Measurement News

September 2002
Issue #115

This is the last issue of MN to be published by Pete Riegel.

A new Editor is sought.

See within.

Norrie Williamson used the Business Trust 1000 mile record challenge as a vehicle for experiments with GPS measurements. See his article within. He writes:

The business trust was a trust put together under the initiative of president Thabo Mbheki who basically had stated that business were doing nothing for development in SA - they then pointed out all the things they were doing and so it was agreed that instead of doing them independently they should get together and co-ordinate things - they also focus on set areas – at this time it is -- Tourism / employment (as these go hand in hand and are seen as being the big potentials for SA growth) and education – they link into currently available projects that have a good background and hence do not develop new bureacracy - to date there are over 145 companies involved and all have the same level of contribution which basically is 2% of profit (rough guidelines) – One company has already made substantial donation and the trust I believe has generated over 1 billion Rand (divide by 10 for dollar) - The purpose of the relay was to link being world class with the trust and to show challenge during adversity, creating an awareness of the projects they had achieved. The promotion of the work of the trust has not been something that money had been spent on - so companies are not joining it for the marketing angles,
but rather because of their belief in the future of SA.

The incoming runner is Simon Meli and he as with all the runners were capable of a sub 30 minute 10km - the background is the Karoo a semi desert section of RSA north of Capetown - we had 6 of these campers for the runners and crew and lost one on the first night so reduced to 5. – The road is the main highway from Capetown to Johannesburg so truck cars etc flew past at around 120km/perhour

They set the record in 99 hours 3 minutes and 27 seconds - in real language that's an average of under 6 minutes per mile - or 38 plus back to back marathons - each person doing a marathon a day for 4 days at that pace.

MEASUREMENT NEWS

#115 – SEPTEMBER 2002

Editor: Pete Riegel - 3354 Kirkham Road - Columbus, OH 43221-1368

Telephone: 614-451-5617 (home, not after 10 PM Eastern time)
FAX: 614-451-5610 (home)
Email: Riegelpete@aol.com

RRTC CHAIRMAN – Mike Wickiser
2939 Vincent Rd – Silver Lake, OH 44224
Phone/fax: 330-929-1605
Email: MikeWickiser@neo.rr.com

Subscription cost:

Subscriptions are not presently available, as the Editor/Publisher has ceased to publish *Measurement News.*

EDITOR SOUGHT

Measurement News needs an Editor! See article within.

ROAD RUNNING TECHNICAL COUNCIL

Founder	Ted Corbitt
Chairman	Mike Wickiser
Vice-Chairman (East)	Paul Hronjak
Vice-Chairman (West)	Tom McBrayer
Registrar of Courses	Karen Wickiser
Webmaster/Secretary	Bob Baumel
MNForum	Jim Gerweck
Validations	Doug Loeffler
Finish Lines	David Katz
Editor, *Measurement News*	Pete Riegel
RRCA Representative	Carl Sniffen
Road Running Info Center Rep	Basil/Linda Honikman
Athlete Representatives	Carol McLatchie, Dan Dillon
National Officer Liaison	Bill Roe
Regional Certifiers	See list in this issue**.**

ONLINE MEASUREMENT FORUM

All it takes to become a subscriber is access to email. Simply send to **MNForum@aol.com** with "Subscribe MNF" in the subject heading box, and you will be added to the list. Postings on any subject related to measurement are also welcome at the same address.

Visit the RRTC website at:

http://www.rrtc.net

A complete list of certified courses may be downloaded from this site.

A complete USATF measurement book can be downloaded from this site.

ABOUT MEASUREMENT NEWS

Measurement News (MN) is the newsletter of the Road Running Technical Council (RRTC) of USA Track & Field (USATF). MN is our way to talk to one another, so that we all know what's going on.

MN is also sent to many foreign measurers associated with AIMS and IAAF, who are also invited to participate in the dialogue.

MN is published bimonthly beginning in January (six issues per year).

If you wish to reproduce or report on anything in MN, go ahead, but an attribution would be appreciated.

MN wants to make road course measurement as good as it can be. All opinions and grievances are solicited. No cows are sacred. If you have a new measurement technique, or if you think things should be done differently, send in your contribution to MN. Your opinion will be given space. Nothing changes until somebody tries!

Electronic copy or clean typed material is most welcome, but send what you can.

MEASUREMENT NEWS

Issue #115 – September, 2002

*** * * * * * * ***

Chairman's Clatter - From Mike Wickiser

New Certifiers: New Jersey Certifier Gene Newman has packed his bags and relocated to Tucson, Arizona. It is a fair bet he won't need that snow shovel any more. Gene's move has created certifier vacancies in New Jersey and Delaware. Gene will be taking over as Arizona state certifier. Both Gene and his wife are retired educators.

Larry Baldasari has accepted the certifier's position for New Jersey.

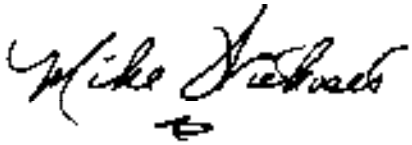
Paul Hess has accepted the certifier's position for Delaware.
I would like to welcome both Larry and Paul to their new positions. They are each well experienced measurers and come highly recommended.

HELP! *Measurement News* needs a new editor. Pete Riegel is retiring as MN editor, having been the pioneering force behind this publication. Starting out as a method to openly discuss course measurement and certification, *Measurement News* grew to worldwide distribution. In 1982 there were about 20 courses certified. Today that number has grown to over 22,000 courses in the USA alone. MN has impacted course measurement around the world, setting the standard by which road-running performances are recognized. It is beyond my words to compliment Pete's accomplishments and dedication. **Thank you Pete** for *Measurement News*. It has helped countless measurers throughout the years. The latest issue is always on my desk and I refer to back issues frequently.

In recent times, MN Forum and email have hastened the information channels among measurers. *Measurement News* has decreased somewhat in size as a result but it remains a valuable tool for the measuring community. A replacement is being sought and Pete has promised his assistance and support for a new MN editor.

Course maps on the web. I am plugging away at scanning course maps and to date all course maps for 1999 through the present have been digitized. Scanning maps in high resolution requires about 3 minutes per page. With just under 3000 scanned files it is easy to see how I spent my summer vacation. I hope to have all Active course maps scanned and available by late this year. Certifiers, next time you get a poor map you can remind the measurer that the certified course map will be readily available to the public. This might help improve map quality. In some cases, I hope so.

Measurement Seminar. The RRTC missed out on our annual RRCA measurement seminar this year. The Phoenix, AZ area has shown a great deal of interest in a course measurement seminar. Gene Newman's move to Arizona coupled with the expressed interest from the area runners and race directors have created an excellent opportunity. Open to all interested individuals, the October 5 & 6, 2002 seminar will include Gene Newman, Tom McBrayer and probably myself. Long time active measurer Tom LaBlonde has agreed to help out with local arrangements.



MEASUREMENT NEWS EDITOR RESIGNS

This issue of *Measurement News* will be the last one mailed to recipients by me. For some time I have noted with displeasure the signs of burnout, and have decided to cease publication of MN.

Measurement News has circulated since 1982, and has done a lot of good to promote accurate course measurement. It has served to give people a forum, and to exhibit their varied talents. And it has published the later additions to the USATF certified course list.

Many of the functions served by *Measurement News* have been replaced by *MNForum* and by other aspects of electronic communication. Some may say that nothing can replace a regularly-delivered magazine. I agree, but if it is to happen it will have to be done by someone else.

I will be mailing refunds to those subscribers whose subscriptions will not be fulfilled.

EDITOR SOUGHT

The job of *Measurement News* Editor can be a very satisfying one. I found it so for many years. It put me in touch with many good people, and I greatly enjoyed the correspondence and opportunities arising from the work. I am sure that the job could offer similar satisfactions to another person.

You may wish to explore the idea. I invite you to write to me with your questions and concerns. Who knows what may come of it? It does no harm to ask a question.

THANKS TO ALL WHO HELPED

Over the years many people have helped to make *Measurement News* what it was. A listing of all those who contributed, in the rough order of their contributions, follows. I offer my profound gratitude for their help.

Baumel
A.Jones
W.Nicoll
Wickiser
Delasalle
Letson
Sandford
Disley
Dziekonski
R.Thurston
McBrayer
Hodgson
Hubbard
Reik
Oerth
Wight
Brannen
Gerweck
H.Jones
K.Young
Knight
Lacroix
Loeffler
Conway
Corbitt
Galloway
Okie
Cundy
Harrison
McDaniel
Nelson
S.Nicoll
Poppers
Williamson
Wilson
Duguay
Heyworth
Hinde
Lucas
Milroy
Smith
Woods
Belleville
Buckner
Cichocki
DeHaye
Ferguson
Glauz
Julin
Kardong
Katz
MNForum
Morss
Phillips
Scardera
Standish
Stewart
D.Thurston
Tillson
Tomlins
Wisser
Coleby
Craig
Damm
Edwards
Franke
GuidoBros
Jaggers
Jewell
Recker
Richardson
RRM
Barrett
Bendy
Brown
Callanan
Delerue
Dugan
Eichler
Gibbons
Grass
Higbee
Hersh
Honikman
IAAF
Ibert
Lewis
Luchner
Melanson
Post
Paulin
Potter
Renner
Shields
Sims
Tinsley
Ungurean
Wallingford
Yaeger
Adams
Allison
Amaison
Antczak
AthWeekly
Atlanta
Aviles
Bell
Benjamin
Betzold
Brand
Bright
Brink
Cantrell
Chalufour
Cordes
Courtney
Daly
Davis
Derderian
D'Errico
Dewey
Disneyland
Dispatch
Dover
Dunn
Duranti
Edens
Fields
Firstbrook
Firth
Frey
Gagarin
Gassmann
Giambalvo
Glaze
Green
Greeney
Hamilton
Hanc
Hansen
Hardwick
Harrell
Hawkins
Highes
Hilker
Hill
Horton
Hronjak
Huntford
Hykes
IMMDA
Irish
J.Riegel
J.Young
Johnson
Kaiser
Klappert
Kennedy
Kernaghan
Kuo
Kursh
Lafarlette
Lamontagne
Lamppa
Langenbach
Larkins
Lytle
MacIntosh
MacPhee
Maltby
Manaus
Mather
Mattics
McGlynn
Mierau
Millet
Minow
Mitchell
Newman
Noel
Nouse
Pate
Patenaude
Peacock
Phegley
Podimhatia
Presley
Reed
Robertson
Rosenthal
RRCA
RTTC
Rudman
RunningStats
RW
Saines
Scarsi
Sessums
Shannon
Simpson
Sorenson
Steinfeld
Stoughton
Stratton
Szczesiul
Tacstats
Tatreau
Teschek
Thornton
Tighe
Toberisky
Tom
Tourino
Ulrich
Vandersteen
Walker
Walsh
Watson
Web
White
Witkowski
Woodard
Zapata

And don't forget the course registrars:

John White
Joan Riegel
Karen Wickiser

RESPONSES TO WIND ARTICLE

From Jim Gerweck:

Hi Pete,
Locked myself in the AC last evening to escape the heat and read MN. A couple thoughts:

The Don Paige in the Hawaii track article is the great Villanova half miler of the early 80s, who I'd forgotten is doing track installation work now. My guess is his "eyeball" exam revealed that the lines were fuzzy, and, just like a poorly defined road edge, could lead to a similarly fuzzy measurement.

In terms of wind measurement, I happened to be the wind guage operator at the CT HS championships last month. In those races, you punch a button on the guage at the start of the race and it measures the wind for a set period of time - I assume it's an average, but Bob Hersh would know better. It would seem measurements for road races should be performed similarly, perhaps taking readings at a set interval of time or distance then averaging all the readings.

I got a nifty little handheld weather device from Kestrel a few months back, which has thermometer, hygrometer, barometer and wind guage all in one. It's about the size of small cel phone, and measures temp, humidity, barometric pressure, THI, but of most interest to us, wind speed. They also make cheaper models w/o the barometer and hygrometer.

If you'd like I could send the unit along to you for testing comparison w/ your coal mine device.

From Pete to Jim:

Dear Jim,

I knew it was Don Paige, as I mentioned on the same page as Ferguson's clip. The article wasn't very clear as to exactly what was wrong with the track.

Years ago I bought a "Turbo-Meter." I still have it. I put a picture of it in MN #39. It measures wind speed. The drawback is that if you hold the thing out in the breeze, the reading will change. Wind speed doesn't hold still for long. There are anemometers that will average the wind for a given period of time, but I don't have one.

As for more experiments, I am hoping somebody else will have an interest. There is so little application for wind-gauging that I am not willing to invest significant time in working out a protocol. As far as I am concerned, a decent job of photographing balloons or banners will do. However, history has shown that folks get this simple procedure wrong. They set up ineffective balloons (like tying them to telephone poles) or they photograph them from a bad angle, instead of at 90 degrees to the direction of movement. Rarely is a balloon or banner operation well-executed. Nobody ever gives it a dry run to see whether it works. Instead, they go out on race day and dick around, and hope for the best. There is an article about setting up balloons in MN #40. I'd change the ribbon support, though. A pole is not good, as the banner can wrap around it. Better is a hangman's gibbet, with the ribbon swinging free. The bottom should be weighted lightly to prevent it from whipping excessively, but still respond to the wind like a pendulum.

I still think balloons or banners are the best way to go, but most folks will cut corners, leaving the evaluator with a "take it or leave it" set of data that falls well short of perfect.

From Scott Hubbard:

Pete,

Was looking at runacrossamerica2002.com and noted that the route will pass thru what looks like central Ohio

starting on Aug 9. Take a look at the site. For some reason, the 'race' field is predominately Japanese. Go figure. Just got the recent MN...puzzled, why did you mount a wind gauge on the front of your bike? I should know the answer to this but; can a race that exceeds the allowable 30% sep still qualify for records if they can prove wind direction was not beneficial? If so, races would be wise to appoint one person to determine wind direction. It's not that hard to figure out. There are always tons of flag poles around, the balloon method is fine, etc.

With Laurent taking on the counter biz, it'll be interesting to see how long it'll take to get mail back and forth between anywhere and Canada. I fear the worst. But, the worst may have to do.

I don't believe it was mentioned in the news article in MN how the Kamehameha track was measured to determine it was short.

We've already matched the '01 total of certified courses in MI w/6 months to go in '02!

From Pete to Scott:

Yes, a course with little drop but lots of separation can qualify for records if they can show absence of wind. The relevant rule, 195.5, is quoted in my article. So far it has been applied to Crescent City Classic in New Orleans, Arts Fest 15k in Evansville, IN, and maybe one or two others. Now that I am out of the loop I am not as aware as I was.

I had been intending to do something with my anemometer ever since RRTC and RRIC finished up with the business of Rule 185.5. I never quite got around to it. Deep down I don't think much of wind measurement in road racing. Still, the existence of the rule provided a convenient excuse to go out and have a bit of technical fun.

Balloons and flags work, but only if the pictures are taken properly. The picture should be taken at 90 degrees to the direction of movement. This will clearly show which way the balloon or banner is blowing. I have seen a lot of pictures taken from other angles, and it is quite hard to judge sometimes. Wayne Nicoll did the balloons for CCC for a few years, and always did well.

I've been watching the latest version of the TransAmerica, and noted, like you, that most of the competitors were Japanese. Way back in the 1980's someone was organizing the Sea to Shining Sea run, a trans-America thing, and I was thinking strongly of giving it a try. I thought I was fit enough to finish. I had dinner with an organizer who wanted information. But the thing never got off the ground. I probably would not have entered anyway, as it would have required a couple of months off work, and all for vanity.

All I know of the Kamahameha track is what I read. How Paige established the length I haven't a clue.

Best, Pete

From Stu Riegel:

Dad,

After reading the article on measuring the effect of wind speed, and the pros and cons of your anemometer, I think I have a solution.

First, something must be done to counter the effect of the rider's body shielding the tailwind. Mounting the anemometer in the airflow is the only way to ensure this, but how to do so in such a manner as to be accessible is the problem we must address.

Second, a conventional rotary anemometer, which gives a readout in miles per hour or meters per second, would be more useful than a linear anemometer, although monitoring its readout would be problematic, especially if the unit were placed directly in the airstream.

I believe my solution addresses both problems, putting a rotary instrument in the airflow, yet within easy reach of the rider. Please see the attached photo for details.

The use of a GPS running watch in the measurement of distance:

(Experiences during the 1000 mile relay record run in South Africa 14 to 18 August 2002)

by Norrie Williamson

Technology moves on with the speed of a sprinter and the Timex GPS watch is currently the cutting edge in sports watches and arguably a useful tool for the measurer's armoury.

Lets first look at the features of the watch: -

There are 2 units; the first is the GPS unit, which is typically strapped to the upper arm using a Velcro band. This unit communicates with 2 to 3 satellites in order to get a 'fix' on the location of the unit using latitude, longitude and altitude. This communication continues every second.

The second unit is a watch radio receiver, which receives information from the GPS unit by radio signal. This ideally has to be worn on the same arm as the GPS unit. The receiver and the GPS communicate every 3.5 seconds, but the information received is based on readings of the satellites every second.

There are a number of modes that can be displayed:

Mode	**Readings**
Stopwatch	Times and splits with choice of: - distance (4 figures), pace, average pace, best pace, distance, speed (km/hr) average speed and best speed. These only record when stopwatch is running.
Recall	Provides the splits and information on each of the above
Odometer	Tracks total distance to 4 figures plus 2 decimal places (i.e. 10metre accuracy)
Monitor	Which records all the time and has Distances as the main reading with options of speed, pace, ave pace, best pace, ave speed, best speed. The reading is for 4 figures with the decimal point moving as the distance increases.

The watch has additional features such as time of day, date alarm etc, but the above are the main ones of interest in measurement. While the watch is waterproof the receiving unit is waterproof to marine standard and can be immersed in 1 metre of water for 30 minutes. GPS does not however work under water.

Points of interest to note in using GPS watch:

1) When switching the GPS unit on it can take about 10 minutes to locate the satellites before being able to display the information. Ideally then this unit needs to be switched on before commencing the training
2) The unit needs to have a clear view of the sky, to get the best results. Running below massive tree overhangs or tunnels, or in narrow streets with high buildings can reduce the accuracy of the unit.

3) If you run through a tunnel (long stretches of overhead trees or narrow roads with high buildings can also affect readings) the unit assumes that when you come out the other side you have completed a straight line between the two points.
4) If the watch is greater than 1.5 metres away from the unit then the radio communication signal tends to break up and information is lost.
5) The unit uses 3 x AAA batteries, and these are stated as lasting 12 hours.

Accuracy of the watch / GPS

The accuracy of the system is very impressive in terms of the needs of a runner, and comparisons with race markings on the road, track split times and the like from a 'training / pacing' viewpoint are very good. Small changes in pace are fairly quickly reflected on the watch readings, and there is clearly a major place for this in the coaching, training, racing market in a number of sports such as Running, canoeing, walking, etc. The information provided is not substantially different from that available on a cycling computer so the impact there is likely to be less.

It is interesting to note that the when in the 'stop watch mode' there are only 4 digits allocated to distance measurement, and as such the initial reading is to 1 metre accuracy until 9.999km where upon the decimal point moves to provide only 2 post decimal point figures and hence 10m accuracy, after 99.99km it drops again to 1 decimal point (100m accuracy) and after 999.9km it drops to kilometre accuracy. By comparison the 'odometer' section maintains 6 figures and hence, 2-decimal point (10m) accuracy at all times. The 'monitor' mode is the least accurate of all in terms of available readings.

However the usefulness of the system to course measurement would require greater levels of accuracy and it is here that several tests and pilot measurements were undertaken.

The basic premise for comparisons with the Clane Jones measurement method is that the calibration length is the 'base accurate distance', and that a course measured using the Clane Jones bicycle measurement is the next most accurate distance.

Once I had gained some confidence in the system, I tried 'calibrating' the GPS system against the calibration distance used for the Commonwealth games marathon down at Salford Quays.

This was done by running along the exact line of the calibration course. It should be noted that this calibration was set out parallel to a kerb line with two yellow 'no parking lines' in the gutter. It was thus very easy to duplicate the line that a bicycle would follow. I found that this proved to be fairly accurate as can be seen from 4 calibration runs below. The changes between the finish of one run and start of the next can be accounted for by the rotation of the unit at each end. It would, in retrospect, have been better to turn in the other direction so that the unit was kept as the centre of rotation as opposed to the outside arm. However natural arm/watch preference and natural safety of

turning into the traffic meant that this was not considered. It is therefore possible that a 'part of a metre' was 'built up at the end of each calibration and that two or more of these would account for an additional metres.

Although the starting and stopping at each end of the run was in a controlled fashion, the actual lining up of the unit against a point in the ground is arguably not as accurate as when one puts the axle of the bike wheel over the nail. We can set certain positional marks to replicate a similar reading point on the bike wheel, but it is much harder to do when looking over the shoulder and trying to line up a point on the ground. So again there is an opportunity for inaccuracy at both ends of the run.
Given the above the results obtained were quite impressive and relatively consistent.

Comparison of calibration distance in Manchester at Salford Quays					
Calibration Distance = 500m	**GPS start reading**	**GPS Finish Reading**	**GPS Distance**	**% error on individual and average**	**Comments**
run 1	0	0.496	0.496	-0.8	On turning adds 1 m to reading
run 2	0.497	0.995	0.498	-0.4	
run 3	0.996	1.496	0.5	0	
run 4	1.502	2.004	0.502	0.4	
		Average	**0.499**	**-0.2**	

I then used the system to run over a measured section of the triathlon course and found an accuracy of about 5m in 2 kilometres compared with the same bicycle measurement. This was a simple one-off run, compared with a section that Hugh Jones and I had set out in the previous days.

Having gained some limited idea of the use on 'straight line' clibration, I was keen to see the effects on a track. I proceeded to run two sets of 5 laps in the 3rd lane of a track, the first where the distances was displayed in the chronometer mode and the second displaying 'pace'. It was only really during this 'experiment' that I became 'sensitive' to the monitor position on my arm and so I ended up playing with trying to run with the monitor unit over a path 200mm inside the lane line. The 'results' of these laps are shown below:

Track to GPS comparison				
Track distance	**gps distance**	**time split**	**% error**	**comment**
0.4000	0.404		1.0000	in 3rd lane of track
0.0142	0.016		12.6307	from finish to start of 3rd lane 400m
0.4000	0.398		-0.5000	
0.0142	0.014		-1.4481	
0.4000	0.409		2.2500	

0.0142	0.014	3.81	-1.4481	
0.4000	0.408	103.8	2.0000	
0.0142	0.014	3.62	-1.4481	
0.4000	0.412	102.03	3.0000	
0.0142	0.014		-1.4481	walk
0.4000	0.403	3.45	0.7500	
0.0142	0.012	102.73	-15.5270	
0.4000	0.408	3.51	2.0000	
0.0142	0.012	101.46	-15.5270	
0.4000	0.411	3.57	2.7500	
0.0142	0.014	101.41	-1.4481	
0.4000	0.409	98.41	2.2500	
0.0142	0.014	3.54	-1.4481	
0.4000	0.409	95.82	2.2500	
		Average % error	9.361826227	%error is greater over shorter distance as expected
4.127851429	**4.195**	**Total distances**	**Average% error over 400m distances**	Appears error of splits becomes cumulative - as part readings add up
Track distance	**GPS distance**	**time split**	**1.875**	
0.460594286	0.457	129		Outside of lane 8
0.398742857	0.403	102.61		inside lane meter over line
0.4	0.404	110.73		inside lane meter 200m from line

Note:-

1) The second reading was from the finish line of the first lap in lane three to the 400m-start line in lane 3. On the first occasion only I walked this section, and perhaps the sudden change in pace over such a short distance accounts for the higher reading and error.
2) The lap button was pushed as I felt I crossed the finish line and again as I ‘felt’ I crossed the start line.
3) The total distance error at the end of 10 laps appears to be 67m – in real terms this means an average of 6.7m per lap (1.67%). This assumes I was running a 400m line with the monitor (i.e. 200mm inside the lane line)

While it is immediately obvious that this would not provide the accuracy to replace the use of the clane Jones, it certainly opened opportunities for using it to determine the basis of a race route prior to race measurement, and even for off road use or use over sections of a race where – for what ever reason – (roadwork, flooding, unfinished routes, sand etc) – the race cannot be

measured with the bike at that particular time. It may also be used for the new breed of ‘off-road’ challenges / adventure races and trail races, for which we have no acceptable method of measurement at present. Similarly it can be used for ultra races where clane Jones becomes impractical. This was exactly the situation I found myself in 7 days after returning from the commonwealth games.

Case study – 1000 mile –10-man relay record run

There was to be an attempt at setting a 1000 mile – 10 man relay record on an A to B course from Cape Town (sea level) to Johannesburg (1700m). As opposed to normal journey runs from A to B the objective here was the covering of ‘not less than 1000 miles’ and so measurement became a major issue.

Pre-measurement of the entire route was not a practical option; not only due to the overall distance, but also that the measurement would have to follow as close as possible to the exact route of the runner. The best option in this regard was for it to be completed as the runner ran each section, particularly as the support vehicle would be used to ‘protect’ the runner from the other vehicles on the road. A significant part of the route was on the main thoroughfare (the N1) between the two cities and the diversions to smaller routes inevitably resulted in becoming main routes to Johannesburg.

I considered three methods of measurement possible as checks and counter checks.:-

a) The Clane Jones bicycle
b) The vehicle odometers
c) The GPS system

The MO adopted was to calibrate each of the 3 vehicles which would be used for seconding the runners against both the GPS and the Clane Jones., and also to calibrate the GPS against the Clane Jones. The objective was to bring the readings of all back to a base of the Clane Jones calibration over a standard 500m distance.

These vehicle and bike calibrations would be undertaken at both the start and finish of the run. Not only were the vehicles ‘calibrated’ over the 500m distance, but also over a 2 or 3km distance as set out by each vehicles odometer and then compared to the equivalent Clane Jones and GPS measured distance.

(See attached calibration sheets)

I had hoped to be able to set up mid event calibrations, but the speed of progress of the relay made this impossible (effectively a constant pace of 17km per hour throughout). I did attempt one using the 200m roadside marker boards. The idea was to calibrate the bike over the 200m and then drive a

2km section in each vehicle, which could be compared against the GPS and the bicycle. However the markers were positioned too far from the roadside to accurately locate start and finish points for bicycle and vehicle position. While the figures seemed reasonable they were not of the standard achieved at the start and finish when dealing with nail heads in the road.

It should be remembered that the start and finish varied in altitude by around 1700m and weather conditions at the start were fair and around 15 oC whereas at the finish it was 10 oC.

The logging of distance and reading of the GPS was restricted to 3 people who took shifts on this duty. The GPS was positioned in the front of the vehicle normally with the watch and unit attached to the 'grab handle' next to the passenger door. The logger controlled the GPS readings and the drivers provided the corresponding vehicle odometers readings.
.
The results obtained from the calibrations and measurements are shown in the attached tables:-

There were several points that only became evident during the course of the 1000 mile run which would impact on any future use of the GPS system for measurement or a repeat run of this nature:-

1) Batteries were typically lasting 14 hours before no signal was received. However during the interim analysis of results en-route it became evident that towards the end of the battery life the accuracy of reading reduced. I took this matter up with the international Timex representative who happened to be in RSA, and he confirmed that during the final ¼ of the battery life this can happen as the unit has double communication:- first to the satellite and then to the watch / receiver. The use of the battery level monitor can reduce avoid this problem. Where this existed in the record run, the value of the vehicle odometer has been used and this factored, first to the GPS calibration ratio and then using the GPS to Clane Jones calibration ratio.
2) When changing the batteries the unit should be kept still as any movement will alter the reading. Stopping the chronometer is one way around picking up spurious readings during this operation. This problem occurred once in the record run, (on the first night) and accounted for a loss of 3.5km of distance. In all future occasions the batteries were changed while the vehicle and unit were stationary and the watch allowed to continue.
3) At all times the GPS system for measuring the route would follow the line of the runner. Obviously no one single vehicle could be used for the full non-stop 1000 miles, and 3 vehicles had been calibrated for this purpose. Attempts were made to restrict this to two vehicles but on occasions, such as when the vehicle got stuck in mud at the side of the road awaiting the runner's arrival, the third vehicle was brought into play.

4) Transferring the unit between seconding vehicles generally followed a set format. The incoming vehicle would stop behind the outgoing vehicle, so that the person ‘logging the distance’ could walk forward to enter the new vehicle and hence would still be logging the distance covered by the runner. Any disparity in distance over thee changes was ignored in calculating the total distance.
5) The main section that would be done differently relates to the watch ‘mode’ in which measurement was undertaken. As can be seen from above the greatest accuracy is displayed in the Chronometer mode where measurements are done to 1 metre up to 9.999km (or miles), thereafter it drops to 10m accuracy, then 100m accuracy, then 1km accuracy. When the total distance increased to over 1000 kilometres, a decision was taken to reset the watch in chronometer mode in order that a greater level of accuracy was obtained. In retrospect, had the total odometer mode being used throughout, the accuracy would have constantly been to 2 decimal points (10m) and this would have been better
6) Occasionally the loggers wore the receiver watch in order to be able to better see the displays, however there were concerns that this sometimes allowed the receiver tio move outside the 1.5m receiving radius and so this practice was stopped.
7) Care had to be taken over ensuring a good ‘sight’ of the sky for the GPS unit. An initial problem was noted during a section in narrow streets with high buildings / cuttings which when combined with the position inside the vehicle could result in under reading.
8) This GPS unit is new to the market and new to each of the ‘loggers’. Only one of the loggers is a course-measurer and hence the finer details and concepts were not always obvious, nor the need to log data in a similar fashion on each occasion. This resulted in intermittent logging of venue / location and time at any one specific point. However in terms of the record run confirmation has been obtained through independent observation, TV footage, media coverage, and calculation of average pace.
   The loggings of the readings are further exacerbated by the fatigue factor of the loggers who would often be faced with a 6 to 9 hour shift with only a 3 hour period for eating, sleeping. This process continued for 99 hours. Typically this was displayed in the loss of a middle digit in the recording of the vehicle odometer, or some other transitional figure reading. In checking the logs all ‘errors’ were either covered by a clear and viable explanation or ignored in arriving at a final distance. Where any doubt existed a conservative distance was taken based on vehicle odometer and calibration factors.

Summary:

It was unfortunate that I found myself using this system with relatively little time to explore the full functions of the watch prior to any measurement. Had this been possible several changes to the MO would have been incorporated, viz:-

1) There is definite benefit in ‘calibrating’ the system prior to a measurement. Apart from the comparison with calibration reading, it makes the wearer more aware of the influence of movement and the position of the monitor on the arm. Although not tested there is a thought that it is better to wear this on a belt, which allows it to be centred on the body at the back.
2) For short distances (up to 9.999km) it is best to measure in the chronometer mode as measurement is to 1 metre reading accuracy. The reading can be started and stopped with the stopwatch button and therefore allows for small off course diversions. Above this distance using the odometer mode will provide readout to 10m. This continues will all movement so the wearer must remain on the line of the course measured.
3) The chronometer mode with lap splits allows a recall system, which means that sections along the route can be identified and measured independently within an overall measurement. This is very useful for ‘piecing’ together a new course prior to final measurement.
4) Batteries must be checked prior to commencing a measurement and should be renewed if it is thought that the measurement will take the battery life beyond about 11 hours. When using the battery level monitor remember that batteries that have been left for sometime without use will seem to show a high level when first tested, even although they are depleted. Erroneous readings can be expected when battery life goes below ¼ or over about 12 hours.

There is no doubt that a period of adaptation is required to the use of this device if the maximum accuracy is to be achieved, and while it is not a replacement for the Clane Jones measurement protocol, it does offer a good alternative for events where the bicycle measurement is impossible / impractical or for early definition of a new course.

This system will be used in the ‘measurement’ of the Augrabies Marathon – a 6-day stage race through the Augrabies falls National Park (South Africa / Namibia) in October 2002. This event has previously been exempt from meeting the AIMs measurement requirement due to the nature of the terrain. Comments and proposals for protocol to be adopted in this measurement are welcome.

I am suggesting that should such a measurement be possible to a ‘replicable’ standard that an alternative standard of measurement be initiated for ‘adventure / off road / trail’ events, to provide a certificate of ‘guidance’ to competitors as to the distance of the event. Comments and input on this proposal would be a matter for discussion with AIMs and other international measurement bodies.

There is a definite role to be played by this system in coaching and training of runners of all standards and its use in racing could well become the subject of discussion as a technological aid in pacing. (Particularly in long distance events)

CALIBRATION OF VEHICLES, GPS TO CLANE JONES - NUMBER

Date	Time	Venue	Calibration distance	No. of rides	Reading 1	Reading 2	Reading 3	Reading 4	Reading 5	Ave Reading	Constant (with SCPF)
14-Aug	10:00	greenpoint	0.5	4	6073	11052	16030	21007	25985.5	4978.125	9966.20625
			No of GPS rides	**GPS 1**	**GPS 2**	**GPS 3**	**GPS 4**	**GPS 5**	**Ave Reading**	**Calibration ratio**	**% error**
			4	0	0.499	1.003	1.502	2.004	0.501	0.998003992	0.2
GPS Start reading	**GPS Finish Reading**	**GPS Distance**	**Vehicle no**	**distance covered**	**GPS Calibration Ratio**	**GPS Correction value distance to calib distance**		**Bicycle start**	**Bicycle Finish**	**Bicycle Distance**	**Bicycle Calibration**
2.033	5.011	2.978	**V1 - JPY 132GP**	3	0.99266667	0.990685296		26172.5	55961.5	2.989000955	0.99633365
2.033	5.001	2.968	**V2 - JNV 822GP**	3	0.98933333	0.987358616		26172.5	55881	2.980923659	0.99364122
2.033	4.961	2.928	**V3 - JNV 810GP**	3	0.976	0.974051896		26172.5	55467	2.939383278	0.97979443

CALIBRATION OF VEHICLES, GPS TO CLANE JONES - NUMBER										
Time	**Venue**	**Calibration distance**	**No. of rides**	**Reading 1**	**Reading 2**	**Reading 3**	**Reading 4**	**Reading 5**	**Ave Reading**	**Constant (with SCPF)**
13;00	Laingsburg North side - using road km marks	0.2	3	62012	64007	65999	67992		1993.333333	9976.63333
GPS Readings	GPS Distance	**Vehicle no**	**start odo**	**finish odo**	**distance covered**	**GPS Calibration Ratio**	**Bicycle start**	**Bicycle Finish**	**Bicycle Distance**	**Bicycle Calibration**
334.6 at 2km and 336.6 at 4km	2	**V1 - JPY 132GP**	84133.7	84135.7	2	1	65999	85829	1.987644463	0.99382223
GPS on vehicle 1 only		**V2 - JNV 822GP**	695591.2	695593.3	2.1		65999	85829	1.987644463	0.94649736
						Bicycle 2km	**Bicycle 3km**	**Bicycle 4km**	**Cycle distance from 2-3km marks**	**Cycle distance from 3 to 4km mark**
GPS on vehicle 1 only		**V3 - JNV 810GP**	No used for logging			65999	75918	85829	0.994223168	0.99342129

CALIBRATION OF VEHICLES, GPS TO CLANE JONES - NUMBER										
Time	**Venue**	**Calibration distance**	**No. of rides**	**Reading 1**	**Reading 2**	**Reading 3**	**Reading 4**	**Reading 5**	**Ave Reading**	**Constant (with SCPF)**
18:00	Johannesburg Zoo - - Rutland Road Cycle calibration	0.5	4	24380	29345	34310	39272	44237	4964.25	9938.4285
GPS Readings	**GPS Distance**	**Vehicle no**	**start odo**	**finish odo**	**distance covered**		**Bicycle start**	**Bicycle Finish**	**Bicycle Distance**	**Bicycle Calibration**
334.6 at 2km and 336.6 at 4km	2	**V1 - JPY 132GP**	0	2	2		2686	22510	1.994681554	0.99734078
GPS on vehicle 1 only		**V2 - JNV 822GP**	0	2.1	2.1		30634	50945	2.043683264	0.97318251
GPS on vehicle 1 only		**V3 - JNV 810GP**	Used only for emergency - not able to recalibrate at finish							

Final summary of calibrations				
	Calibration ratio of vehicle to clane Jones			
Vehicle	**Before CPTN**	**Laingsburg**	**Finish JHB**	**Ave start / finish**
No 1	0.996333652	0.99382223	0.997340777	0.996837214
No 2	0.99364122	0.94649736	0.973182507	0.983411863
No 3	0.979794426	used in emergency only		0.979794426

Subj: **MNF2002-08-18**
Date: 8/18/2002 2:13:48 PM Eastern Daylight Time
From: mnforum@rrtc.net
To: mnf-list@rrtc.net
Sent from the Internet (Details)

MNF #1017 18Aug2002

GPS MEASUREMENTS

I've spent some time playing around with the Timex GPS Speed Distance Watch. Last week I ran a 6.85 mile course that I certified. I hit the split button on the watch at each mile point. Here are the results for the first 6 miles:

Mi.	Reading	Diff	% Error	Cum Error
1	1.0161	-0.0161	-1.61	-1.61
2	1.0232	-0.0232	-2.32	-3.93
3	1.0383	-0.0383	-3.83	-6.15
4	0.9944	0.0056	0.56	-3.27
5	0.8785	0.1215	12.15	12.71
6	1.216	-0.216	-21.6	-9.45
TOT	6.1665	-0.1665	-16.65	

Not bad, although something was whacky on the 5th mile - perhaps the split was painted in the wrong spot, I have to go back and check it against the map.

One thing seems clear is that the device is far from being accurate enough for certification use.

I am going to measure a half marathon this afternoon and will bring it along to see how it works on a bike rather than on foot. Report forthcoming.

Jim Gerweck
zgerweck@aol.com

USATF/RRTC CERTIFIED COURSE LIST
New Entries, July - August 2002
Closing Date August 26, 2002

DISTANCE	COURSE ID	ST	LOCATION	COURSE NAME/RACE	m/km DROP	pct SEP	MEASURER	REPLACES
21.1 km	AK 02001 FW	A	Anchorage	Trent-Waldron Glacier HMAR	0.0	1	D Epstein	AK 97003 FW
5 mi	AK 02002 FW	A	Anchorage	Alaska Run for Women II	0.1	0	C Waythomas	
5 km	AL 02008 JD	A	Helena	Kudzu Run	-0.8	2	R Melanson	
5 km	AL 02009 JD	A	Birmingham	Pet Trek 5k	0.4	3	R Melanson	AL 98010 JD
5 km	AL 02010 JD	A	Athens	Summer Sun 5k	0.4	1	R Melanson	
5 km	AZ 02006 ETM	A	Tucson	Tucson 5000	0.0	1	T LaBlonde	
5 km	AZ 02007 ETM	A	Phoenix	Race for the Cure	0.4	12	R Strachan	AZ 99011 FC
42.2 km	AZ 02008 ETM	D	Mesa	Valley of the Sun Marathon	0.7	17	B Strachan	
5 km	CA 02003 TK	A	San Francisco	Gift of Life 5k	0.0	3	T Knight	
1 mi	CA 02004 TK	A	San Francisco	Concourse Mile	0.4	22	T Knight	
42.2 km	CA 02005 TK	A	San Francisco	The Chronicle Marathon	0.0	0	T Knight	CA 01013 TK
10 km	CO 02016 DP	A	Englewood	Centennial Airport's Runway Run	0.0	3	D Borgmann	
5 km	CO 02017 DP	A	Englewood	Centennial Airport's Runway Run	0.0	7	D Borgmann	
42.2 km	CO 02018 DP	A	Colorado Springs	American Discovery Trail	9.4	83	J McMillin	CO 01016 DP
5 km	CO 02019 DP	A	Denver	Race for the Cure	-1.0	18	D Poppers	CO 01008 DP
21.1 km	CT 02011 DR	A	Fairfield	Fairfield Half Marathon	0.0	1	Guido Bros	
5 km	CT 02012 DR	A	Madison	Breaking Barriers Foundation 5k	0.0	1	B Stephenson	
5 km	DC 02002 JS	A	Washington	3M 5K	0.0	0	J Sissala	
5 km	DC 02003 JS	A	Washington	Anacostia Park 5k	0.0	1	J Sissala	
3 mi	DC 02018 RT	A	Washington	Presidential Fitness Challenge	0.0	7	R Thurston	
4 mi	DC 02019 RT	A	Washington	Hugh Jascourt Four Mile	0.0	1	R Thurston	
5 km	DE 02001 GAN	A	Newark	Mark INC 5k	0.0	2	D White	
15 km	FL 01047 DL	A	Melbourne Beach	Space Coast Classic 15k	0.0	0	B Dillard	
42.2 km	FL 01053 DL	A	Clearwater	Florida Gulf Beaches Marathon	0.0	0	C Lauber	
10 km	FL 02007 DL	A	Naples	Hope For Children 10k Road Rac	0.0	0	F Fidler	
5 km	FL 02008 DL	A	Naples	Hope For Children 5k Road Race	0.0	0	F Fidler	
10 km	FL 02013 DL	A	Miami	10k Run for Reconstruction	0.0	1	D Matuszak	
5 km	FL 02014 DL	A	Ft. Lauderdale	17th ST. Causeway Bridge 5k	0.0	2	G Witkowski	
8 km	FL 02015 DL	A	Orange Park	Run to the Sun 8k	0.0	2	D Aldred	
5 km	FL 02016 DL	A	Orange Park	Autumn Fitness 5k	-0.2	3	D Aldred	
5 km	FL 02017 DL	A	Orange Park	Spartan 5k	0.0	7	D Aldred	
5.009 km	FL 02018 DL	A	St. Petersburg	St. Anthony's Triathlon 40k-2002	0.0	0	E McDowell	
40 km	FL 02018 DL	A	St. Petersburg	St. Anthony's Triathlon 40k-2002	0.0	1	E McDowell	
10 km	FL 02019 DL	A	St. Petersburg	St. Anthony's Triathlon 2002 10k	0.0	1	E McDowell	
5 km	FL 02020 DL	A	Boca Raton	YMCA 5k	0.0	2	G Witkowsky	
5 km	FL 02021 DL	A	Boca Raton	Run for Jerusalem	0.0	5	G Witkowsky	
5 km	FL 02022 DL	A	Green Cove Springs	Memorial Day 5k	0.4	2	D Aldred	
1 km	FL 02023 DL	A	Coconut Creek	Tradewinds Park 1000 Meter	0.0	0	D Matuszak	
1.5 km	FL 02024 DL	A	Coconut Creek	Tradewinds Park 1500 Meters	0.0	0	D Matuszak	
2 km	FL 02025 DL	A	Coconut Creek	Tradewinds Park 2000 Meters	0.0	0	D Matuszak	
5 km	FL 02026 DL	A	St. George Island	St. George Island 5k Sizzler	0.0	2	B McGuire	
5 km	FL 02027 DL	A	Coconut Creek	Over the Hill 5k	0.0	2	G Witkosksy	
5 km	FL 02028 DL	A	West Palm Beach	Race for the Cure	0.0	5	D Loeffler	
5 km	GA 02007 WC	A	Augusta	Georgia Games - Lake Olmstead	1.8	6	T Crute	
5 km	GA 02008 WC	A	Marietta	Marietta Meander	4.4	8	W Cornwell	GA 90014 WN
5 km	IL 02028 JW	A	Chicago	Mt. Greenwood Run	0.0	3	C Hinde	
8 km	IL 02045 JW	A	Elgin	Grand Victoria 8k	0.4	3	C Hinde	
5 km	IL 02047 JW	A	Chicago	Chicago Distance Classic	0.0	1	J Knoedel	IL 99018 JW
5 km	IL 02048 JW	A	Bensenville	Blue Hawaiian 5k	0.0	3	C Hinde	
5 km	IL 02050 JW	A	Decatur	Decatur Race for the Cure 5k	0.0	1	R Goodwin	IL 94003 JW
5 km	IL 02051 JW	A	Sterling	Music in Motion 5k	0.0	3	D Lindsey	
10 km	IL 02052 JW	A	Chicago	Kemper Chicago Classic	0.0	0	J Knoedel	IL 01090 JW
8 km	IL 02053 JW	A	Oak Park	Frank Lloyd Wright 8k	0.0	2	J Knoedel	
5 km	IL 02054 JW	A	Chicago	Unity 5k	0.0	10	C Hinde	IL 00043 JW

DISTANCE	COURSE ID	ST	LOCATION	COURSE NAME/RACE	m/km DROP	pct SEP	MEASURER	REPLACES
5 km	IL 02055 JW	A	Chicago	Lakeview at 50 5k	0.0	10	C Hinde	
5 km	IL 02056 JW	A	Chicago	Bastille Day	0.0	8	C Hinde	IL 02011 JW
2.582 mi	IL 02057 JW	A	Huntley	24 Hour Inline Skate	0.0	0	C Hinde	
7 km	IL 02059 JW	A	Batavia	Windmill Whirl	0.0	3	C Hinde	
5 km	IL 02060 JW	A	Country Club Hills	Harvest Hop	0.0	1	C Hinde	
10 km	IL 02061 JW	A	Wheaton	Marianjoy 10k	0.0	0	J Knoedel	
5 km	IL 02062 JW	A	Wheaton	Marianjoy 5k	0.0	39	J Knoedel	
5 km	IN 02001 JG	A	Chesterton	Running with the Irish 5k	0.0	1	M Kingery	
5 km	IN 02002 JG	A	Michigan City	See Jane Run 5k	0.0	1	T Konieczny	
5 km	IN 02049 JW	A	Hammond	Friendship Race	0.0	0	C Hinde	
8 km	KS 02018 BG	A	Topeka	Topeka Lions " Journey for Sight"	0.0	1	D Halferty	KS 90016 BG
10 km	KS 02019 BG	A	Junction City	Coor's Freedom Run	0.0	1	D Halferty	
5 km	KS 02021 BG	A	Leawood	Race for Hope	0.0	2	L Joline	
5 km	KS 02022 BG	A	Overland Park	Red Apple	0.0	0	L Joline	
5 km	KS 02023 BG	A	Shawnee	Run for the Wild	0.0	0	B Taylor	
5 km	KS 02027 BG	A	Leawood	Cancer Awareness	0.0	5	L Joline	
5 km	KY 02001 EM	A	Bowling Green	Purple Strider 5k	0.0	2	E Main	
5 mi	MA 02009 RN	A	Boston	Sugar Bowl 5 Miler	0.0	0	S Vaitones	MA 01016 RN
10 km	MA 02010 RN	A	Rockport	Rockport Run for Wellspring 10k	0.0	0	S Vaitones	
5 km	MA 02011 RN	A	Rockport	Rockport Run for Wellspring 5k	0.0	1	S Vaitones	
5 km	MA 02012 RN	A	Wakefield	Take the Lake 5k	0.0	5	S Vaitones	MA 01020 RN
10 km	MD 02006 JS	A	Rockville	Rockville 10k	0.0	2	J Sissala	MD 98013 JS
5 km	MD 02007 JS	A	Rockville	Rockville 5k	0.0	3	J Sissala	MD 98012 JS
5 km	MD 02008 JS	A	Towson	Notre Dame Prep 5k Run/Walk	0.0	0	J Sissala	
5 km	MD 02009 JS	A	Baltimore	FILA 5k	0.2	11	J Sissala	
5 km	MD 02010 JS	A	Baltimore	Run to Remember September 11	1.2	20	J Sissala	
Cal	ME 02004 WN	A	Old Town	University Park 1000 ft.	0.0	100	W Nicoll	
2 km	ME 02005 WN	A	Orono	Marsh Island Race Walk Loop	0.0	0	W Nicoll	
5 km	MI 02022 SH	A	Wyoming	Hot Streetz	0.0	15	R Dewey	
10 km	MI 02025 SH	A	Jackson	Rose Run	-1.0	65	S Hubbard	MI 84004 AP
5 km	MI 02026 SH	A	Portage	P.C.O.C. Strut	0.0	9	R Dewey	
10 km	MI 02027 SH	A	Portage	P.C.O.C. Strut	0.1	8	R Dewey	
10 km	MI 02028 SH	A	Grand Rapids	Standard Federal	-0.1	5	R Dewey	
5 km	MI 02029 SH	A	Kalamazoo	Homecoming Classic	0.0	0	R Dewey	
10 km	MI 02030 SH	A	Kalamazoo	Standard Federal	0.0	1	R Dewey	
10 km	MI 02031 SH	A	Flint	Flint Journal Catch Your Breath	0.0	1	S Hubbard	MI 98016 SH
5 km	MI 02032 SH	A	Rockford	Mitchell's Run Through Rockford	0.0	0	R Dewey	MI 00027 SH
8 km	MI 02033 SH	A	Zeeland	Pumpkin Fest	0.0	3	R Dewey	
50 mi	MN 02010 RR	A	Minneapolis	Fans	0.0	0	G Chace	
100 mi	MN 02010 RR	A	Minneapolis	Fans	0.0	0	G Chace	
0.404 km	MN 02010 RR	A	Minneapolis	Fans	0.0	0	G Chace	
2.665 km	MN 02010 RR	A	Minneapolis	Fans	0.0	0	G Chace	
3.897 km	MN 02010 RR	A	Minneapolis	Fans	0.0	0	G Chace	
100 km	MN 02010 RR	A	Minneapolis	Fans	0.0	0	G Chace	
5 km	MN 02011 RR	A	Fort Snelling	Snelling	0.0	0	R Recker	
10 km	MN 02012 RR	A	Robbinsdale	Whiz Bang	0.8	2	R Recker	
5 km	MN 02013 RR	A	Jordan	Scott County Fair	0.0	0	R Recker	
21.1 km	MN 02014 RR	A	Minneapolis	Aquetennial	1.1	46	R Recker	
10 mi	MN 02015 RR	A	Twin Cities	Twin Cities Marathon 10 Mile	0.6	80	R Recker	
5 km	MO 02020 BG	A	St. Louis	Race for the Cure	1.2	5	T Eckelman	MO 01014 BG
Cal	MO 02024 BG	A	St. Charles	Cave Springs Crossing 1000 ft.	0.0	100	D Spetnagel	
21.1 km	MO 02025 BG	A	St. Charles	Lewis & Clark	0.0	0	D Spetnagel	
5 km	MO 02026 BG	A	Lexington	Cannon Ball Run	0.0	2	L Joline	
5 km	NC 02020 PH	A	Raleigh	Entertainment & Sports Arena 5k	0.0	0	P Hronjak	NC 01048 PH
10 km	NC 02021 PH	A	Raleigh	Entertainment & Sports Arena 10l	0.0	0	P Hronjak	NC 01049 PH
21.1 km	NC 02022 PH	A	Raleigh	Umstead Half Marathon	0.0	0	P Hronjak	NC 01050 PH
5 mi	NC 02024 OH	A	Charlotte	Hit the Brixx 5 Mile Run	1.1	1	T Rhodes	
5 km	NC 02025 PH	A	Charlotte	Mama Ricotta's Dine & Dash 5k	0.0	3	T Rhodes	NC 01024 PH

DISTANCE	COURSE ID	ST	LOCATION	COURSE NAME/RACE	m/km DROP	pct SEP	MEASURER	REPLACES
5 km	NC 02026 PH	A	Research Triangle Park	Run for Research	0.2	1	D Dover	NC 99009 PH
5 km	NC 02027 PH	A	Pikeville	Independence Day Twilight Run	0.0	0	P Hronjak	
5 km	NC 02028 PH	A	Mathews	Mathews 5k	0.4	3	T Rhodes	NC 96017/ PH
5 km	NC 02029 PH	A	Charlotte	Summer Breeze 5k	0.0	2	T Rhodes	NC 01035 PH
5 km	NC 02030 PH	A	Selma	Selma Railroad Run	0.0	1	P Hronjak	
5 km	NC 02031 PH	A	Raleigh	Run for Life	0.3	2	P Hronjak	NC 95007 WN
5 km	NC 02032 PH	A	Raleigh	Cameron Village 5k	0.0	1	P Hronjak	NC 01036 PH
10 km	NH 02009 WN	A	Portsmouth	Jingle Bell Run for Arthritis	0.0	1	R Fitzpatrick	NH 93001 WN
5 mi	NJ 02002 DB	A	Spring Lake	Spring Lake Five	0.0	4	D Brannen	NJ 85049 GD
5 km	NJ 02025 GAN	A	Mt. Holly	Rancocas Romp 5km	0.0	0	L Baldasari	
5 km	NJ 02026 GAN	A	Teterboro	Teterboro Airport 5k	0.0	1	P Hess	
5 km	NJ 02027 GAN	A	Westfield	Westfield 5k Pizza Run	0.0	2	P Hess	
5 km	NM 02002 DS	A	Albuquerque	Race for the Cure 2002	0.0	2	T Navarro	NM 01008 DS
10 mi	NY 01001 DK	A	East Northport	East Northport 10 Mile Run	0.2	3	D Katz	
5 km	NY 02001 DK	A	Farmingdale	Vytra's Women's 5k - B	-1.0	4	D Katz	
42.2 km	NY 02015 AM	A	Hamlin	Ontario Shore Marathon	0.0	0	G Brooks	NY 01013 AM
21.1 km	NY 02016 AM	A	Hamlin	Ontario Shore 1/2 Marathon	0.0	1	G Brooks	
42.2 km	NY 02019 AM	A	Buffalo	Nissan Buffalo Marathon	0.0	0	J Grandits	NY 01023 AM
4 mi	NY 02032 AM	A	New York	NYRRC 4 Mike 102nd ST Finish	0.0	0	P Hess	
5 km	NY 02033 AM	A	Buffalo	Coalition for Brain Research 5k	-0.8	13	J Grandits	
3.5 mi	NY 02034 AM	A	Liverpool	Corporate Challenge South	0.0	4	D Oja	
5 km	NY 02035 AM	A	Seneca Falls	St. Anthony Italian Festival 5k	0.0	3	G Tillson	
0.5 km	NY 02036 AM	A	Liverpool	Onondaga Lake Park Racewalk	0.0	0	D Oja	
0.625 km	NY 02036 AM	A	Liverpool	Onondaga Lake Park Racewalk	0.0	0	D Oja	
5 km	NY 02037 AM	A	Binghamton	Otsiningo Park 5k	0.0	1	G Groome	NY 93012 AM
5 km	NY 02038 AM	A	W. Islip	Elizabeth McNamee 5k	0.0	8	E Melnik	
8 km	NY 02039 AM	A	Fallsburg	Run/Walk for Our Future 8k	0.0	1	B Cavanagh	
Cal	NY 02040 AM	A	Middletown	Egarton Rd. 400 meter	0.0	100	S Holmbraker	
Cal	NY 02040 AM	A	Middletown	Egarton Rd. 400 meter	0.0	100	S Holmbraker	
42.2 km	NY 02041 BDC	A	Buffalo	Casino Niagara Intl. Marathon	0.1	70	B Conway	
Cal	NY 02041 AM	A	Bethel	Airport Rd. 400 meter	0.0	100	B Cavanagh	
Cal	NY 02042 AM	A	Claryville	Claryville RT.19 - 400 meter cal.	0.0	100	B Cavanagh	
5 km	NY 02043 AM	A	Rome	Paul Revere's 5k	0.0	2	D Oja	
5 km	NY 02044 AM	A	Goshen	John Burke 5k	0.0	4	S Holmbraker	
5 km	NY 02045 AM	A	Honeoye Falls	Fishes and Loaves 5k	0.0	0	G Tillson	
5 mi	OH 02010 MW	A	Akron	Labor of Love Run - 2002	0.0	0	M Wickiser	OH 00011 MW
10 km	OH 02031 PR	A	Cincinnati	Cincinnati Thanksgiving Day Race	0.0	0	D Connolly	
5 km	OK 02004 BB	A	Bartlesville	City of Legends 5km	0.0	1	G Lafarlette	
5 km	OK 02005 BB	A	Owasso	Ram Run	0.0	3	G Lafarlette	
5 km	OK 02006 BB	A	Oklahoma City	Okla Firefighters Memorial Run	0.0	3	J Smith	
5 km	OK 02007 BB	A	Sand Springs	Catch a Sandite Run	0.0	1	G Lafarlette	
5 km	OK 02008 BB	A	Oklahoma City	Sooner State Games 5kn Run	0.0	0	J Smith	
5 km	OK 02009 BB	A	Checotah	Honey Springs Memorial Run	0.0	0	G Lafarlette	
8 km	OK 02010 BB	A	Bethany	Bethany YMCA Liberty Run	0.0	5	J Smith	
5 km	OK 02011 BB	A	Tulsa	Riverside Parkway Sand Run	0.0	2	G Lafarlette	
10 km	OR 02003 LB	A	McMinnville	Dustin's Run	0.0	9	J Spaulding	
8 km	PA 02005 WB	A	Swarthmore	Independence Eve 8km Run	0.0	1	B Belleville	
21.1 km	PA 02012 WB	A	Erie	PISP Half Marathon - Beach 1	0.0	0	M Vieyra	PA 96033 PR
5 mi	PA 02013 WB	A	York	Bon-Ton / YNC 5 Mile Race	0.4	2	P Barner	
5 km	SC 02016 BS	A	Charleston	Race for the Cure - Charleston	0.0	1	D White	SC 95018 BS
10 km	SC 02017 BS	A	Aiken	Whiskey Road Race	0.0	0	K Dixon	SC 85004 WN
5 km	SC 02018 BS	A	Columbia	Lou Holtz 5k Run	0.0	7	D White	
5 km	TN 02017 RH	A	Knoxville	Fireball Classic	-1.1	6	A Morgan	TN 89009 WN
1 mi	TN 02018 RH	A	Knoxville	KTC Kid's 1 Mile	-1.0	7	A Morgan	TN 89009 WN
10 km	TN 02019 RH	A	Franklin	Franklin Classic 10k	0.0	2	J Zeigler	TN 00010 RH
5 km	TX 02008 JF	A	Austin	Run for the Children	0.0	2	J Ferguson	TX 01007 JF
5 km	TX 02053 ETM	A	Houston	Run Wild Sports V.3	0.0	0	E McBrayer	

DISTANCE	COURSE ID	ST	LOCATION	COURSE NAME/RACE	m/km DROP	pct SEP	MEASURER	REPLACES
5 km	TX 02054 ETM	A	Decatur	Lightin' Challenge	0.0	11	M Polansky	
10 km	TX 02055 ETM	A	Dallas	Dino Dash 10k	0.3	2	C Clines	TX 98006 ETM
5 km	TX 02056 ETM	A	Dallas	Race Against Violence	0.1	2	C Clines	
6 km	TX 02057 ETM	A	Fort Worth	Summer Sizzlin' 6k	0.5	5	M Polansky	
5 km	TX 02058 ETM	A	Dallas	Big D 2002 30k, 15k, & 5k	0.0	0	K Ashby	
15 km	TX 02058 ETM	A	Dallas	Big D 2002 30k, 15k, & 5k	0.0	0	K Ashby	
30 km	TX 02058 ETM	A	Dallas	Big D 2002 30k, 15k, & 5k	0.0	0	K Ashby	
5 km	UT 02003 DP	A	Salt Lake	East Millcreek Recreation	0.4	2	L Smithee	UT 99008 FH
42.2 km	UT 02004 DP	A	Ogden	Ogden Marathon	6.9	56	L Smithee	
Cal	UT 02005 DP	A	Murray	Murray - Main St. 400m	0.0	100	L Smithee	
Cal	UT 02006 DP	A	Salt Lake	Downtown - West st. 400m	0.0	100	L Smithee	
5 km	VA 02020 RT	A	Fairfax	PVI Runfest 5k	0.4	2	R Thurston	VA 00023 RT
Cal	VA 02021 RT	A	Lynchburg	Fort Ave 300 meter	0.0	100	R Thurston	
10 mi	VA 02022 RT	A	Lynchburg	Virginia Ten Miler	0.0	0	R Thurston	
4 mi	VA 02023 RT	A	Lynchburg	Virginia 4 Miler	1.4	46	R Thurston	
42.2 km	VA 02026 RT	A	Virginia Beach	Trigon Bay Bridge Marathon	0.2	57	M Robinson	
5 km	VA 02027 RT	A	Fort Eustis	Superday 5k	0.0	5	S Bartram	
42.2 km	VT 02001 WN	A	Burlington	Vermont City Marathon	0.7	1	B Lorenz	
Cal	WA 02002 BL	A	North Bend	North Bend Way 300.01 meter	0.0	100	B Langenbach	
42.2 km	WV 02017 RT	A	Cairo	Ridge Runner Marathon	1.0	2	J Corra	WV 95021 RT
5 km	WV 02024 RT	A	Benwood	Debbie Green 5k 2002	0.0	0	J Corra	
5 km	WV 02025 RT	A	Benwood	Debbie Green 5k 2002 - alternat	0.0	0	J Corra	
Foreign								
10 km	PUR 02030 PR	A	Santa Isabel	La Constitucion 10k	0.0	15	P Zapata	
Renewed								
20 km	AZ 88003 FC	A02	Phoenix	South Mountain Classic	0.0	1	F Cichocki	
Cal	IL 91018 JW	A02	Decatur	Albany St. 1225 ft. Calibration	0.0	100	J Burch	
5 km	NC 85047 PH	A	Burlington	Holly Hill Labor Day 5k	0.0	1	A Linnerud	
10 km	NJ 87014 DB	A	Ridgewood	Ridgewood 10km	0.0	0	D Brannen	
5 km	NJ 87015 DB	A	Ridgewood	Ridgewood 5km	0.0	0	D Brannen	
10 km	OK 84041 BB	A02	Ada	Fireball Classic 10 km	-0.2	1	G Lafarlette	
5 km	OK 88028 BB	A02	Ada	Run for Son 5 km	-0.3	1	J Smith	
5 km	OK 92056 BB	A02	Choctaw Nation Grounds	Choctaw Nation Celebration	-3.0	40	G Lafarlette	

Copies of these certificates available from: **Karen Wickiser - Course Registrar**
(Send course name & ID number and $2.00) **2939 Vincent Road** **Phone 330-929-1605**
Each certificate inclides a course map. **Silver Lake, OH 44224-2916** **FAX 509-351-5383**
A complete listing of USATF Certified courses is available at - www.RRTC.Net **Mikewickiser@neo.rr.com**

PIANO TUNER PUZZLE -- SOLUTION AND DISCUSSION

Bill Glauz's solution (it was his puzzle):

Tuning by fifths one goes up 12 fifths (each being 7 half steps) to get back to a C. (C, G, D, A, E, B, F#, C#, G#, D#, A#, F, C.) Thus, the frequency increases by the multiple (3/2)12, or 531,441/4096 = 129.746... The targeted new C is up seven octaves, for an increase in frequency of 27, or 128. Therefore the C found by tuning by fifths will be sharp by 1.36...%. It would sound horrible, a terrible discord.

These kinds of problems didn't bother the early musicians when the only instruments were flutes, one-stringed instruments, or the human voice, because only one note at a time could be played, so chords were not a factor. However, with the invention of the harpsichord, organ, and piano, major arguments broke out about how to tune such instruments, between musicians and geometricians. (The latter tried to explain music in terms of geometric constructions, such as dividing a vibrating string into even fractions to get other vibration frequencies.)

Just as an octave spans 8 white notes (hence the name, octave) and if perfect the frequencies are in the ratio of 2:1, and a perfect fifth has a 3:2 frequency ratio, other chords have similar mathematical representations. A perfect fourth has a 4:3 ratio. A fifth plus a fourth = an octave; 3:2 X 4:3 = 4:2 or 2:1. A ratio of 5:4 is a perfect third. 6:5 is a perfect minor third (C and Eb, for example). A ratio of 5:3 is a perfect sixth, and 7:4 is a perfect seventh. The problem with all this is that if some of the chords are made perfect by the tuning process, the others will be way off and discordant. In the tuning by fifths example, for instance, by the time E is "tuned", it could be played with the C below it, a third, but its sound would be unacceptable to the ear.

The early musical scales date back to Pythagoras (500 B.C.), and consisted of just the present seven white keys, A-G. It was tuned using geometry like that above, but there were always problems. Some chords didn't sound good, so wouldn't be used. A scale of only five notes was often employed. By about 1400 A.D. keyboards with 12 half-steps in an octave, like the present ones, were introduced. Tuning was still a terrible problem. Some combination of perfect fifths and out-of-tune notes were usually used, or else a combination of some perfect thirds and out-of-tune notes, but the result was that some notes just couldn't be played with others.

Finally, in the early 1700's, Johann Sebastian Bach and his organ builder, Gottfried Silbermann, argued mightily about how to tune the organ, and Bach won out. He invented the "equal-tempered" scale in use today. In it, octaves are kept perfect, but all other chords are slightly out of tune, and none are grossly out of tune. The half step was defined mathematically as a frequency ratio of 2(1/12). Calculating a fifth with this method, if C has a frequency of 256 cps, G would have a frequency of 383.5666 cps, rather than the 384 cps of a perfect fifth, or about 0.1 % off. (Where have we heard that number before?) A piano tuner would tune G to a perfect fifth by ear, then flatten it until he heard about 2 beats per second. And that is basically how it was done for a couple of hundred years. (Nowadays, tuners use electronic tone generators that can be set to any desired frequency, such as the 383.5666 cps for G in the above example.)

David Reik's Solution:

July 7, 2002

From: David Reik (davidreik@aol.com)
To: Peter Riegel (riegelpete@aol.com) and Bill Glauz (wglauz@kcnet.com)
Re: The Piano Puzzle

I am no expert on how pianos are tuned, or on sound in general, but I have been interested in the subject for a long time. I will try to present my current understanding of the subject; please set me straight where I am confused.

When I was a junior in high school, a professional musician who was acting as a music teacher showed me how you could play a major scale from any note on the piano if you went up a whole step, a whole step, a half step, a

whole step, a whole step, a whole step, and, finally, a half step. This was a revelation to me, even though I had played the cello in the Sedgwick Junior High School orchestra. In college, in Music History class, Bach's set of twenty-four pieces for the keyboard, "The Well-Tempered Clavier," was mentioned. It contains twelve pieces, each in a different major key, and twelve pieces, each in a different minor key. As I recall, Bach was trying to demonstrate that if a keyboard instrument was tuned correctly, you could, without any re-tuning, play in any key, that is, play a piece based on a scale that started with any note on the keyboard. Apparently, keyboard instruments, prior to that time, had been traditionally tuned in a way that was specific to a particular key (C, I would guess), but that didn't work for other keys. I would guess that keyboards were tuned to produce perfect intervals relative to C; that is, not only would C to C be a perfect octave, but C to G would be a perfect fifth, C to E would be a perfect third, C to F would be a perfect fourth, and C to A would be a perfect sixth.

The term "sixth" seems to refer to a note that has a wave cycle that is three-fifths as long as the base note's wave cycle, the term "fifth" to a note that has a wave cycle that is two-thirds as long the base note's cycle, the term "fourth" to a note with a wave cycle that is three-quarters as long, and the term "third" to a note that has a wave cycle that is four-fifths as long as the base note's. The upper note in an octave has a wave cycle that is half the length of the base note's wave cycle. I'm not sure of the correct terminology, but I think I can say that the waves of these notes go in and out of phase with the waves of the base note in a way that sounds musical: with a sixth, the phases come together every third wave of the base note; with a fifth, the phases come together every second wave of the base note; with a fourth, the phases come together every third wave of the base note; with a third, the phases come together every fourth wave of the base note. With an octave, the phases come together at every wave of the base note.

I think the terms "third," "fourth," "fifth" and "sixth" are confusing because they have nothing to do with the fractions they seem to suggest. The term "third" is used because a "third" is the first note combined with the third note of a major scale, "fourth" because a "fourth" is the first and the fourth note, "fifth" because a fifth is the first and fifth note, and "sixth" because a sixth is the first and sixth note.

If you tuned a keyboard instrument the way that is suggested in Bill Glauz' "Puzzle of the Month" you would be tuning relative to a different base note each time you went up a fifth. When you arrived at a C, 84 half steps above the original C, twelve fifths above the original C, you wouldn't be exactly seven octaves above the original C; if the original note had a frequency of one and you went up twelve fifths, multiplying by 1.5 each time you went up a fifth, the note arrived at would have a frequency of 129.74633789. If you had gone up seven perfect octaves, the note would have a frequency of 128, so you are 1.36% sharp.

I can't claim to know what is actually done, but I would guess it would have to be something like this: If you want to be able to play in any key, that is, if you want to be able to play a scale starting at any note, you have to tune the instrument so that each half step is the same; the frequency of each half step has to be multiplied by the same number to get the frequency of the half step above it. Assuming we want to give the highest priority to having perfect octaves, and that we are going to have twelve half steps to go up an octave, I think the magic number is approximately 1.059463. Using that number to establish half steps, we get "fifths" that are 1.49830614272 times the frequency of the base note, 0.113% flat of a true fifth. But, if we tune the piano using the method described in the Glauz puzzle but use 1.49830614272 to establish what a "fifth" is, rather than 1.5, at the end of twelve "fifths" we are at a frequency 127.999042344 times the frequency of the note we started with, only 0.000748% off an exact seven octaves.

Using 1.059463 to establish half steps gives us thirds that are 0.79% sharp, fourths that are 0.11% sharp, fifths that are 0.11% flat, and sixths that are 0.91% sharp, with octaves that are essentially perfect. All the intervals would be within 1% of true; maybe that's an unhearable deviation. I can't see any other way to establish half steps that would allow equivalent scales to be played starting at any note.

Am I missing something?

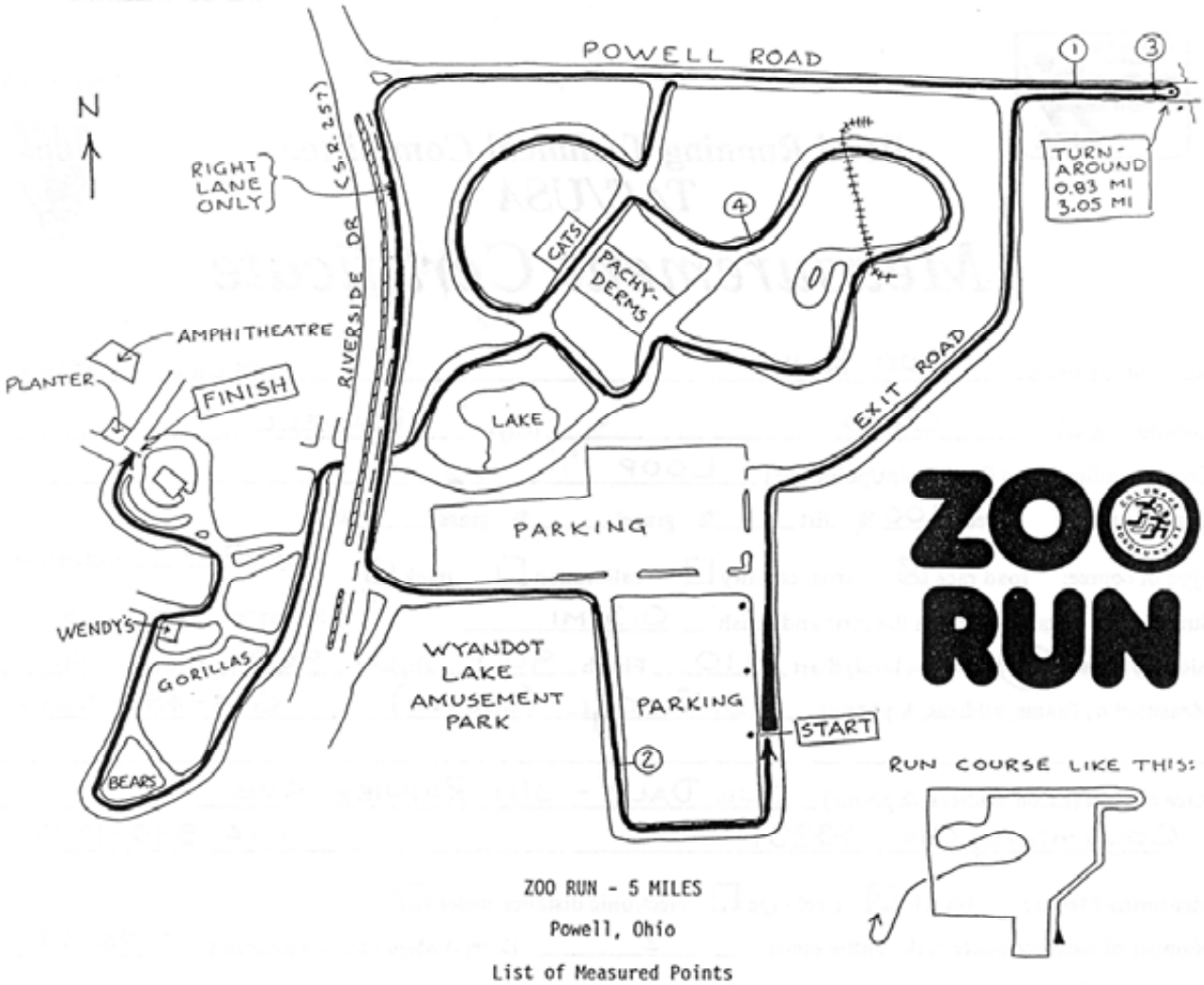
Alan Jones also sent a correct solution, but David's was the first.

CERTIFIER ABBREVIATIONS APPEARING IN THE CERTIFIED COURSE LIST

"No." indicates the number of courses certified as of July 1, 2002

Abb.	No.	Certifier
ACL	618	A. C. Linnerud
AM	603	Amy Morss
AP	86	Al Phillips
AS	67	Allan Steinfeld
BB	1045	Bob Baumel
BC	36	Bill Callanan
BDC	11	Bernie Conway
BG	708	Bill Glauz
BH	236	Basil Honikman
BH	4	Ben Hablutzel (4 AK courses)
BL	1	Bob Langenbach
BN	38	Bill Noel
BS	554	Brian Smith
BT	100	Bob Teschek
BU	2	Ben Buckner
CEG	8	Charles George
CJ	38	Carl Jeansonne
CW	490	Carl Wisser
DB	483	Dan Brannen
DK	98	David Katz
DL	783	Doug Loeffler
DLP	120	Don Potter
DM	17	Dale Matty
DP	314	Dave Poppers
DR	403	David Reik
DS	32	Don Shepan
EL	47	Elizabeth Longton
EM	3	Elizabeth Main (nee Longton)
ETM	1602	Tom McBrayer
FC	163	Felix Cichocki
FH	119	Finn Hansen
FW	69	Frederic Wilson
GAN	359	Gene Newman
GD	177	George Delaney
GLD	19	Gordon Dugan
GN	96	Greg Nelson
GT	27	George Tuthill
HWC	3	Harold Canfield
JD	317	John DeHaye
JF	54	John Ferguson
JG	3	Jim Gerweck
JL	140	Jim Lewis
JMC	92	John McGrath
JS	277	John Sissala
JW	1051	Jay Wight
KL	200	Kevin Lucas
KU	119	Karl Ungurean
KY	42	Ken Young
LB	154	Lee Barrett
LE	13	Len Evens
MF	107	Michael Franke
MR	250	Mike Renner
MW	277	Mike Wickiser
PC	127	Paul Christensen
PH	368	Paul Hronjak
PR	1478	Pete Riegel
PT	2	Patricia Thornton
RE	315	Robert Edwards
RH	323	Bob Harrison
RL	193	Bob Letson
RN	307	Ray Nelson
RR	386	Rick Recker
RS	1037	Ron Scardera
RT	718	Bob Thurston
SH	528	Scott Hubbard
SV	16	Steve Vaitones
TB	66	Tom Benjamin
TC	308	Ted Corbitt
TD	151	Tom Duranti
TF	31	Tom Ferguson
TK	375	Tom Knight
WB	208	Bill Belleville
WC	207	Woody Cornwell
WG	250	Bill Grass
WH	12	William Hughes
WN	1561	Wayne Nicoll
WS	5	Wade Stockman

MAP OF THE MONTH



ZOO RUN - 5 MILES

Powell, Ohio

List of Measured Points

START - On east parking lot road, at third pole south of main entrance road. Marked with nail and washer on west side of road.

TURNAROUND - 0.83 miles - On Powell Road, 12 feet west of telephone pole on south side of road. Pole is about 20 feet west of a small drainage ditch. A small white sign by the ditch reads "DEL 750 0076." Marked with nail and washer on south side of road.

1 MILE - On Powell Road, 88 feet east of telephone pole D3 A29. Pole is opposite 4840 Powell Road. Point is also opposite the west tree in the front yard of 4840. Marked with nail and washer on south side of road.

2 MILE - On west parking lot road, 89 feet south of the third pole south of the main entrance road. Marked with nail and washer on east side of road.

3 MILE - On Powell Road, 24 feet east of green electric box on north side of road. This is the first electric box east of the mailbox for 4733 Powell Road. Mark is just east of driveway next to red shed painted with "Willowbrook", and is marked with nail and washer on south side of road.

TURNAROUND - 3.05 MILES - same as TURNAROUND above.

4 MILE - On zoo path, about 20 feet uphill from the elephants on the path leading to the North American exhibit.

FINISH - 5 MILES - On the zoo path on the west side of the amphitheatre. Even with the south edge of the first planting island south of the amphitheatre.

Measured by Pete Riegel, Columbus, Ohio

TAC Certified Course OH 90030 PR

PUBLICATIONS AVAILABLE FROM RRTC

Printed Course Lists - You can obtain a list of certified courses for any state. Send $2.00 for any state list. You will receive a list that is current as of the last published Measurement News. If you wish the courses to be sorted in a special way, let us know. Otherwise it will be sorted by distance as the list appears in MN. You can obtain other specially-sorted lists - for instance, you might want to have all the 5k's in IL, IN, and MO. It can be done. Just say what you want. If you are online, lists can be sent that way. Contact Mike Wickiser at MikeWickiser@neo.rr.com

Attention RRTC certifiers: Your lists are free. Any time you want one let us know. You can mark up any mistakes and we will correct it and send you a new copy.

Web Page Access to Course Lists: The complete list can be downloaded from the RRTC website at **http://rrtc.net/download/** Also, try the certified course Search Engine at the USA-LDR website **http://www.usaldr.org/**

Individual Certificates - These may be obtained by sending the course number and $2.00 per course desired. **SEND THE COMPLETE ID, INCLUDING PREFIX AND SUFFIX LETTERS, Thus: CA 92057 RS.** Send course name, length and location as well. If you are thinking of hiring a measurer, this is an excellent way to see the sort of work you can expect. In addition, you may wish to check out a course you intend to run. Bring the map to the course and see if the race director got it right!

Above material may be obtained from: Mike Wickiser - 2939 Vincent Rd. - Silver Lake, OH 44224-2906

Measurement Calculation Computer Program by Bob Baumel, version 1.2 for Macintosh or IBM PC. This software can be downloaded for free from the RRTC website at **http://www.rrtc.net/download/** or Bob will distribute it by email attachment (send requests to webmaster@rrtc.net) or on floppy disks (send blank, formatted diskette and stamped return mailer to Bob at: 129 Warwick Road, Ponca City OK 74601-7424). Be sure to specify Mac or PC version.

Electronic Certificate Templates (available to Certifiers only), now in an Adobe Acrobat format which isn't tied to any word processor. Requires Acrobat or Acrobat Reader 4.0 or greater (Current Acrobat Reader may be downloaded for free from www.adobe.com). The template allows you to fill in certificates on the computer and print them. Available in both FS and non-FS version. Distributed by Bob Baumel by email or diskette [same addresses as for Measurement software]. Bob can customize the template with certifier's personal info at the bottom (name, address, phone, etc.) so you can avoid re-typing it every time (Be sure to specify exact ID text desired when requesting a template).

Online course measurement book, edited by Bob Baumel. It's a revision of the one you can buy from USATF, but the basic procedures have not changed. Available at: **http://www.rrtc.net**

Course Measurement Procedures - the Bible of course measurement. Complete instructions for measuring courses for USATF certification. The same procedures are now used for IAAF and AIMS courses. $9.00 postpaid. Available from: USATF - Book Order Dept. - PO Box 120 Indianapolis, IN 46206

Course Measurement Video - a concise 17 minute introduction to course measurement, intended as a supplement *to Course Measurement Procedures*. See how it's done! Version 2 sells for $10 but there are still a few copies of the original version available for $7.50. Send to: Tom McBrayer - 4021 Montrose - Houston, TX 77006-4956.

OTHER PUBLICATIONS AND EQUIPMENT

Road Race Management is a monthly newsletter providing race organizing ideas and news for race directors. $97 per year from: Road Race Management - 4904 Glen Cove Pkwy - Bethesda, MD 20816 Phone: 301-320-6865 Fax: 301-320-9164

Jones/Oerth Counters - Write to: Paul Oerth - 2455 Union St - Apt 412 - San Francisco, CA 94123. Phone: 415-346-4165 Fax 415 346 0621. Email: Poerth@aol.com. US Price is $70 for the 5 digit model, $80 for the 6 digit model, postpaid. Foreign price is $75/$85 plus postage. Foreign orders shipped by airmail. Visa, MasterCard, American Express cards accepted. **Note: Payment in advance is required.**

RunScore - The flagship of IBM-style finish line programs. For information contact: Alan Jones - 3717 Wildwood Dr - Endwell, NY 13760. Or check it out on the internet at: www.runscore.com

Apple Raceberry JaM - Race management software for Macintosh and Windows. Check it out on the Internet at http://www.raceberryjam.com or call Jack Moran at (952) 920-0558.

TOPOGRAPHIC MAPS

USA topographic maps are available from:

U. S. Geological Survey 303-202-4200
USGS Map Sales
PO Box 25286, Bldg 810
Denver Federal Center
Denver, CO 80225

Delivery will be made in approximately 4 weeks. Ask for latest price.

Maps can be located and ordered online at: **http://www.usgs.gov**

Maps can be obtained in just a few days from:

Map Express – PO Box 280445 – Lakewood, CO 80228-0445

1-800-MAP-00EX (1-800-627-0039)

Maps can be located and ordered online at**:**
http://www.mapexp.com

Topo Maps on CD-ROM - 3-D TopoQuads includes authentic USGS 7.5-minute quadrangle maps, assembled into one seamless database

See an interactive online demo at **http://www.delorme.com**

Also - check out Street Atlas USA from the above – it's a seamless street map of the whole USA at a decent price.

USGS TOPOGRAPHIC MAPS ONLINE - FREE

Maps.Com has a section where you can click on to all USGS maps, free. This can be very handy for obtaining accurate elevation information.

Check out**:** **http://www.maps.com**

ROAD RUNNING TECHNICAL COUNCIL

Chairman: Mike Wickiser – 2939 Vincent Rd – Silver Lake, OH 44224
Phone/fax: 330-929-1605 email: MikeWickiser@neo.rr.com

REGIONAL CERTIFIERS - CONTACT THESE PEOPLE FOR CERTIFICATION INFORMATION

		Telephone	Email address
AK -	Frederic Wilson - 2420 Glenwood - Anchorage, AK 99508	907-279-2773	uphere@alaska.net
AL -	John DeHaye - 824 Annlau Ave - Huntsville, AL 35802	256 881-9326	jjdehaye@yahoo.com
AR -	Don Potter - #7 Kali Court - Conway, AR 72032	501-796-4081	donp@tcworks.net
AZ -	Gene Newman – 920 N. Night Heron Dr – Green Valley, AZ 85614	520-648-3353	newmangc@cox.net
CA -	Ron Scardera - 5660 Valley Oak Dr - Los Angeles, CA 90068	323-467-7750	rscar@pacbell.net
CO -	Dave Poppers - 5938 S Franklin St - Centennial, CO 80121	303-795-9743	dpoppers@earthlink.net
CT -	David Reik - 87 Wood Pond Road, West Hartford, CT 06107	860-677-2724	Davidreik@attbi.com
DC -	Robert Thurston - 13 Kennedy St NE - Washington, DC 20011	202-726-1518	Thurret@aol.com
DE -	Paul Hess – PO Box 501 – Gladstone, NJ 07934	908-781-0027	
FL -	Doug Loeffler - 1399 W. Royal Palm Rd - Boca Raton, FL 33486	561-391-2880	DougLoeffler@aol.com
GA -	Woody Cornwell - 1701 Violet Way - Dalton, GA 30720	706-226-5207	ewcornwell@cs.com
HI -	Peter Riegel - 3354 Kirkham Rd - Columbus, OH 43221-1368	614-451-5617	Riegelpete@aol.com
IA -	Michael Franke - 3824 51st St - Des Moines, IA 50310	515-276-3140	Mfranke@worldnet.att.net
ID -	Michael Renner – East 1606 19th Ave – Spokane, WA 99203	509-535-2822	
IL -	Jay Wight - 4556 Opal Drive - Hoffman Estates, IL 60195-1185	847-359-4598	Jaywight@earthlink.net
IN -	Jim Gerweck – 156 Fillow St - Norwalk, CT 06850	203-838-2748	zgerweck@aol.com
KS -	Bill Glauz - 2704 W. 137th St. - Leawood, KS 66224-4529	913-402-1501	wglauz@kcnet.com
KY -	Peter Riegel - 3354 Kirkham Rd - Columbus, OH 43221-1368	614-451-5617	Riegelpete@aol.com
LA -	John Ferguson - 3026 Sesbania - Austin, TX 78748-1912	512-282-4175	fergusonj@hayscisd.net
MA -	Ray Nelson - 3524 West Shore Road - Apt. 705 - Warwick, RI 02886	401-737-2416	ride9336@ride.ri.net
MD -	John Sissala - 120 Evans St - Rockville, MD 20850	301-340-8107	sissala@starpower.net
ME -	Wayne Nicoll - 31 Kilcare Rd - Andover, NH 03216	603-735-5721	nicoll57@webtv.net
MI -	Scott Hubbard - 1453 W. Hill Rd. - Flint, MI 48507	810-234-8993	Runningshorts@aol.com
MN -	Rick Recker - 19 South 1st Street #2203 - Minneapolis, MN 55401	612-375-0805	rick_recker@hotmail.com
MO -	Bill Glauz - 2704 W. 137th St. - Leawood, KS 66224-4529	913-402-1501	wglauz@kcnet.com
MS -	Bob Harrison - 1736 Meadow Oak Court - Montgomery, AL 36117-6830	334-279-5517	rnharrison@knology.net
MT -	George Tuthill - 810 S 7th Ave - Bozeman, MT 59715	406-587-2289	tuthill@physics.montana.edu
NC -	Paul Hronjak - 4413 Pinehurst Drive, Wilson, NC 27896	252-237-8218	hronjak@simflex.com
ND -	Peter Riegel - 3354 Kirkham Rd - Columbus, OH 43221-1368	614-451-5617	Riegelpete@aol.com
NE -	Karl Ungurean - 203 E. Denison - Davenport, IA 52803	563-324-2250	UngureanK@aol.com
NH -	Wayne Nicoll - 31 Kilcare Rd - Andover, NH 03216	603-735-5721	nicoll57@webtv.net
NJ -	Larry Baldasari – 3448 Nottingham Way – Hamilton Square, NJ 08690	609-890-8343	larsurf@aol.com
NM -	Don Shepan - 3007 Ronna Dr - Las Cruces, NM 88001	505-524-7824	Drshepan@aol.com
NV -	Bill Callanan - 5209 Copper River Ave - Las Vegas, NV 89130	702-656-3741	Callan@lvcm.com
NY -	Amy Morss - 248 Spring Hill Rd., Sharon, NH 03458	603-924-4164	Amorss@koko.mv.com
OH -	Peter Riegel - 3354 Kirkham Rd - Columbus, OH 43221-1368	614-451-5617	Riegelpete@aol.com
OK -	Bob Baumel - 129 Warwick Road - Ponca City, OK 74601-7424	580-765-0050	bobbau@earthlink.net
OR -	Lee Barrett - 3027 NE 20th Ave - Portland, OR 97212	503-284-2809	cudapdx@attbi.com
PA -	Bill Belleville - 2902 Morris Road - Ardmore, PA 19003	610-649-4278	Wjbellevil@aol.com
RI -	Ray Nelson - 3524 West Shore Road - Apt. 705 - Warwick, RI 02886	401-737-2416	ride6887@ride.ri.net
SC -	Brian N. Smith - 1465 Winton Rd - Mount Pleasant, SC 29464-3921	843 881 5566	Bnewbatt@awod.com
SD -	Peter Riegel - 3354 Kirkham Rd - Columbus, OH 43221-1368	614-451-5617	Riegelpete@aol.com
TN -	Bob Harrison - 1736 Meadow Oak Court - Montgomery, AL 36117-6830	334-279-5517	rnharrison@knology.net
TX -	E. T. McBrayer - 4021 Montrose - Houston, TX 77006-4956	713-523-5679	mametm@aol.com
UT -	Dave Poppers - 5938 S Franklin St - Centennial, CO 80121	303-795-9743	dpoppers@earthlink.net
VA -	Robert Thurston - 13 Kennedy St NE - Washington, DC 20011	202-726-1518	Thurret@aol.com
VT -	Wayne Nicoll - 31 Kilcare Rd - Andover, NH 03216	603-735-5721	nicoll57@webtv.net
WA -	Bob Langenbach – 4261 South 184th St – SeaTac, WA 98188	206-433-8868	boblang@wolfenet.com
WI -	Jay Wight - 4556 Opal Drive - Hoffman Estates, IL 60195-1185	847-359-4598	Jaywight@earthlink.net
WV -	Robert Thurston - 13 Kennedy St NE - Washington, DC 20011	202-726-1518	Thurret@aol.com
WY -	Tom Knight - 307 Dartmouth Ave - San Carlos, CA 94070	650-594-9406	Tdk@stanford.edu

FOREIGN - Peter Riegel - 3354 Kirkham Rd - Columbus, OH 43221-1368 614-451-5617 Riegelpete@aol.com

CERTIFIERS - Please check this listing to be sure we have your data correct. August 27, 2002