arrived at Battelle Park at roughly 9:00 am. Pete took most of the measurers on a bicycle tour of the course, but four of us who hadn't finished setting up our borrowed bikes (Tom Knight, Bob Thurston, Doug Loeffler and myself) remained at the Start/Finish area to wait for a second tour. As the first group was touring, the remaining four of us took this opportunity to examine a (simulated) construction area on the course, that would have to be taped across.

This "construction" area, located just west of the Start/Finish area, would have to be traversed twice when measuring the course: first in an east-to-west sense just after leaving the Start, and then in a west-to-east direction after returning from the course's northern turnaround. Different measuring lines (i.e., tangent lines) would be required when measuring in these two directions. We found that a length of 15 m comfortably spanned the construction site with several metres to spare. Tom Knight and I taped a 15 m length across this site along the east-to-west measuring line, while Bob

BB

Thurston and Doug Loeffler taped a similar interval along the west-to-east measuring line. The endpoints of both intervals were marked so they could be easily used during the bicycle riding.

Then the first tour group returned, and the four of us who had stayed behind went out with Pete for our own tour of the race course. In this process, we familiarized ourselves with the course, and learned how runners were permitted to run it.

The next step was to lay out a pair of 300 m calibration courses, along the eastern and western edges of a straight north-south portion of the race course that included the 2 km mark. Corresponding to our responsibilities in the US course certification program, Wayne Nicoll headed up the initial layout of the Eastern cal course, while I had similar responsibility for the Western cal course.

I began work on the western cal course at 10:55 am, leading a 3-measurer team consisting of Doug Loeffler (rear tapeman), Jay Wight (lead tapeman), and myself (endpoint marker). Measured pavement temperature was 31°C. We used a 60 m tape owned by Bob Thurston. (Note: In the meantime, Bob Thurston did a measurement of the eastern cal course using a 30 m tape owned by me!) We set a nail at the northern endpoint, and laid out 5 tape lengths with Thurston's 60 m tape, pulled with a tension of 50 newtons using a spring tension handle. (The 50 N figure was specified by markings stamped on the tape.) Then we shortened the southern endpoint by 3.8 cm, based on the measured 31°C temperature, and we set a nail at the adjusted position.

Our resulting 300 m course was checked by a team led by Tom Knight, using a 30 m tape owned by Tom. They found the distance (corrected for temperature) between our two nails to be 299.978 m. The discrepancy of 2.2 cm is just 1 part in 13 600, which is well within reasonable tolerance. (The nominal US government accuracy standard for steel tapes is 1 part in 12 000.) For greatest accuracy, it would probably have been best to average Tom's and our measurements. But for the sake of simplicity, the distance between the nails was taken as an even 300 m for all subsequent calculations.

I don't have any data on the measurement of the Eastern cal course, although I understand that it was more confused than our measurements of the Western cal course. I believe that a total of five measurements were taken of the Eastern cal course.

I did all my bicycle measuring, including precalibration of the bike, one ride of the race course, and postcalibration of the bike, between 11:50 am and 12:47 pm, using a bicycle borrowed from Bernie Conway. This was actually the same bike I used last Fall when checking the Springbank Road Race course in London, Canada. (See my article in Jan 1990 *Measurement News*.)

In calibrating the bike, I used both the eastern and western cal courses. In both Precal and Postcal, all my odd-numbered rides were southbound on the western cal course, while my even-numbered rides were northbound on the eastern course. My northbound rides averaged 0.75 counts more than my southbound rides. This was probably *not* due to any significant difference in length between the two courses; I think it occurred because Wayne laid out

BB

his cal course farther from the road edge, at a distance that felt unnatural to me, so I tended to deviate from a straight line when riding it.

In riding the race course, I started and finished at the 2 km point instead of the Start/Finish, since the 2 km point was right on the calibration course. I tried to ride a fair line, taking the inside edges of curves at 30 cm from the curb as well as I could estimate it. (This differs from standard layout measurements for TAC certification, where I would normally ride a tighter line.)

Actually, this course has no real curbs at all (except at the card-key gate—northern turnaround), but Pete Riegel painted lines along the inside edges of some corners, intended to *simulate* curbs.

At the simulated construction site, I used the 15 m taped intervals measured previously. I simply carried the bike from the mark at one side of the construction site to the corresponding mark on the other side while holding the front wheel locked. Then, when working up my results after I finished measuring, I explicitly included the 15 m taped distances in the calculations.

At the course's southern turnaround, I followed Pete Riegel's instructions by simply riding up to the point and turning around the bike on the spot (which is the procedure in the TAC Course Measurement manual). Thus, I did not make any allowance for extra distance covered by a runner when circling around the turnaround cone.

In riding the course, I needed to pass through locked gates on five occasions: These consisted of two large metal gates inside the park (each traversed in both directions), and the card-key operated gate at the park entrance at the course's northern turnaround. I was able to handle three of these five gate crossings (namely, the card-key gate and both crossings of the internal park gate at the course's southeast corner) by simple sideways offsets, as illustrated on page 16 of the IAAF measuring manual (draft text dated March 7, 1990). A simple offset could be used at the southeast gate because the central portion of this gate was high enough to pass my bike under (although this central portion was not on the measuring line, thus the need for an offset).

For the two crossings of the internal park gate between the 1.609 km and 2 km marks, I used the technique described on page 18 of the IAAF draft text. In this method, the bike is ridden up to the gate, and is then picked up and carried *backward* a distance of one bike length while holding its front wheel locked. Then it is rolled forward through this one-bike-length distance, so as to compensate for distance that cannot be ridden because of the locked gate.

Actually, the procedure on page 18 of the IAAF draft text is not quite correct, as it fails to account for the width of the gate. Therefore, I actually carried my bike backward through a distance of one bike length *plus the gate width* (by eyeball estimate). Note that if you use the manual's technique for five gate crossings, and fail to account for the gate widths, then the error could add up to around a whole metre.

After completing the bicycle measuring, I returned to the pavilion at the Start/Finish area where I had lunch, did my preliminary calculations, and turned them in to Pete Riegel. Then I realized that I still needed some documentation of the Start/Finish and Turnaround points for my course

BB

map, so I got back on the bike and rode to the relevant points. (Note that with a little more foresight, I could have gathered that documentation during my measuring ride, making this additional trip unnecessary.)

At the course's southern turnaround, I obtained a (taped) distance of 22.34 m between the (existing) turnaround point and telephone pole 359A64 Later, I heard Pete Riegel describe this distance as 22.8 m. Thus, Pete's and my measurements of this short interval between the turnaround and telephone pole differed by nearly half a metre. The main reason for this discrepancy is that the road between the turnaround and telephone pole has some *curvature*. I have chosen to use my own (smaller) measurement of this interval because it makes the final race course safer; i.e., a race director using this distance to re-locate the turnaround will make the course a little longer.

In reality, however, it really doesn't matter how well we document the Start/Finish and Turnaround locations, because this course is still inherently non-reproducible due to the arbitrary simulated "curbs" painted by Pete Riegel at the corners!

General Observations

My immediate reaction after completing my measuring ride was a feeling of insecurity about whether I had measured all the locked gates correctly. I was worried about parallax errors, and my eyeball estimations of gate width. Worse yet, what if I completely forgot to include the extra bike length when using the technique from page 18 of the IAAF-draft manual? Then my measured distance would be off by nearly two metres for each gate where this happened.

Thus, I felt the measurement of this course to be non-robust because of the five gate crossings, particularly if the technique on page 18 of the IAAF draft manual is used for all five gates. Of course, we did have fourteen different people measuring this course, so if anybody actually dropped a whole bike length at one of the gates, it will probably become clear once we have compiled everybody's raw data for every measured point. But if this were a real validation situation with only *one* measurement, I would tend to lack confidence in the result.

Could we have dealt with the locked gates in a more robust manner? The most accurate procedure would have been to handle the gates the same way as the construction site; i.e., mark points on either side of the gate, and tape the distance between those marks. While this might seem like overkill, it would have the following advantages:

1) Greater Confidence: Everything is written down—the counter readings at both marks and the taped distance between the marks. So you know afterwards exactly what you did.

2) Avoids Parallax Error: Instead of sighting down the front of the front wheel and the back of the back wheel (with different, non-cancelling parallax errors), you simply sight down the center of your front axle (at both marks), just as you *always* do while measuring.

3) Explicitly Accounts for Width of Gates.

BB

Because of these advantages, I think that in post-race validation situations, locked gates ought to be handled by taping through them. (Indeed, this is precisely what I did in November 1987 when validating the Mohawk Park 12 km course in Tulsa, Oklahoma, which had three locked gates at the time of my measurement.) A more approximate method, such as that illustrated on page 18 of the IAAF draft manual, is acceptable in simple pre-race layout measurements because the most likely errors in such methods (such as forgetting to roll the extra bike length) tend to be in the "safe" direction; i.e., they make the laid-out course longer. Similarly, it's OK to neglect the gate width in a layout measurement, as this also makes the course longer.

The aspect of this measuring occasion that I found most disturbing can be seen on the preliminary results sheet distributed by Pete Riegel that evening. The fourteen measurements ranged from 5015.2 m to 5023.2 m, which is a span of 8 metres. That span is 60% greater than the 5-metre Short Course Prevention Factor that we use for a 5000 m race. This means that if some of these measurements were used to lay out a course at 5005 m, then other measurements would find the laid-out course to be shorter than 5000 m. In fact, a simple statistical calculation (which I will probably write up in detail in *Measurement News*) indicates that if you randomly pick two measurements from this population of measurers, the probability is about 8% that the two selected measurements will differ by more than 5 metres.

Perhaps you will say that this isn't a problem because in standard IAAF procedure, once a course is "certificated" by an IAAF-approved measurer prior to the race, there isn't any requirement for post-race remeasurement. The course will never be found short in a post-race remeasurement because no such remeasurement will ever be made! But this is a specious answer because the method will not be credible unless an expertly laid out course can reliably withstand checking by another expert measurer. Regardless of standard procedure, there may be situations where post-race remeasurement is warranted by questions that arise about a course, even though the course had been IAAF-certificated prior to the race.

A large part of the problem was that, in the present exercise, a single measurement was intended to serve as *both* a validation and a layout. I wrote in my "Larger vs. Average Constant" essay (printed in May 1990 *Measurement News*) that "pre-race layout measurements and post-race validation measurements serve very different purposes." For this reason, many TAC Certifiers will ride the course differently in a validation or layout (cutting corners more tightly in a layout). When told that their single measurement would have to serve as both validation and layout, it's possible that some of the participants (such as Wayne Nicoll) were thinking more in a "validation" mode, while others (such as Doug Loeffler) thought more in a "layout" mode.

Let me hasten to add, however, that the agreement of our 14 measurements, viewed realistically, was excellent given the curviness of this course. According to Pete Riegel, the curves on this course add up to about 2300° (or about 40 radians). By way of comparison, I did a different measurement four years ago of another course with about 2300° of curves, with an Oklahoma measurer whom I consider quite good (although not quite in the same class as the participants in this seminar). I "beat" that measurer by 14.5 metres.

BB

Viewed in this light, a spread of only 8 metres in 14 separate measurements is not bad at all.

The problem is not in our measurement results, but rather in current IAAF procedures which specify precisely the same method of calculation for layout and validation measurements, and allow a spread of only 0.1% between the layout point and validation rejection point, with no other safety factors or tolerances. In TAC we have additional safety factors in layout (larger constant; require at least two measurements and choose "better" one), and we now allow a slight negative tolerance (0.05%) in validation. These procedures have evolved over a period a years, and some (particularly the negative tolerance in validation) involved some very emotional debate.

Pete Riegel has remarked that when we in TAC/RRTC were bitterly debating the validation tolerance question several years ago, most measurers elsewhere in the world just yawned, as if we were arguing about angels on the head of a pin. The present exercise shows that we were addressing a real problem; we weren't arguing about angels dancing on pins.

In raising these points, I do not wish to imply that IAAF must completely revamp its procedures before proceeding further with its certification program. I agree with Pete that right now, it's most important to have *some* reasonably meaningful IAAF measurement procedures in place, and to establish procedures for IAAF road records as soon as possible, even if these procedures aren't perfect.

I point out only that some of the current IAAF procedures haven't been thought out as fully as possible. It would be great if all the lessons learned by TAC over the years could be absorbed instantly by IAAF. But I suppose that IAAF will need a number of years to refine its procedures until these issues have been adequately dealt with.

Before concluding this report, I want to say how grateful I am to Pete and Joan Riegel for hosting this event, and to John Disley for traveling from England to officiate. It was a great pleasure meeting John, whom I had known only by correspondence for the past five or six years. I was also very happy to meet five of the US measurers whom I did not know previously, and to renew acquaintances with all the other measurers. (In one case, namely Bernie Conway, that acquaintance goes back fourteen years when we both belonged to the same running club in London, Canada.)

Finally, I share Pete Riegel's sentiment when he wrote that he hadn't had as much fun since the Los Angeles Olympic Marathon measurement. We have now collected a dataset of 14 measurements that is, in many ways, better than the Los Angeles dataset. The present measurements were more nearly independent, there were no "conga lines" of bicycles when taking counter readings, and the weather was far more constant. This dataset may provide material for many more studies of course measuring technique.

Sincerely,

Bob

Bob Baumel

Battelle Park IAAF test course Measured: 90/06/16

Length of Calibration Course = 300 m
Measurements Computed using AVERAGE Constants WITHOUT 1.001 factor

Bob Baumel
Pre-Calibration (11:50 am, 30 deg C):

Start	Finish	Counts
39300	42114	2814
42114	44928.5	2814.5
44928.5	47741.5	2813
47741.5	50555.5	2814

Working Constant: 9379.5833 counts/km

Post-Calibration (12:47 pm, 30 deg C):

99000	01812.5	2812.5
01812.5	04626	2813.5
04626	07438.5	2812.5
07438.5	10251.5	2813

Finish Constant: 9376.2500 counts/km

Constant for Day: 9377.9167 counts/km

Course Measurement (12:02-12:38 pm, 31 deg C):

	Counter Reading	Interval (counts)	Interval (metres)	Cumulative (metres)	
Start/Finish	79507			0.00	
Arrive Constr	80346.5	839.5	89.52	89.52	
Leave Constr	80346.5	TAPED	15.00	104.52	
1 km	88824.5	8478.0	904.04	1008.56	
Arrive Constr	93422.5	4598.0	490.30	1498.86	
Leave Constr	93422.5	TAPED	15.00	1513.86	
1.609344 km	94209	786.5	83.87	1597.73	
2 km	98097.5	3888.5	414.64	2012.37	<== Ended Ride Here
2 km	51300				<== Began Ride Here
3 km	60699	9399.0	1002.25	3014.62	
Turnaround	62764.5	2065.5	220.25	3234.87	
4 km	69976	7211.5	768.99	4003.86	
Start/Finish	79507	9531.0	1016.32	5020.18	

Adjustments to Make Course the Correct Distance (all in metres):

	Cumulative Measurement	After TA Adjustment	Desired Distance	Required Adjustment
Start/Finish	0.00	0.00	0.00	0.00
1 km	1008.56	1008.56	1001.00	7.56 TS (toward Start)
1.609344 km	1597.73	1597.73	1610.95	13.22 TF (toward Finish)
2 km	2012.37	2012.37	2002.00	10.37 TS
3 km	3014.62	3014.62	3003.00	11.62 TS
Turnaround	3234.87	3227.28	N/A	7.59 toward S/F
4 km	4003.86	3988.68	4004.00	15.32 TF
Start/Finish	5020.18	5005.00	5005.00	0.00

Bob Baumel's Field Notes 90/06/16 BB

Calibration Course Layout

Cal Course layout
10:55 31°C
- 11:08

~~long rod~~
- ~~elevator~~ 38 mm

Bicycle Pre-Cal

11:50 cal
30°

39300	
42114	2814
44928½	2814.5
47741½	2813
50555½	2814

9379.5833

Course Ride

12:02 31°C

2 km 51300
3 km 60699
TA 62764.5
4 km 69976
S/F 79507
Con 1 80346.5
1 km 88824.5
Con 2 93422.5

1 mile 94209
2 km 98097.5

12:38 31°

Bicycle Post-Cal

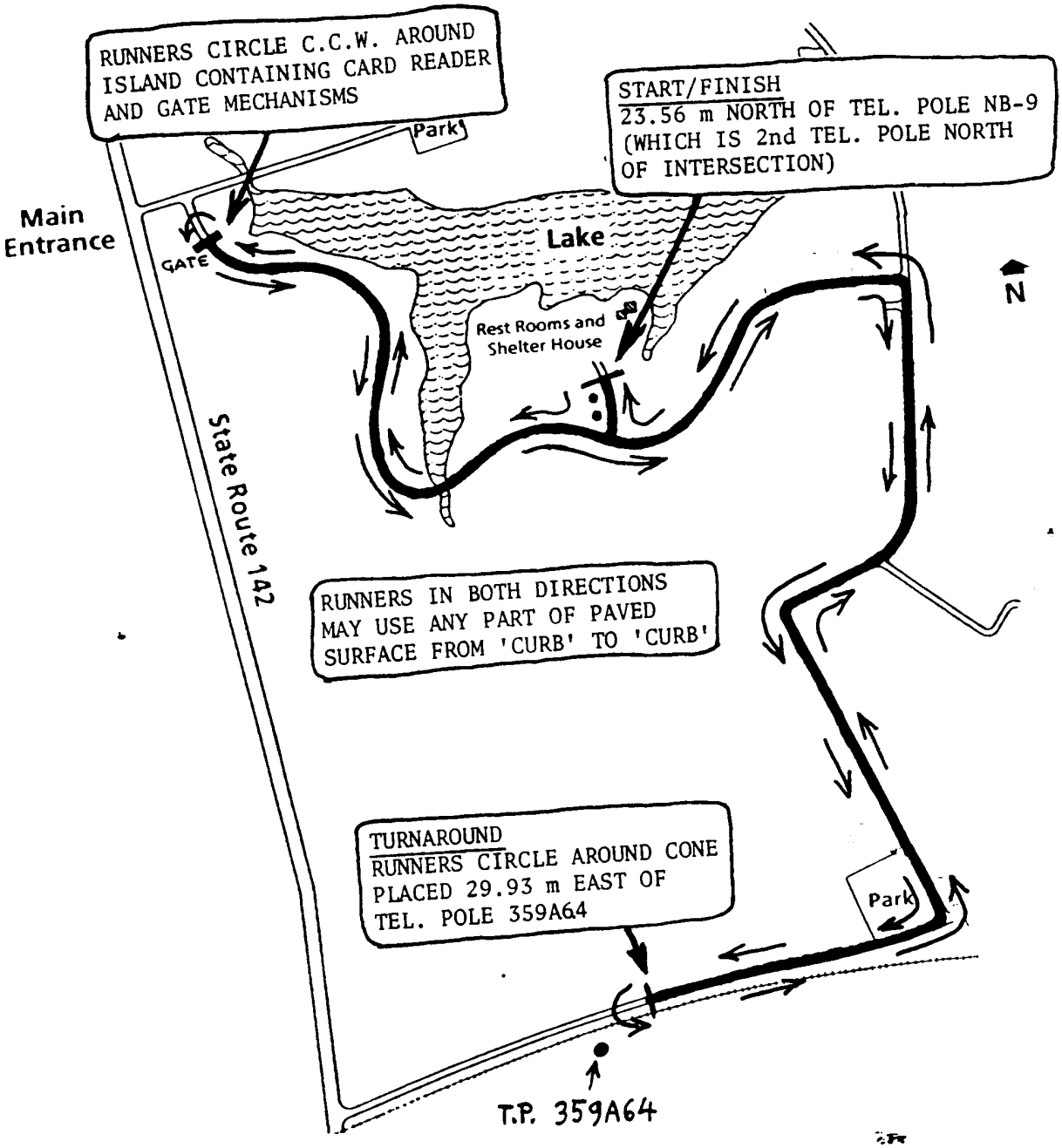
ReCal

99000	
01812.5	2812.5
04626	2813.5
07438.5	2812.5
10251.5	2813

12:47 30°

9376.25
CD = 9377.9167

BATTELLE PARK
WEST JEFFERSON, OHIO



ADJUSTED COURSE
BASED ON MEASUREMENT
BY BOB BAUMEL
90/06/16

BB

IAAF Course Measuring Seminar
Interval Measurements "Backed Out" from Pete Riegel's Seminar-Day Summary
by Bob Baumel

Measurer	0-1 km	1-1.6 km	1.6-2 km	2-3 km	3-4 km	4-5 km	3-5 km	Total
Riegel	1007.4	588.6	414.8	1002.5	989.5	1015.6	2005.1	5018.3
Wight	1007.4	588.8	414.4	1001.9	988.7	1015.2	2003.9	5016.4
Wickiser	1008.1	589.2	414.8	1002.4	989.2*	1016.2*	2005.4	5019.8
Baumel	1008.6	589.2	414.7	1002.2	989.3	1016.3	2005.6	5020.2
Nicoll	1009.2	590.2	414.7	1002.7	989.7	1016.8	2006.5	5023.2
Tillson	1007.7	589.0	414.6	1002.8	????	????	2005.5	5019.5
McBrayer	1008.2	589.1	414.3	1002.0	989.3	1016.3	2005.6	5019.1
Conway	1007.1	588.8	414.6	1001.7	988.8*	1015.6*	2004.4	5016.5
Hubbard	1007.9	589.0	414.4	1003.0	????	????	2003.3	5017.5
Thurston	1008.6	589.2	414.6	1002.2	989.2	1015.5	2004.7	5019.2
Loeffler	1006.0	589.7	411.9	1000.8	????	????	2006.8	5015.2
Disley	1007.6	589.1	414.9	1002.1	????	????	2004.8	5018.5
Morss	1010.8	588.4	414.6	1002.5	988.6	1016.4	2005.0	5021.2
Knight	1008.2	589.1	414.4	1002.5	989.2	1015.8	2005.0	5019.1

Note: Six of the measurers (listed with question marks on Riegel's sheet) miscalculated their adjustments for the 4 km split or Turnaround. In two of these cases, I think I know what the mistake was; so I could correctly back out the 3-4 km and 4-5 km interval measurements (marked with asterisks) in spite of the error. In the other four cases, I could not determine the 3-4 km and 4-5 km measurements with any confidence.

Because of this problem regarding the 3-4 km and 4-5 km intervals, I have added a column for the combined 3-5 km interval, which can be determined without reference to the mistaken data items.

Pete,

If you want to print my table of backed-out interval measurements, I suggest using this version.

In previous version, I tried calculating the 3-4 km and 4 km - 5 km intervals for every measurer, even when I had no confidence in the result.

Now, I have simply omitted the figures I have no confidence in (marked with ** in the previous version).

Bob

MEASUREMENT CHECK BY LOTUS 1-2-3 USING SUBMITTED DATA

BOB BAUMEL - RECEIVED 7-2-90

PRECAL			POSTCAL		
39300			99000		
42114	2814	2813.875	101812.5	2812.5	2812.875
44928.5	2814.5	9379.583	104626	2813.5	9376.25
47741.5	2813		107438.5	2812.5	
50555.5	2814		110251.5	2813	

CONSTANT FOR DAY = 9377.916 CTS/KM = 9.377916 CTS/METER

	RECORDED COUNTS	INTERVAL COUNTS	INTERVAL METERS
START	79507		
BEG CON	80346.5	839.5	89.52
		TAPED	15.00
END CON	80346.5		
1K	88824.5	8478	904.04
END CON	93422.5	4598	490.30
		TAPED	15.00
BEG CON	93422.5		
1M	94209	786.5	83.87
2K	98097.5	3888.5	414.64
2K	51300		
3K	60699	9399	1002.25
TA	62764.5	2065.5	220.25
4K	69976	7211.5	768.99
FINISH	79507	9531	1016.32
TOTAL			5020.18
DESIRED LENGTH			5005
DIFFERENCE			15.18
REMOVE AT TURNAROUND			7.59

TK

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July 3, 1990

John Disley and Pete Riegel

Thank you once again for the excellent seminar on Road Course Measurement held in Columbus in June . I thoroughly enjoyed myself and always learn a lot when getting together with other measurers. Enclosed you will find my short writeup of my measurements for the 5 KM Road Course . I would like to make a few comments:

(1) Using the initial tabulation of results Pete handed out, we had a spread of 8 Meters or 0.16 % for the 14 measurements . Given that there was about 40 Radians of turns in the course, one might argue that we are seeing a + or - 0.10 Meter swing of average radius from the 0.30 Meters from curbs required for our different riders . If one takes the largest value obtained of 5023.2 Meters and used that value for an IAAF Measurer laying out a new course, then 4 other riders acting as IAAF Validators would have found the course short by 0.7, 1.7, 1.8, and 3.0 Meters respectively (.014, .034, .036, and .06 % short respectively) . This certainly argues in favor of allowing some shortness tolerance for validation checks of courses for record purposes. At the present time it also calls into question using the same measurement to both Validate an Existing Course and Lay Out a New Course. I know very well that when I lay out a new course, I measure tighter than I did on my ride for this 5 KM course; I'm always very nervous about ever producing a short course. Here I made a special effort to keep the 0.30 Meter distance.

(2) In retrospect, it would have been nice if after everyone was

TK

done measuring the first time we had carefully marked all curves at 0.30 Meters from curblines and had everyone measure again.
By the way when I was laying out the course for the Cascade Runoff in Portland, Oregon in 1983 the race staff had carefully marked in white along all curves at 0.30 Meters from curbs and 0.20 Meters from uncurbed road edges .
After reading the draft text of the IAAF Measurement of Road Race Courses handbook, I became concerned that IAAF was committed to allowing zero short course tolerance for validations while TAC has accepted a 0.05% short course tolerance . If this is true than we could have a situation where in a given race a competitor sets an American Record which is not acceptable to be sumitted for consideration as a World Record . Is my interpretation the wording on page 10 of the IAAF Measurement correct?
How will the assignment of validators for IAAF Road Courses and World Records be handled in the future. In the US, we have a Validation Chairperson. How do we avoid the cozy relationships that can be developed between races and particular measurers? Or do we? Maybe cozy relationships are not bad at all.
Where does the line get drawn as far as when a race uses the process to get for free a layout measurement of their course that normally they would have to pay a reasonable sum of money to get? That is, for IAAF measurements, are fees in addition to expenses to be allowed?

Thomas D. Knight

TK

Details for Tom Knight
Battelle Park 5KM Road Course measured on 6/16/90

CONSTRUCTION SECTION

I worked with Bob Baumel to lay out a 15 Meter steel taping across the construction zone following the SPR which was approximately 90 Meters from the start as the runners proceed along the course. We marked the two end points with BBTK with yellow crayon. Also, Bob Baumel and I checked a 15 Meter steel taping across the same construction zone which the runners come to again at about 1500 Meters from the start as the runners proceed along the course. This steel taping along the SPR was done initially by Bob Thurston and Doug Loeffler and the two end points were marked RTDL with red/yellow crayon.

When actually measuring the course with the bike, I froze my front wheel at the beginning end point of the given construction section and carried the bike to the ending end point of the given section whereupon I began riding the bike with Jones Counter counting distance again.

CALIBRATION COURSE:

Originally I was scheduled to be in charge of checking Calibration Course #1 along the East side of the road being laid out by Wayne Nicoll et al but, being in the second group for the reconnaissance ride, I ended up being assigned the job of being in charge of checking Calibration Course #2 along the West side of the road laid out by Bob Baumel et al . My team of three (Tom Knight-lead puller, Bernie Conway-lead marker, and Scott Hubbard-tail holder) measured between the two nail heads laid out by the Baumel team and obtained a length of 299.935 Meters before temperature adjustment . We used a 10 lbf pull with my Lufkin Tension Gauge for my 30 Meter /100 ft Lufkin steel tape as specified by the manufacturer. We used my bi-metal thermometer's temperature reading of 90 degrees F , for a delta TF of 22 degrees above 68 degrees F . Using the temperature correction factor for my Lufkin Steel Tape of 6.45/1,000,000 per delta TF, we multiplied this correction factor times 22 degrees times 299.935 Meters to give .043 Meters, which has to be added to our measurement between two fixed points since the temperature was above 68 degrees F . Thus the resulting reported length became 299.935 + .043 = 299.978 Meters . The difference between this result and the Baumel's team value of 300.000 Meters is .022 Meters or 2.2 Centimeters (Approximately 1 Part Per 13,636 or .007% - which is better than the manufacturer's specs) . Therefore I accepted the distance to 300.000 Meters and used this value for my calibration distance. I assumed the others had done an equally good job for the 300 Meter Cal Course on the East side of the road.

BICYCLE MEASUREMENT:

Practically all my data are presented on the sheet with the calculations shown for Actions on Roadway . I decided for the simplicity of the numbers to not start measuring from the 2 KM point of the course although that point was closest to the two calibration courses. I decided that it was important to do a check on the part of the course repeated to eliminate any recording errors or errors at the gates (which are a little

TK

tricky) . Therefore, I stopped at the 3 KM, 2 KM, and 1 MILE points on the way back to the FINISH . Subtracting the distances on the way out from the distances on the way back to the FINISH I obtained the following:

Distance Measured	Back minus Out (Counts)	Back minus Out (Meters)
1 MILE - 2 KM	0.75	0.08
2 KM - 3 KM	-2.25	-0.24
3 KM - TURN AROUND	0.50	0.05

The agreement for the 1 MILE - 2 KM and 2 KM - 3 KM was satisfying (considering that each case involved a gate) and reassured me that I had not written down and errant count for these parts . The agreement for the 3 KM - TURN AROUND was great as expected, and implied again that I had not written down an errant count figure for the 3 KM point. Of course it implied nothing about the value written down for the actual TURN AROUND; I had decided to not ride up to the Utility Pole used for referencing the TURN AROUND, during my bike measurement of the course as explained below, which would have provided a double check of the count value at the TURN AROUND; I preferred instead to be very, very careful as I wrote down the count value and keep one continuous ride of the course going as much as possible from the start.

There were 4 gates on the course that we had to measure through. The two at the main entrance to the park only had to be travelled through once, while the other two were travelled through twice each. I was able to trip the first gate at the main entrance to the park that I came to so this was no problem. For the remaining 5 gate passes that I came to, I marked with crayon on the road in line with the rear extent of my rear tire with the front extent of my front tire lining up with the first part of the gate. I then used our standard method of freezing the front wheel and moving back to the crayon mark with the front extent of my front tire and rolled forward another bike length. Then of course I froze my front wheel again and carried the bike around the gate lining the rear extent of the rear tire with the other side of the gate. I then threw in the approximately 1 1/2 Counts for the gate width by spinning the front wheel slightly and continued on my way.

IMPORTANT COURSE END POINTS:

A.) TURN AROUND

I measured the distance from the Turn Around to being in line with the center of Utility Pole #359A64 with steel tape (after parking the bicycle at the turn around during my bike measurement) to be 22.90 Meters . Later on , after I had completed recalibration of the bicycle, I measured this distance with the bicycle and got 54,779 - 54,569 Counts = 210 Counts . For my calibration value of 9.3441667 Counts/Meter this gives 22.47 Meters . I'm a little surprised at this difference of 0.43 Meters, but I do remember the difficulty of stretching out the steel tape by myself as well as the usual difficulty of sighting across a road, as the Utility Pole is on the opposite side of the road from the turn around on the slightly curving road. A friend of mine has made a 90 degree turn sighting device which he attaches to the top tube of his bike which could help. I'll try to get one from him and report on how I like it. At any case, since I never like to produce short

TK

courses, I will use the smaller value of 22.47 Meters obtained with the bicycle. Note that I did not mark with crayon the exact location across from the Utility Pole I used with the steel tape and so may have used a different location for the bicycle measurement.

So using my calculated Turn Around Action on Roadway to Move TURN AROUND 7.05 Meters TOWARD Start/Finish Area, this would put the TURN AROUND at 29.52 Meters East along the North Edge of the Road from Being In Line with the Center of Utility Pole #359A64 for my final adjusted course. (If I had instead used my larger Steel Taped value of 22.90 Meters for the unadjusted location of the TURN AROUND from the Utility Pole, my adjusted value would have been 29.95 Meters East of being In Line with the the Utility Pole Center)

START/FINISH:

I measured the distance from the START/FINISH to a point in line with the center of Utility Pole #NB-9 two different ways: first, first ,I used steel tape before doing my bike measurement and obtained a value of 23.52 Meters . After I had reached the FINISH I used the bicycle and measured 26,838.5 - 26,619 Cts = 219.5 Cts . 219.5 Counts/ 9344.16667 Counts/Meter = 23.49 Meters , excellent agreement . This time I had a crayon mark I measured to opposite the center of the Utility Pole.

TK

BATTELLE PARK 5KM ROAD COURSE Measured: 6/16/90

Length of Calibration Courses = 300 m
Measurements Computed using AVERAGE Constants WITHOUT 1.001 factor

Tom Knight Using Fuji Bike with 27" Pneumatic Tires

Pre-Calibration: 2:55 P.M. 92 Deg F

Start	Finish	Counts	
61000	63803.5	2803.5	West Side
63803.5	66605.5	2802	East Side
66605.5	69409	2803.5	West Side
69409	72213	2804	East Side

Working Constant: 9344.1667 counts/km

Post-Calibration: 4:25 P.M. 94 Deg F

31000	33803.5	2803.5	West Side
33803.5	36606.5	2803	East Side
36606.5	39410	2803.5	West Side
39410	42213	2803	East Side

Finish Constant: 9344.1667 counts/km

Constant for Day: 9344.1667 counts/km

Course Measurement: S/F (3:15 PM 92 Deg F) to S/F (4:20 PM 94 Deg F)

	Counter Reading	Interval (counts)	Interval (meters)	Meters Adjust	Meters CUM LENGTH	Meters Desired Length	Meters To Add
START/FINISH	80000				0.00		
REF A	80834.5	834.5	89.31		89.31		
REF B (Steel Tape)			15.00		104.31		
REF B	80834.5	0.0	0.00		104.31		
1 KM	89281	8446.5	903.93		1008.24	1001.00	-7.24
REF C	93862	4581.0	490.25		1498.49		
REF D (Steel Tape)			15.00		1513.49		
REF D	93862	0.0	0.00		1513.49		
1 MILE	94645	783.0	83.80		1597.29	1610.95	13.66
2 KM	98516.25	3871.25	414.30		2011.59	2002.00	-9.59
3 KM	07884	9367.75	1002.52		3014.11	3003.00	-11.11
TURN AROUND	09942.5	2058.5	220.30	-7.05	3227.36		
3 KM AGAIN	12001.5	2059.0	220.35	-7.05	3440.66		
4KM	17127	5125.5	548.52		3989.18	4004.00	14.82
2KM AGAIN	21367	4240.0	453.76		4442.94		
1 MILE AGAIN	25239	3872.0	414.38		4857.32		
START/FINISH	26619	1380.0	147.69		5005.00	5005.00	0.00
MEASURED DISTANCE		46619.0 Counts	5019.10 Meters	(Includes 30 Meters Steel Tape)			

Actions on Roadway(We mean along the runners' path):
(1) Move 1 KM 7.2 Meters TOWARD START
(2) Move 1 MILE 13.7 Meters TOWARD FINISH
(3) Move 2 KM 9.6 Meters TOWARD START
(4) Move 3 KM 11.1 Meters TOWARD START
(5) Move TURN AROUND 7.05 Meters TOWARD Start/Finish Area
(6) Move 4 KM 14.8 Meters TOWARD FINISH

(6)

Turn Around 22.9 Meters Past of being in line with telephone Pole

2KM 98,516.25 359A64

Contact OB.T.to Contact

3KM 07,884

Turn Around 09,942.5 T Temp 94° F

12,001.5 (3K back again)

4KM 17,127

2KM back again 21,367

(5)

1 Mile Again 25,239

FINISH 26,619 4:20PM T ≅ 94° F

Finish 26,619 > 219.5

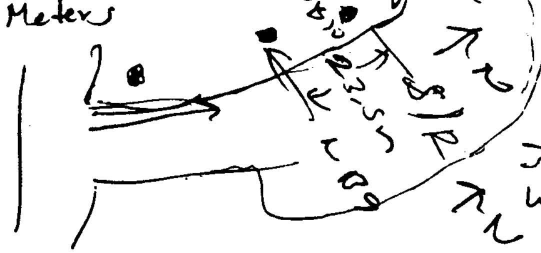
NB-9 + Pole 26,838.5

1 Mile Backward 27,998.5

(8)

Start/Finish Location

23.52 Meters North of telephone Pole # NB-9



NB-9 is middle of 3 poles on west side of Road

(9)

Pole

7A 09,942.5 2K 21,367

2K 98,516.25 − 09,942.5

11,426 11,424.5

(10)

Postal 4:25 PM 94° R

W 31,000 > 2803.5

E 33,803.5 > 2803

W 36,606.5 > 2803.5

E 39,410 > 2803

42,213

11,213

2803.25

300 m.

(11)

Corner

51,659 Corner

52,508 3K

54,569 7A

54,779 Pole T [3rd cm tall on left of tar

359A64 small light blue on left]

2100

22.48

TK

6/16/90 ①

Construction Zone

Way out 15 meters BRTK Yellow

WayBack 15 meter RTDL Red/Yellow

6/16/90 ②

Cal Course

300m — 65mm

[(300 − .065)m]

90°F 29°C

90 − 68 = 22

299,935 Meters before Temp adj

$\Delta l = (6.45 \times 10^{-6})(22)(299.935) = .043$

6/16/90 ③

L = 299.935 + .043 meter

L = 299.978 meters

North Side of Road Calibration Course

Measured between nails & temp adjusted at 90°F ≈ 32.2°C

Pre Calibration 6/16/90 2:55PM T = 92°F ④

W 61,000 > 2803.5
E 63,803.5 > 2802
W 66,605.5 > 2803.5
E 69,409 > 2804
72,213

11,213
2,803.25

300 m

Start 80,000 3:15PM T = 92°F ⑤

Staple NB-9

RefA 80,834.5

RefB = RefA + 15m 80,834.5

1KM 89,281

RefC 93,862

RefD = RefC + 15m 93,862

1Mile 94,645

Steeltape Temp. Correction F = 9/5 C + 32

$\Delta l = 6.45 \times 10^{-6}/°F \; L = 1.16 \times 10^{-5}/°C \; L$

Variation from T = 20°C = 68°F

For 300m Δl = 1.74cm for ΔT = 5°C = 9°F

[25°C, 77°F; or 15°C, 59°F]

Also $\Delta l \cong 4''$ / 20°F ½ Mile ≅ 10.4cm / ½ Mile 20°F

4.09" 48°F, 88°F

C = 5/9(F − 32) 8.9°C, 31.1°C

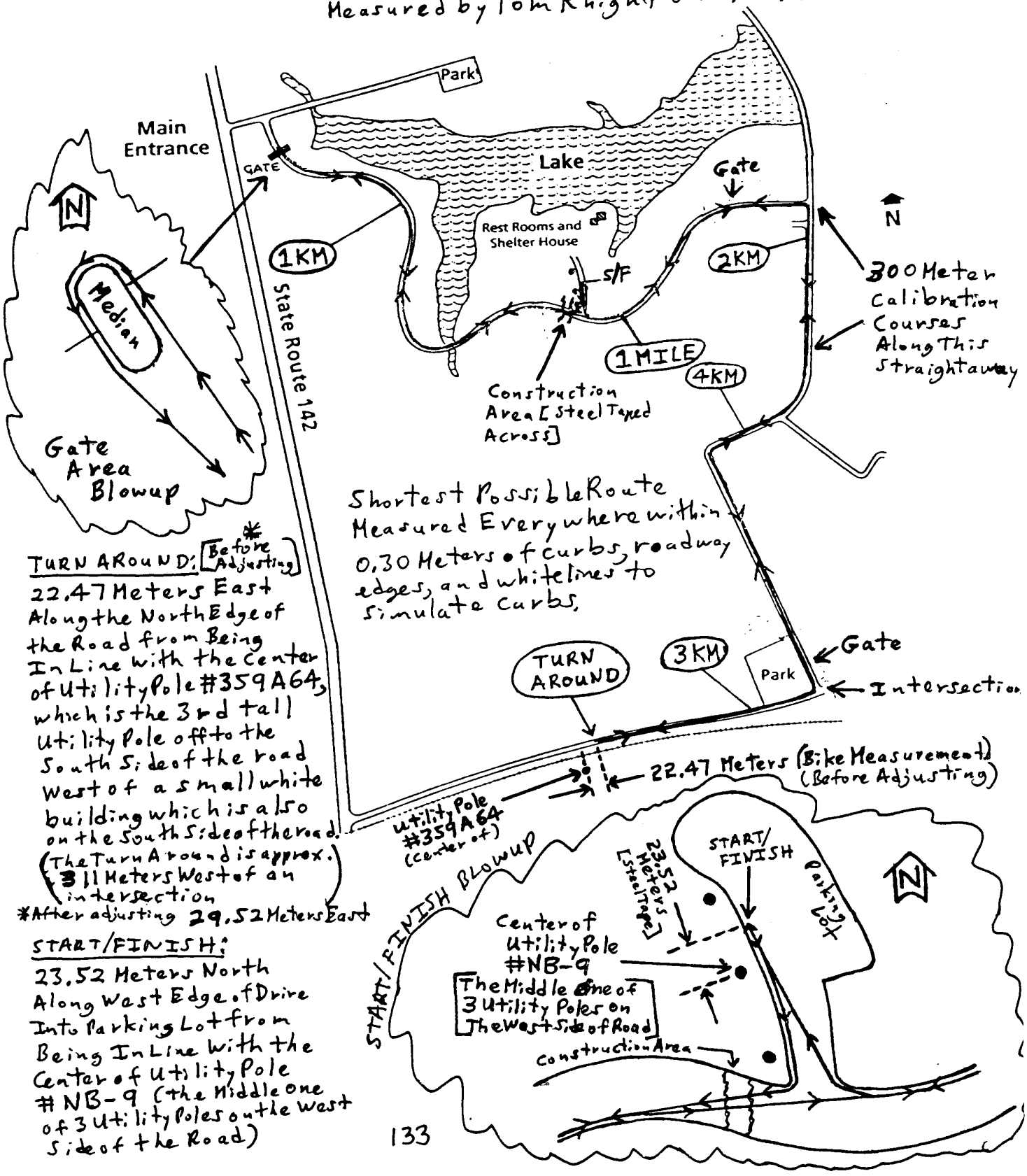
Goetz Travel 800-777-4720
460.50 447 AA 800 433-2300

TK

BATTELLE PARK

WEST JEFFERSON, OHIO

Battelle Park 5KM Road Course
Measured by Tom Knight on 6/16/90



TURN AROUND: [Before Adjusting]*
22.47 Meters East Along the North Edge of the Road from Being In Line with the Center of Utility Pole #359A64, which is the 3rd tall Utility Pole off to the South Side of the road West of a small white building which is also on the South Side of the road. (The Turn Around is approx. 311 Meters West of an intersection

*After adjusting 29.52 Meters East

START/FINISH:
23.52 Meters North Along West Edge of Drive Into Parking Lot from Being In Line with the Center of Utility Pole #NB-9 (the Middle one of 3 Utility Poles on the West Side of the Road)

TK

MEASUREMENT CHECK BY LOTUS 1-2-3 USING SUBMITTED DATA

TOM KNIGHT - RECEIVED 7-6-90

PRECAL			POSTCAL		
61000			31000		
63803.5	2803.5	2803.25	33803.5	2803.5	2803.25
66605.5	2802	9344.166	36606.5	2803	9344.166
69409	2803.5		39410	2803.5	
72213	2804		42213	2803	

CONSTANT FOR DAY = 9344.166 CTS/KM = 9.344166 CTS/METER

	RECORDED COUNTS	INTERVAL COUNTS	INTERVAL METERS
START	80000		
BEG CON	80834.5	834.5	89.31
		TAPED	15.00
END CON	80834.5		
1K	89281	8446.5	903.93
END CON	93862	4581	490.25
		TAPED	15.00
BEG CON	93862		
1M	94645	783	83.80
2K	98516.25	3871.25	414.30
3K	107884	9367.75	1002.52
TA	109942.5	2058.5	220.30
4K	117127	7184.5	768.88
FINISH	126619	9492	1015.82
TOTAL			5019.10
DESIRED LENGTH			5005
DIFFERENCE			14.10
REMOVE AT TURNAROUND			7.05