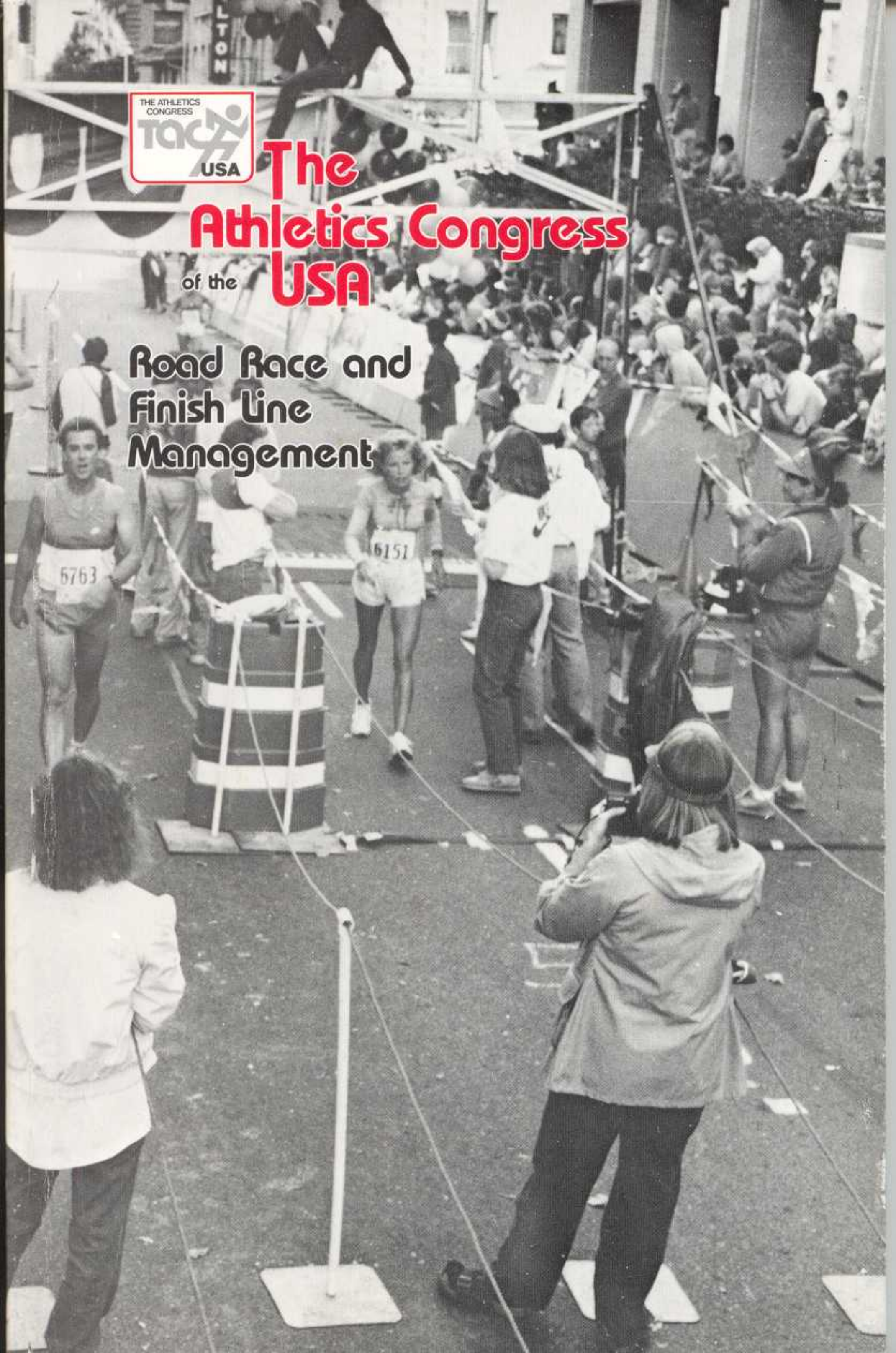
THE ATHLETICS CONGRESS
TAC
USA

The Athletics Congress of the USA

Road Race and Finish Line Management



Cover: Example of Toll-Booth System with four finish lines in operation. Race was the five mile race with 2000+ finishers connected with the 1985 Portland Marathon. Note that the women's finish line is separated from the men's by fixed ropes; modulating ropes control the runners crossing the three men's finish lines. Photo by John Perry.

$6.00

THE ATHLETICS CONGRESS

TAC USA

ROAD RACE AND FINISH LINE MANAGEMENT

PREPARED BY

ROAD RUNNING TECHNICAL COMMITTEE OF THE ATHLETICS CONGRESS

primary author:

Ken Young, P.O. Box 42888, Tucson, AZ 85733 (602)-326-6416

working group members:

Paul Christensen, 3715 NE 18th, Portland, OR 97212
(503-288-1665) . . . . toll-booth systems

David Katz, PO Box 822, Port Washington, NY 11050
(516-883-5599) . . . . multi-plex system, manual recording

Judy Stolpe, PO Box 1049, Coronado, CA 92118
(619-437-4667) . . . . pull-tag/spindle system, color-coding

contributors

Bob Baumel, Nancy Blankman, Gabriel Duguay, C.E. George, Jennifer Hesketh-Young, Carl Johnson, George Kleeman, Jack Moran, Wayne and Sally Nicoll, Peter Riegel, Allan Steinfeld, Phil Stewart

An official publication of The Athletics Congress of the USA, 200 South Capitol Avenue, Suite 140, Indianapolis, Ind. 46225; telephone (317) 638-9155. TAC/USA is the National Governing Body for Athletics in the United States (Track and Field, Long Distance Running, and Race Walking), and is the United States' member of the International Amateur Athletic Federation.

Copyright 1985 by The Athletics Congress of the USA, Inc.

A companion volume to this booklet is *Road Race Course Measurement and Certification Procedures* which is available for $4 from TAC/USA Book Order Dept., P.O. Box 120, Indianapolis, IN 46206.

TABLE OF CONTENTS

INTRODUCTION

WARNING! Don't try to digest this manual in its entirety in one reading. It is PACKED with ideas. Some you already know; some are common-sense. Some will help you do a better job; some may show you things you have been doing wrong. NOBODY does everything right, not even the "experts" that contributed to this manual. All members of the working group learned a lot; you can, too.

Runners are becoming more selective in the races they choose to run. They have become "educated" consumers and look for QUALITY in return for their entry fees. Races that offer quality continue to attract runners; races that don't offer value for the entry dollar are shrinking. Don't think it is just a few "elite" runners that are interested in their times. Returns from a recent running club survey contained comments from roughly half the respondents, criticizing the QUALITY of the local races.

This manual deals with only ONE aspect of a road race, i.e., getting the runner's time CORRECT. It sounds simple, yet it is the one thing most often missed. Obtaining a known time over a known distance is the basic reason for entering a race for most people. If you give the runner an incorrect time, it gives a poor impression of your entire race.

If a national record is set in your race, you would want that mark to be recognized. Open and age-group records are officially ratified by The Athletics Congress which defines the standards by which such marks are judged. This manual not only tells you what the rules are (see Appendix A), it gives you procedures to follow so that marks set in your race may receive due recognition in the event that a national record is established.

Races come in all sizes. The problems encountered in a 20 person race are quite different from the problems encountered in a 20,000 person race. The available equipment and personnel (not to mention money) also may be quite different. It doesn't do you much good to read about the latest high-tech finish line system if you only have two stop watches and a clip board.

Race finish systems are "do-it-yourself" systems. This manual will show you how to design your own system with the equipment and personnel you have available for your races. This manual will NOT tout one particular system as the BEST system. Although ideas developed by a particular race or finish line company may be referenced, we will NOT profile one or more race finish systems. Not only would such profiles probably not fit your needs, such profiles would not be fair to the many excellent race finish systems that space limitations would prohibit from being profiled.

Check the Table of Contents for sections of interest to you. When you encounter terms that are unfamiliar, check the glossary in Appendix B. We found a wide variety of terms being used to describe the same things. Standardizing terminology was one of the first steps in writing this manual. Hopefully a uniform set of terms to describe things will improve the exchange of ideas on finish systems.

Chapter II deals with the THEORY of finish line systems. You don't have to know the theory to understand and use the rest of the manual. The theory is presented so you can examine the REASONS why certain procedures are recommended or proscribed. When we state that no single finish line should handle more than 120 runners per minute, we have good solid reasons for this statement, founded in theory but backed up by observation of real finish lines when more than 120 runners per minute were finishing.

Chapter III deals with the "nuts-and-bolts" of the finish system, i.e., those details that hold the entire system together. If you have experience in handling race finish systems, you may wish to compare your experiences with particular sub-systems with other people's experiences. You may find some useful ideas to improve your system OR you may find a better system!

If you are a novice race director, you should start with Chapter IV which describes the overall design of a finish line system. Once you see the overall structure of the finish line system, you are in a position to design a system for your own purposes and can refer to the examples for races of various sizes. Once you have designed your system, THEN refer to Chapter III for the details of the sub-systems you may wish to use.

Chapters V, VI, and VII deal with pre-race and post-race problems. A well thought-out system for registering runners can save time and prevent headaches later. The awards search after the race often depends on how well the registration system was designed BEFORE the race. PLAN AHEAD!

This manual is a compilation of methods and ideas developed by many experienced technical co-ordinators for road races. This experience is derived from thousands of races and from trying hundreds of ideas. We trust that even the most experienced race director will find new and useful ideas to help make his/her race even better.

Many professional finish line operators sent descriptions of how their particular system works. We wish to express appreciation for these sources as well.

ACKNOWLEDGEMENTS

No one person could have written this manual. Many of the procedures expressed here were not even well understood until the working group sat down and argued them out. Much of the theory came about as a result of these arguments as well.

The working group was convened in Tucson for three days in mid-August 1985. Jennifer made sure all the day-to-day necessities were taken care of, things like food and a place to sleep. As the working group arrived, each was put to work, almost as they stepped off the plane. Every section of the first draft was gone over. Details of different finish systems were argued at length.

A philosophical or attitude change became evident after the first day. Rather than trying to write a manual describing how good finish line systems work, the attitude became one of writing a manual describing how a good finish line system SHOULD work.

Each member of the working group was and is an advocate of a particular system. Each is highly experienced and many different ideas were tried while evolving to their present preferences. All will admit that their ideas are still evolving. The interaction helped clarify the weak and strong points of the different systems so that better systems could be designed and presented.

We also wish to acknowledge the written contributions from several persons. Bob Baumel and Jack Moran contributed significantly to the theory section. Wayne and Sally Nicoll, Allan Steinfeld, and Phil Stewart went over the entire first draft and contributed many useful comments.

Writing a manual doesn't do much good if it is never printed and distributed. Jennifer handled the administrative effort nearly single-handedly. Her contribution ranged from having copies of the two drafts printed and then mailing them out to nearly fifty people around the country, to arranging for typesetting and printing (Gann Printing) to be CONTRIBUTED. Alvin Chriss was instrumental in co-ordinating the production of the manual with the requirements of TAC's Indianapolis office.

One hopes that the impact of this manual will be positive and widespread so that all of those who contributed so much time and effort to its preparation will feel their efforts were worth the sacrifice.

THE START

Getting the runners and your timing devices started at the same time when you are dealing with thousands of anxious runners is not an easy task. Let's look at the technical aspect, i.e., getting the timing started, and then consider the people problem. Refer to TAC Rule 37 regarding timing requirements and TAC Rule 60 regarding the start.

Timing Requirements

Watches and Timing Devices

There are basically two categories of timing methods. The fully automatic timing method is started automatically and records finish times automatically, i.e., without direct human input to the timing device. Hand timing refers to those devices started AND stopped (or read) manually. NOTE that mixed systems are not acceptable for official (record-keeping) purposes, i.e., starting manually and recording finish times automatically.

A timing device that is "stopped" on an individual will be referred to as a "stopped" time; a timing device whose display is "frozen" but may be returned to the "running" time will be referred to as a "split" or "cumulative split" time; a timing device that is visually read while running, i.e., the display is not frozen, will be referred to as a "running" time. Note that a "stopped" time means that the watch cannot be returned to the running time. If you are able to return to the running time, the time is referred to as a "split" time.

A "split" time should not be confused with a "lap" time. When a "lap" time is taken, the running watch "snaps back" or resets to zero, i.e., each lap time represents the time elapsed since the PREVIOUS lap time was taken. A "split" time is more properly referred to as a "cumulative split" time since it represents the cumulative time elapsed since the watch was "started" such as at the start of the race. When a split time is taken, the running watch is NOT reset.

Unfortunately, many digital watches confuse lap and split times. Watches that provide ONLY split times may erroneously refer to these as "lap" times. Watches that provide both options usually identify lap times correctly but refer to split times as "cum" times, short for "cumulative split" times.

Mechanical watches are those which provide a 30 or 60 second sweep hand (most commonly). Digital watches are those which provide a digital "read-out" which is usually a liquid crystal display (LCD). Electronic "timing devices" are basically the same as digital watches EXCEPT in the manner in which times are "out-putted." Electronic timing devices such as those produced by Chronomix, Seiko or Heuer employ a printed tape of places/times and will be referred to as "printing timers." Certain models of printing timers can be interfaced directly with computers.

Computers with built-in "real-time" clocks are considered to be electronic timing devices. Real-time clocks that operate from 60 Hz (cycles per second) or other alternating current input are not as accurate as those which incorporate timing circuits such as used in the printing timers.

Although mechanical watches are acceptable, they are NOT recommended. The drift or error accumulation in mechanical watches is roughly ten to one hundred times greater than for digital watches. Digital watches are fine for timing small races and taking times on selected individuals. Electronic timing devices are better suited for timing larger races.

Official Times and Provision for Alternate Times

It is said that a person with one watch always KNOWS what time it is, but the person with two watches is never sure! Actually, the person with one watch only THINKS he knows what time it is.

If you only have one watch and it malfunctions, you may never know, especially if the error is only a few seconds. If you have two watches and one malfunctions, you are never sure which is the culprit so you have to go with the more "conservative" or slower time. If you have three watches and one malfunctions, the two that agree are correct and the other is wrong.

Suppose you have ten watches going. Which do you use? Refer to TAC Rule 37.5. PRIOR to the start, you need to assign three official timers and one or two alternate timers. In the event that one of the three official watches fails, the designated alternate becomes the third official timer. This means you need to designate the first alternate and the second alternate timers PRIOR to the start. You may wish each official timer to start an "official" watch AND and "alternate" watch. You may NOT have one timer responsible for TWO official watches.

The times reported by these three official timers will be used to determine the official winning time(s) for your race. You may wish to employ your primary timing system, e.g., your printing timer as one of the official watches, PROVIDED the device was present at the start and started in the proper manner.

Synchronizing the Primary Timing Device

Since your primary timing system will be used to provide finish (split) times for most if not all of the runners in your race, it is important that these times be correct. The split (or stopped) times reported by the official timers for the first finisher should be compared with the time assigned to the first finisher by the primary timing system.

You should also perform a "closing" time check as follows. Take split times on your first finisher and, once these are checked and recorded, return to running time. Repeat this procedure for one of the last finishers, taking split times for each official watch AND the primary timing system simultaneously. This checks that the primary timing system did not malfunction after the first finisher was timed.

Now that you have all these times, what should you do with them? TAC Rule 37.7 states that you take the MIDDLE time of three or the SLOWER time of two to be the official winning time. Suppose your primary timing device returns a time of 30:42.7 and is used as one of the three official watches, having been started at the start, and your two other official timers report 30:43.1 and 30:42.5. The MIDDLE time or the official winning time is 30:42.7 which happens to be your primary timing device which means it is just fine as it is.

Suppose your primary timing device returned the SLOWEST of the three times, i.e., 30:43.1, and the other two watches returned 30:42.5 and 30:42.7. The official time for the first finisher is 30:42.7. You may either report the remainder of the times taken by the primary timing device JUST AS THEY APPEAR or you may wish to subtract 0.4 seconds from each time returned by the primary timing device.

Suppose your primary timing device returned the FASTEST of the three times, i.e., 30:42.5, and the other two watches returned 30:42.7 and 30:43.1. The official time for the first finisher is still 30:42.7. However, ALL of the times returned by the primary timing system MUST have 0.2 seconds ADDED to the times. The proper amount to add is the difference between the primary timing system and the official (middle) time.

When you report the three (or two) split times from your official watches for record-keeping purposes, you should include fractions of seconds. When you prepare race results, you may wish to report times to FULL seconds. If this is done, the proper procedure is to first make all necessary adjustments (if any) as above. Then raise ALL non-zero fractions of seconds to the next slower full second (TAC Rule 37.8). An exception should be made for 5 kilometers (road) where times should be reported to tenths of seconds, i.e., raise non-zero hundredths of seconds to the next slower tenth.

If you report non-winning times to full seconds when you submit race results, you should note any adjustments that were made (if any) to the non-winning times. If the official winning time indicates that the times reported by the primary timing device need to be adjusted to slower times and this was not done before raising non-winning times to their next full second, the adjustment will also be raised to the next full second and applied accordingly.

Consider a non-winning time of 32:47.1 with an upward adjustment of 0.1 seconds required. If you neglect the adjustment and simply report 32:48, the time will be adjusted by one full second to 32:49. If you had applied the adjustment BEFORE raising the times, the 32:47.1 would be adjusted to 32:47.2 and raised to 32:48.

If your watches return times to hundredths of seconds, the procedure for "returning" hundredths of seconds to tenths of seconds is the same. For example, a time of 43:47.02 is returned to 32:47.1. This means that a time of 32:47.02 is returned to the next higher full second or 32:48.

Reporting Times from a Running Watch

What if you don't have three official split or stopped times? Times may be reported from a "running" watch. These should be reported to full seconds. Note that a "running" watch LCD display that reads 32:47 is really 32:47.xx where the fractions of seconds usually are going by too fast to read. When submitting a mark for record purposes, report the running time as read and identify it as a "running" time BUT realize that for determining the offical winning time, you should add one second, i.e., the 32:47 running time is REALLY a 32:48. When you report such a time in your final race results for general distributiion, please report the 32:48, i.e., ADD that second.

Handling Automatically Truncated, Rounded, or Raised Times

Another problem occurs when the primary timing system returns times only to full seconds, i.e., the fractions of seconds are not available. In such cases, fractions may be dropped (truncated), they may be rounded (0.49 and less is dropped and 0.5 and greater is raised), or all non-zero fractions may be raised to the next full second in compliance with TAC Rule 37.8.

Suppose your primary timing system truncates and returns a winning time of 30:42. Suppose your three official timers report 30:42.5, 30:42.7 and 30:43.1. The primary timing system had a time of 30:42.xx and truncated the fractions. Hence, the official winning time should be reported as 30:43, based on the official watches.

The problem arises with the non-winning times. If the primary timing system actually had a time of 30:42.1 that was truncated, the official time is 30:42.7 and 0.6 seconds should be added to all times. Unfortunately, since ALL times are truncated with unknown fractions of seconds, a reported time of 32:45 could be 32:45.1 which would be adjusted to 32:45.7 and taken up to 32:46. A reported time of 32:45 could also be 32:45.6 which would be adjusted to 32:46.2 and taken up to 32:47! In such cases, the SLOWEST time represents a time that the runner ran AT LEAST as fast as, i.e., add TWO seconds to each non-winning primary time.

The rule to follow in reporting non-winning times when using primary timing devices that return times to full seconds is as follows. Determine the official winning time, raised as appropriate to the next full second. Determine how many seconds need to be added (subtracted) to the winning time reported by the primary timing device. Add one second to this figure.

The official winning time in the above example is 30:42.7, raised to 30:43. If the winning time reported by the primary timing device is

30:43, the winning time is OK and each non-winning time needs one second added. If the winning time were reported as 30:42, add one second to the reported winning time and TWO seconds to each non-winning time. If the winning time were reported as 30:44, subtract one second from the reported winning time and all non-winning times are OK (–1 second + 1 second = 0 seconds adjustment).

Official Times when Fractions of Seconds are Unavailable

Times reported from a "running" watch or those times obtained from a primary timing device that does not return fractions of seconds may be used to determine the official winning time. A "worst case" scenario must be assumed. A time of 30:42 read from a running watch should be treated as 30:42.99. A time of 30:42 reported by a "truncating" primary timing device should also be treated as 30:42.99. A time of 30:42 reported by a "rounding" primary timing device should be treated as 30:42.49. A time of 30:42 reported by a primary timing device which raises non-zero fractions should be treated as 30:42.00

Once the official winning time is determined, perhaps from a mixture of times which fractions of seconds reported and times without fractions reported, the necessary adjustments to the non-winning times may be determined as discussed in the previous section.

Timing the Start

All official timers MUST be AT THE START. This means within ten meters of the starter or starting device. Timers at road races rarely observe the smoke or flash associated with the starting pistol. Often races are started by voice command.

Sound travels at 300 meters per second. If you are 100 meters away, your watch will "lag" by 0.3 seconds due to the time required for the report of the starting pistol to reach you. If you are a half mile away, the lag is 2.4 seconds, i.e., such a watch would read 2.4 seconds TOO FAST!

Since it is not practical to recall a false start for a road race with thousands of runners, the timers MUST be prepared to start their watches (or timing devices) WHEN THE FIRST RUNNER BREAKS. Timers need to be briefed on this procedure so they won't be caught off-guard. This is a second reason why it is essential that the timers be physically present at the start.

Multiple Starting Lines

Multiple starting areas present additional problems. If you have separate starting lines AND finish lines for men and women, you can time these as TWO separate races although it is beneficial to synchronize these starts as well. If you have the possibility of runners from different starting lines crossing the SAME finish line, you MUST synchronize the different starts.

If you are using TWO starting lines and these are close enough so that a single starting pistol can be used to start each race, the starter should be stationed equi-distant between the two starting lines.

If your starting lines are too far apart for a single starting pistol or you are using three or more starting lines, co-ordination of the starts may be accomplished by Ham Radio, Police Radio, or by using hand-held FM Radio Transmitter-Receivers (tuned to the same frequency). You should NOT use citizens band (CB) radio or rely on very loud noises such as a cannon to co-ordinate starts. Remember each of these methods depend on people and even a basically good system can be fouled up by incompetent people.

Each start should have an FM transmitter-receiver which is channeled through a public address (PA) system. General race instructions and a minute by minute count-down can be handled by announcers at EACH starting area using a separate microphone to the PA system. At one minute to go, the starter should "clear" the FM channel, asking all others users to cease (or to use a secondary system on a different frequency if available). The chief starter (located preferably at the largest starting line) will make all last minute announcements which are broadcast to each of the other starting lines over each PA system via the FM radio link. A starting "horn" will broadcast better than a starting pistol.

Each starting area should have its own starting horn. When the starter for a given (secondary) starting area hears the horn over the PA system, he/she sounds the starting horn for that starting area, reinforcing the broadcast horn. All starts should be backed up with synchronized, digital, time-of-day watches in case of failure in the FM broadcast.

Auxiliary Watches and Digital Display Clocks

An auxiliary watch is any watch that is not an official watch. Auxiliary watches may be started at the start but often are started at a distance or lagged (started a known time after) from an official watch. This means that there may be TWO (or more) reflexes involved in starting an auxiliary watch. Thus, watches NOT started at the start, CANNOT BE USED AS OFFICIAL WATCHES. Note that the PRIMARY timing device may be an official watch or it may be an auxiliary watch.

Auxiliary watches are frequently used for enroute times, e.g., at the kilometer or mile marks, or other enroute marks. Digital display clocks are commonly started from another watch since they are not convenient to move around and may be pre-set so that they show the actual running time although started after the actual start.

If you intend to report official times for record purposes at intermediate (enroute) distances, the intermediate distance must be certified (with a signed certificate) AND at least two official timers must be present so that an official winning time may be determined. Auxiliary watches are not suitable for this purpose.

Although some primary timing devices are fairly portable and can be moved to the start and used as official watches, many are not portable and cannot serve this purpose unless the start and finish are in the same location. IF the primary timing device is NOT an official watch but has been started from another watch, it MUST be synchronized against at least two official watches.

In the event your primary timing device is NOT an official watch, do the following. Determine the official winning time for the first finisher as per TAC Rule 37.7 and described above. Compare this with the winning time according to your primary timing system. If it is the SAME as the official winning time, you are OK. If the primary timing system shows a time that is SLOWER than the official winning time, you may either report the times as returned by the primary timing device OR you may subtract the difference from each non-winning time returned. If the primary timing system shows a time that is FASTER than the official winning time, you MUST ADD the difference to each time returned by the primary timing device.

Managing the Start

The essential problem is to get ALL the runners BEHIND the starting line before the gun goes off. If you have tens or a few hundreds of runners, this is not a severe problem. When you have thousands of runners, you have a problem. Here are some tips.

Pseudo-Starting Line

Assuming you have a certified course, starting at the proper line is important. If the runners start ahead of the proper start, your certification is not valid!

Have TWO starting lines. Make one highly visible, e.g., start banner, big white line across the pavement, pace signs, ropes, i.e., anything to attract attention to THIS IS THE START. Place this "starting line" some 5 to 30 meters BEHIND the true starting line, depending on the size of the race. One to two minutes before the start of the race, allow the runners to "move up" to the true starting line.

This insures that the runners have room behind the starting line and helps reduce the "packing" at the start which often leads to tripping and falls when the gun goes off. Pace signs help in this regard. Funneling the runners into the REAR of the starting area by cordoning off the front is also useful. Packet pick-up should be to the REAR of your starting area if in the vicinity of the start.

Starting Command and Count-Down

A second-by-second count-down in a large race is an invitation to a false start. If you employ a count-down, announce minute-by-minute to one minute to go and the 40 seconds and 20 seconds. HOWEVER, build in a "safety factor" by telling the runners they have 20 seconds to go when actually they have 10 seconds to go.

Likewise, your starting command should either be a single word or just the starting pistol or starting horn. If you use a two or three command starting procedure, this has the same effect as a count-down and invites false starts.

Seeded Runners

If you wish to make sure your seeded runners have a position on or near the starting line, the pseudo-starting line provides the space needed to "insert" these seeded runners in the few minutes prior to the actual start. Once the seeded runners are in place, drop the restraining rope at the pseudo-starting line and allow the main pack of runners to spread forward prior to the start. This should not be done more than one or two minutes prior to the actual start.

In some very large or "mega" races such as Bay-to-Breakers, only a small number of "seeded" runners are actually timed. In this case, it is necessary to "control" the start to insure that the "seeded" runners were actually at the start. At the Bay-to-Breakers, a "seeded runners" area is cordoned off and only runners with appropriately low bib-numbers are permitted to enter. As they enter this area, their bib-numbers are marked with a colored marking pen to signify they were present at the start. Once in this area, they are not permitted to leave until the gun goes off.

Starting the "Wave" Start

A "wave" start is a device intended to reduce the finish line density by spreading the finishing runners out over a longer time. The wave start employs a single starting line but multiple starting TIMES, i.e., the field of divided into groups and each group is started at a different time. The first group to start consists of the FASTEST runners and each group's projected finish time is slower than that of the previous group. The wave start is discussed in more detail in Chapter II.

The wave start presents real opportunities for cheating. Runners are assigned a group with a specific starting order. The primary timing system is synchronized with the first start and actual running times for each individual are determined by subtracting the starting lag for his/her group from his/her finishing time. Thus, a runner that is supposed to start ten minutes after the first wave, could "improve" by starting in the wave that starts only five minutes after the first wave. Thus, he/she would have an extra five minutes to run before the "watch" on his/her group was "started."

To insure the validity of any record that might be set in such a race and to simplify the awards search, it is important that the potential award winners and record-setters start in the first group. Most top 50-59 men and 40-49 women will be seeded in the first (fastest) group. It is recommended that the first group also include ALL men over 60, women over 50 and all runners under 15, regardless of their estimated or projected finish time. These do not constitute a large fraction of the field and will insure that all award winners are in the first group.

If all potential record-setting runners are started with the first group, this simplifies the problem of assigning proper times. Note that each subsequent start in a "wave start" is actually being timed as an auxiliary time since each start is "timed" from the original start.

The Bolder Boulder 10 km in Boulder, CO has used a wave start for several years. Each starting group is given the same color of bib-number, e.g., a group may have all green numbers. Each group is assigned a cordoned-off area to assemble. Monitors circulate within each area to make sure that only runners with the proper color bib-number are present. Prior to a group starting, the group is moved to the starting line en mass.

FINISH LINE THEORY

The Ladder

The information gathered at a typical finish line consists of three lists. One is a list of places and times, usually provided by a printing timer such as a Chronomix. This forms one leg of the ladder. Second is a list of places and runners' names or bib-numbers, usually collected at the chute exit. This forms the other leg of the ladder. Third is a list of times and runners' bib-numbers, usually manually recorded at the finish line. These are the "rungs" in the ladder, keeping both "legs" synchronized. Without the select times, you have no guarantee that the runners are properly matched with their finish times.

Arrival Rates and Processing Rates

Each of the various types of systems designed to gather race finish information has a "processing rate" related to it. The processing rate is the number of finishers that can be processed per minute. For example, an operator using a printing timer is capable of timing 120 runners per minute (120 rpm). If pull-tags are collected and spindled at the end of a "processing" chute, runners can be processed at roughly 30 rpm.

Each race has a "peak arrival rate" which may also be expressed in runners per minute. If runners arrive at the finish line at a rate significantly greater than the processing rate, they will "build-up" in the processing chutes (if they don't back up across the finish line). We will show that allowing runners to build-up in the chutes is NOT the best way to go and, in fact, is the way to disaster.

Ideally, your processing system should be capable of handling the peak arrival rate without allowing runners to stand in the chutes awaiting processing. In fact, the BEST systems are designed to KEEP RUNNERS MOVING.

The remainder of this chapter will deal with the problems of estimating peak finishing rates, chute build-up, finish line back-up, ideal chute length, and the theory of the "wave" start for handling "mega-races."

Estimating Peak Arrival Rates

The distribution of finishers as a function of time is roughly a "normal" distribution for most races, at least in the period during which the arrival rates are greatest. The diagram shows the number of finishers for each minute in the 1985 Perrier 10 km in New York City and the 1985 Elizabeth River Run 10 km in Norfolk, VA. Only the male finishers for the Perrier race are shown although the race was a mixed race. Both male and female finishers are counted for the River

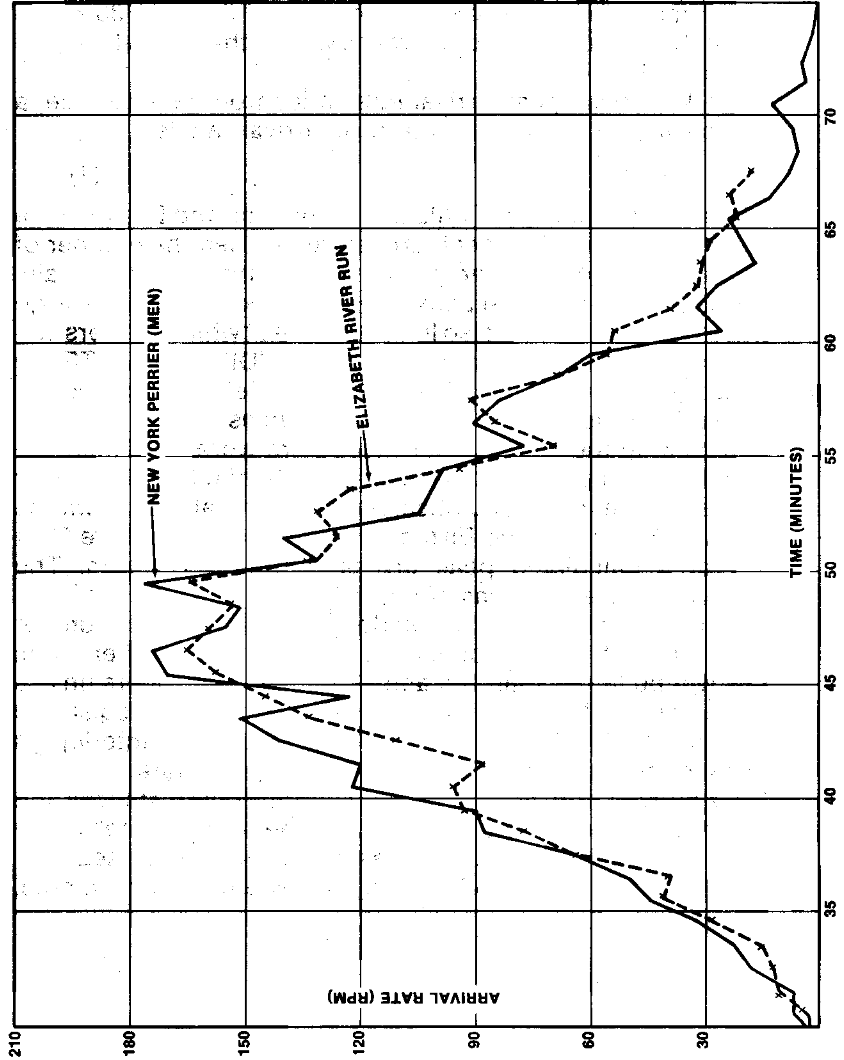


FIGURE 2-1.
Observed number of finishers by minute for typical 3000 person 10 km races.
The 1985 Elizabeth River Run (Norfolk, VA) with 3061 finishers and the men's results for the 1985 New York Perrier (New York, NY) with 3080 finishers are presented.

Run. These races were chosen since each had close to 3000 finishers. Later, we will compare these races with a "theoretical" race of 3000 finishers at 10 km.

Although the actual peak arrival rate varies from race to race, a good (conservative) estimate of the peak arrival rate is:

$$P = 0.6\ N/D \qquad (1)$$

where N is the total number of finishers in the race and D is the race distance in kilometers. The peak arrival rate is then the number of finishers to be expected in the peak minute. This formula usually OVERESTIMATES the actual peak minute, especially for very large races where road-way width also limits the rate at which runners can pass by any given point. Equation (1) may UNDERESTIMATE the actual peak minute for elite or restricted entry fields and/or exceptionally "fast" courses such as down-hill courses.

For example, in the 1985 Perrier race, there were 3080 men finishers. Equation (1) predicts a peak arrival rate of 0.6 x 3080 / 10 or 184.8 runners per minute. The observed peak arrival rate (from the diagram) is 175 rpm. For the Elizabeth River Run, there were 3061 finishers for a calculated peak arrival rate of 183.7 rpm. The observed peak arrival rate was 165 rpm.

Obviously, in planning a race, you do not know the exact number of finishers. In such cases, you should use the number of entrants since this will be larger than the actual number of finishers unless you have a very high percentage of "interlopers" or unregistered runners. Note that it is recommended to PROCESS interlopers which means they "count" toward your peak arrival rate.

Table I is derived from equation (1) for various race distances and sizes. The peak arrival rates are given in "runners per minute" which is abbreviated "rpm." Peak arrival rates for 20 km may be used for a half-marathon and those for 15 km may be used for a 10 mile race.

TABLE I. Peak Arrival Rates versus Race Size and Distance (arrival rates in rpm)

(size)	5km	8km	10km	12km	15km	20km	25km	30km	mara			
500	60	38	30	25	20	15	12	10	7	s	f	
1000	120	75	60	50	40	30	24	20	14	i	i	l
1500	180	113	90	75	60	45	36	30	21	n	n	i
2000	240	150	120	100	80	60	48	40	28	g	i	n
2500	300	188	150	125	100	75	60	50	36	l	s	e
3000	360	225	180	150	120	90	72	60	43	e	h	
4000	480	300	240	200	160	120	96	80	57			
5000	600	375	300	250	200	150	120	100	71			
6000	720	450	360	300	240	180	144	120	85			
8000	960	600	480	400	320	240	192	160	114			
10000	1200	750	600	500	400	300	240	200	142	m	f	
15000	1800	1125	900	750	600	450	360	300	213	u	i	l
20000	2400	1500	1200	1000	800	600	480	400	284	l	n	i
25000	3000	1875	1500	1250	1000	750	600	500	355	t	i	n
30000	3600	2250	1800	1500	1200	900	720	600	427	i	s	e
40000	4800	3000	2400	2000	1600	1200	960	800	569		h	

Estimating Chute Build-Up

In designing a finish line system, you need to know not only the rate at which runners are arriving but also the rate at which they are being processed. Different processing rates are associated with the different "sub-systems" as discussed in the following chapter.

If the processing rate or the rate at which runners are "removed" from the chutes (R) is less than the peak arrival rate (P), you can expect a build-up of runners awaiting processing. This usually occurs when runners are waiting (in the chutes) to be recorded rather than waiting to be timed since recording or collecting bib-number information is usually slower than timing. The greater the discrepancy between the peak arrival rate and the processing (removal) rate, the greater the build-up.

Given a set of race finish results, determining the build-up of runners awaiting processing can be determined for a variety of assumed processing rates. Consider the 1985 Elizabeth River Run, a mixed race with 3061 finishers. In the following table, the number of finishers arriving in the preceding minute is given for each minute from 38 to 64 minutes. Chute build-up for processing rates of 160, 140, 120, 100, and 80 rpm is given.

TABLE II. Determination of Chute Build-up (B) for various processing rates using the 1985 Elizabeth River Run data.

time (min)	# arriving in past min	R = 160	R = 140	R = 120	R = 100	R = 80
38	64	0	0	0	0	0
39	77	0	0	0	0	0
40	93	0	0	0	0	13
41	96	0	0	0	0	29
42	88	0	0	0	0	37
43	110	0	0	0	10	67
44	133	0	0	13	43	120
45	145	0	5	38	88	185
46	148	0	13	66	136	253
47	165	5	38	111	201	338
48	158	3	56	149	259	416
49	153	0	69	182	312	489
50	164	4	93	226	376	573
51	133	0	86	239	409	626
52	126	0	72	245	435	672
53	131	0	63	256	466	723
54	123	0	46	259	489	766
55	95	0	1	234	484	781
56	70	0	0	184	454	771
57	85	0	0	149	439	776
58	91	0	0	120	430	787
59	70	0	0	70	400	777
60	56	0	0	6	356	753
61	54	0	0	0	310	727
62	39	0	0	0	249	686
63	32	0	0	0	181	638
64	31	0	0	0	112	589

Runners "accumulate" when their arrival rate exceeds the processing rate. Otherwise, all arriving runners are assumed to be processed and any extra capacity in the processing rate goes to reduce the accumulation, if any. For example, at 43 minutes, the arrival of 110 runners is completely covered by R=120 and up. Ten runners accumulate for R=100 resulting in an accumulation of 10 since none had accumulated prior to that time. For R=80, 30 runners accumulate, adding to the 37 that had previously accumulated, bringing the total awaiting processing to 67.

After 60 minutes, the arrival rate has dropped to less than 60 rpm. Finish lines processing runners at 140 rpm or better would be "caught up" by this time, i.e., no build-up of runners awaiting processing. A finish line processing runners at 120 rpm would only have

6 runners waiting. A finish line processing runners at 80 rpm would still have 753 runners waiting to be processed!

The maximum chute build-up (B) in each case can be readily determined by scanning the accumulation of finishers for each minute. A general relation can be developed if one assumes the distribution of finishers to be "normal" or to follow a "bell-shaped" curve. The "exact" solution is rather complicated. A fairly simple, more conservative guide to the maximum chute build-up (B) is given by:

$$B = 0.307\ N\ \{(P/R) - 1\} \qquad (2)$$

where N is the total number of finishers, P is the peak arrival rate (equation 1), and R is the estimated processing rate. The maximum chute build-up (B) is given in numbers of runners. Again, this gives an overestimate to be on the safe side.

As an example of how well equation (2) predicts the maximum chute build-up (B), let's compare a theoretical 3000 person race having a normally distributed population of finishers as calculated by the "exact" method with the 1985 New York Perrier male finishers (3080) and 1985 Elizabeth River Run both male and female finishers (3061) and with equation (2) for a 3000 person race.

TABLE III. Maximum Chute Build-Up (B) for a 3000 person 10 km Race (theoretical and observed distributions)

process rate	"exact" method	Perrier men	River Run	equation (2)
170 rpm	30	5	0	54
160 rpm	85	26	5	115
150 rpm	158	76	40	184
140 rpm	245	126	93	263
130 rpm	346	212	159	354
120 rpm	459	314	259	461
110 rpm	585	434	369	586
100 rpm	723	561	489	737
90 rpm	874	710	621	921
80 rpm	1037	889	787	1151

Note that if you plan on a particular processing rate and maximum chute build-up, equation (2) will overpredict by roughly an amount equivalent to 10 to 15 rpm in the processing rate. This is not a large safety factor and differences between experienced finish line personnel and untrained personnel will greatly exceed this difference.

Other factors affect the distribution and the maximum chute build-up. A "single-sex" race generally has a narrower distribution than a "mixed-sex" race. This means higher arrival rates near the peak and greater build-up. This is clear when comparing the Perrier men's distribution with the Elizabeth River Run mixed race. Races with qualifying times or "elite" races may be expected to yield higher peak arrival rates than would be indicated by equation (1) and correspondingly greater chute build-up.

Suppose that your last year's race was 10 km with 1,200 runners. The calculated peak density would be 72 rpm. If your processing rate is 60 rpm, the expected maximum chute build-up would be 74 runners. Allocating two runners per meter of chute, a chute length of 37 meters (120 feet) would be adequate.

Now suppose that this year's registration suggests you will have 1800 runners, a 50% increase. The calculated peak density is 108 rpm. If your processing rate remains the same at 60 rpm, the calculated maximum chute build-up is 442 runners. This would require 221 meters of chutes, i.e., a SIX FOLD increase in chute length to accommodate a 50% increase in numbers!

From this example, it is obvious that increasing chute length is NOT the answer to handling larger races. The ONLY way to handle larger races is to improve the processing rate. This can be done by selecting a faster system for processing runners in the chutes OR by parallel processing, i.e., increase the number of processing chutes or the number of finish lines.

Finish Line Back-Up

There are two solutions to handling the high peak arrival rates associated with large, short races. One approach is to "divide-and-conquer" by using many finish lines. The peak arrival rate on any given finish line is then greatly reduced. This method is termed the "toll-booth" method.

Under the toll-booth method, the peak arrival rate for any given finish line should not exceed the processing capacity of a single sub-system for recording bib-numbers. Since processing rates generally are low, finish line back-up is not a problem for a PROPERLY designed toll-booth system. The number of finish lines for a toll-booth method is the estimated peak arrival rate DIVIDED by the processing rate for a single recording sub-system.

The second method improves the overall processing rate for a given finish line by using several processing chutes, each operating in PARALLEL. For example, using four processing chutes, each having a processing rate of 30 rpm, yields an overall processing rate of 120 rpm (provided runners are switched optimally). This second method is termed the "multi-plex" method.

In the multi-plex method, the stream of finishers must be switched from chute to chute as each chute fills up. The frequency that switches need to be made depends on how quickly runners back up.

If we assume that runners will WALK into the chutes at 80 meters per minute (3 mph) and are spaced one meter apart, then the maximum rate at which runners can enter the chutes is 80 rpm. For a marathon, you may expect a significantly slower "walk-thru" speed. Depending on weather conditions, the walk-through rate may be from 40 to 60 rpm for a marathon. You may expect slower walk-through rates for a race comprised of a high fraction of novice runners who don't know what to expect after they cross the finish line.

If the arrival rate is not greater than the walk-through rate or 80 rpm under normal conditions, all finishing runners can decelerate to a walk and enter the processing chutes. If the arrival rate is greater than 80 rpm, runners will "pile-up" in the deceleration zone BEFORE entering the chutes.

Assuming that the runners arrive at the finish line at regular intervals (ignoring "clusters"), the maximum rate at which the "pile-up" moves from the head of the chutes to the finish line is given by:

$$U = [P -(W/S]/[(1/S)-(P/F)] \qquad (3)$$

where P is the peak arrival rate (rpm), W is the "walk-thru" speed in meters per minute, S is the separation between runners in the chute in meters, and F is the finishing speed as the runners cross the finish line in meters per minute. There is no backup as long as the peak arrival rate is less than the walk-through rate which is estimated at 80 rpm. There is "instant disaster" for P greater than or equal to F/S since U becomes infinite.

For a 10 km race, the finishing speed at 45 minutes is roughly 10,000/45 or 220 meters per minute. If the peak arrival rate is 120 rpm, the "back-up" moves toward the finish line at 87 meters per minute. If the deceleration zone is 20 meters long, the build-up will reach the finish line in just under 14 seconds!

If the peak finishing rate is 150 rpm, the propagation of the build-up back towards the finish line is 216 meters per minute which gives you 5.5 seconds between chute switches. This is why some races resort to increasing the length of the deceleration zone. In this case, a deceleration zone of 60 meters (rather excessive) would allow chute switching every 17 seconds. This is NOT the best solution.

According to equation (3), instant disaster would occur for peak arrival rates above 220 rpm. Unfortunately, runners tend to arrive at the finish line in "clusters" which tends to aggravate the finish line back-up problem. Middle-of-the-pack runners also tend to finish at rather different speeds, from an all-out sprint to a "survival shuffle." This suggests the REAL problem is maintaining proper finish order in the deceleration zone. More judges (physically controlling runners rather than standing around watching!) can help up to a certain point. Maintaining proper finish order for arrival rates above 100 rpm for a single finish line is very difficult.

The conclusion to be drawn from this exercise is that a single finish line for a multi-plex system SHOULD NEVER EXCEED a peak finishing rate of 120 rpm! It is recommended that peak finishing rates not exceed 100 rpm.

Processing Runners in Batches

Returning to the 120 rpm peak arrival rate in the above example, chute switching at the peak finishing period would need to be accomplished at 10 to 15 second intervals. During this period, 20 to 30 runners would be expected to finish. Also during this period, runners would ENTER the chutes at 80 rpm, or 13 to 20 runners would be able to enter the chutes. The 20 meter deceleration zone could hold 20 runners, each walking one meter apart. Thus, the actual build-up would not reach the finish line PROVIDED switches were not delayed more than 15 seconds each.

Each "switch" would encompass 20 to 30 runners. This block of runners will be termed a "batch" in the multi-plex system and will be assumed to encompass 30 runners (to be on the conservative side).

The most efficient way of processing runners requires KEEPING THEM MOVING. Once they stop, your processing rate will drop which means an increased potential for chute build-up. This makes matters worse and pretty soon you have a non-functioning finish system.

Ideal Chute Length

The ideal chute length is that length required to spread the runners out so they can WALK by the processing station AT THE SAME RATE as they are being processed AND NO LONGER. We assume that two runners STANDING occupy one meter of chute but WALKING runners occupy a minimum of one meter of chute each.

The ideal chute length is determined by the peak arrival rate (P) and the single chute processing rate (R). If the peak arrival rate is NOT GREATER than the single chute processing rate, the chute serves simply to guide the runners past the processing station. The deceleration of the runners decreases their separation but will still permit a 60 to 80 meters per minute (2 to 3 mph) walk-through rate in the chutes. Since the separation will be greater than a meter, the spacing of the runners and their walk-through speed will equal the arrival rate.

In the multi-plex system, the arrival rate much of the time will exceed the single chute processing rate. When this occurs, runners are switched from chute to chute at intervals which permit 20 to 30 runners to enter a given processing chute between each switch.

In this situation, the purpose of the chutes is to spread out the runners so that the rate at which they WALK by the recorder at the end of the chute is equal to the single chute processing rate for that method of recording finishers. If the runners cannot WALK by the recorder, some of them will be forced to STOP. Once stopped, they will be hard to get moving again which will slow the flow of runners through the chutes and reduce the processing rate.

The ideal chute length for multi-plex systems is determined by the processing rate (R), the number of runners accepted in a single batch, assumed to be 30, and the walk-through speed (W). The walk-through speed is that speed the runners walk by the recorder at the END of the processing chute. This depends on the race length and the length of the processing chutes (which will be a function of the processing rate). For short races, the walk-through speed may range from 30 to 60 meters per minute (1.1 to 2.2 mph); for a marathon, the walk-through speed may range from 20 to 40 m/min. (0.7 to 1.5 mph).

Suppose the runners are walking at 60 m/min. and are one meter apart, they will pass by a given point at 60 rpm. If they are two meters apart, they will pass by at 30 rpm. Hence, for a processing rate of 30 rpm, the runners should be spaced two meters apart. Since each batch contains some 30 runners, if they are spaced 2 meters apart, the ideal chute length for recording systems where R = 30 rpm is 60 meters.

Since runners will tend to slow more as the processing chute length increases, the ideal chute length does not increase inversely with the processing rate. The ideal chute length (L) in meters, may be estimated by:

$$L = 15 + (500/R) \qquad (4) \qquad \text{for short races, and}$$
$$L = 10 + (400/R) \qquad (5) \qquad \text{for long (marathon) races,}$$

where R is the single chute processing rate (rpm). The walk-through rate has been assumed to be a linear function of the single chute processing rate, given by $W = 20 + (R/2)$.

A pull-tag/spindle system with a typical processing rate of 30 rpm should use 32 meter chutes for a 10 km race and 24 meter chutes for a marathon. A manual recording system with a typical processing rate of 20 rpm should use 40 meter chutes for a 10 km race and 30 meter chutes for a marathon. A place card/pull tag system with a processing rate of 80 rpm should use 21 meter chutes for short races and 15 meter chutes for a marathon.

The Wave System for Handling Mega-Races

The concept behind the "wave" or multiple starts from the same starting line is straight-forward. By spreading out the start, one can reduce the arrival rates at the finish line. The best example of such a "wave" start is the Bolder Boulder 10 km in Colorado.

The 1983 Bolder Boulder race employed 23 separate groups of runners seeded by their estimated time as filled out on their entry blank. Each group was identified by COLOR and by NUMBER BLOCKING. For example, a runner expecting to complete the race in 45 minutes was given a GREEN number in the 5000 block of numbers. That runner would locate the green signs indicating 5000-5999. Groups average about 700 to 800 runners each.

Over 300 marshalls working in the staging area were responsible for making sure runners line up with their proper group and that the groups move to the starting line in their proper order. Groups start roughly 15 seconds apart. As each group is started (with a starting gun), the elapsed time from the first starting gun is recorded. This is later fed into the computer and all runners starting in that block have that elapsed time subtracted from their overall time.

The KEY to reliability in a wave system is to be able to conveniently spot and remove runners who DO NOT belong in a particular starting group. Color coding and number blocking PLUS plenty of marshalls are needed to make this work.

The benefits are twofold. First, each runner is given a better opportunity to run a representative time, i.e., it should not take more than a few seconds for any runner to reach the starting line. If all the runners in Bolder Boulder were started at the same time, it would take several minutes for all the runners to cross the starting line.

Second, the peak arrival rate may be reduced. This means the finish system capacity may be reduced, i.e., fewer finish lines and/or fewer processing chutes.

There are many ways that runners could be assigned to different starting times. The simplest way would be to distribute entrants randomly among several starting groups. As an example, consider a hypothetical 20,000 person 10 km race with a mean (average) time of 50 minutes and a standard deviation of 8 minutes normally distributed. Such a race may expect 68% of its finishers to arrive between 42 minutes and 58 minutes. This would produce an AVERAGE arrival rate over 16 minutes of 850 rpm (13,600 runners divided by 16 minutes). The peak of the actual distribution is 1000 rpm; that calculated by equation (1) is 1200 rpm.

Divide this race into ten identical starts, each separated by a fixed time lag, e.g., one minute or two minutes, as shown. Each start will have 2000 runners and will be normally distributed with a mean of 50 minutes and a standard deviation of 8 minutes. By "adding up" each of the ten curves for each of the ten starts, the curves shown in Figure 2 are obtained.

There is a reduction in the peak arrival rate, from 1000 rpm with no lag (simultaneous start) to 925 rpm for a one minute lag between groups and to 792 rpm for a two minute lag. Note that the AREA under each curve is the SAME. The reduction is peak arrival rate is accomplished by spreading the distribution. We could get even lower peak arrival rates by spreading the distribution even more but few cities will permit ten back-to-back races, completely separated in time!

A better way is to "seed" the runners according to their projected finish time. If we start the fastest runners first and delay the start of the slower runners, we will "spread" the distribution of finishers and consequently will lower the peak arrival rate. Of course, we could start the slower runners first and the fastest runners last and "handicap" our race so that all 20,000 runners would finish together! In other words, seeded starts MUST place the fastest runners in the first start and each start should be comprising of successively slower runners.

When entering the race, each runner must "predict" a finishing time. For simplicity, assume that only predicted times in "whole" minutes are obtained, i.e., a runner who predicts a time of 50 minutes anticipates running closer to 50 minutes than 49 or 51 minutes.

In this case, EACH start has a different MEAN time associated with it and the standard deviation will be much smaller. Here, we will assume a standard deviation of 90 seconds for each one minute predicted group since it seems plausible that most runners can predict their finishing time for a 10 km race to plus or minus one minute and each group covers a range of plus or minus 30 seconds.

Again, divide the race into ten starting groups. For simplicity, in calculations as well as in actually seeding a race, each starting group will encompass several predicted times and groups will be roughly the same size. The breakdown is shown in Table IV.

TABLE IV. Assignment of Runners into Ten Equal-Sized Seeded Groups.

group	predicted times	group size
I	28 to 39 min.	1893 runners
II	40, 41, 42 min.	1592 runners
III	43, 44, 45 min.	2252 runners
IV	46 and 47 min.	1809 runners
V	48 and 49 min.	1956 runners
VI	50 and 51 min.	1985 runners
VII	52 and 53 min.	1895 runners
VIII	54, 55, 56 min.	2452 runners
IX	57, 58, 59 min.	1815 runners
X	60 and up	2351 runners

Now consider a positive lag of one minute between successive starts, i.e., in the desired direction of fastest first, slowest last. Each one minute predicted time group is added into the finishing distribution separately, even though several such groups may start at the same time.

The results of this exercise are shown in Figure 3. The peak arrival rate is reduced to 661 rpm. This compares favorably with the random assignment for one minute lag which yields a peak arrival rate of 925 rpm. Clearly, assigning the runners by estimated finish time is worth

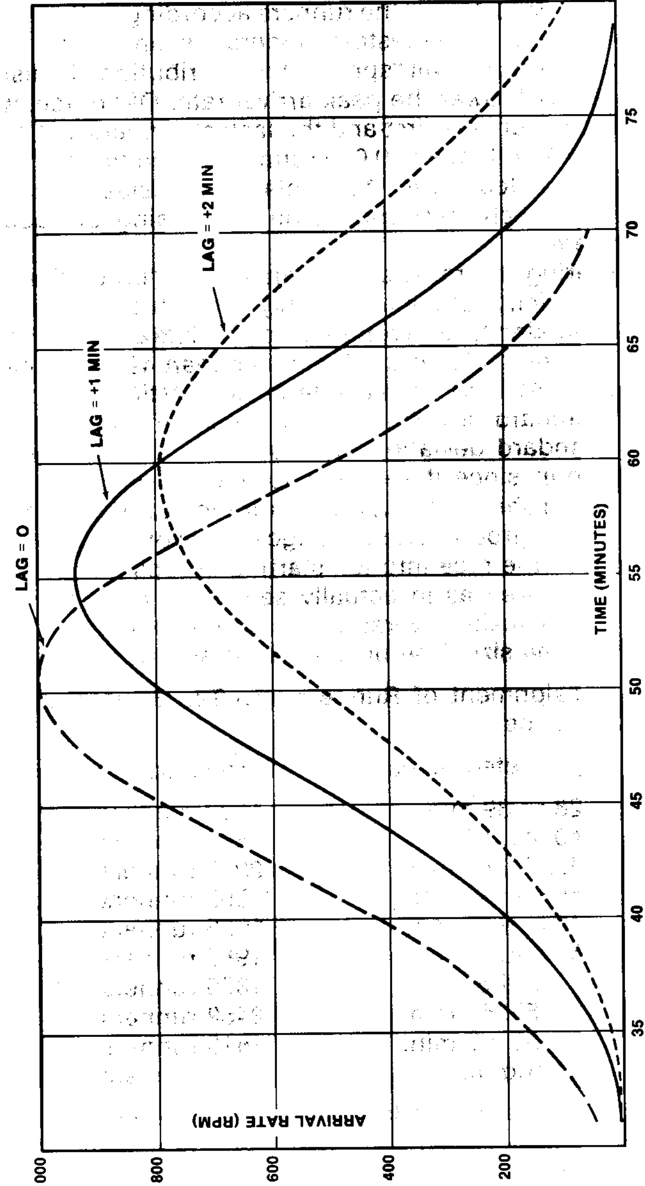


FIGURE 2-2.
Theoretical distributions of finishers for a randomly assigned wave start with ten equal-sized starting groups.
A lag of zero represents a single start; a lag of one minute represents one minute gaps between starts; a two minute lag represents two minute gaps between starts.

the effort, PROVIDED it is done right. For comparison, a time lag of negative one minute (slowest first, fastest last) produces a peak arrival rate in excess of 1800 rpm!

There are better ways still! Remember that the AREA under the curve remains constant. For a given time lag, the lowest peak arrival rate would result if the arrival rate went from zero to the peak value immediately and remained there until the last finisher crosses. This means if we use LARGER groups for the first and last groups which normally have lower arrival rates anyway and SMALLER groups near the peak, we can "flatten" the distribution while keeping the overall time lag constant. Likewise, we can vary the time between starts, for example, leaving two minutes between large groups and only one minute between smaller groups.

With the constraints on assigning runners to starting groups as above, consider an example with unequal-sized starting groups. In addition, assume a two minute gap between each of the first and last four starting groups and a one minute gap between the others. The first and last groups are the largest, as shown in Table V.

TABLE V. Assignment of Runners into Unequal-Sized Seeded Groups (a "better-yet" method).

group	predicted times	group size
I	28 to 42 min.	3485 runners
(2 min.)		
II	43 and 44 min.	1432 runners
(2 min.)		
III	45 and 46 min.	1701 runners
(2 min.)		
IV	47 min.	928 runners
V	48 min.	967 runners
VI	49 min.	989 runners
VII	50 min.	996 runners
VIII	51 min.	989 runners
IX	52 min.	967 runners
X	53 min.	928 runners
(2 min.)		
XI	54 and 55 min.	1701 runners
(2 min.)		
XII	56 and 57 min.	1432 runners
(2 min.)		
XIII	58 min. and greater	3485 runners

As shown in Figure 4, the reduction in peak arrival rate is substantial. Whereas the one minute lag with ten equal-sized groups allowed a peak finish rate of 661 rpm, the "better-yet" method allows a peak finish rate of 498 rpm! The fluctuations in the calculated arrival rate result from separating the groups seeded by time. The

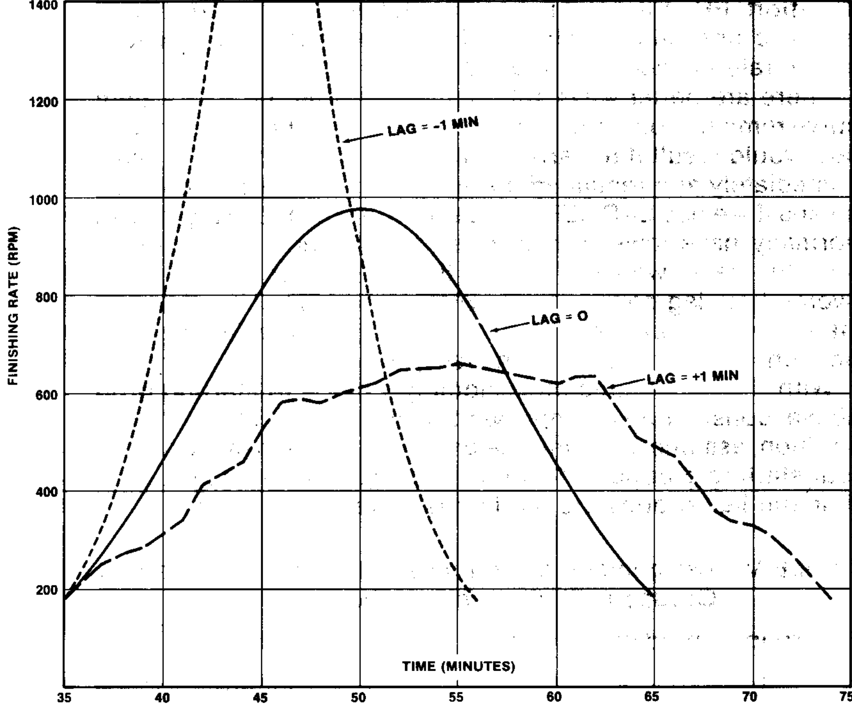


FIGURE 2-3.

Theoretical distributions of finishers for a seeded wave start with ten starting groups.

Table IV shows the group sizes and seeded times. A lag of "+1" represents seeding fastest first and slowest last with one minute gaps between groups. A lag of "-1" represents seeding slowest first and fastest last with one minute gaps.

distribution is "stretched" only at certain points rather than uniformly. Figure 4 also suggests that the first and last groups could be started with a smaller gap, i.e., one can "fine-tune" the wave start by trying various combinations of group size and number and starting time gaps between the groups.

As part of the design of a finish system, the wave start needs to be considered for mega-races. Simply having a wave start is NOT going to solve all the problems. A poorly designed wave start will create more problems than it solves. A properly designed wave start can substantially lessen the peak load on the finish line system. The wave start does need to be TAILORED to the particular situation.

Due to the potential for cheating inherent in the wave start by "advancing" one's starting position and thereby "running" a faster time, ALL potential age record breakers and age groups award winners should start in the FIRST group. In the above example, men over 65 and under 8, and women over 55 and under 8 would start in the first group. This would add very few runners to that group while protecting any records that may be set AND makes your awards search faster and more reliable (cheat-proof).

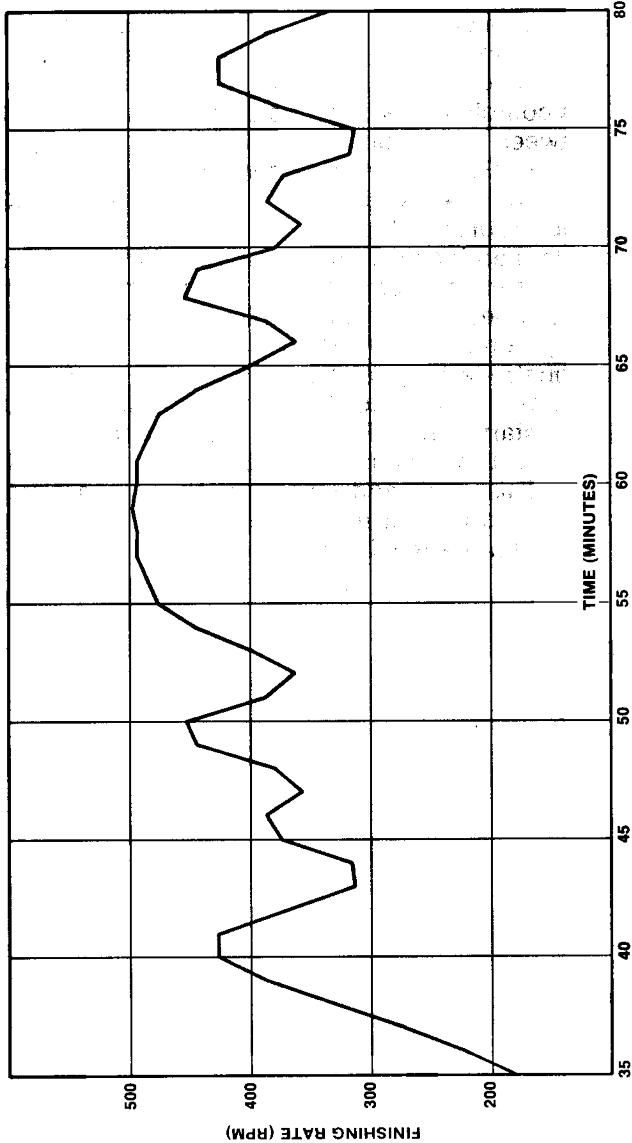


FIGURE 2-4.
Theoretical distribution of finishers for a "better method yet" approach.
Groups of unequal size and different gaps in starting times are chosen to minimize the peak finishing rate. Table V gives groups sizes and starting times.

FINISH LINE SUB-SYSTEMS

Any finish line system consists of parts or "sub-systems" which are intended to provide specific types of information. Except for very small races, it is not possible to simply ask each finisher his or her name as each finishes. The timing function is usually separate from the "recording of runners" function. In practice, the time/place sequence obtained from a printing timer located at the finish line is matched with a place/bib-number sequence obtained in the processing chutes. The two lists are kept synchronized by means of "selected" times which tie particular runners to known finish times, i.e., a (partial) list of times/bib-numbers.

Each sub-system will be evaluated in terms of the numbers of personnel and equipment required, the reliability and robustness of the sub-system, and the time required to process a single runner. Reliability refers to the reliability of the information that is recorded, at the time it is recorded. Robustness refers to the likelihood that recorded information will survive normal processing and normal (to be expected) mishaps, e.g., dropping cards or tags.

Each sub-system is described as a "single entity" which may be, and, for large races, often is replicated. For example, the manual recording system for a single processing chute is described and assigned a processing rate of 20 to 30 rpm. If you have four processing chutes for a given finish line and are processing runners through each chute simultaneously, the over-all processing rate is four times than for a single sub-system, i.e., 80 rpm to 120 rpm.

Time versus Bib-Number or Name

Small races usually can record the desired time/runner sequence directly. If the race is REALLY small, as each runner finishes, his/her time can be recorded and if the recorder does not recognize the runner, there is sufficient time to ask the finisher what his/her name is and record it before the next finisher arrives. This method is useful up to peak finishing rates of 5 rpm.

As the race size increases, use of bib-numbers (aka competitor numbers) speeds up the process and allows all small races to be handled in this manner. In such cases, finish chutes are not required although they are advised and the electronic timing device is used to provide split times for each finisher in addition to the "running" time recorded manually. For such races, you may wish to employ a very short finish chute to help sort out clumps of runners. The use of bib-numbers extends this method of directly recording times and runners to peak finishing rates of up to 15 rpm.

For races larger than this, the time/bib-number system is reduced to "select" timing. "Select" timing is also known as "random" timing or "check" timing, among others. Here we will refer to the process of "selecting" and timing certain runners from the stream of finishers as "select timing." In most cases, select timing is used to insure that the two primary lists of time/place and place/bib-number remain synchronized.

In some cases, select timing is the ONLY timing mode and all runners not "selected" for timing receive "interpolated" times. If this "select timing only" system is employed, it is MANDATORY that "real," i.e., known times, be differentiated or distinguished from "interpolated" times. For record purposes, only real times are valid. If a runner is assigned an interpolated time, the time for record purposes will be the NEXT SLOWER real time! If real and interpolated times are not distinguished, any record will be disallowed.

NOTE that when bib-numbers are used, they MUST be affixed to the FRONT of the runner. Your race flyer/entry blank should state "Wear your number on your front."

Manual Select Timing.

Personnel:	one required, two recommended
Equipment:	stop watch, clip board, pens, paper
Reliability:	very good to excellent
Robustness:	excellent
Process Rate:	6 to 12 runners per minute
Date Reduction:	easy, manual copying as needed

Manual select timing is MANDATORY for all races of any size in order for non-winning times to be considered for record purposes. ALL races should employ manual select timing!

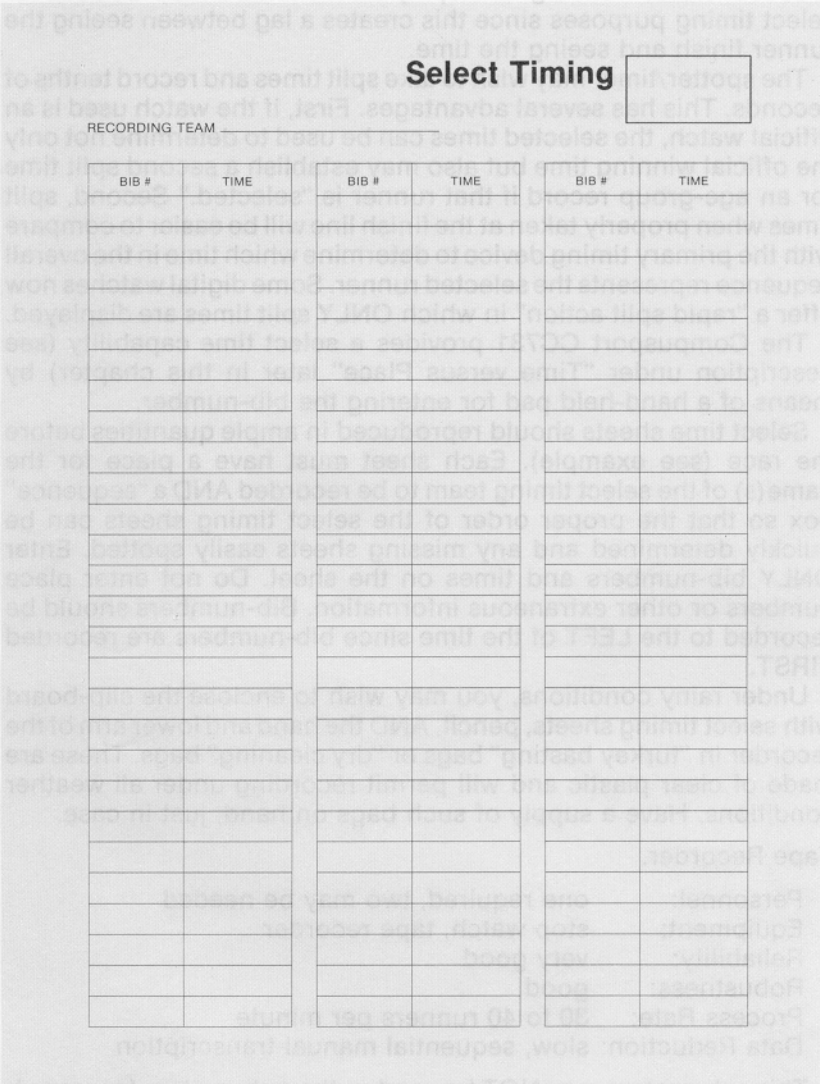
The preferred manual select timing team consists of two persons, one to select and time the incoming runner; the other to record bib-numbers and times as called by the spotter.

The select timing team must be placed at the finish LINE with a clear view of on-coming runners. The select timing team is VITAL to the reliability of the final race results. DO NOT pull them from their position, REGARDLESS of whatever other disasters may be occurring.

Select timers should focus on individual finishers or the lead finishers in a pack. The spotter selects an on-coming runner and reads aloud the bib-number to be recorded. DON'T select people without numbers or with partially visible numbers UNLESS you are selecting EVERY finisher. A time without a matching runner name or number has little value. Quality is more important than quantity.

Select timers can usually time most if not all of the early finishers. As the finishing rate increases, it is important to concentrate on getting a limited amount of GOOD data rather than trying to select time most of the finishers and ending up with a lot of poor data.

As the selected runner crosses the finish, the spotter reads the runner's time to be recorded. If the watch used by the spotter has inaccurate times, i.e., either not started at the start or checked against other watches, the value of the select timing is reduced. If



Select Timing

RECORDING TEAM ____________________

BIB #	TIME	BIB #	TIME	BIB #	TIME

FIGURE 3-1.
Example of "Select Timing" form, used to verify proper matching of runners and times.

the select timing team is not at the finish line, the selected times will differ from those recorded at the finish and their value will be reduced. Times from digital display clocks should NOT be used for select timing purposes since this creates a lag between seeing the runner finish and seeing the time.

The spotter/timer may wish to take split times and record tenths of seconds. This has several advantages. First, if the watch used is an official watch, the selected times can be used to determine not only the official winning time but also may establish a second split time for an age-group record if that runner is "selected." Second, split times when properly taken at the finish line will be easier to compare with the primary timing device to determine which time in the overall sequence represents the selected runner. Some digital watches now offer a "rapid split action" in which ONLY split times are displayed.

The Compusport CC731 provides a select time capability (see description under "Time versus Place" later in this chapter) by means of a hand-held pad for entering the bib-number.

Select time sheets should reproduced in ample quantities before the race (see example). Each sheet must have a place for the name(s) of the select timing team to be recorded AND a "sequence" box so that the proper order of the select timing sheets can be quickly determined and any missing sheets easily spotted. Enter ONLY bib-numbers and times on the sheet. Do not enter place numbers or other extraneous information. Bib-numbers should be recorded to the LEFT of the time since bib-numbers are recorded FIRST.

Under rainy conditions, you may wish to enclose the clip-board with select timing sheets, pencil, AND the hand and lower arm of the recorder in "turkey basting" bags or "dry cleaning" bags. These are made of clear plastic and will permit recording under all weather conditions. Have a supply of such bags on hand, just in case.

Tape Recorder.

Personnel:	one required, two may be needed
Equipment:	stop watch, tape recorder
Reliability:	very good
Robustness:	good
Process Rate:	30 to 40 runners per minute
Data Reduction:	slow, sequential manual transcription

This sub-system may NOT be used as the only system for recording times and places. It should ONLY be used as a back-up system.

This method of recording runners' times is capable of handling a higher density of runners than the manual select timing and is often used on the course to provide enroute information, e.g. to verify that a given runner did indeed pass thru a given check point, such as a turn-around point.

The final product is a verbal record of runners' bib-numbers, times and often comments that may prove useful later in assessing problems. One way of "overlaying" the times on the bib-number sequence is to have a second person calling times at set intervals, such as 5 or 10 seconds, while the first person is reading bib-numbers into the tape recorder.

Another way is to read times into the tape BEFORE the race ever starts. This may be accomplished using a "stereo casette tape recorder" by reading times into one channel and later reading bib-numbers into the other channel (on the two track tape). At the race, the tape is synchronized with the actual race time clock before the first finisher arrives and bib-numbers are read into the second channel. For example, the first finisher in a 10k race is not expected to arrive before 27 minutes. The day before the race, read times onto the tape, starting at 27 minutes and every 10 seconds thru 65 minutes. At the finish line, prepare to start your tape recorder as close to 27 minutes as possible.

When reading bib-numbers into the tape recorder, you should verbalize EACH DIGIT. For example, #1059 should be read as "one," "zero," "five" and "nine."

This system is used to best advantage to provide a runner sequence check at the head of the chutes, particularly if you are recording runner sequence at the ENDS of the chutes.

There are several disadvantages to this system. The information recorded on the tape must be transcribed. This is not only a time consuming process but is also generally not readily available at the race site for other purposes.

Background noise may render much of the information recorded irretrievable. Unfortunately, this is not realized until after the race is finished. Make sure you start with fresh batteries.

Video-Tape Recorder.

Personnel:	one required, two may be needed
Equipment:	video-tape recorder
Reliability:	good to very good
Robustness:	very good
Process Rate:	30 to 100 runners per minute
Data Reduction:	very slow, sequential manual transcription

This sub-system may NOT be used as the only system for recording times and places. It should ONLY be used as a back-up system.

The best feature of video-tape recorders is that a continuous visual record of the finish adequate to resolve virtually any finish place dispute is provided. The disadvantages are that it is somewhat expensive and does require experienced personnel and planning. This makes video-taping suitable for large and mega-races or races that have sizeable budgets.

Although video-taping the finish is very useful even without time reference points, you will find that being able to reference the video sequence with the proper time is exceedingly valuable. Some video-cameras are available with built-in clocks that can be set to the race time clock. More often, the video-camera is set up so that a digital display clock is in the picture to provide the time reference.

Proper placement of the video-camera determines its ultimate usefulness. Most persons suggest elevating the camera, above and behind the finish line so that a view looking down toward the approaching runners is available. One should attempt to keep the camera close enough to the runners so that bib-numbers are readable, when visible. A tripod or some stabilizing platform makes viewing easier.

Not all runners will be able to be identified by bib-number using this method. It SHOULD NOT be used in lieu of a finish chute to determine runner placement. AT low finishing rates, a majority of bib-numbers will be visible. Some will be partially or completely hidden by clothing, arms and hands, or other runners. For races with higher finishing rates, this becomes more of a problem. When finishing rates exceed 100 runners per minute, you will be fortunate to identify more than 20% of the finishers by bib-number.

Video-taping is rarely used to provide a complete time/runner sequence. Its principal advantage is in resolving questions regarding proper finish order, back-up select timing and in verifying particular performances such as age group records.

An alternate to a video-camera is a standard camera. One camera that also provides times encoded on the film negative is the Minolta X-700 with the Quartz Data Back system. The operation and use of the standard camera is very similar to that for the video-camera.

Video methods used at the finish are one of the few methods available to identify a runner other than by his/her bib-number. All too often, one runner uses another's bib-number. Many times this is unintentional; sometimes the runner simply decides to run a race for which entries have already closed and "borrows" a bib-number from a legitimate entrant who will not be running.

Make sure you start with fresh batteries and especially for long races, try to have an auxiliary power source.

Direct Computer Entry.

Personnel:	one required, two recommended
Equipment:	computer, stable power source, power cables
Reliability:	very good
Robustness:	good
Process Rate:	6 to 12 runners per minute
Data Reduction:	very fast, computer compatible

No finish line should depend solely on a computer for ANY link in the finish system. Such systems should be used ONLY to complement the recommended manual systems.

There are several ways computers can be used at finish lines and there are a wide variety of computers that can be used. Using a computer to provide time/bib-number sequences is a secondary use in large or mega-races since the computer usually is employed to record place/bib-number sequences.

Direct computer entry requires a means of keying in an approaching runner's bib-number and then signalling the computer when that runner crosses the finish line. Clearly, the computer must have an internal clock which can be "zeroed" or "referenced" to the race starting time. The computer then matches the bib-number against a file of name, age/sex and bib-number information for each entrant to produce finish line and award results.

For large races, a partial list of time/bib-numbers may be fed directly to the main computer where the "selected" times are incorporated into the data stream of time/place and place/bib-number so that the final list of times for each runner is properly synchronized.

In small races, where it is feasible to "select" all finishers, direct computer entry is gaining adherents. It has the advantage of producing "instant" race results. It should NEVER be used as the ONLY timing/recording system.

Time versus Place

Most small races are capable of recording bib-numbers and matching times for all finishers. Hence, a list of time/places is not needed although useful to provide a check to assure times have been properly recorded.

For larger races, the time/place sequence is to be compared to a place/bib-number sequence. The naive assumption is that the 232nd time corresponds to the 232nd runner in the chutes. The time/bib-number sequence completes the linkage and insures that the two primary lists remain synchronized.

Tic Sheet Recording.

Personnel:	two required
Equipment:	stop watch, clip board, pens, paper
Reliability:	very good
Robustness:	very good
Process Rate:	30 to 50 runners per minute
Date Reduction:	slow, manual transcription

This time-honored method used for scoring cross-country races is fast disappearing. The most common method is to use prepared sheets listing seconds from 0 to 59 vertically with a one inch space to the right of the time for making "tics" or check marks, hence the name "tic-sheet." Each column represents one minute and each column is headed with a space where the hours and minutes may be entered (see example).

The timer reads a finish time for each finisher (and ONLY times corresponding to finishers). Depending on the finishing rate, the recorder either makes tic marks next to the seconds called for each time read (high finishing rates) or the recorder records bib-numbers in place of a tic mark (low finishing rates). When bib-numbers are recorded, these serve as a "selected" times. You should record bib-numbers whenever possible since these are more useful than tic marks. However, a bib-number or tic mark MUST be recorded for each finisher.

Another method is to write the (sequential) finish PLACE rather than a tic mark. This is generally used with a place stick or place card method of recording runners and the two place sequences should be compared as frequently as time permits. This variation allows a more rapid matching of times with selected runners such as award winners.

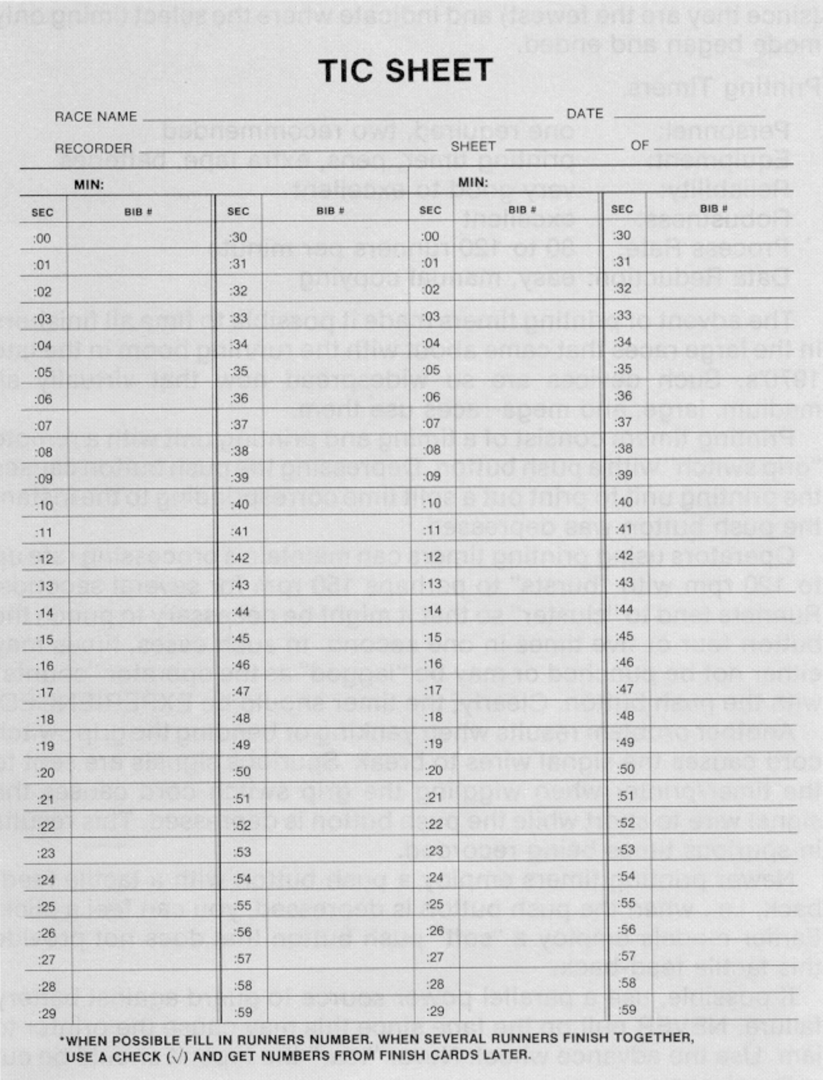
Select Timing Only.

Personnel:	one required, two recommended
Equipment:	stop watch, paper, pens, clip boards
Reliability:	poor to fair
Robustness:	excellent
Process Rate:	6 to 12 timed runners per minute
Date Reduction:	easy, manual copying

This method of timing is often employed for large and mega-races where space or other limitations prevent multiple finish lines or other recommended methods of dealing with large or mega-race finishes. It is NOT recommended since it fails to time the majority of the runners properly. Depending on the frequency of the "selected" times, from 90 to 99% of the runners finishing near the peak finish rate will receive interpolated times.

The select timing only method is used when the finishing rate exceeds the processing rate for the primary timing system. Such races start by timing all finishers, usually with a printing timer capable of finishing rates up to 120 rpm. The select timing also commences with the first finisher and continues throughout the race. As the finishing rate approaches "saturation" for the primary timing system, the primary timing system is either ignored or it is used in a "select timing" mode to supplement the regular select timing team. Once the finishing rate has decreased to acceptable rates after the peak, the primary timing system once again is used to time all finishers.

Interpolated times are not valid for record-keeping purposes. In such cases where a runner betters an existing record, the NEXT SLOWER "real" time is taken for the record. The distribution of runner's times between the actual or "real" times is not known. Thus, it is MANDATORY in such cases to distinguish "real" from "interpolated" times. The easiest way is to "flag" the real times in the results



TIC SHEET

RACE NAME ______________________ DATE __________

RECORDER ______________ SHEET ________ OF ________

MIN:				MIN:			
SEC	BIB #	SEC	BIB #	SEC	BIB #	SEC	BIB #
:00		:30		:00		:30	
:01		:31		:01		:31	
:02		:32		:02		:32	
:03		:33		:03		:33	
:04		:34		:04		:34	
:05		:35		:05		:35	
:06		:36		:06		:36	
:07		:37		:07		:37	
:08		:38		:08		:38	
:09		:39		:09		:39	
:10		:40		:10		:40	
:11		:41		:11		:41	
:12		:42		:12		:42	
:13		:43		:13		:43	
:14		:44		:14		:44	
:15		:45		:15		:45	
:16		:46		:16		:46	
:17		:47		:17		:47	
:18		:48		:18		:48	
:19		:49		:19		:49	
:20		:50		:20		:50	
:21		:51		:21		:51	
:22		:52		:22		:52	
:23		:53		:23		:53	
:24		:54		:24		:54	
:25		:55		:25		:55	
:26		:56		:26		:56	
:27		:57		:27		:57	
:28		:58		:28		:58	
:29		:59		:29		:59	

*WHEN POSSIBLE FILL IN RUNNERS NUMBER. WHEN SEVERAL RUNNERS FINISH TOGETHER, USE A CHECK (√) AND GET NUMBERS FROM FINISH CARDS LATER.

FIGURE 3-2.
Example of "Tic Timing" form, used to obtain times for all finishers manually.

(since they are the fewest) and indicate where the select timing only mode began and ended.

Printing Timers.

Personnel:	one required, two recommended
Equipment:	printing timer, pens, extra tape, batteries
Reliability:	very good to excellent
Robustness:	excellent
Process Rate:	80 to 120 runners per minute
Data Reduction:	easy, manual copying

The advent of printing timers made it possible to time all finishers in the large races that came about with the running boom in the late 1970's. Such devices are so widespread now that virtually all medium, large, and mega-races use them.

Printing timers consist of a timing and printing unit with a remote "grip switch" with a push button. Depressing the push button causes the printing unit to print out a split time corresponding to the instant the push button was depressed.

Operators using printing timers can maintain a processing rate up to 120 rpm with "bursts" to perhaps 150 rpm for several seconds. Runners tend to "cluster" so that it might be necessary to punch the button four or five times in one second. In such cases, times may either not be punched or may be "lagged" as the operator "counts" with the push button. Clearly, the timer should be EXPERIENCED.

Another problem results when yanking or bending the grip switch cord causes the signal wires to break. Spurious signals are sent to the timer/printer when wiggling the grip switch cord causes the signal wire to short while the push button is depressed. This results in spurious times being recorded.

Newer printing timers employ a push button with a tactile feed-back, i.e., when the push button is depressed, you can feel a click. Earlier models employ a "soft" push button that does not provide this tactile feed-back.

If possible, use a parallel power source to guard against battery failure. NEVER pull on the tape since this may cause the printer to jam. Use the advance wheel. Never "tear" the tape; it should be cut with scissors.

Most printing timers are sensitive to shock. They should be placed on a sturdy platform and kept isolated from crowds of runners trying to read their times.

Chronomix CC707. This is an economy printing timer. It is used for single finish line systems with times input from one hand-held push-button. Two CC707's can handle two finish lines. If you have three CC707's, use one as a back-up. There is no display of "running time" and the timer can not be pre-set.

When using the CC707 for road races, make sure the middle button on the timer/printer unit is "out." If the middle button is pushed in, the device will print "lap" times, i.e., the elapsed time since the push button was previously depressed. Prior to the race start, do a quick test to make sure the times printed represent cumulative split times and not lap times.

Places and times to tenths of seconds are printed (2 per second) on a special thermal tape. Times may be input up to 5 per second, depending on the skill and experience of the operator. Since times are printed out not faster than 2 per second, additional times are accumulated in a buffer until they can be printed out. If the 400 "times" capacity of the buffer is exceeded, times will be lost.

Problems with the CC707 under rain or high humidity suggest keeping the printer inside a car or van. This does not seem to be a problem with later models.

Chronomix 727 Compusport. This is commonly referred to as a "nine-channel Chronomix" since it provides up to nine separate input channels AND prints the channel number on the special thermal tape in addition to the place and time. The running time is displayed and the timer can be pre-set although if this option is used, the printing timer MUST be synchronized with the official watches. The 727 also has the capability of "driving" a digital display clock.

The 727 printer is still limited to 2 split times per second but the buffer can store up to 2000 split times. The 727 may also be "downloaded" onto a computer system. The most common use of the 9-channel timer is in the "toll-booth" method which uses several finish lines and single processing chutes for each. Note that a power failure means ALL nine channels are down.

Chronomix CC731 Compusport/Seiko Sports Printing Timer. There are two modes of operation of interest in road-racing. The first of these is much like the Chronomix 727 in that it provides up to eight separate channels and can handle up to eight separate finish lines.

The second mode of operation provides two channels PLUS the option of entering selected time/bib-number pairs. The bib-number is followed on the next line by the time as entered by the select timer. The primary timer ALSO enters a time for the same runner since ALL finishers are timed by the primary timer. IF the select timer happens to enter the time SOONER than the primary timer for that same runner, the select time will PRECEDE the primary time. The primary time (the slower of the two) is the CORRECT time to report. If the primary timer is quicker, the selected time is the correct time to report.

The CC731 has the advantage of using plain paper tape which makes the printer more reliable in adverse weather conditions. This feature also permits rapid matching with manual recording sheets when used with that system. The running time is displayed and the timer may be pre-set in which case, it must be synchronized with the official watches. It can also activate the Chronomix digital display clock.

Heuer HL305 Centigraph. Although this desk-top printing timer is no longer manufactured and marketed, quite a few are functional and well-guarded by their advocates. Its advantages include a mechanical plain paper/ink ribbon printer capable of printing four double-spaced times per second and a pre-set function. If using the pre-set function, the HL305 must be synchronized with the official times.

The HL305 uses an external 12V negative ground power supply such as a car battery. Many of its other features are now incorporated in the Chronomix CC731.

Seiko Stop Watch/Printer Model SP-11. This is a combination of a hand-held, digital display stop watch with a printer that can be activated from the stop watch. The special thermal tape is obtained through any Seiko sports distributor. The buffer is minimal which limits use to races where the peak arrival rate is less than the printing rate of roughly 60 rpm. One roll of the printer tape can handle from 300 to 600 finishers which limits the size of the race the SP-11 can handle. This is recommended for races with less than 500 finishers and for select and split timing.

Direct Computer Entry.

Personnel:	one required, two recommended
Equipment:	computer, power source
Reliability:	very good
Robustness:	very good
Process Rate:	80 to 120 runners per minute
Data Reduction:	very fast, computer compatible

No finish line should depend solely on a computer for ANY link in the finish system. Such systems should be used ONLY to complement the recommended manual systems.

Direct computer entry of finish times is very similar in principle to the printing timers with the advantage that the time/place sequence does not have to be transcribed for computer processing of results. In addition, as long as sufficient space is allocated in memory, times will not be lost due to "overflow."

Many computer systems store times to full seconds only. Some "read" seconds and truncate all fractions. Others start at one second and truncate, thereby effectively meeting the requirements of TAC Rule 37.8. For 5 kilometer road races, it is recommended that times be kept to tenths of seconds, taking all non-zero hundredths up to the next full tenth of a second. Refer to Chapter I for handling automatic truncation, rounding off or rounding up.

Place versus Bib-Number or Name

This is generally the slowest sub-system at the finish line and is the one which determines the overall processing rate. Producing a list of places and bib-numbers requires keeping the runners in finish order until their bib-number has been recorded. The longer the time between the runner crossing the finish line and his/her finish being recorded, the more likely it is that "position-shifting" will occur as runners try to "improve" their finish place. This means that "chute monitors" MUST be employed to maintain finish order prior to recording and "finish judges" to keep runners in the proper order in the deceleration zone.

It is important that all runners who cross the finish line be processed through the chutes. Unofficial runners or interlopers often cross the finish line and exit before being processed. When this occurs, the time/place sequence will not match the place/bib-number sequence. See Chapter IV for details on handling interlopers.

Sub-systems that allow a significant time lag between finishing and processing are down-graded in terms of reliability. Such systems should either be coupled with a second (redundant) place/-runner system such as a tape recorder or bolstered with four or five select timing teams capable of recording more than 30% of all finishers directly. You should design systems to keep chute build-up to a minimum to reduce position shifting and loss of finish sequence. Keeping the runners moving helps maintain the finish sequence.

The first three sub-systems described are "hand-out" systems, i.e., something is handed to the runner and the runner is expected to act upon it. This is better for short races where runners may be more aware of their surroundings. Hand-out systems typically have higher processing rates and consequently less chute build-up with fewer and shorter chutes than "take-from" systems. The last three sub-systems are take-from systems in which the runner is essentially passive.

The philosophy for handling large fields (high finishing rates) is to divide and conquer. Given a single finish line, the "hand-out" systems are not readily amenable to proliferation. The "take-from" systems are more easily multiplied for parallel processing as in the multi-plex system.

The processing rates given are for SINGLE systems. If you "multiply" or "replicate" your system, you multiply your processing rate. For example, if you have three finish chutes processing runners in parallel and the processing rate given for a single system is 30 rpm, your maximum processing rate is 90 rpm.

Place Stick.

Personnel:	two required, three to four recommended
Equipment:	pre-numbered tongue depressers, clip board, pens
Reliability:	good

Robustness: very good
Process Rate: 40 to 60 runners per minute
Data Reduction: very slow, manual recording of verbal information

This system is designed for small races. The real back-up occurs in getting runners to hand in their sticks and get their names recorded. Reliability suffers since not all runners will hand in their sticks. Robustness is very good since runners are "tied" to their place directly.

As each runner finishes, he/she is handed a pre-numbered tongue depresser indicating overall finish position. Care must be taken when processing place sticks that can be misinterpreted by inverting the number, e.g., 86 could be inverted to read 98. Numbers should be written using a laundry marker at one end of the tongue depresser, reading with the blank end of the tongue depresser to the right of the number as properly read.

No more than 10 to 15 place sticks should be held at one time by the person handing them to the runners. A second person should check number sequences and feed place sticks to the person handing out them out as needed. Interlopers (unofficial runners) that cross the finish line should "receive" a place stick, even if the place stick is pocketed by the person handing them out. This helps preserve the time/place/runner matching.

A short chute (5 to 10 meters) may be helpful in sorting bunches of runners to insure that each receives the proper place stick. Once a runner has received a place stick, it is no longer necessary to control the finish order. It is the runner's responsibility to report to a recorder where the place stick is handed in and the relevant information (name, age, sex) is verbally provided and manually recorded. Runners not reporting should be regarded as interlopers and ignored for awards and results.

The processing rate reflects handing out place sticks. Unless another sub-system is also being used in conjunction with the place stick method, the runners waiting to hand in their place sticks can spread out as they please in much the same manner they would await the awards ceremony. This does not contribute to chute build-up since runners could, in principle, hand in their finish stick well after the race is over with and still be properly placed in the final results.

The recording process is slow BUT can be speeded up by using competitor numbers rather than requesting the runner to give name and age, or can be speeded up by utilizing more than one recorder, e.g., places 1-100 report here, places 101-200 report here, etc. In this case, a form of number-blocking or letter-coding is suggested to speed the awards search.

If you have more than 100 runners, you may wish to cordon off an area, requiring runners to pass by check stations where they will be asked to hand in their place sticks. This improves the reliability of the system.

Place Card Only.

Personnel:	two required, three to four recommended
Equipment:	pre-numbered 3x5 cards, lots of pencils
Reliability:	good
Robustness:	very good
Process Rate:	60 to 100 runners per minute
Data Reduction:	slow, manual copying of handwritten information

This system operates much as the place stick system with the exception that the runner receives a place card on which the runner fills out his/her name and age on the place card in the space indicated BEFORE turning in the card. This greatly speeds up recording of runners' names. Place cards should be numbered on BOTH SIDES (see examples).

Using two persons to alternate handing out place cards facilitates the process. For larger races, one person may serve as a "bank," feeding sets of ten fanned cards to two or three workers who hand them out to the finishers. Interlopers that cross the finish line should "receive" a place card, even if the card is pocketed by the person handing them out. This helps preserve the time/place/runner matching.

Pre-printed place cards may either be pre-numbered or un-numbered. The un-numbered cards are convenient for smaller races since the place numbers can be written in using a water-proof marker prior to race day. Suppose you prepare a set of numbered place cards from #1 thru #999 but only use the first 243 for your race. You can "replenish" your stock for your next race by taking un-numbered cards and filling in numbers 1 thru 243. You can also number in different colors if you have two separate finish lines, e.g., men and women, or two distinct races.

Pre-numbered place cards are intended to be used for larger races. If you have more than one finish line or race distance, you will need to have different colored card stock, e.g., white cards for the 10 km race and blue cards for the 5 km race. This is preferred to using two different number sequences to distinguish between finish lines or events since the awards search will start with separating the two sets of place cards. Errors in this initial sorting are easily spotted if you use different color place cards.

COMPLETE THIS CARD AND TAKE TO SCORERS' TABLE,

NAME: ______________________________

SPECIAL CATEGORY, IF ANY: ____________________

AGE:	SEX:	FINISH POSITION
________	MALE: ____ FEMALE: ___	

FINISH LINE CARD PLACED

Bib Number ____________________

Name ______________________________

Club, City ____________________________

Age ________ Male ☐ Female ☐

RUNNER: FILL OUT & TURN IN TO SCORE-KEEPER

FIGURE 3-3.
Examples of "Place Cards," used in "hand-out" recording systems.

Place cards should NOT have a specified place for the runner's time. This may be inadvertently filled in by the runner and may confuse matters later if an erroneous time is entered.

A short chute (5 to 10 meters) may be helpful in sorting bunches of runners to insure that each receives the proper place card. Once a runner has received a place card, it is no longer necessary to control finish order. It is the runner's responsibility to fill out and hand in the place card. You will need tables with plenty of pencils. You should also employ one or two monitors to answer questions ("What do I do with this card?") and to remind runners to fill out the cards. Again, runners who do not turn in their place cards should be regarded as interlopers.

If you have more than 100 runners, you may wish to cordon off an area, requiring runners to pass by check stations where they will be asked to hand in their completed place cards. This improves the reliability of the system.

Place Card/Pull-Tag.

Personnel:	two required, three to four recommended
Equipment:	pre-numbered 3x5 cards
Reliability:	very good
Robustness:	excellent
Process Rate:	60 to 100 runners per minute
Data Reduction:	slow, manual copying

This system is the next step in sophistication for the "hand-out" methods. Now, all the runner is expected to do is to hold onto a place card for a few seconds. The peelable pull-tag which has been affixed to the bib-number at registration is removed by a chute worker and affixed to the place card. The chute worker keeps the place card. The runner is not permitted to exit the chute with a place card. Place cards are the same as used for the place card only system. Pull-tags should be stapled to the bib-number "points-out".

Each runner is handed a pre-numbered place card after crossing the finish line, usually at the HEAD of the chute. Cards should be fanned so that only one card is handed to a given runner. One worker (the "bank") may be assigned to "feed" cards to the person or persons handing out the place cards. No more than 10 to 15 cards should be handled at one time. With practice, two or three persons can alternate handing out the cards, each one doing ten, then stepping back, fanning ten more, and so forth. Again, place cards should be given to all runners that cross the finish line.

Processing chutes may be short (20 meters or less) and somewhat wider in this method since runners within a chute may BE PROCESSED IN PARALLEL. Once a runner has received a place card, it is no longer necessary to control finish order. Place several chute workers in the worker lane to collect tags and cards. A given worker picks the closest unprocessed runner and collects the pull-tag and place card. The worker affixes the pull-tag to the place card and "bags" the card. "Bags" may be open-top boxes conveniently placed for two workers to use or may be "nail aprons" tied around the workers waist.

The "end of chute worker" makes sure cards and tags have been collected from the runners before they exit. Any runner that proceeds this far without being processed, is then processed by the "end of chute" worker. This insures that virtually ALL place cards are collected quickly to speed the awards search and results posting. Runners without pull-tags are instructed to fill-in their name, age and sex on the place card. Interlopers' place cards are simply marked "void."

If you wish to replicate this system by employing two or more processing chutes in order to handle higher finishing rates, EACH processing chute should have its own place card sequence. This may be accomplished by simply grabbing the next set of 100 place cards and using these for the newly opened chute.

If you utilize more than one processing chute for a given finish line, you will need to utilize the "chute opening" and/or "chute closing" methods described for the pull-tag/spindle method. Briefly, a "chute opening" peelable label should be carried by or precede the first runner into a newly opened or reopened chute and a "chute closing" peelable label should be carried by the last runner or follow the last runner as a chute is closed. These labels are then affixed to "place" cards since the actual number printed on the card no longer reflects the true overall finish place anyway.

The need for extra processing chutes is limited since the single chute processing rate is usually close to 80 rpm. The recommended solution is to keep the peak finishing rate to less than 80 rpm on any given finish line and replicate finish lines as in the toll booth method. Each finish line would use different COLOR place cards.

Pull-Tag/Spindle.

Personnel:	one required, four or five recommended
Equipment:	spindles, chute tags, time tags, unofficial runner tags, substitute tags
Reliability:	good to very good
Robustness:	fair to very good
Process Rate:	30 to 40 runners per minute
Data Reduction:	slow, manual copying

This system requires the runner to do little more than remain in place in the chutes and keep moving forward. Pull-tags are removed from runners in their finish order and placed on a spindle to preserve finish order. Note that the individual pull-tags do not have a place or finish order attached. Finish order is determined by relative placement of the pull-tag on the spindle. If pull-tags are not spindled in proper order or if pull-tags slip off the spindle, the finish order is lost.

Likewise, without supplementary checks, spindles may be switched or "inverted", e.g., places may be counted from the wrong end of the spindle.

The main advantage is that the system can be easily replicated for several parallel processing chutes capable of handling much larger races. Another advantage is that it does not require any extra effort on the part of the runner. This is particularly important for long races or races held on hot days.

This system without built-in checks, can be subject to severe problems. It is strongly recommended that most or all of the "safety" features described below, be built into a pull-tag/spindle system. The more safety features you have, the higher the reliability and robustness of your system. Some of the WORST finish line disasters have come from pull-tag/spindle systems. These occur when sufficient supplementary checks are not used and/or the personnel are not trained properly in this method. AVOID DISASTERS! Remember Murphy's Law.

Several types of spindles are available. The best spindle is the "spring-top" spindle which automatically "locks" tags on the spindle. It does require some effort to remove them which is a safety feature. By inserting the "spring" end thru the "loop," you can carry the spindle plus tags conveniently.

Spindles may also be made from coat hanger wire by bending them to form a rectangle roughly 10cm x 25cm (4"x10") with the long open side extending beyond the rectangle and the short open side bent into a short hook like a safety pin. This serves two purposes. First, the "front" end is obvious and the likelihood of reversing place order within the spindle is greatly reduced. Second, by "closing" the spindle when you are done placing pull-tags on it, you reduce the chances of tags coming off the spindle.

Another type of "spindle" is the fish line stringer (available at most sporting goods stores). This consists of a flexible length of braided nylon with a ring on one end and a metal tip on the other. Again, the front end is obvious. The metal end of the stringer can be looped and tied through the ring, thereby "locking" the stringer against losing tags.

If more than one processing chute is used for a given finish line, you will need to use chute tags to identify the spindle sequence. Usually, one spindle is used for a single batch of runners in a given chute. Since the suggested methods for switching chutes and identifying the switching order are the same for any multiple processing chute (multi-plex) system without regard to the particular subsystem used, the discussion of chute operation in the following chapter should be referred to.

The chute tag illustrated has a place for the approximate time of the first finisher in that chute. This serves as an additional check of both the chute number AND the matching of runners and times. In

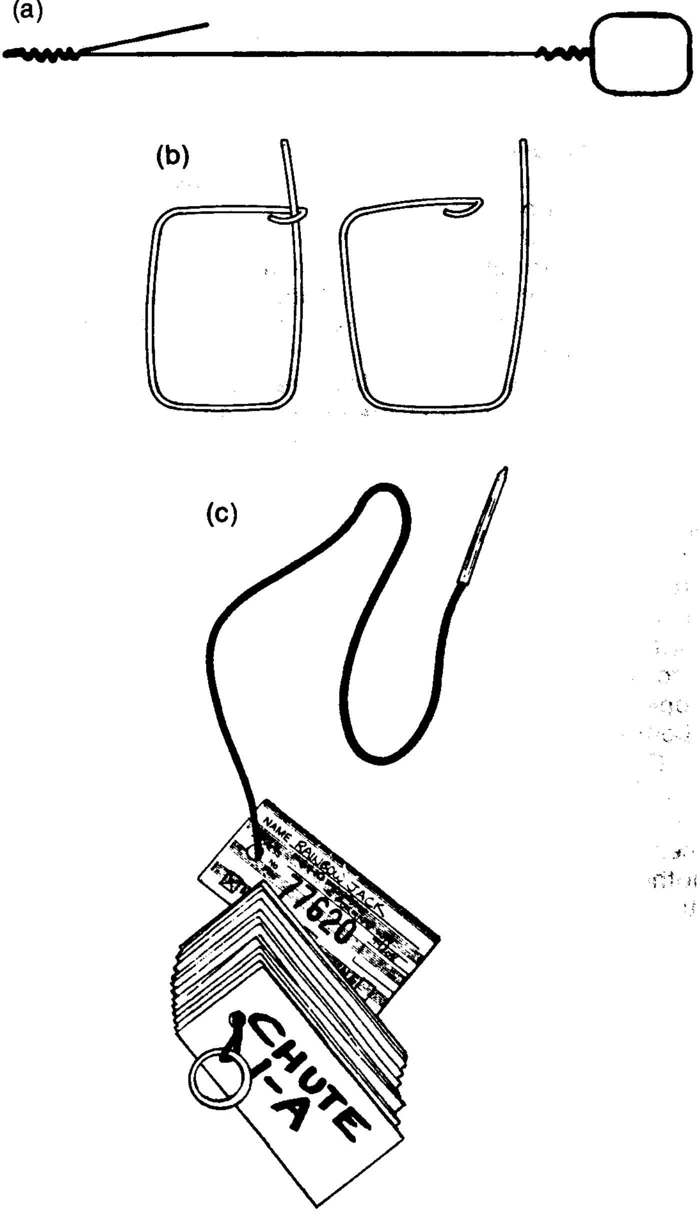


FIGURE 3-4.
Examples of "Spindles," for collecting pull-tags.
(a) is a "spring-top" spindle; (b) is a "coat-hanger" spindle; (c) is a "fish line" stringer.

addition to a person responsible for opening and closing chutes, a second person is responsible for the chute tags.

Chute tags are handled in one of two ways. If you have a limited number of personnel, the chute tag may be handed to the FIRST runner entering the newly opened chute who then gives it to the pull-tag collector at the end of the chute. With more people available, you can use workers to carry the chute tag instead of a competitor who might just throw your chute tag away.

Some systems employ both chute opening and chute closing tags. Chute closing tags work in the same way that chute opening tags do. They also provide redundancy to make sure separate chute sequences within the same physical chute are KEPT separate.

Time tags should also be used to keep spindles in their proper order and provide preliminary times for your awards ceremony. Time tags are pre-printed and have times hand-written on the tag, every ten seconds to twenty seconds, e.g., 35:20, 35:30, 35:40, etc. The first runner finishing AFTER 35:20, is handed the 35:20 time tag. That time tag is spindled just ahead of that runner's pull-tag. By making the time tags a different size or different color from the pull-tags, they will stand out for ready identification.

If you are using time tags every ten seconds, it is recommended that two workers be used with ALTERNATING series of time tags, e.g., one worker has time tags 35:00, 35:20, 35:40, etc. on one hoop; the second worker has time tags 35:10, 35:30, 35:50, etc. on the other hoop.

Time tags are NOT an adequate substitute for manual select timing. You should ALWAYS employ manual select timing. Time tags are intended to provide quick estimates of times for runners ON RACE DAY.

Another "safety" procedure is for a chute worker with a waterproof marker to mark a sequence number within that chute on the pull-tag while the runners are awaiting processing in the chute. This can help catch errors such as reversed "batches" of pull-tags which may fit in between time cards.

Runners without bib-numbers and/or pull-tags need to be accounted for in order to help preserve the runner/time matching. The "interloper" tag for non-registered runners is placed on the spindle when a numberless and unregistered runner is encountered.

If a numberless runner is encountered who claims to be registered, a "substitute" tag should be used. The example shown is perforated so that a "fill-in" portion can be handed to the runner to be filled out and handed in later. The remaining section is spindled to preserve finish order. If the tag puller has to fill out a blank tag before spindling, the process rate is greatly reduced, something to be avoided. If interloper and substitute tags are not used, properly matching runners and times is very difficult.

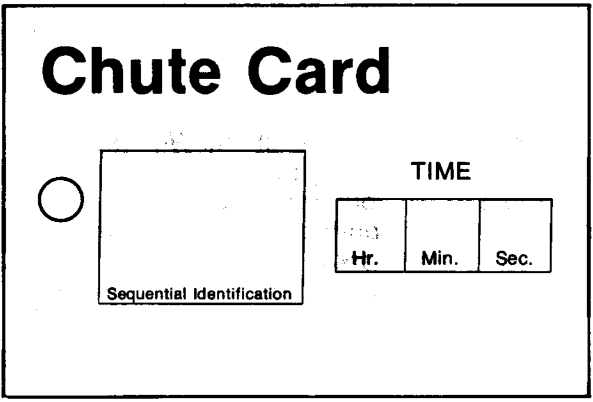


FIGURE 3-5.
Example of a "Chute Tag" or a "Chute Card."
These are used to "open" or "close" processing chutes in multi-plex systems.

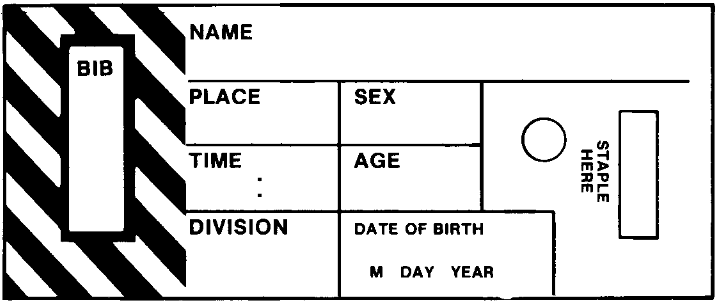


FIGURE 3-6.
Example of a "Pull-Tag," to be spindled.
Note bib-number information as well as name/age/sex information is included. Tag is also color-coded.

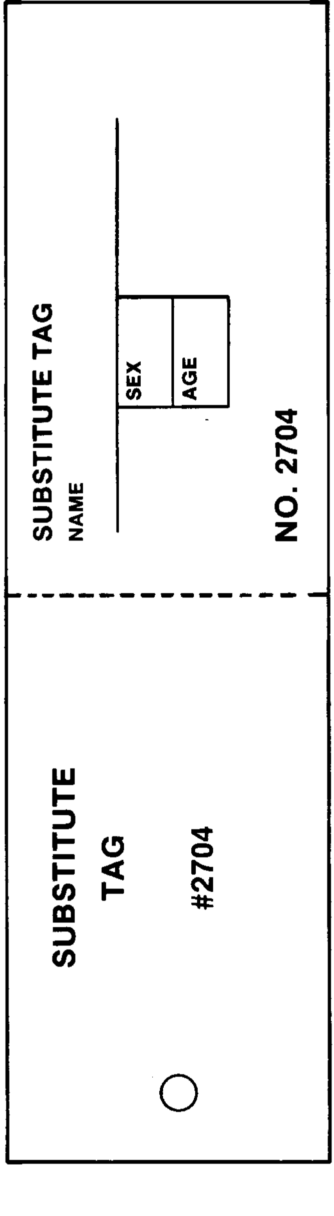


FIGURE 3-7.
Example of a "Substitute Tag."
This tag is used in the pull-tag/spindle system for registered runners who have lost their pull-tag. Note the perforation allows half of the tag to be spindled while the remainder is filled out by the runner and handed in later.

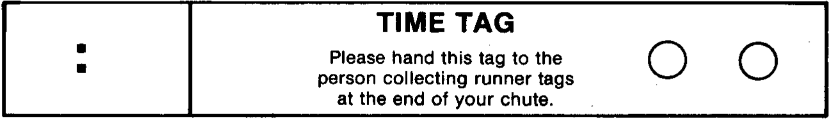


FIGURE 3-8.
Example of a "Time-Tag," which is spindled in the finisher pull-tag sequence to give approximate finish times.

FIGURE 3-9.
Example of an "Interloper Tag."
This tag is used in the pull-tag/spindle system to identify unregistered runners and to preserve proper time/place/bib-number order.

The person assigned to be the tag-puller needs to be well briefed and experienced. Tags should be pulled and spindled INDIVIDUALLY. NEVER gather two or more tags before placing them on the spindle. It is very easy to reverse order. This is a ONE PERSON operation. You should NEVER have two persons collecting and spindling pull-tags for a given processing chute. One person may be assigned to guide and hold the runners while their pull-tag is collected by the collector.

You should NEVER use boards for posting places (place boards) to preserve pull-tag finish order in this type of system. That may work fine with place card/pull-tags since each pull-tag has already been "tied" to its place. In the pull-tag/spindle system however, this is not true. The ONLY record of finish order is the sequential placement of pull-tags. This must be preserved, otherwise you have nothing. Do not take unnecessary risks. You may "fan" the pull-tags and use masking tape on the reverse side to hold them in position WHILE STILL ON THE SPINDLE. These then may be "posted" for viewing on race day.

Manual Recording.

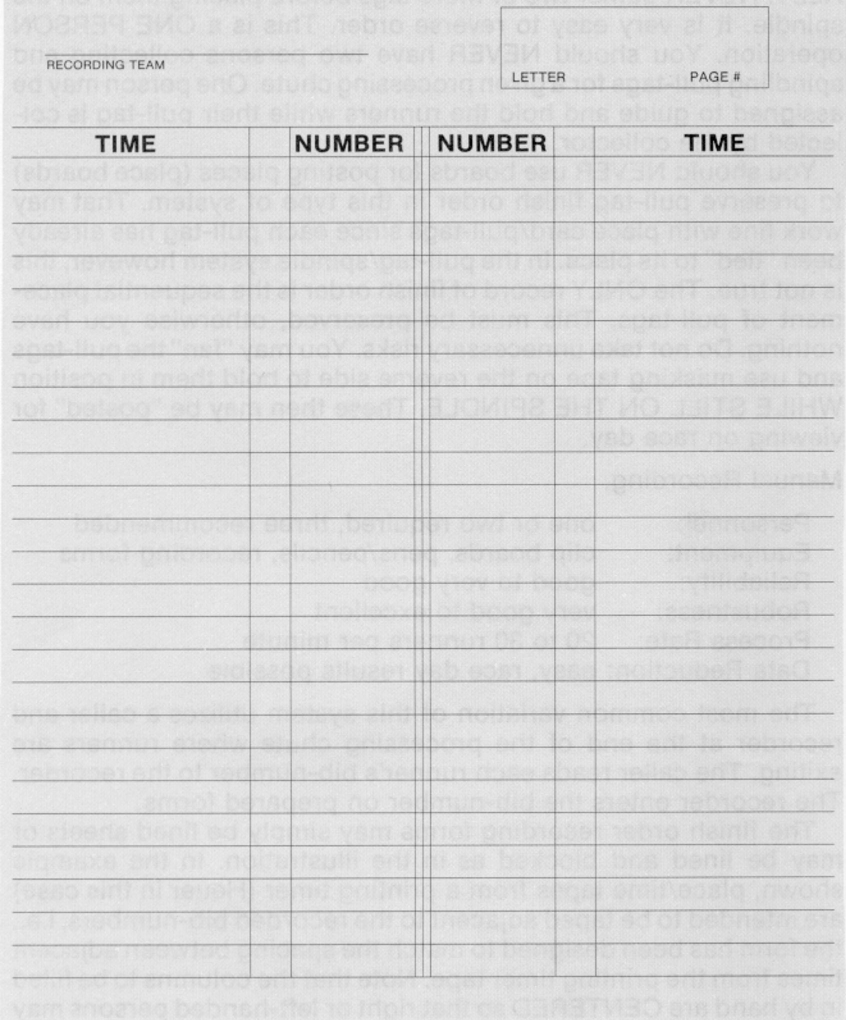
Personnel:	one or two required, three recommended
Equipment:	clip boards, pens/pencils, recording forms
Reliability:	good to very good
Robustness:	very good to excellent
Process Rate:	20 to 30 runners per minute
Data Reduction:	easy, race day results possible

The most common variation of this system utilizes a caller and recorder at the end of the processing chute where runners are exiting. The caller reads each runner's bib-number to the recorder. The recorder enters the bib-number on prepared forms.

The finish order recording forms may simply be lined sheets or may be lined and blocked as in the illustration. In the example shown, place/time tapes from a printing timer (Heuer in this case) are intended to be taped adjacent to the recorded bib-numbers, i.e., the form has been designed to match the spacing between adjacent times from the printing timer tape. Note that the columns to be filled in by hand are CENTERED so that right or left-handed persons may rest their hand on the clip board while writing. An example of such a recording sheet with matching printing timer tapes is shown.

The caller should stand IN the processing chute, controlling the flow of runners out of the chute. The caller will read aloud the bib-number (and letter code if present). The caller should verbalize each digit, e.g., #659 should be read as "six," "five," and "nine," rather than as "six hundred fifty nine."

When more than one processing chute is used, it is necessary to use chute cards as described in the pull-tag/spindle system. A chute card is used to identify each "batch" of runners, i.e., those runners

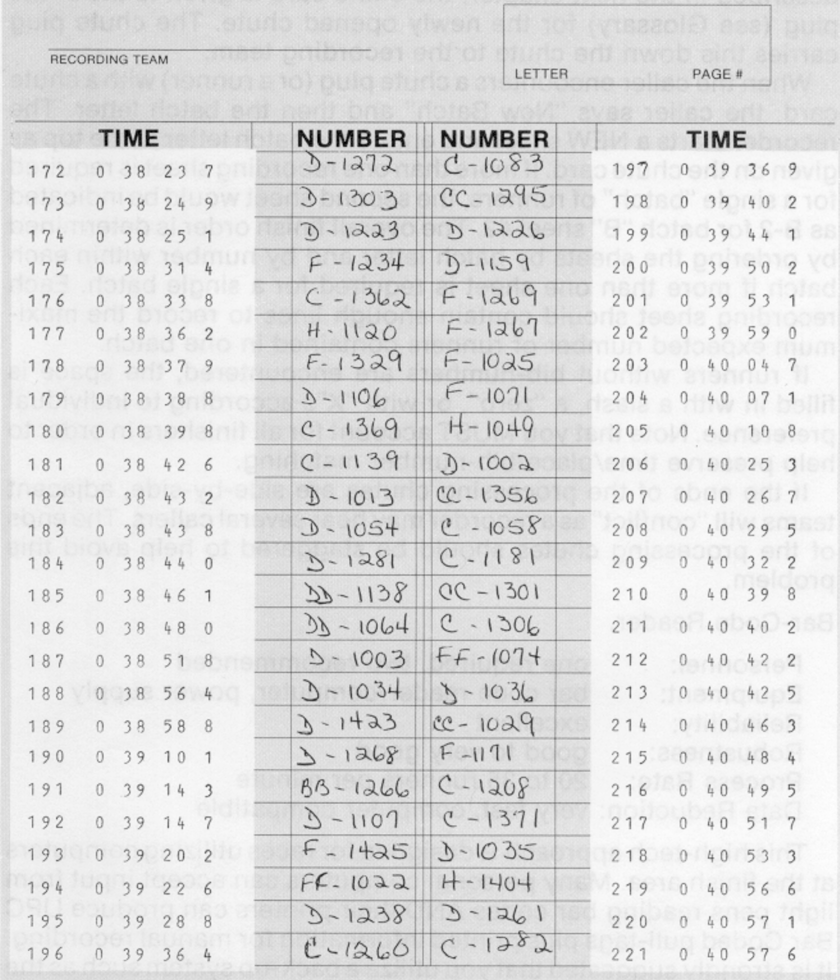


RECORDING TEAM

LETTER | PAGE #

TIME		NUMBER	NUMBER		TIME

FIGURE 3-10.
Example of a bib-number recording form for use with a manual recording system.
The columns allotted to "times" are for placing place/time tapes from a printing timer.



RECORDING TEAM

LETTER PAGE #

TIME		NUMBER	NUMBER	TIME	
172	0 38 23 7	D-1272	C-1083	197	0 39 36 9
173	0 38 24 9	D-1303	CC-1295	198	0 39 40 2
174	0 38 25 1	D-1223	D-1226	199	0 39 44 1
175	0 38 31 4	F-1234	D-1159	200	0 39 50 2
176	0 38 33 8	C-1362	F-1269	201	0 39 53 1
177	0 38 36 2	H-1120	F-1267	202	0 39 59 0
178	0 38 37 9	F-1329	F-1025	203	0 40 04 7
179	0 38 38 8	D-1106	F-1071	204	0 40 07 1
180	0 38 39 8	C-1369	H-1049	205	0 40 10 8
181	0 38 42 6	C-1139	D-1002	206	0 40 25 3
182	0 38 43 2	D-1013	CC-1356	207	0 40 26 7
183	0 38 43 8	D-1054	C-1058	208	0 40 29 5
184	0 38 44 0	D-1281	C-1181	209	0 40 32 2
185	0 38 46 1	DD-1138	CC-1301	210	0 40 39 8
186	0 38 48 0	DD-1064	C-1306	211	0 40 40 2
187	0 38 51 8	D-1003	FF-1074	212	0 40 42 2
188	0 38 56 4	D-1034	D-1036	213	0 40 42 5
189	0 38 58 8	D-1423	CC-1029	214	0 40 46 3
190	0 39 10 1	D-1268	F-1171	215	0 40 48 4
191	0 39 14 3	BB-1266	C-1208	216	0 40 49 5
192	0 39 14 7	D-1107	C-1371	217	0 40 51 7
193	0 39 20 2	F-1425	D-1035	218	0 40 53 3
194	0 39 22 6	FF-1022	H-1404	219	0 40 56 6
195	0 39 28 8	D-1238	D-1261	220	0 40 57 1
196	0 39 36 4	C-1260	C-1282	221	0 40 57 6

FIGURE 3-11.
Completed sheet used for manual recording with Heuer place/time tapes in place.
Note the use of "letter-coding" to identify age groups.

who finish between one "switch" and the next. Each batch should be identified by a LETTER which is written on the chute card. As described in the next chapter, the chute card is given to the chute plug (see Glossary) for the newly opened chute. The chute plug carries this down the chute to the recording team.

When the caller encounters a chute plug (or a runner) with a chute card, the caller says "New Batch" and then the batch letter. The recorder starts a NEW sheet and enters the batch letter at the top as given on the chute card. If more than one recording sheet is required for a single "batch" of runners, the second sheet would be indicated as B-2 for batch "B" sheet #2. The overall finish order is determined by ordering the sheets by batch letter and by number within each batch if more than one sheet is required for a single batch. Each recording sheet should contain enough lines to record the maximum expected number of runners contained in one batch.

If runners without bib-numbers are encountered, the space is filled in with a slash, a "zero", or with "X"s according to individual preference. Note that you MUST account for all finishers in order to help preserve time/place/bib-number matching.

If the ends of the processing chutes are side-by-side, adjacent teams will "conflict" as a recorder may hear several callers. The ends of the processing chutes should be staggered to help avoid this problem.

Bar-Code Reader.

Personnel:	one required, two recommended
Equipment:	bar code reader/computer, power supply
Reliability:	excellent
Robustness:	good to very good
Process Rate:	20 to 35 runners per minute
Data Reduction:	very fast, computer compatible

This high-tech approach is designed for races utilizing computers at the finish area. Many personal computers can accept input from light pens reading bar codes AND their printers can produce UPC Bar Coded pull-tags plus printed information for manual recording. It is strongly suggested that you utilize a back-up system such as the place card/pull-tag in case of computer failure. If the pull-tag can carry the bar code AND be peelable, the advantages in processing time from the place card system can enhance the computer compatible recording AND still provide a back-up if the computer/bar code system fails to function.

Two cautions should be noted. DO NOT attempt to read bar codes directly pinned to the runner. The bar code information should be REMOVED from the runner before attempting to read it. To preserve finish order, collected bar codes may be skewered on a spindle as in the pull-tag/skewer system OR gathered on a place card as in the place card/pull-tag system.

Avoid high ambient light levels, i.e., out-of-doors. Most finish areas have enough light to confuse the bar code reader, slowing if not stopping the recording process. Best results are obtained when batches or strings of bar codes are carried indoors where they are read.

DESIGN OF THE FINISH LINE SYSTEM

The keys to managing the finish line are reliability and redundancy. Murphy's Law is ALWAYS operative; if something can go wrong, it WILL go wrong.

Redundancy not only improves the overall reliability of your finish line system but can improve versatility as well. For example, manually recording bib-numbers at the exit of each finish chute can provide "on-site" results and a faster award search than the place card/pull-tag system but the latter is less subject to recording error and position shifting in the chutes and may be preferred for final race result preparation.

Before designing a finish line system, the race director needs to determine the expected number of finishers and the expected peak finishing rate. Next, the race director needs to determine the personnel and equipment available. At this point the race director may wish to hire a finish line group or contact the local TAC or RRCA club for help. If so, he/she will have learned enough to evaluate any such proposals to see if they really know what they are doing!

Finish line systems are made up of three basic types of sub-systems. Each of these sub-systems is described in detail in the preceding section. Unless you have a VERY small race, you will need a time/place sub-system (usually a printing timer), a time/bib-number sub-system (select timing), and a place/bib-number sub-system (such as the pull-tag/spindle method).

The physical layout of a finish line system consists of the pre-finish area (as runners approach the finish line), the finish line itself, the deceleration zone just past the finish line where the runners slow down, and the processing chutes where the runners are processed. The time/place and time/bib-number systems are located AT the finish line. The place/bib-number system is located in the processing chute zone. Judges and monitors are needed in the deceleration zone to PRESERVE FINISH ORDER as runners are channeled into the processing chutes (one processing chute per finish line at one time). Preserving order is easiest when the finishing rate on a finish line is relatively low.

Toll-Booth versus Multi-Plex Systems

There are two approaches to finish line design. One approach is the "toll-booth" approach in which a large number of separate finish lines are used, each having only a single processing chute. This is similar to a toll road with a toll-booth for each lane of traffic. The approaching runner is directed to choose the least congested finish line which "spreads" the arrivals out fairly evenly.

This form of processing runners is called "parallel" processing as contrasted to "sequential" processing in which ALL runners would be required to cross the SAME finish line.

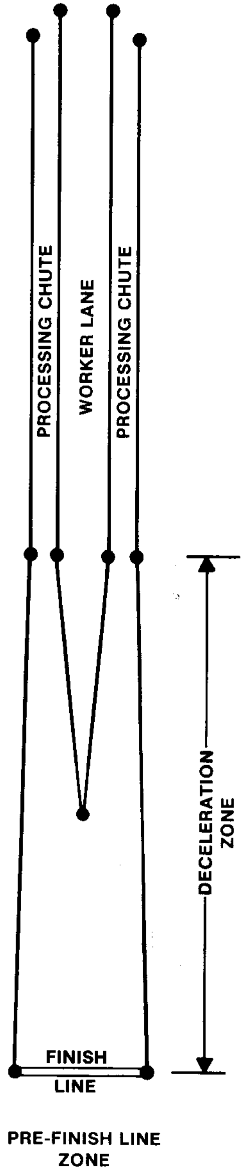


FIGURE 4-1.
Basic Layout of Finish Area.
Solid circles indicate stanchions; solid lines indicate fixed (non-moveable) ropes. Deceleration zone should be about 20 meters long. The finish line must be at least two meters long but not more than 10 meters long. Processing chutes should be one meter wide.

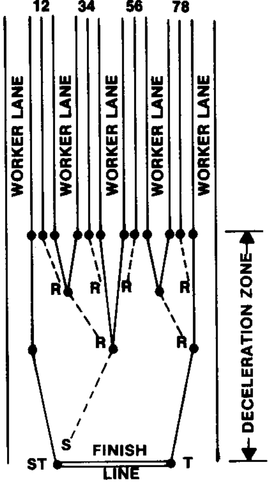


FIGURE 4-2.
Example of Multi-Plex Finish System with Eight Processing Chutes. Dashed lines represent moveable ropes. "S" identifies the switching rope handler; "R" identifies secondary rope handlers; "T" and "ST" represent the primary timer(s) and select time teams respectively.

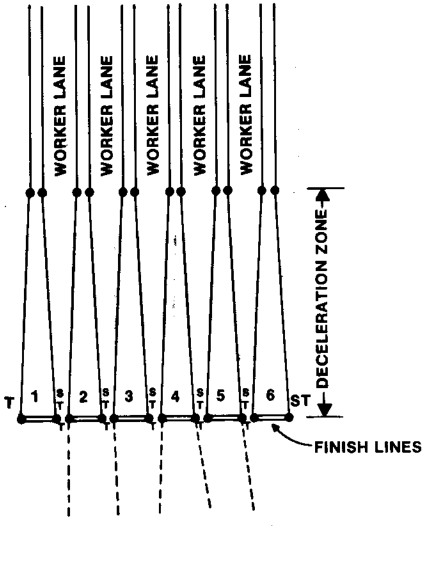


FIGURE 4-3.
Example of Toll-Booth Finish System with Six Finish Lines. Dashed lines represent moveable ropes. "R" identifies the modulating rope handlers, "T" and "ST" represent the primary timers and select time teams respectively.

The toll-booth method usually is carried out using a multi-channel Chronomix although the method can be carried out using several separate single or dual channel printing timers. The advantages of the method are that peak arrival rates are low for any given finish line which permits select timing a greater fraction of the runners (better error control) and reduces problems keeping the runners in order after they cross the finish line.

The multi-plex system employs fewer separate finish lines but uses several processing chutes for each finish line. A typical multi-plex design for a large race may employ three finish lines with 4 or 6 processing chutes for each finish line.

The multi-plex system is usually operated with a single finish line or with separate finish lines for men and women. In this mode, a sequential finish order is readily available on race day for posting of results. The multi-plex system may be operated using any type of printing timer and does not require a multi-channel timer. The multi-plex system does involve switching the flow of runners from one processing chute to another. The frequency of switching may approach three or four switches per minute.

Most multi-plex systems work with "pairs" of processing chutes (see diagrams). The smallest number of processing chutes recommended for a multi-plex system is two. If one processing chute "breaks down" for whatever reason, there is still a functioning chute and the finish line can remain open. Note that in the multi-plex system, processing chutes can process runners in PARALLEL although chutes must be filled in SEQUENCE.

With a toll-booth system, closing a single finish line is no problem. Toll-booth systems usually operate with a single finish line open until the arrival rate dictates opening more (all) finish lines. Toward the end of the race, all but one finish line will be closed. This practice simplifies the awards search.

Combining Sub-Systems

Putting together the sub-systems to create an overall finish line system is somewhat like a Chinese menu, one from group A, one from Group B and one from Group C. In this case, two groups represent the legs of the ladder and the select timing represents the rungs. By completing the ladder, the matching of runners and times can be kept synchronized so that each runner is assigned the proper time.

If you choose a "weak" sub-system, you should employ a second sub-system from that same group for redundancy and to provide a back-up in case your first choice system fails. Certain sub-systems are quite amenable to "doubling-up," e.g., using two printing timers at the finish line, each producing a list of times/places. If one fails, you still have a good time/place sequence.

The Pre-Finish Line Area

Leading into the finish line for large races, you should have crowd control barricades to prevent spectators from interfering with the runners. Cones and/or ropes are NOT EFFECTIVE for controlling spectators. Snow fencing is good. Steel riot-control fencing which comes in interlocking sections is very good. These may be obtained (borrowed) from local authorities.

If you employ separate finish lines for men and women, you will need to split the flow well ahead of the finish line. As runners approach the finish line, course monitors and signs can be used to direct women runners to one side and men runners to the other. Another 50 to 100 meters further along, use cones to separate the flow again with signs and course monitors. Cones will allow runners to cross-over to the correct side. Snow-fencing or ropes may be used within 50 meters of the finish to keep the finishers separate.

If you employ separate finish lines which do not segregate the runners, e.g., two finish lines for men, separation of the stream of finishers should occur just prior to the finish line. This may be accomplished simply by allowing incoming runners to see which finish lines are less crowded and choose the least crowded finish line.

Runners tend to "follow-the-leader" which means some finish lines will be under utilized and others will be over-crowded. A good method to reduce this problem is to use "modulating" ropes in the pre-finish area. A modulating rope is different from a "switching" rope in that a modulating rope is NOT intended to CLOSE a finish line (or chute) in normal operation.

Each barrier separating one finish line from another should have a modulating rope 10 to 20 meters in length attached. The handler for a given modulating rope should keep the rope fairly taut and nearly perpendicular to the line of the finish. If the handler sees that one of the adjacent finish lines is noticeably less utilized than the other, he/she should take one side-step TOWARD the more heavily utilized finish line. This effectively reduces the flow in the more constricted approach zone and increases it in the less constricted zone. You may wish to position a "captain" to help co-ordinate the overall flow by directing the modulating rope handlers.

An overhead display may be created using construction scaffolding which can be rented in sections and assembled as needed. Finish line banners, advertising, and/or digital display clocks may be placed over the finish line. This serves as a visual finish for approaching runners. Few things are worse than not knowing where the finish line is. Runners may get upset if they stop or slow after crossing what they thought was the finish only to have someone else pass them.

Such scaffolding at the finish line creates protected areas where timers may be stationed. Timers MUST be located AT the finish line. NOT in front of the finish line and NOT behind the finish line BUT RIGHT ON THE FINISH LINE. Elevated stair-step placement is another preferred method for seating of timers so they can view the finish line unobstructed. Your timers should be protected from crowds and other distractions. Without them, you have no times.

MARK THE FINISH LINE CLEARLY ON THE GROUND.

The Finish Line

Definition of the Finish Line

The finish line MUST be clearly marked. TAC Rule 64 states that the finish line is to be a line drawn across the surface from finish post to finish post. For the purposes of aiding the judges (in the case of close finishes), a string or thread may be strung across the finish BUT this is not to be considered the finish line. The "true" finish line is the leading edge of the marked line on the ground, i.e., that part of the marked finish line first encountered by the finishing runners.

The best finish line is one that is painted on the road surface. Often, local officials become perturbed by this practice. Yellow lumber crayons are excellent for making the finish line, EVEN WHEN THE ROAD IS WET! You may wish to "tape" the finish line with athletic tape or masking tape. Unless the surface is fairly clean, these may not stick too well. You may also "chalk" the finish line using the lime and marker used for marking the course.

Another alternative is "Spray Chalk" which is a chalk which sprays on like paint but can be hosed off after a race. It will stand up to hard rains so you won't lose the line for a race. Boards or masking tape can be used to define the line, spraying in between to obtain a good edge.

It is important that the finish line be well-defined. This is the line to be used for all timing and is the line to be used for judging close finishes. If the line wiggles or is poorly defined (or non-existent), judging close finishes is difficult. When $5,000 is riding on the difference between a first place finish and a second place finish, you better do it right!

The finish line MUST be at least 2 meters long and may be up to 10 meters long. If the finish line is too wide, your timers will have difficulty focusing on the finishers and it will be difficult to judge close finishes and maintain the correct finish sequence. If it is too narrow, sprinting finishers may collide with each other or with your finish line personnel.

Judging Close Finishes

The finish line marked on the ground is the guide for the finish judges. Judges should be cognizant of the rules for judging the finish (see TAC Rule 34) and placed AT the finish line, preferably judges on each end of the finish line.

If prize money is involved, setting up an Accutrack system is highly recommended. Accutrack is used in major track meets to provide fully automatic timing and relies on still photography. In road racing, the sole purpose of this system is to judge close finishes objectively. This eliminates many potential problems and is worth the extra effort.

The height and positioning of the tower required for the Accutrack camera is dictated by the site parameters and the Accutrack operator. A pole opposite the tower (at the other end of the finish line) is used to "judge" the relative position of the runners as they cross the finish line. A finish tape MAY NOT be deployed at the finish line although you may have a finish tape a one-half meter BEHIND the finish line. Officials and workers MUST be excluded from the area one-half meter on either side of the finish line while the system is being used.

The Deceleration Zone.

There should be a "deceleration" zone between the finish line and the opening of the chutes. This zone is usually triangular in shape tapering down from the width of the finish line to the width of the processing chutes. In multi-plex systems, all switching occurs in the deceleration zone.

The zone is often defined by moveable ropes, particularly in the multi-plex system. These moveable ropes MUST NOT extend beyond the finish line into the pre-finish area. If this occurs, an overlap may occur in your finish order since not all runners are finishing at the same speed. If your switching rope extends into the pre-finish area, the judge of position for runners near the switch point is at the lead end of the switching rope rather than at the finish line itself. If the switching rope does not extend to the finish line, the switch is less reliable, again due to runner overlap.

The deceleration zone should be AT LEAST 10 meters long and may be as long as 30 meters. The length of the deceleration zone depends on the length of your race since the finishing speed in a 5 kilometer race will be much greater than in a marathon and a longer deceleration zone will be needed.

Processing chutes should NEVER extend to the finish line. Only the boundaries between adjacent finishing areas may extend to the finish line and it is REQUIRED that finish area boundaries DO extend to the finish line.

Single Chute Operation.

When a single finish chute handles all the runners, you need to erect "buffer" zones between the chute and the spectators. This buffer zone or worker lane is to allow the various chute workers space to perform their varied functions without interference. It also discourages runners from "jumping" out of the finish chutes and leaving gaps in your finish order. Unofficial runners or "interlopers," often think they are doing you a favor by leaving before they are recorded (i.e., caught). However, they have already messed you up by crossing the finish and having their time recorded. Jumping out of the chute compounds the problem.

Multiple Chute Operation.

When a given finish line feeds two or more chutes, runners must be "switched" from one chute to another as each chute fills. This is necessary in order to preserve finish order. If runners are allowed to choose a chute, i.e., runners are free to enter two or more chutes as they please, finish order is NOT preserved and the results are meaningless in terms of times and records.

Multiple chute systems are usually set up in PAIRS of chutes. This allows a systematic switching from side to side using a "switching" rope. If the peak finishing rate is less than 30 rpm, you can direct runners adequately without a switching rope; if the peak finishing rate is greater than 60 rpm, you should use a switching rope to maintain proper finish order. The switching rope MUST switch at or just after the finish line is encountered by the runners.

Two Chute Operation

Required personnel:

one chute captain who can double as the chute card director
one switching rope handler
two chute plugs
four to six deceleration zone workers/judges

Switches between the two chutes are accomplished using a switching rope which should be strong enough to withstand constant tension. Pennants or surveyor's flagging may be used to improve the rope's visibility. Thick braided rope may be too heavy for quick switching.

The switching rope should be attached to the forward stanchion so as to create two deceleration zones (right and left) leading into each chute. This design is facilitated by placing a worker lane between the two processing chutes. The worker lane may serve a variety of functions in addition to normal monitoring and processing of runners, e.g., medical, press, photographers, etc.

The worker lane tapers from a width of 1.5 meters or more to a single stanchion in the deceleration zone, half-way to the finish line. The switching rope is attached to this head stanchion which must be STURDY. This creates two fixed deceleration zones. By switching from one side to the other, time to remove a "downed" runner may be gained without interrupting the flow of finishing runners.

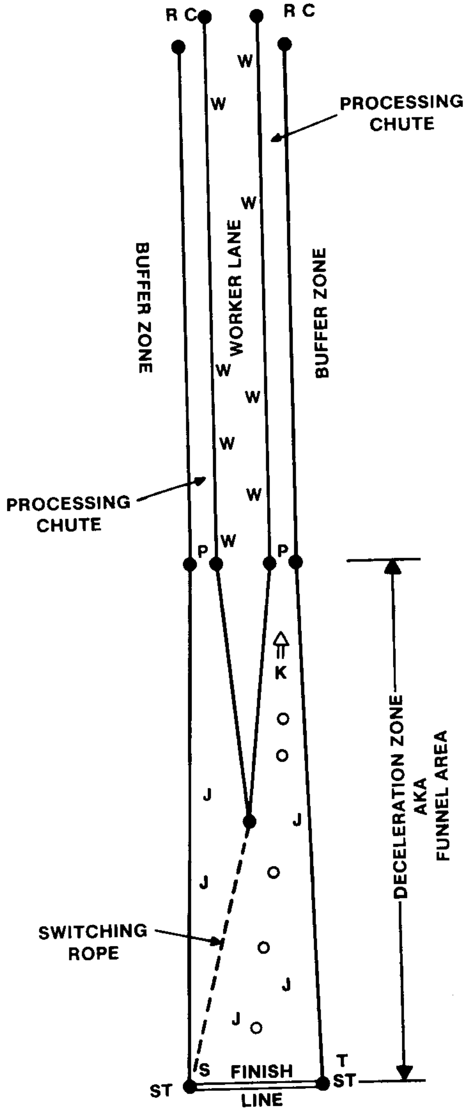


FIGURE 4-4.
Example of Two Chute Operation in Multi-Plex System.
Open circles represent runners. "S" is the switching rope handler; "J" identifies finish position judges/ workers; "K" is the finish line captain; "P" are chute plugs; "W" are chute workers; "RC" identifies recorders or collectors. Double arrows represent movement of workers.

The recommended order of operation is as follows:

(1) As the first runner approaches the finish, the switching rope is held taut (the rope should NEVER touch the ground while in operation) and to one side, completely blocking entrance on one side. This channels runners to the open processing chute.

(2) When the flow of runners at the end of the chute is about to stop, or after a pre-determined number of runners has entered the chute, the switching rope handler looks for a break in the flow of runners and makes the switch.

(3) The chute captain directs (leads) the first runner in the next "batch" to the entrance of the desired processing chute. The captain gives the first chute open card (tag) to the chute plug who then leads the runner to the end of the chute. The chute plug hands the chute open card to the recording team and returns to the head of the chute.

The switches must be quick and decisive. You can't have runners simultaneously entering BOTH deceleration zones. The switching rope handler must carefully monitor BOTH the flow of incoming runners and the flow of runners through the processing chutes. Too infrequent switching will "stuff" your processing chutes and cause runners to stop. This MUST be avoided.

Note that the chute open cards separate batches of runners so that a new batch can be started down a processing chute WHILE the last of an earlier batch is still being recorded. The chute plug occupies a "place" in the processing chute to insure that the chute open card is recorded. If you rely on a runner to perform this task, you may lose the separation between batches which means you WILL lose your finish order sequence.

For improved reliability when using finishers to carry chute open tags, you should also use "chute closing" tags which would be carried by the LAST runner in a batch. If both tags are reliably spindled, each batch will be separated by TWO tags, a chute closing tag followed by a chute open tag. If either is missing, the remaining one still serves the intended purpose. The likelihood that both are lost for the same switch is very small.

Four Chute Operation

Required personnel:

- one chute captain who can double as the chute card director
- one switching rope handler
- two secondary rope handlers (optional)
- four chute plugs
- four to six deceleration zone workers/judges

The four chute operation utilizes the same basic principles as described for the two chute operation. Now there are two chutes at the end of each deceleration zone rather than one. Each chute entrance is manned by a chute plug who may serve to "close" or "open" the chute. This function may also be accomplished using secondary ropes which serve to create four possible deceleration zones, one side of each being moveable.

The recommended order of operation is as follows (refer to the four chute diagram):

(1) The lead runner is directed to Chute #2. Note that inside chutes are used first to permit a straighter path for the fastest runners. The chute captain gives the chute open card to chute plug #2 who leads the runner to the end of the chute.

(2) Workers in the deceleration zone help direct the flow of runners to the open chute as the chute captain returns to the deceleration zone and prepares for the next switch.

(3) To make the next switch, the switching rope handler calls the switch. The chute captain leads the switch runner to Chute #3 and gives the chute open card to chute plug #3.

(4) Chute plug #3 takes the chute open card from the chute captain and leads the runner to the end of the chute where the chute open card is recorded (or spindled).

(5) While runners are channeled into Chute #3, the chute captain directs the secondary rope handler between Chutes #1 and #2 to close Chute #2 thereby opening Chute #1. Note that this switch is done IN THE ABSENCE of runners finishing.

(6) On the next switch, runners are directed left to Chute #1 (since Chute #2 is closed by a secondary rope). At this time, the secondary rope handler between Chutes #3 and #4 closes off Chute #3, AGAIN in the absence of oncoming finishers.

(7) The chute sequence 2-3-1-4 is repeated as needed. Towards the end of the race, you may wish to revert back to a 2-3-2-3 switching by tying off the secondary ropes to the outside of the deceleration zone. At the very end, you should return to a single processing chute.

Having a pre-established sequence for switching chutes helps guard against chute sequence mix-ups in case chute open cards are not properly recorded. This is not to say that this order must always be followed. The chute captain may see problems on one processing chute and skip that chute until the problem is solved.

Six Chute Operation

Required personnel:

one chute captain
one chute card director
one switching rope handler
four secondary rope handlers
six chute plugs
four to six deceleration zone workers/judges

Now there are three processing chutes on each "side" of the

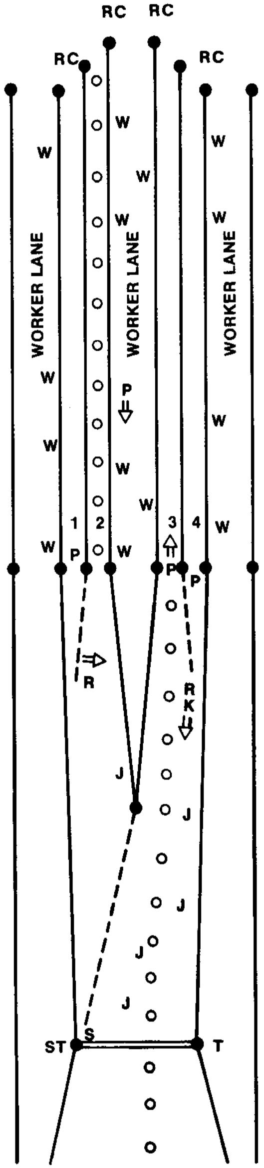


FIGURE 4-5.
Example of Four Chute Operation.
Codes as in Fig. 4 with the addition of "R" for moveable rope handlers. Note that rope handler between chutes 1 and 2 is preparing for the next switch, chute plug 3 is leading runners down the processing chute while chute plug 2 is returning to position. Recommended chute sequence is 2-3-1-4 and repeat.

central worker lane. The functions of chute captain and chute card director are now handled by two people. The chute captain makes sure the secondary rope handlers open and close the appropriate chutes and guides the lead runner in each batch to the proper chute. The chute card director should not give the chute plug a chute open card UNTIL runners have actually been directed to that chute.

The three side-by-side chutes (on each side of the worker lane) are EACH separated by a secondary rope, i.e., two secondary ropes on each half for a total of four secondary ropes. Switching runners is STILL accomplished by the switching rope (left-right-left-right). All secondary rope changes are done in the absence of finishing runners. Secondary rope changes open chutes from the inside to the outside. The chute opening sequence is then 3-4-2-5-1-6 and repeat.

Note that most switches require only two rope movements. The switching rope ALWAYS switches. Only one secondary rope moves at a time unless changing from chute #1 back to chute #3.

Eight Chute Operation

Required personnel:

one chute captain
two chute card directors
one switching rope handler
two secondary rope handlers
four tertiary rope handlers (2/2/2 system)
eight chute plugs
four to six deceleration zone workers/judges

There are two possible ways to design an eight chute operation. The two level system breaks in half with four chutes on each side (2/4 system). The three level system breaks in half and in half again to produce 4 sets of twin chutes at the tertiary level (2/2/2 system).

In the two level (2/4) system, the switching rope separates chutes 1-2-3-4 from 5-6-7-8. The secondary ropes A and B separate chutes 1-2- from 3-4 AND chutes 5-6 from 7-8 respectively. The adjacent chute pair opening/closing operations are accomplished with chute plugs and do not require ropes.

Utilizing all the basic chute opening, switching and closing operations discussed earlier, the recommended sequence of chute openings is as follows:

(1) Chute #4 is the first chute to be used. The switching rope blocks chutes 5-8. Secondary rope A blocks chutes 1-2; secondary rope B blocks chutes 7-8. Chute plugs block chutes 3 and 6.

(2) Chute #5 is the next chute to be used. The switching rope moves to block chutes 1-4. While chutes 1-4 are blocked, secondary rope A moves to block chutes 3-4. Chute 1 is blocked by a chute plug.

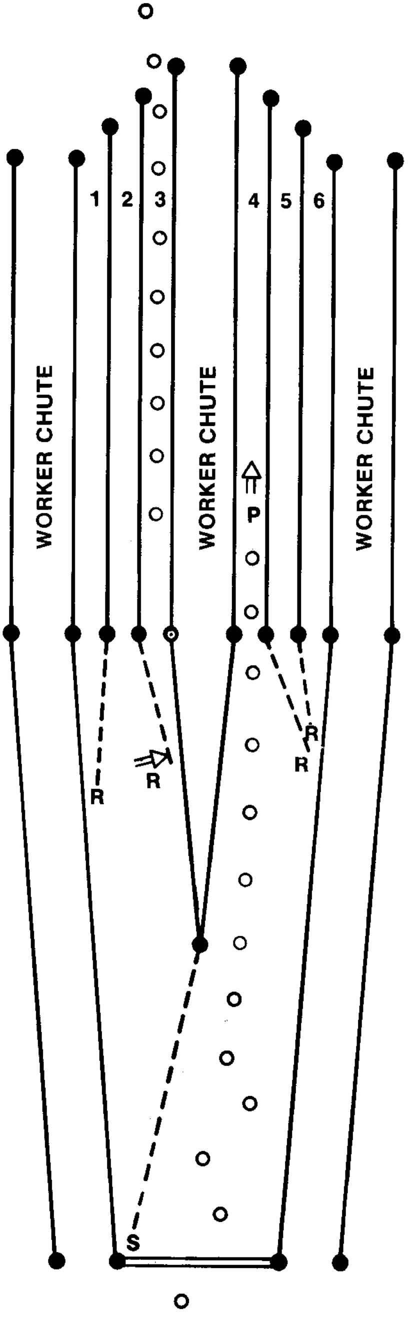


FIGURE 4-6.
Example of Six Chute Operation.
Codes as for Figs. 4 and 5. Rope handler between chutes 2 and 3 is preparing for next switch, closing off chute 3 which is still processing runners. Recommended chute sequence is 3-4-2-5-1-6 and repeat.

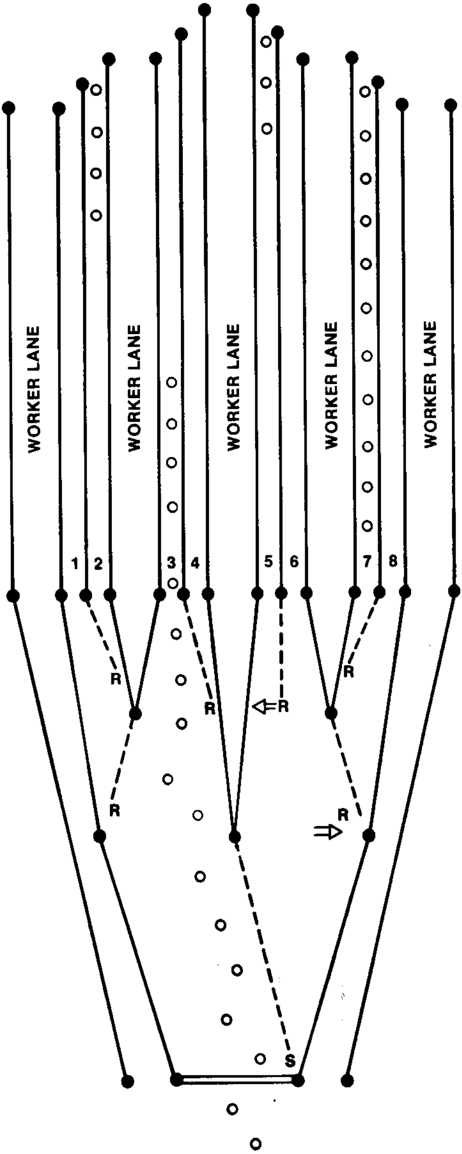


FIGURE 4-7.
Example of Eight Chute Operation.
This represents the 2/2/2 structure with secondary and tertiary rope handlers. Recommended chute sequence is 4-5-2-7-3-6-1-8 and repeat.

(3) Chute #2 is the next chute to be used. The switching rope moves to block chutes 5-8. While chutes 5-8 are blocked, secondary rope B moves to block chutes 5-6. Chute 8 is blocked by a chute plug.

The chute opening sequence is then 4-5-2-7-3-6-1-8 and repeat. The chute captain leads the runners to the proper chutes and directs the secondary rope handlers. Two chute card directors may be used, one for each "half" of the finish area.

In the three level (2/2/2) system, the same SEQUENCE of chute openings should be used. In this case, the tertiary level of chute pairs is opened and closed by tertiary rope switches rather than chute plugs.

Processing Chute Design and Construction

Processing Chute Dimensions.

Processing chutes should be wide enough to allow runners to move forward freely and narrow enough to discourage position shifting. A width of one meter is generally considered suitable. Chutes may be slightly wider at the head of the chute to accommodate runners more easily.

Processing chutes MUST NEVER be constructed within TEN METERS of the finish line. The deceleration zone and processing chutes perform separate and non-overlapping functions. The lead stanchion of each chute should be brightly colored and padded for safety. Lead stanchions also need to be sturdy enough to accommodate switching ropes.

Processing chutes should not be longer than required for the particular place/bib-number recording system to be used. If your chutes are longer than 100 meters, your system is not optimally designed. If you wish to utilize chutes to channel runners away from the finish area, SEPARATE the processing function from the transportation function. For example, if you wish to exit the runners 250 meters from the head of the chutes and the ideal chute length (L) is 60 meters, place your recording teams at 60 meters and the REST of the chutes are now "transport" chutes which need to be monitored ONLY to keep runners moving, i.e., the finish order does not have to be "protected" past this point.

Chute Construction.

Finish chutes are defined by stanchions and ropes. Stanchions consisting of a heavy base and rigidly attached one meter vertical pole may be used for paved and unpaved finish areas. Rebar pounded into the ground can suffice for dirt finish areas. Stanchions should be sturdy enough to remain upright when bumped. End stanchions should be SOLIDLY fixed. Stanchion height should be

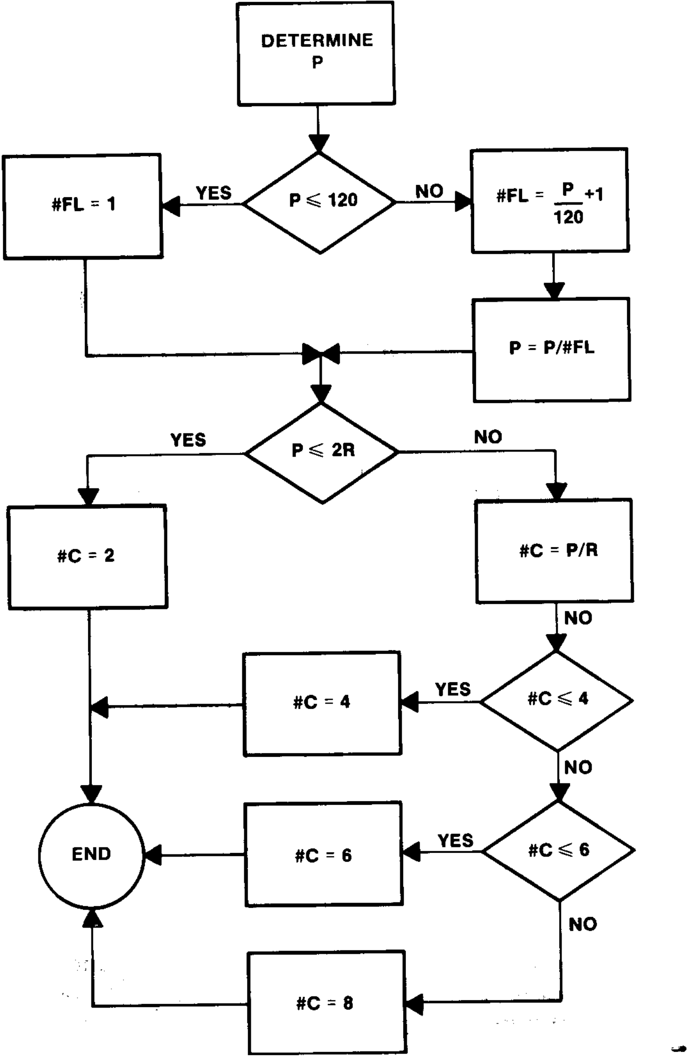


FIGURE 4-8.
Flow Chart Showing Method for Determining the Proper Number of Finish Lines and Processing Chutes in the Multi-Plex System.
Calculate P from Equation 2-1. Follow diagram to determine number of finish lines (#FL). Determine R for place/bib-number recording system of choice (see Chapter III). Determine proper number of chutes PER finish line (#C).

"waist-level" or roughly one meter.

The "ropes" used to define the chutes often have brightly colored pennants attached which improve the visibility of the rope. Another alternative is to use pink surveyor's ribbon. The space between stanchions is dictated by their sturdiness. Stakes in dirt can support up to 10 meters of chute ropes while the small 30 cm x 30 cm metal plate base stanchions used on pavement may only support 2 to 3 meters of rope. Ropes should be looped through rings or hooks on the tops of the stanchions and wrapped again around the top of the stanchion. If they sag, they can be wrapped around another time.

Handling Interlopers and Other Problems

A well-designed and operated finish system rarely has problems with interlopers (non-registered runners) PROVIDED one simple rule is followed. EVERY runner that crosses the finish line and is timed MUST be recorded as a finisher. If you do not observe this rule, your time/place and you place/bib-number sequences will become unsynchronized. This can be corrected by proper use of select times but it is easier if you don't have to adjust the sequences to begin with.

Some races use a finish line simply for interlopers. This is usually off to the side and no times are provided. This does require more space which may be at a premium to begin with and may be confusing to registered runners who may inadvertently finish with the interlopers. It still doesn't eliminate interlopers crossing the real finish line. In most cases, such "side" finish lines are not worth the effort and don't cure the problem anyway.

In the hand-out systems, interlopers cannot be relied on to return their place stick or place card. Such place sticks or cards should be pocketed by the handler or assistant and brought to the recording station where they can be marked "invalid" or "interloper" and inserted into the finish sequence.

In the take-from systems, you need an "interloper" tag to be spindled in place of a "real" pull-tag. A chute worker should be assigned to scan the runners waiting processing in the chutes for interlopers and registered runners who for whatever reason do not have a pull-tag. When such runners are spotted, the interloper is handed an "interloper" tag and requested to hand it in at the end of the chute. You should also consider registered runners that finish "twice" to be interlopers.

The registered runner without a pull-tag should be recorded. To prevent this occurrence from stopping your processing, a "substitute" tag should be used. This two-part, perforated tag is handed to the runner. At the end of the chute, the substitute tag is separated with the NUMBER ONLY portion being spindled and the fill-out portion to be carried by the runner to a "scorer" table where he/she is to fill out the necessary information and hand in the tag.

In the manual recording system, runners without numbers should be entered with X's. If the runner claims to be registered, send the runner to the scorer with his/her problem.

In the place card systems, interloper place cards should be "X"ed out and collected. For registered runners without a pull-tag, the runner should WRITE his/her name and age/sex on the place card. The recorder needs to have a supply of pens/pencils for this task. The best procedure for an "in-chute" recorder is to give the pencil to the runner with instructions to fill it out so the place card may be collected by the end of chute recorder. Usually, the end of chute recorder will remove the runner from the chute so processing may continue while the registered runner completes the place card.

For longer races or races held under hot and humid conditions, you should have several "substitute runners" to stand-in for casualties. If a runner collapses after crossing the finish, the substitute collects that runner's pull-tag or place card and enters the stream of runners to be processed where the casualty would have been.

If you are using a manual recording system, the substitute should have 3x5 cards and pens available to COPY the runner's number rather than attempting to remove the number. Time is of essence. This preserves your finish order and allows immediate medical attention (and identification) for your casualty. Rapid identification of a medical casualty may help alert medical personnel to be able to treat the casualty properly.

Wheel-chair finishers present a similar problem since the chairs are usually too wide for the chutes. A substitute runner should collect the necessary pull-tag, place card, or runner number (copied) and join the sequence of runners to be processed. The wheel-chair finisher may then exit through a gap provided in the deceleration zone for that purpose. Usually the number of wheel-chair finishers is too small to warrant a separate finish line.

Example of Finish System Design for a Large Race

As an example, consider the hypothetical case of a 2500 person 10 kilometer race. The flow chart illustrates the sequence of decisions. First determine the estimated peak finish rate (P) from equation (1). This is 150 runners per minute.

Since the estimated peak finish rate is greater than 100, divide P by 100 and add one. This gives 2.5 or TWO finish lines. The flow chart is set up so you can simply drop the fractions. If you are close to 3, you might consider using three finish lines. In this case, TWO are required and two should be sufficient.

Suppose that 35% of your field consists of women. By having separate finish lines for men and women, you can reduce your race to "two" races, one of roughly 900 women; the other of roughly 1600 men. Your most experienced people should be assigned critical jobs on the men's finish line since they will be faced with the highest finish rates (P for men = 96 rpm) which will be very close to the capacity of the system.

Let's consider four different systems or options. The particular option you use will depend on your particular needs and the equipment you have available.

The first option (A) is a toll-booth system using six finish lines. The other three options employ the multi-plex system. Option B is a pull-tab/spindle system; Option C is a manual recording system; Option D is a place card/pull-tag system. The pull-tag/spindle system should permit a processing rate of 30 rpm whereas the manual recording system should allow a processing rate of 20 rpm. The place card/pull-tag system should yield a processing rate of 80 rpm. The toll-booth method may employ either the place card/pull-tag system or the pull-tag/spindle system since the expected peak arrival rate for each finish line is 150 rpm divided by six finish lines or 25 rpm for each finish line.

For any of the multi-plex options, IF you go with one finish chute per finish line, you could get into trouble rather quickly. The maximum chute build-up for the men's finish line (P = 96 rpm) as calculated from equation 2 for the fastest processing rate (R = 80 rpm) is 98 runners. Allowing two waiting runners per meter of chute, even the fastest system would require a chute of 50 meters in length.

Using the pull-tag/spindle system (R = 30 rpm) the expected build-up is more than 1000 runners requiring more than 500 meters of chutes! If the runners were able to walk at a normal walking pace of 80 m/min (3 mph), they would be in the chutes for more than six minutes!

Back to the flow chart. IF we split runners evenly between the two finish lines, the peak arrival rate for each finish line would be 150 divided by 2 or 75 rpm. Splitting unevenly (men and women), yields P = 96 rpm for the men's finish line and 54 rpm for the women's finish line. Let's follow the flow chart using the uneven split.

For the place card/pull-tag option (D), R = 80 rpm. Since both the male and female peak arrival rates are less than twice this, i.e., 160 rpm, two finish chutes for each finish line are indicated.

For the pull-tag/spindle option (B), R = 30 rpm. The women's finish line can get by with two chutes since $P < 2$ times R or 60. The men's finish line requires four chutes, i.e., the number of chutes equals 96/30 (which is P/R) or 3.2. Since chutes are arranged in pairs, 4 chutes are needed.

For the manual recording option (C), R = 20 rpm. The women's finish line requiries four chutes 54/20 = 2.7 and this is raised to the NEXT higher EVEN number or four. The men's finish line requires six chutes, 96/20 equals 4.8 which is raised to six.

Note that this method of determining the number of finish lines and finish chutes eliminates chute build-up since the overall processing rate is never less than the estimated peak arrival rate. For example, in Option C on the men's finish line requires six finish chutes. Each chute can process runners at 20 rpm. Six chutes working together can process six times that or 120 rpm. The estimated peak arrival rate is 96 rpm. Hence, runners are quickly processed through the chutes and at no time is there any significant build-up of runners waiting to be processed. Chutes should NOT be used as storage areas for runners awaiting processing.

The toll-booth system (Option A) with six finish lines reduces the peak arrival rate to 25 rpm on each finish line. Note that ANY of the sub-systems used to record runners/places in the processing chutes EXCEPT the manual recording system is capable of handling this arrival rate with a single processing chute!

Each finish line will need at least one printing timer and its operator PLUS AT LEAST one team of select timers. Each finish line requires at least two and preferably three official timers for the first finisher across that finish line in order to synchronize the primary timing system (see section on Timing Requirements) EXCEPT for Option A since the first finisher synchronizes ALL the channels for the multi-channel Chronomix. Option A is assumed to use a place card/pull-tag system for comparison although the pull-tag/spindle method could also be used.

The breakdown of personnel required for each option is given below. Note that these are MINIMUMS. More people at the right places can reduce your problems. In particular, you should have TWO select time teams per finish line rather than one.

	Option A	Option B	Option C	Option D
# finish lines	6	2	2	2
# chutes (total)	6	6	10	4
(in pre-finish line zone)				
sex separators	3	1	1	1
modulating rope handlers	5	0	0	0
(at finish line)				
official timers	3	6	6	6
@ printing timer operators	6	2	2	2
select time teams	12	4	4	4
printing timer supervisor	1	1	1	1
@ chief timer	1	1	1	1
(in deceleration zone)				
* finish "judges"	6	2	2	2
@ chute captains	0	2	2	2
@ switching rope handlers	0	2	2	2
secondary rope handlers	0	0	2	0

Options (continued)

@ chute card directors	0	2	2	2
(at head of chutes)				
* place card handlers	6	4	0	4
* chute plugs	0	6	10	4
* plug supervisors	0	1	1	1
* time tag teams	0	4	0	0
(in the worker lane)				
* chute monitors	0	12	20	0
* in-chute collectors	12	0	0	8
* trouble shooters	6	6	10	4
(at end of chutes)				
* recorders/collectors	6	12	20	4
recorder supervisor	1	1	1	1
TOTAL PERSONNEL	66	69	87	49

@ must be experienced personnel
* may be recruited race day but should be well-briefed

The final decision as to which system to go with depends on the available personnel and equipment (how many printing timers are available?), the physical space available for finish lines and chutes, and the type of race day awards, results, etc., that are desired.

Positions indicated by "@" require well-trained people and should not be entrusted to amateurs. Positions indicated by "*" may be filled on race day by volunteers although they do need to be well-briefed on their jobs.

Example of a Short Race of Medium Size

Now consider an 800 person race at 5 kilometers distance. Although the number of runners is not excessive, they will all finish within a relatively short time span. The estimated peak arrival rate is 96 rpm according to equation (1).

Since the peak arrival rate is not greater than 100 rpm, you can get by with one finish line (Option A). You may wish to separate men and women finishers. Note that shorter races usually have a higher fraction of women runners. Here, we may expect 40% women. Splitting the finish line would yield estimated peak arrival rates of 58 rpm for the men and 38 rpm for the women (Option B).

For races where the total number of runners is not excessive, the place card/pull-tag system is recommended for its reliability and robustness. With a high processing rate (R = 80 rpm), single processing chutes for each finish line would be preferred to having two processing chutes for a single finish line (unless your available equipment prohibits this option). Additional workers should be assigned to the deceleration zone to keep runners in the proper order and to handle potential medical problems.

Another option using dual finish lines would be the pull-tag/spindle or the manual recording methods (Options C and D). The processing rate for the pull-tag/spindle method is 30 rpm. This requires a multi-plex system with two processing chutes for the women and four processing chutes for the men. The manual recording method with a processing rate of 20 rpm requires the same number of processing chutes.

	Option A	Option B	Option C	Option D
# finish lines	1	2	2	2
# chutes (total)	2	2	6	6
(in pre-finish line zone)				
sex separators	0	1	1	1
(at finish line)				
official timers	3	6	6	6
@ printing timer operators	1	2	2	2
select time teams	2	4	4	4
printing timer supervisor	1	1	1	1
@ chief timer	1	1	1	1
(in deceleration zone)				
* finish "judges"	1	2	2	2
@ chute captains	1	0	1	1
switching rope handlers	1	0	2	2
@ chute card directors	1	0	2	2
(at head of chutes)				
* place card handlers	2	4	0	0
* time tag teams	0	0	4	0
* chute plugs	2	0	6	6
plug supervisors	1	0	1	1
(in worker lanes)				
* chute monitors	0	0	12	12
* in-chute collectors	6	6	0	0
* trouble shooters	2	2	6	6
(at end of chutes)				
* recorders/collectors	2	2	12	12
recorder supervisors	1	1	1	1
TOTAL PERSONNEL	28	32	64	60

Again, the choice of options depends on available equipment. The awards search with a dual finish line is much quicker than when using a single finish line.

Example of a Small Race

Now consider a 400 person race at 15 kilometers distance. After worrying about high finishing rates, this will seem like a small race. However, this type of race is encountered MUCH more frequently than the ones previously discussed and they too can be mismanaged.

The estimated peak arrival rate is 16 rpm according to equation (1). Clearly, a single finish line is adequate. Again, for a race of this size, a place card/pull-tag system OR even a place card system where the runners "write-in" their name/age/sex on the place card before handing it in to the scorer are the systems of choice. Since the place card system processing rate is on the order of 80 rpm, you should be able to handle the peak arrival rate with no difficulty.

Note that EVEN if you use the place card/write-in method, you STILL need competitor numbers that are visible as runners approach the finish line. This race is still large enough to REQUIRE select timing since you will not be able to "select" all finishers and must rely on matching the printing timer tape and the place card order for final race results.

The personnel required include three official timers (one may be the printing timer operator if the primary timing device is also an official time), a printing timer operator, a finish judge, a place card handler and someone to collect the place cards. With a chute monitor to answer runner's questions regarding what they are supposed to do with the place card and another to help handle interlopers or other problems, the total personnel required at the finish line is ten.

Example of a Really Small Race

Now consider a 200 person marathon race. The estimated peak arrival rate is now down to less than 3 runners per minute. Due to "clustering" or "bunching" of the runners as they finish, you may have five or six finish in one minute and none the next minute, even at the peak period!

This peak arrival rate is low enough that you should be able to select ALL finishers. Indeed, this is the preferred method for races of this size and finishing rate. In addition to the printing timer which gives "stopped" times for each finisher, two teams of select timers are suggested. The timer half of each select time team can take a "stopped" time on the first finisher and if the printing timer is also an "official" time, you have three official stopped times on the first finisher.

Having two select time teams provides back-up and helps catch errors in transcribing runner's numbers. With finish densities this low, you have time to assign a worker to ask each finisher their name and age which may then be entered on the select time sheets. These then serve as the basis for your award search and may be copied and posted for race day results.

RACE REGISTRATION

Registration of runners applying to your race is where everything starts. This is the first impression your runners will receive about your race. It affects various aspects of your race from seeding the start to the awards search and final race result preparation. The efficiency of your awards search often depends on the way your registration system is designed. PLAN AHEAD!

Entry Forms

The entry form is usually comprised of a section where you tell the entrant about your race and another section where the entrant tells you about himself/herself. The latter section will be termed the "entry blank" since it is a "blank" form to be filled in. The former section will be called a "race flyer" since it is designed to "fly" to as many potential entrants as possible. All information you intend to convey to the runner should be on the entry form.

Race Flyer Information

The race flyer MUST contain certain specific pieces of information about your race. (1) Runners need to know the date and time of the race start, the precise location of the race start, and the distance of the race. (2) Runners also need to know when and where bib-numbers and race packets may be picked up for pre-entries, the deadline for mail entries, where and when late entries will be accepted, and what the registration fees are. (3) Runners often decide whether or not to run your race based on the awards to be given, the age/sex divisions in your race, special awards, and "freebies" such as T-shirts, finisher medals, certificates, etc.

The race flyer SHOULD contain information about the course and what the runners can expect in the way of amenities. Course information should include a map of the course suitable for a runner to review the course prior to the race, a discussion of terrain, i.e., hilly, flat or downhill, and a statement of race protocol, e.g., "stay to the right side of the road-way at all times." Amenities such as location of porta-johns or restroom facilities, number and location of aid stations, location of split times, placement of kilometer and mile markers or signs and expected weather conditions should be noted.

Entry Blank Information

The information to be filled in by the runner on the race entry blank is intended to help you fulfill your part of the agreement between you and the entrant. If you have awards based on age and sex, you will need to know the runner's age, sex and date of birth. If you promised to mail out race results, you will need the runner's complete address. In any event, address and phone number infor-

ENTRY FORM **Please Print Clearly**

LAST NAME ____________ FIRST NAME ____________

ADDRESS ____________

CITY ____________ STATE ____ ZIP CODE ____ SEX ____

WORK PHONE NO. ___ - ___ - ____ AGE ON RACE DAY ____ __ - __ - __ DATE OF BIRTH

HOME PHONE NO. ___ - ___ - ____

WAIVER. I know that running a road race is a potentially hazardous activity. I should not enter and run unless I am medically able and properly trained. I also know that, although police protection will be provided, there will be traffic on the course route. I assume the risk of running in traffic. I also assume any and all other risks associated with running this event including but not limited to falls, contact with other participants, the affects of the weather, including high heat and/or humidity, and the condition of the roads, all such risks being known and appreciated by me.

Knowing these facts, and in consideration of your accepting my entry fee, I hereby for myself, my heirs, executors, administrators or anyone else who might claim on my behalf, covenant not to sue, and waive, release, and discharge (list of organizations associated with the race and the local government and police), Race Officials, Volunteers; any and all sponsors including their agents, employees, assigns or anyone acting for on their behalf, from any and all claims or liability for death, personal injury or property damage of any kind or nature whatsoever arising out of, or in the course of, my participation in this event.

This Release and Waiver extends to all claims of every kind or nature whatsoever, foreseen or unforeseen, known or unknown.

The undersigned further grants full permission to (name of race, club, or organization conducting the race) and/or agents authorized by them, to use any photographs, videotapes, motion pictures, recordings, or any other record of this event for any purpose.

Applications for minors will be accepted only with a parent's signature.

SIGNATURE OF ATHLETE SIGNATURE OF PARENT

FIGURE 5-1.
Example of Entry Blank and waiver.
Note spaces to be filled in represent the lower third of boxes for ease in reading. The box in the upper right hand corner is for the registrar to enter the bib-number for late registration. Note redundency between age and date of birth. Although the waiver does not prevent you from being sued, it helps establish a better case for defense. Make sure the waiver is signed before accepting an entry fee. Make sure you keep you entry blank/waivers safe in case they are needed.

mation is strongly recommended in the event of a medical emergency.

Some entry blanks provide little boxes to fill in. Each box is supposed to contain one letter or one number. The number of boxes provided usually corresponds to the allotted space for that piece of information in the computer file. Experience shows that writing is often confused with the box outline and may be difficult to interpret. It is recommended to use only the BOTTOM third of the box, leaving the "top" open (see example). Other entry blanks have spaces (underlined blanks) to be filled in. In both cases, entry blanks should state clearly and in large bold-faced letters, PRINT CLEARLY.

Make sure the REVERSE side of the entry blank DOES NOT contain information the runner will need. Often, the reverse side of the entry blank is where the mailing label for race flyer mail-out is placed. When the entry blank is returned, you can estimate the effectiveness of direct mailing by checking the number of entry blanks returned with mailing labels on the reverse.

Entry blanks should contain ONLY that information you need from the runner. These include but are not limited to (1) full name, (2) sex, (3) age on race day, (4) date of birth, i.e., day, month, year, (5) address, (6) telephone number, (7) emergency contact (name and phone number), and (8) waiver with signature and date. Having the entrant check a box corresponding to one of several age/sex divisions clutters the form and is NOT recommended. Age or date of birth information already provide what you need to place the runner anyway.

Redundancy helps avoid errors due sloppy handwriting or an oversight on the part of the entrant. Most races offer awards based on AGE AS OF DAY OF RACE. Runners may put down their current age without realizing they have a birthday before the race day. The longer the required pre-registration period is before the race, the more this type of error occurs. This error is COMMON but usually goes undetected unless you ask for date of birth IN ADDITION TO age on race day. If you simply ask for date of birth, some runners will enter their next birthday. If you have both AGE and DATE OF BIRTH, you can catch both of these errors. You will also be able to provide a date of birth in the event one is required to verify a national age record.

Although the "waiver" on race entry blanks does not eliminate the possibility of being sued, such waivers may be considered by the court when deciding claims. The waiver should specifically hold harmless the race organization, the sponsors, the sanctioning body, and the local authorities. A suggested waiver form is illustrated.

The entry blank should also carry a disclaimer stating, "No Refunds." This will save you a lot of headaches.

Some of the information on the entry blank is intended to make things go smoother. T-shirt size information can be used to place the proper sized T-shirt in the runner's race packet, saving time during packet pickup. If you are seeding runners, you will need an estimated or projected finish time. If you have more than one race, you may wish to know which event the runner plans on running. If you have a TAC championship event, you will need a TAC number.

If you do have two or more events, each having the same entry fee, it will simplify matters if you do NOT try to classify or assign numbers by event ahead of time. Simply register ALL runners as if they were going to run the same event. This allows runners to change their minds without needing to be "re-registered."

Pre-Race Regisration

The immediate goal of your registration system is to provide each runner with a bib-number. You should have a registration roster which lets you know which runner has which number. If you computerize your registration, you should prepare two rosters, one in bib-number order and the other in alphabetical order. If you do not use a computer, one convenient method is to write the bib-number on the completed entry blank at the time of registration and then keep the entry blanks in bib-number order.

Your registration system will have a number of other goals. One goal is to provide rapid identification of award winners at the conclusion of the race. Another is to provide some form of race results. Bib-numbers and entry rosters provide quick identification in case of medical emergencies. This information is also used to build up mailing lists for race flyers and other direct mailings. Registration systems for large races are often designed to facilitate the award search.

Registration for a Manual Recording Finish System

If your system for determining the place/bib-number sequence is a manual recording system, your award search will be conducted using a list of bib-numbers in finish order. If you had to check your registration roster for EACH number to find that runner's age and sex, your award search would take a VERY long time.

Number Blocking

One method for speeding the award search is to "number block" or to assign bib-numbers according to age group. For larger races, you may wish to "color block" by sex, e.g., men receive black bib-numbers, women receive red bib-numbers. You should only color-block by sex when you employ SEPARATE finish lines for men and women. Otherwise select timing and manual recording become more complicated.

In order to number block, you need to know roughly how many entrants are to be expected in each age/sex division. Your BEST reference is simply your race results from last year. If you do not have past results, you may refer to the following table based on a large sample of 10 kilometer race results.

TABLE I. Representative Break-Down of Runners by Age and Sex for 10 Kilometer Races.

age group	percent of men	percent of women
<10	0.5%	0.6%
10-11	1.1%	1.1%
12-13	2.0%	2.0%
14-15	3.0%	2.5%
16-17	2.7%	2.7%
18-19	2.7%	3.3%
20-24	11.1%	16.0%
25-29	19.9%	24.9%
30-34	19.7%	20.9%
35-39	16.9%	14.1%
40-44	10.3%	7.0%
45-49	5.3%	2.8%
50-54	2.8%	1.3%
55-59	1.3%	0.5%
60-64	0.5%	0.2%
65-69	0.2%	0.1%
70+	0.1%	0.01%

Before using this table, you need to determine how many men and how many women entrants to expect from a field of a given size. The ratio of men to women varies with geographical location and with race distance. The male/female ratio is lowest in the western United States at 2.4 to 1 for 10 km races and highest in the southeast at 4.1 to 1. The ratio for the mid-west, mid-Atlantic and northeast is close to 3 to 1. The male/female ratio is highest (fewest women) for longer distances and lowest (most women) for shorter distances. For the marathon, a ratio of 6 to 1 may be used. For races at other distances, you may estimate an intermediate value.

Suppose you have a 3000 person 10 km race in the mid-west (male/female ratio of 3:1). You may expect 750 women and 2250 men. Suppose you have age groups for 15 and under, 16-19, 20-29, 30-34, 35-39, 40-44, 45-49, 50-59, and 60+. Please note these choices are for purposes of illustration and are NOT a recommendation. Depending on the emphasis of your race, you may wish to expand the younger and/or older age group award divisions. Note that you do NOT need to give the same NUMBER of awards in each group but may wish to make awards in rough PROPORTION to the expected number of entrants, e.g., 10 awards in the M30-34 but only one award for M70+.

For this example, bib-numbers can be blocked as shown in Table II. Note that each age/sex group is allotted extra space (about 50%) to allow for deviations from the expected age/sex distributions and for registration above your expected number of entrants. If you start filling up number blocks and have to "jump" to unused number blocks for one age group, you lose some of the advantages of number blocking. This method is not efficient at using bib-numbers and may be expected to "waste" 30% or more of the numbers you buy. At 17 cents per bib-number, wasting 1000 bib-numbers costs $170.

TABLE II. Example of the Use of Number Blocking for a 3000 Person Race.

group	% in group	# in group	assigned numbers
seeded	x	x	# 1- 99
M<=15	7.6%	148	# 100- 399
M16-19	5.4%	122	# 400- 599
M20-29	31.0%	698	#1000-1999
M30-34	19.7%	443	#2000-2999
M35-39	16.9%	380	#3000-3599
M40-44	10.3%	232	#3600-3999
M45-49	5.3%	119	#4000-4199
M50-59	4.1%	92	#4200-4399
M60+	0.9%	20	#4400-4499
F<=15	6.2%	47	#5000-5099
F16-19	6.0%	45	#5100-5199
F20-29	40.9%	307	#5200-5699
F30-34	20.9%	157	#5700-5999
F35-39	14.1%	106	#6000-6199
F40-44	7.0%	53	#6200-6299
F45-49	2.8%	21	#6300-6399
F50-59	1.8%	14	#6400-6499
F60+	0.3%	2	#6500-6599

When number blocking is used, the awards search is done by scanning the first two digits of the bib-numbers for the desired number block.

Letter Coding

An alternate method for manual recording systems is to use a water-proof marker to write a letter code in front of or following the bib-number. This means you can assign bib-numbers in the order you register runners, a more efficient use of bib-numbers. Once the bib-number is assigned, the proper letter code needs to be written on the bib. ONLY the recording team at the end of the chute needs to copy this letter code. All other uses of the bib-number do not require the letter code.

In theory, 26 age/sex divisions can be coded using single letters. However, in practice you are advised NOT to use letters that are similar in appearance or letters that sound like or look like numbers. The letters 'D', 'O', and sometimes 'Q' tend to "look alike." You may also wish to avoid 'U' and 'V' and also 'M' and 'N'. You may use ONE of each but not both. The letter 'A' sounds like the number '8.' The letter 'L' looks like the number '1' and the letter 'Z' looks like the number '2.'

Using double letter codes for women, corresponding to the single letter code for men is another option. For example, the M40-44 division may be coded as 'F' and the F40-44 division as 'FF.'

Registration for a Pull-Tag Finish System

The methods described in this section apply to both the pull-tag/spindle system AND the place card/pull-tag system. Pull-tags should ALWAYS carry the bib-number even though they also carry the runner's name, age and sex. This will facilitate the use of select times to insure accuracy of the assigned times.

The pull-tag methods may use letter-coding or color-coding or combinations of both. Color-coding alone may cause problems since color discrimination varies from person to person. Color-coding doesn't help a color blind awards searcher. Identifying ONLY the youngest and oldest age groups with color codes makes it easier to extract these awards. Most of the other awards will be in the first quarter of the field and may be quickly located without color coding.

Pull-tags for pre-registered runners can be printed using a suitable computer OR they may be filled out by hand using a ball-point pen (indelible ink). Pull-tags should contain (1) the runner's bib-number, (2) the runner's name, and (3) the runner's age and sex. Other information such as the runner's hometown or club/team may also be given. A variety of pin-feed pull-tags, with and without color coding are available.

Peelable Pull-Tags

Pull-tags for a place card/pull-tag system must be peelable so that the runner may affix the pull-tag to the place card after finishing. The standard three-across, "small" peelable labels ($0.005 each) with pin-feed for computer printing are the most commonly used. Pull-tags should not be much larger than 10 cm x 2.5 cm (2.5"x1") or they will obscure your place cards.

Peelable pull-tags need to be cut apart with their backing paper intact. They should be stapled to the competitor number with two staples, one at each END of the pull-tag, so that it can be torn from

FIGURE 5-2.
Example of Bib-Number with a Detachable Pull-Tag.
Note that the pull-tag has the bib-number, runner's name/age/sex information and a place for color-coding.

the number without destroying the pull-tag. Pull-tags should be stapled so that the "flat" side is on the BACK of the bib-number with the two "ends" of the staple on the front side. This reduces chaffing and makes it easier to pull the tag free of the bib-number in the processing chutes.

The pull-tag should be stapled so that it does not obscure any part of the bib-number since this is needed for select timing. If the pull-tag is computer printed, CHECK to make sure the pull-tag is being affixed to the SAME bib-number as listed on the pull-tag.

Another method for peelable pull-tags is to use "piggy-back" labels. These are more expensive ($0.015 each) but have the advantage that they may be stuck to the bib-number and then peeled from the bib-number (leaving the second backing paper on the bib-number) and affixed to the place card. This eliminates the need to staple the pull-tag to the bib-number BUT will slow the processing rate.

Pull-Tags for the Spindle System

The pull-tag/spindle system does not require peelable pull-tags. A non-peelable pull-tag may be attached to the bib-number in the same fashion as the peelable pull-tag OR it may be "part" of the bib-number itself (see example). In addition, the pull-tag may be attached to the runner rather than to the bib-number. If you use this latter option, you STILL NEED bib-numbers if you expect your results to be accurate since the SELECT TIMING depends on readable bib-numbers. A pull-tag dangling from a runner's shirt is not readable from any reasonable distance.

Pull-tags MUST be readily removable or detachable. This is accomplished either by stapling as described above OR by means of perforations separating two sections of the pull-tag. Runners must be instructed NOT to pin the part of the pull-tag that later will be detached and collected in the processing chute. You should use a chute worker to check each finisher before they reach the pull-tag collection point, to make sure the pull-tag is not pinned and to catch other problems such as interlopers or registered runners with missing pull-tags.

If you make your own pull-tags for a pull-tag/spindle system, make sure you PRE-PUNCH a hole for the spindle or stringer. The hole should be 1 cm (3/8") or larger in diameter to facilitate spindling. Perforated pull-tags are convenient since they can be stapled to the bib-number using the non-removable section.

Color-Coding

At this point you may wish to add color-coding to the pull-tag. One simple way is to use water-proof markers with several distinctively different colors. The "open" men's division or the 20-29 and 30-34 age groups do not need color codes since they are usually the first finishers anyway. You can double the number of available groups by marking an 'X' in the age group color for men and an 'O' in the SAME age group color for women.

Color-coding may also be added using stickers of various colors. Stickers should be on the order of 2 cm (¾") in diameter and roughly circular or square, i.e., not long and thin but short and fat. Most office supply stores can provide colored "dots" which are used for bulk mailing at $0.004 each.

Pre-colored peelable pull-tags are also available (at $0.05 each). These need to be filled in by hand (ball-point pen) but avoid the need to affix color dots or color marking. It is not clear the additional price is worth the savings since color dots are much cheaper and just as fast as selecting the proper color peelable tag would be. Make sure the bib-number is entered on the pull-tag, especially if the pull-tag comes with a "number" of its own which may confuse things.

Pull-Tags with Bar Codes

If your pull-tag is an integral part (separated only by perforations) of your competitor number, you can employ colored dots or colored marking to distinguish age/sex divisions. The entrant information in such cases needs to be filled in by hand. Some competitor numbers provide a bar-code on the pull-tag to be used with bar code systems. The bar code reflects the bib-number but should not be considered a substitute for a human-compatible bib-number on the pull-tag portion.

Another recent development is the computer-driven printer which "creates" its own bib-number and bar code. If you use a personal computer for registration, once the entrant information is entered, you can print out a bib-number on specially provided forms made of tear resistant material. The form provides for a detachable pull-tag on which the bar code and entrant name/age/sex/hometown information for manual processing is entered.

Packet Pickup

You can avoid packet pickup completely by mailing out race packets. However, escalating postage costs mean that mailing the bare minimums (bib-number plus a couple information sheets in a 9x12 envelope) runs $0.56 per entrant.

Many large races have "packet stuffing parties (no beer)" the night before packet pickup where all the components such as bib-numbers, pull-tags, envelopes, flyers, information sheets, pins, "freebies" and sometimes T-shirts are gathered. Set up an assembly line such that pull-tags or code letters are attached to the correct bib-number and then placed in an envelope into which flyers, pins, etc. have been stuffed.

Using Computers to Facilitate Packet Pickup

If you computerize your registration, have the computer print out a set of peelable pull-tags in bib-number order. These can be affixed to the OUTSIDE of the registration packet for easy identification. This is especially convenient if you are already using a computer to print out peelable pull-tags for a place card/pull-tag system.

Another convenience using a computerized system is to assign the bulk of your bib-numbers (those not given to the top or seeded runners), in the SAME order as you plan to organize packet pickup. Most packet pickups are arranged alphabetically by last name. If you assign bib-numbers alphabetically and print pull-tags alphabetically, when you have finished your packet stuffing, your registration packets will ALSO be arranged alphabetically. If you employ number blocking, packet pickup is logically organized by age group rather than by name although you can alphabetize within each age group.

Another method to speed packet pickup is to post rosters in alphabetical order by last name. This roster should give the runner's name and bib-number as a minimum. This is crucial if you do not assign bib-numbers in alphabetical order BUT organize packet pick-up by bib-number.

Organizing Packet and T-Shirt Pickup

The number of packet pickup stations depends on how many packets need to be picked up and how many hours runners may pick up their packets. Use LARGE signs to identify "packet pickup" and the location for each group, e.g., A-F, G-L, etc., or #1-999, #1000-1999, etc.

MOST runners will wait to the last minute. Close the doors at the last minute but figure on taking another half hour to complete packet pickup. If 10% of your entrants wait to the last minute to pick up their packets, figure roughly 30 seconds per pickup and 30 minutes to finish the last minute rush which means each station can handle 60 last minute people. If your packet pickup period is more than five hours total, each station can handle 600 packets. If your pickup period is less than five hours, the number of packets per station should be reduced accordingly.

Packets may already contain the size T-shirt indicated by the entrant on the entry blank. This certainly speeds handing out packets but does make bulky packets. Another alternative is to ask each entrant as they pick up their packet, what size T-shirt they want. It usually takes 3 or more seconds to elicit a response and 5 or more seconds to find the right size T-shirt. If stocks are running low, you may have to go back and try to get another choice (lots of luck!). This option is even worse!

For larger races, the preferred method is to include a T-shirt card in the race packet. Once the runner receives the race packet, he/she takes the T-shirt card to a "T-shirt" station where the sole function is to distribute T-shirts. You should display one T-shirt of each size to help runners decide what size they want.

One way to reduce surplus T-shirts is to give T-shirts ONLY to entrants who register by a particular date, roughly two weeks in advance of the race. The entry form should indicate size preference which may be entered into the computer registration file.

When pre-registration is "closed," the computer can tell you how many small, medium, large, and extra-large T-shirts to order. Obviously, the T-shirt firm needs to have everything else ready to go. This option does make it easier to provide extras like children's sizes and even different styles. Another option is to mail-out T-shirts to late entrants at some time AFTER the race.

Avoiding Packet and Bib-Number Switching

Two types of errors occur with packet pickup and pre-registration. One runner may pick up a packet for another runner as well as his/her own packet. Now, there is a chance that the packets will be inadvertently switched. The situation is worst when husband and wife, parent and child, or a similar combination of tough vs weak age group competition is switched. If a husband-wife switch bib-numbers, the husband could run a 10 km race in the 33 minute range and be well out of the awards. If he is wearing his wive's bib-number, SHE is credited at the finish line with HIS time, which for a woman is a national-ranking time.

Some of these errors can be caught by using separate finish lines for men and women. It is better to stop such errors BEFORE they occur. When handing out TWO packets to one runner, use a magic marker to mark "HIS" and "HERS" on the outside of each packet or something similar.

Another error is frequent when late registration is not permitted. Suppose a registered runner is injured and can't run or simply decides not to run. A friend wants to run the race but didn't register in time (or doesn't want to pay the late registration fee). He picks up his friend's packet and runs with that bib-number. Not only is this is violation of TAC Rule 72.6 which can get the offending runners (both of them) barred from TAC sanctioned competition, but it can really mess up your awards. Suppose you have nice age group awards that are worth something. Further suppose the "bandit" is an average 25 year old runner, capable of 38 minutes for 10K. Suppose the entrant is a 60 year old man. You see the problem! THIS HAPPENS!

Two ways to guard against this are to (1) require identification before handing out registration packets and/or (2) require runners to sign for their packet. In the latter case, a clip board with forms listing bib-numbers in sequence and space to sign are needed. Nothing eliminates cheating, but you can make it much harder to cheat.

Late Registration

The best way to reduce late registration to manageable levels is simply charge a substantial late registration fee. Late registration fees as high as $30 (above the regular fee) have been charged (and received!). Some races do not permit late registration. Most races can use the extra income.

The first step is to provide tables with pencils (cheaper than pens since most will disappear) and entry blanks. Again, use BIG signs to indicate these as late registration tables. On each late registration table, affix a sign (on the table surface), telling the entrant what to do and where to take the completed entry blank. These entry blanks MUST have a place for the registrar to write in the assigned bib-number. This usually takes the form of a 3 cm x 1.5 cm (1"x½") box in the upper right hand corner of the entry blank (see example).

Number Blocking and Color-Coding

If you are color-coding by pre-colored pull-tags or number blocking for age/sex group identification, late registration stations should be clearly identified by the age/sex groups they are handling. DO NOT allow more than one registrar to handle the SAME age/sex division in such cases or you will get frustration and confusion. One registrar may handle several age/sex divisions AS LONG AS the each age/sex division is handled by only ONE registrar.

In these cases, each registrar is responsible for a particular set of bib-numbers or a particular set of pre-colored pull-tags. If the late registrant is in the WRONG line, tell them to go to the BACK of the correct line (they learn after a few times). Don't borrow registration material from another registrar and don't interrupt another registrar.

If you are NOT using color-coding or number blocking OR you are using a color dot system or a water-proof marker for color-coding pull-tags OR if you are letter-coding for manual recording, you DO NOT need to have separate late registration stations for different age groups. If you have several late registration stations, each station should have a supply of bib-numbers AND a supply of colored markers or color dots. Each station should have a KEY to the coding system, taped to the table top so time won't be wasted trying to find it.

Handling Entry Fees

You may wish to separate the cashier and registrar functions. In this case, the entrant is directed to the cashier first where the entry fee is paid and the entry blank stamped "paid." Otherwise, the entry fee is collected by the registrar when the entrant is registered.

When a registrar is handed a late entry blank, he/she should first check to see that all the blanks are completed. If NOT, send the entrant BACK to the table with the pencils and entry blanks and instruct them to return to the BACK of the line (no special priviledges for incompetency). Then, check that the entrant is at the correct station. If NOT, send him/her to the BACK of the correct line.

If the entry blank is acceptable, the registration fee is accepted and the entry blank marked "paid" (unless this function is handled by a cashier). Then, select the next bib-number (in the proper sequence if number blocking). WRITE this number in the box provided on the entry blank BEFORE doing anything else!

If you are number blocking, hand the entrant his/her bib-number and file the entry blank in a box provided.

If you are letter-coding for manual recording, check your coding key for the proper letter code for this entrant's age/sex division. Mark this code on the bib-number with a water-proof marker. Hand the entrant his/her bib-number and file the entry blank in a box provided.

If you are using pull-tags, enter (1) the bib-number, (2) the runner's last name and first name, and (3) the runner's age/sex (on the proper pull-tag if using pre-colored pull-tags). If you are using pre-colored pull-tags, hand the entrant his/her bib-number and file the entry blank in a box provided.

If you are using plain pull-tags with manual color-coding or letter-coding, check the coding key for the proper color or letter for that runner's age/sex division. Mark the pull-tag accordingly and hand the entrant his/her bib-number and file the entry blank in a box provided.

AWARD SEARCH AND POSTING RESULTS

The search for award winners requires both speed and reliability. The only thing worse than an award ceremony that is an hour overdue is one where the wrong runners receive the awards. It is nice if you can announce unofficial times at the award ceremony but the most important things are speed and reliability. If you are in doubt, don't announce it!

The hardest part of the awards search is taken care of during race registration. Each finish line sub-system for recording places and runners has its corresponding system for award searching. Implementation of the various systems is covered in Chapter 3. In this section, we will focus on the mechanics of how each system should work at the race to produce a list of award winners.

The only systems to produce a list of award winners directly are the computer based systems. Using direct computer entry or bar code reading, bib-numbers represent file locations. A complete set of preliminary race results may be easily generated, tentative only in the sense that assigned times may not be reliable since they may not have been checked against the select times. With a complete race finish order available with name, age and sex information to match, sorting to produce a list of award winners is straightforward.

Manual systems usually start with awards forms that identify the age/sex division and leave spaces for the names and times for each award to be given in that division, plus a couple extra to cover any errors. You may wish to have more than one age/sex division's awards on a given page but it is better to use a separate page for each. If you do group them, place the faster age groups together and the slower ones together. Otherwise if you mix them, the posting of award winners for the faster groups may wait for the slower groups to be determined.

Your awards search should take place AWAY from the finish area and PROTECTED from participants and spectators. You will need to assign workers to relay the various lists gathered at the finish area to the awards search area.

One method for simplifying the awards search is to have separate finish lines for men and for women. Even if the size of your race is such that you can get by with one finish line, often the convenience in locating women's awards winners is worth the extra effort to have separate finish lines. Your women runners will like it, too!

Manual Recording Systems

If you employ manual recording, your awards search may be augmented by using number blocking or letter-coding. In fact, if you DON'T use such a method, only small races have much chance of locating all the award winners before everyone leaves.

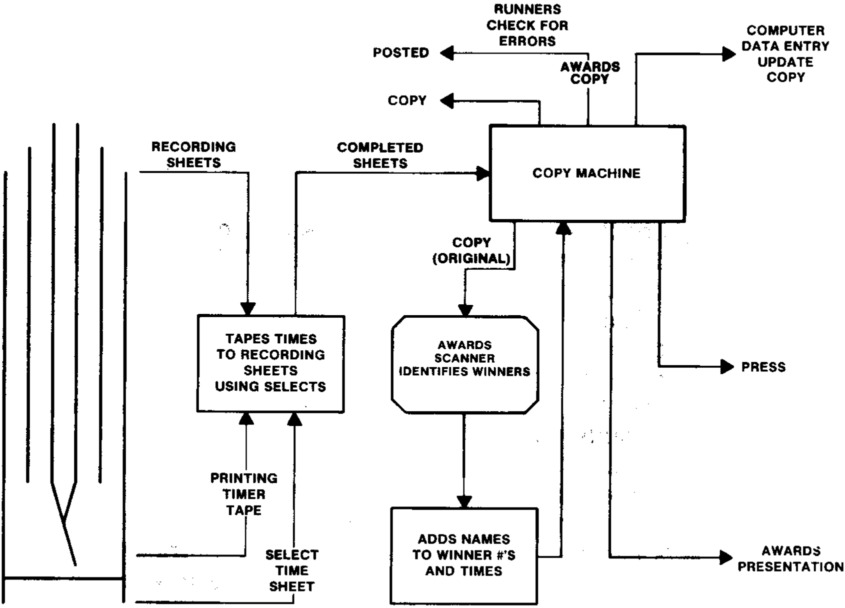


FIGURE 6-1.
Flow of Information for Manual Recording Finish Line System.
Recording and select time sheets plus printing timer tapes are carried to awards search area where time tapes are matched with recording sheets using select times. The completed sheets are copied and distributed as shown. One copy is examined by the awards scanner who prepares the list of award winners.

Having several keys to your coding method taped to the work table for easy reference. Award forms should have the code or number block for that age/sex division shown with each list of award winners for easy reference. Place the chute finish order sheets in their proper sequence.

The first chute will probably give all the open awards plus most of the 35-39, 40-44 and 16-19 age division awards. The easiest method is to place each runner in the proper award category, starting with the first finisher, then the second, and so forth, until you have completed the first chute.

For subsequent chutes, it is faster to choose an age group that you still need award winners for, determine the number block or code for that group, and scan the entire sheet looking for one age/sex division at a time. Complete each sheet in this fashion, scanning for those age/sex divisions you still need award winners for. Finish one sheet before going to the next.

The best method for determining tentative times for the award ceremony and results posting is to match the printing timer tapes (possible with the CC731 and HL305) with the finish order, using the select times to keep times/runners synchronized. This will yield fairly reliable times for the award winners and is fairly quick. Copies of these sheets can be posted as available for the runners. Times should be recorded on the awards form as award winners are located.

The overall flow of information is shown in Figure 6-1. The recording sheets, printing timer tapes and select timing sheets are gathered in the "results" area where they are matched using the selected times. The completed sheets are copied and distributed to the awards search and press and posted for the runners. Copies of the completed awards list are similarly distributed.

If you don't match time/place and place/bib-number lists as above, you can use chute opening and chute closing cards that include time information, to fix the first chute finisher on the time/place sequence from the finish line. Counting down, you can match an (unofficial) time for each award winner.

If you use a place stick method, you also will have a manually recorded list of finishers in place order. However, in this case, you should have also recorded the runner's age and sex in addition to their name. The awards search is the same as described above except no codes are involved.

Place Card Systems

Place card systems produce "batches" of unsorted place cards with pull-tags attached or with hand-written name/age/sex information. For your awards ceremony, you don't NEED the overall order of finishers, just the award winners.

For races with less than 500 finishers, affixing the place cards to "place boards" is a convenient way to scan for awards AND post results. Place boards may be constructed of "tag board" or plywood. A 3'x4' place board may be divided into 12 rows of 9 columns each to accommodate 3"x5" place cards. Each grid is numbered sequentially; each place board can hold 108 place cards.

As place cards are collected from the processing chutes, they are affixed to the place board in their proper location with double-sided tape. As each board is completed, it may be quickly scanned for award winners. If enough trained workers are available, select times can be located and written on the place cards in ink. The printing timer tapes then can quickly be checked, adjusted if necessary, and these times entered in pencil.

Once each place board has been processed, it may be posted. Once posted, it should be guarded!

For larger races, this system becomes awkward. The recommended procedure is to search for award winners by a hierarchial sort.

Award searchers should be divided into two groups. The first group sorts ALL the place cards by age/sex division. A shoe box "half", marked on ALL sides with the age/sex division should be ready for EACH age/sex division you have. If you employ two DIFFERENT finish lines, say for men and for women separately, you would use DIFFERENT color place cards for each and do a preliminary sort, separating men and women. If you employ color-coding, each box for sorting should be amply marked with the color-code for that age/sex division.

These preliminary sorts can be done at 20 to 30 sorts per minute per worker. This is generally the "rate limiting" step. Figure how long you have before your awards ceremony and divide that time in minutes into the total number of entrants in your race. Then divide that by 25 to obtain the number or workers you need to assign to preliminary sorting.

For example, in the 2500 person 10 km race previously considered, suppose you wished to have your awards ceremony commence 90 minutes after the start of the race. Say the race starts at 9 AM, and you wish to start the awards ceremony at 10:30 AM. The first cards can be expected to arrive at your awards search area roughly 45 minutes after the start of the race. Leave a "safety factor" of 15 minutes gives you 30 minutes. Divide this into 2500 runners to obtain 83 cards per minute. Divide this by 25 cards per minute per worker to yield four workers (to be on the safe side).

Once the preliminary sort has started, your second group can start their awards compilation. Each worker in the second group can handle four or five age/sex divisions, provided they are balanced between large and small groups. Keep aside ONLY as many of the highest placed cards in each age/sex division as there are awards PLUS TWO more in reserve.

For example, suppose in the M40-44 division you have four awards. Keep the first six cards that are sorted into the M40-44 box.

Say their overall places are 12, 24, 32, 35, 41, and 68. Any subsequent cards sorted into the M40-44 box may be shunted directly into the "final results" bin if their places are higher than 68. Any subsequent cards that are found with lower places, are inserted in the proper order and the highest place card is bumped to the "final results" bin.

Once all the place cards have been sorted and the award winners culled, your awards search is completed and it is merely a matter of transcribing them. If any award winner is subsequently disqualified, you have a "reserve" to fill in with no delay. Tentative times may be taken from the overall time/place order for age group award winners and from the first select timing sheets for the open awards.

The award search depends on quickly gathering place cards from finishers and bringing them to the awards search area. Monitors and helpers in the "control" area beyond the end of the chutes can keep this delay to a minimum.

Pull-Tag Systems

The MOST IMPORTANT aspect here is that you should NOT take pull-tags off their spindles before the proper finish order is recorded. This means the awards search must be made while the pull-tags are still on the spindle. The award winners form should show the color code with each age/sex division for easy reference.

The first step is to get the spindles in sequence. Chute opening and closing tags and time tags are used for this purpose. Again, most of your award winners will be on the first spindle. The first spindle should be processed in order. Record the first finisher in the proper award division list, then the second, and so forth until you are through the spindle. Record only the indicated number of award winners and back-ups.

The second and subsequent spindles should be scanned for specific age groups. Pick an age group, determine its color code, and scan spindles in sequence until you have located and recorded as many award winners as required.

Times for award winners need to be determined AT THE TIME the award winner is located. Time tags should give you a good fix on the time. Depending on the time available, you may wish to simply assume a linear distribution of times between two time tags OR you may wish to use the printing timer tapes in conjunction with the time tags to give a more accurate finish time to each award winner. Open winners may be determined directly from the select timing sheets.

Posting of results in this system is possible, provided you DON'T remove the pull-tags from the spindles. This may be achieved by carefully spreading the pull-tags while still on the spindle and then using masking tape on the reverse side to hold them in the spread out position. Once the spindle has been scanned for award winners, it may be posted, quite literally, on one to two meter high "posts." Posted results should be guarded!

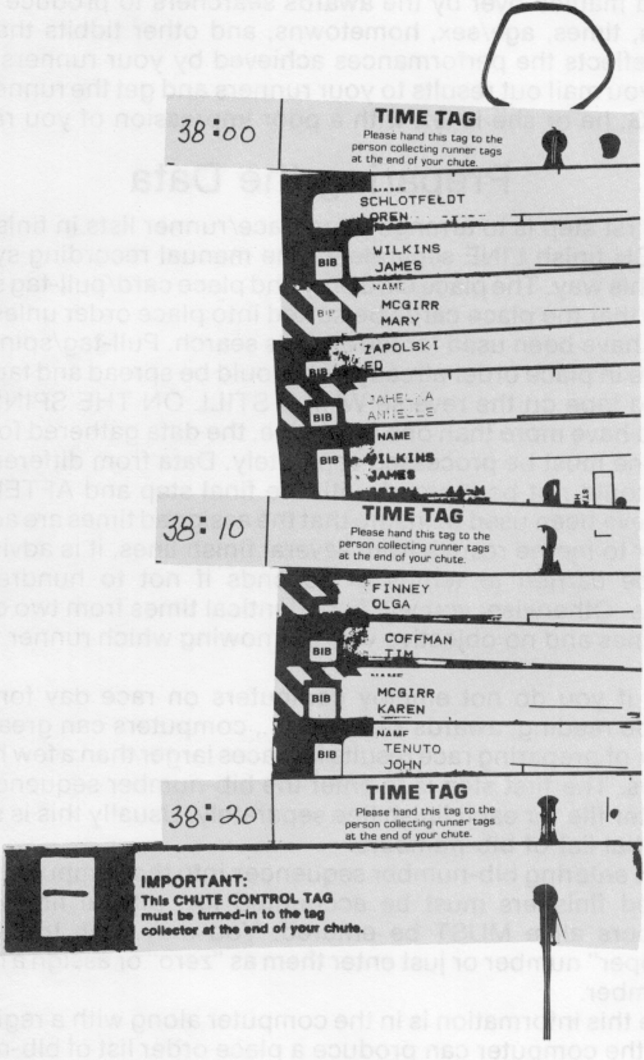


FIGURE 6-2.
Example of Results Display for the Pull-Tag/Spindle System.
Note that the pull-tags are STILL attached to the skewer; pull-tags have been spread and taped on the reverse side. Award winners are found by scanning the color/pattern code. Approximate times may be determined from the time tags which also serve to keep spindles in order.

RACE RESULT PREPARATION

The final step is to reduce the mass of data gathered at the finish line and mauled over by the awards searchers to produce a list of runners, times, age/sex, hometowns, and other tidbits that accurately reflects the performances achieved by your runners on that day. If you mail out results to your runners and get the runner's time WRONG, he or she is left with a poor impression of you race.

Preparing the Data

The first step is to arrange your place/runner lists in finish order for EACH finish LINE separately. The manual recording system is set up this way. The place card only and place card/pull-tag systems require that the place cards be sorted into place order unless place boards have been used for the awards search. Pull-tag/spindle systems are in place order already but should be spread and taped with masking tape on the reverse WHILE STILL ON THE SPINDLE.

If you have more than one finish line, the data gathered for EACH finish line must be processed separately. Data from different finish lines should not be merged until the final step and AFTER select times have been used to insure that the assigned times are accurate. In order to merge results from several finish lines, it is advised that times be carried to tenths of seconds if not to hundredths of seconds. Otherwise, you will find identical times from two different finish lines and no objective way of knowing which runner finished first.

Even if you do not employ computers on race day for timing, bar-code reading, awards search, etc., computers can greatly ease the task of preparing race results for races larger than a few hundred finishers. The first step is to enter the bib-number sequence into a computer file for each finish line separately. Usually this is simply a sequential list of bib-numbers.

When entering bib-number sequences into the computer file, ALL recorded finishers must be accounted for, official finishers and interlopers alike MUST be entered. You may wish to assign an "interloper" number or just enter them as "zero" or assign a negative bib-number.

Once this information is in the computer along with a registration roster, the computer can produce a place order list of bib-numbers with the corresponding name, age and sex for each place.

Using Select Times

If you are working up your results manually, the easiest way to use select times is simply to go through all the select times in finish order. Write the selected times on the recording sheet adjacent to the runner's number or directly on the place card or pull-tag for that runner. REMEMBER that these times are the MOST reliable times you have. If there are discrepancies, the discrepancies almost always occur elsewhere. You can count on these times as being correct. LEAVE THEM ALONE! Write them in INK.

If you are using a computer to help with results processing, take the place ordered bib-number sequence and enter the select times next to the corresponding bib-number. Again, these are the most reliable times you have. Write them in INK.

If you have more than one set of select times, it is convenient to enter one set of times in one color ink and the others in different colors of ink. This allows you to identify which times are from which team. Red ink should be reserved for corrections.

When two teams select the same runner, you can compare the times recorded. One team may be consistently "faster" or "slower" than another team. It helps to recognize how each team compares with the printing timer (primary timing system) when trying to identify which primary time corresponds to the selected time. This is why select time teams should be ON the finish line so that the times closely reflect the primary timing system.

If you are using a manual recording finish system and have spaced your recording sheets so that bib-numbers will match up with your printing timer tapes, simply lay the tape in the space provided and align the tape so it matches the selected times written next to the bib-numbers. Start from the beginning and, as long as the two lists remain synchronized, tape the time tape to the recording sheet in its proper position.

If you are using display boards or "spread" pull-tags on the spindle, you will need to identify those times which correspond to selected times on the printing timer tapes (you may wish to enter the bib-number on the timer tape next to those times). Next, count the number of times BETWEEN the two selected times. Then, count the number of place cards or pull-tags BETWEEN those with the selected times written on them. IF they match, you may write in the times from the timer tape directly on the place cards or pull-tags for each runner IN-BETWEEN the selected times. Do this in PENCIL. Not only does this distinguish primary times from selected times, it allows you to correct errors more easily.

If you are using a computer system, the procedure is the same as for place cards or pull-tags but it is much easier to count the number of times in-between those selected. Again, if the sequences match, enter the times from the primary system in pencil.

If the time/place sequence and the place/runner sequence do NOT match, there are two possibilities. The most COMMON problem is too many times. Extra times usually occur due to interlopers that escape before being recorded in the chutes. If you have TWO printing timer tapes, compare them.

If you need to eliminate an "extra" time, delete the FASTEST time in the block IN-BETWEEN the selected times. This assures that the assigned times are NOT FASTER than the runner actually ran. Table I gives an example of how this works.

TABLE I. Example of Using Selected Times. In this example, there are more primary times than runners recorded. Delete the FASTEST primary time in-between the selected times.

Primary Times	Selected Times	Bib Numbers	Assigned Time
44:34.2	44:34	# 637	44:35
44:35.6		(delete this time)	
44:36.1		#1421	44:37
44:37.2		# 259	44:38
44:37.9		#–100*	44:38
44:39.5		#1822	44:40
44:40.1		# 690	44:41
44:40.4		#1426	44:41
44:42.6	44:42	#1467	44:43

* interlopers assigned negative bib-numbers

If you have too few times, check to see if you have too many times in the preceeding or following blocks. This may occur if you have runners shifting positions in the chutes. This may also occur if your pull-tags gatherers collect two or more tags BEFORE spindling and have reversed them. In either case, there is little that can be done since you don't know which runners are in error. However, detection of errors of this type tells you where the weaknesses in your finish system lie. This is also why a redundant place/runner system is suggested when using the pull-tag/spindle method. If such a back-up system (voice tape recorder) is available, check to see if the discrepancy can be resolved.

If you have too few times, a time needs to be "created." The "created" time should be equal to the selected time AT THE END of the block in which the error occurred. Again, this assures that the assigned times are NOT FASTER than the runner actually ran. Table II gives an example of this procedure.

TABLE II. Example of Using Select Times. In this example, there are fewer times than recorded runners. An extra time needs to be "created" which is the same as the selected time at the END of the block.

Primary Times	Selected Times	Bib Numbers	Assigned Time
44:34.2	44:34	# 637	44:35
44:35.6		#1201	44:36
44:36.1		#1421	44:37

Table II. (continued)

44:37.2		# 259	44:38
44:37.9		#-100	44:38
44:39.5		#1822	44:40
44:40.1		# 690	44:41
44:40.4		#1426	44:41
(time created)		# 94	44:43
44:42.6	44:42	#1467	44:43

If you have a single finish line OR if you have separate finish lines for men and women, you are ready to produce final race results. If you are producing results manually, simply transcribe place/time/name/age/sex information in sequence, deleting interlopers.

If you are using a computer, create a sequential file of times from your bib-number sequence work-sheets. Enter times for ALL finishers but program your computer to delete interlopers. Check to make sure the bib-number and time sequences match properly. If you don't have the same number of bib-numbers and times, something is wrong.

If you have several finish lines, you are now ready to merge the results from each finish line to produce an overall list. If your times have been entered to tenths or hundredths of seconds, you should have relatively few "ties." Otherwise, you will encounter "ties." If you intend to "break" ties, use a tie-breaking scheme which is non-discriminatory, i.e., don't break ties by age, sex, or alphabetically. Give each runner an equal chance. You can use a random number generator or simply use finish line sequence, reversing order each time a choice is to be made.

The Select Only Mode

Although a select-only mode is NOT recommended it is sometimes used to handle high finishing rates. In this case, not all runners receive a "real" time, i.e., times need to be "created" in-between the "real" times.

There are three ways to create in-between or "interpolated" times. The simplest way is simply to assign ALL runners not explicitly timed, the NEXT SLOWER real time, in accordance with the way records are kept. This insures that no runner is assigned a time FASTER than they actually ran. This produces gaps in the continuity of the times reported but does serve the function of identifying real and interpolated times.

The most common method is to assume a linear distribution of times between the real times. Thus, if you have ten runners between real times 5 seconds apart, e.g., 46:10 and 46:15, times should be spaced 5/(10+1) seconds apart or 0.455 seconds. The real times here are assumed to be read from a running watch, hence the 46:10 should be reported as a 46:11. Including the second real time in the five second range gives 11 runners to spread out uniformly over 5 seconds. This is where the formula comes from. Table III shows how this works. Note that the "real" times are flagged with an "*" to conform with record-keeping requirements.

TABLE III. Example of Producing Interpolated Times in the Select Only Method.

real times	calculated times	race results
46:10*	46:11.00	46:11*
	46:11.45	46:12
	46:11.91	46:12
	46:12.36	46:13
	46:12.82	46:13
	46:13.27	46:14
	46:13.73	46:14
	46:14.18	46:15
	46:14.64	46:15
	46:15.09	46:16
	46:15.55	46:16
46:15*	46:16.00	46:16*

The third way is rather uncommon but is intended to produce a "more realistic" distribution of times. It does nothing to improve the accuracy of the assigned times. Note that the time gap (inter-arrival time) as assigned above between successive runners arriving at the finish line is the same between 46:11 and 46:16. The third method is to assume the inter-arrival times are RANDOMLY distributed. This is not true either since a considerable amount of non-random "clustering" is evident, even at high finishing rates. However, it does look more realistic.

The procedure is to select random numbers (pseudo-random numbers when using a computer), one for each time to be interpolated plus one for the next real time. Add these together and divide them into the time difference between (adjacent) real times. When you multiply this by each random number, you obtain a "random" inter-arrival time between adjacent runners.

Results Format

Your race results should contain all the information that is needed by the various persons that will use your results. Some groups have several results formats depending on who the results are being sent to. Newspapers are interested in the winners and to a lesser extent on complete lists of finishers.

At the other end of the scale, the National Running Data Center which maintains national rankings and records, is interested in

EVERYTHING. Not only does the NRDC want COMPLETE results, it also NEEDS age/sex information on each runner and would also appreciate receiving date of birth and address information. Note that address lists submitted are kept confidential and not released without authorization.

The race result format drastically affects the time required to process your race results for national rankings, especially for large races. A sequential listing for a 10,000 person race may take 6 hours to process. The same results, broken down by sex and into ten year age groups, i.e., all 40-49 men are listed sequentially in their own list, etc. may take only one hour.

Results should be in COLUMNAR format. The condensed format used by newspapers is exceedingly difficult to scan for specific information. Likewise, if the information submitted is in TWO separate lists, e.g., place/time/name AND bib-number/name/ age/sex-/address separately, it should be possible to quickly cross-reference the lists. This is accomplished by providing an alphabetical entry roster OR, if the entry roster is in bib-number order, by giving bib-numbers with the race result list. Otherwise, cross-referencing is far too time consuming.

The order of information is less important. The most convenient form for processing would match the format used in the national ranking lists, e.g.,

time	name	age	town	st	date of birth
43:59	Joan Smith	41F	Anytown	AL	09/24/44

Your race results should be headed by the DATE of the race, the name of the race, distance, and the town the race was held in. If the race was held on a certified course, the certification code number should be given, e.g., "Race was held on certified course AL-85099-PR." This not only shows the course was certified but it identifies the particular course used.

The form used for completing the documentation needed to process race results for national records and/or rankings is illustrated. This helps you organize your official times, synchronize your primary timing device, and lets us know what was done at your race.

National Governing Body for Athletics in the United States

The Athletics Congress of the USA

Please reply to:
KENNETH C. YOUNG
Records Committee/LDR
P.O. Box 42888
Tuscon, AZ 85733
(602) 326-6416

APPLICATION FOR RECOGNITION OF ROAD RACE PERFORMANCES

Please review this application prior to your race. If you have questions regarding the intent or content of any of the sections, please contact the NRDC. You should have copies available on race day to facillitate obtaining the appropriate signatures. Copies of this form may be submitted and you do not need to have ALL the signatures on the same form (submit as many as necessary). In the case of small races, the race director may handle or be directly involved in several of these functions, e.g., chief timer, starter, etc. and may sign several places as appropriate.

Please submit this application, together with the pertinent attachments and a complete set of official race results, listing time, name, age/sex, and hometown for each finisher, to: NRDC, P.O. Box 42888, Tucson, AZ 85733.

A. THE COURSE

I, the undersigned, hereby attest that the race known as ____________________

__________, held on ____________________, over a distance of __________

was run on the course number __________ AS IT WAS CERTIFIED.

____
(signature of race director)

B. THE START

I, the undersigned, hereby attest that the start of the above named race was a fair start and in accordance with TAC Rule 60.

____
(signature of starter)

C. THE WINNING TIME

Time for Watch #1 ____ : ____ : ____ ____________________ (signature of timer)

Time for Watch #2 ____ : ____ : ____ ____________________ (signature of timer)

Time for Watch #3 ____ : ____ : ____ ____________________ (signature of timer)

Type of Primary Timing System __________

Winning Time ____ : ____ : ____ ____________________ (signature of operator)

All times should be entered with full fractions of seconds as available for the device used.

I, the undersigned, herey attest that the times reported above are accurate and that the timing was done in accordance with TAC Rule 37.

____
(signature of Chief Timer)

NOTE: The three watches refer to official watches, started AT the start and designated as official watches. These watches should be used to take "split" or "stopped" times for the first finisher. Such times should be reported to tenths or hundredths of seconds. You may have only two official times. The primary timing system is usually a printing timer. It may be an official time if started at the start. If any of the times are read from a running watch, times should be entered AS READ in whole seconds and identified as "running" times.

FIGURE 7-1.
Form to be used when reporting race results for official recognition of performances.
The listed information is that needed to evaluate the validity of times reported for a given race.

D. NON-WINNING TIMES

1. If non-winning performances are submitted for record recognition and stopped times were recorded for such individuals, please enter here.

   name ______________________ time # 1__________ time #2 __________

2. Was "select timing" aka. "synch timing" , "tic-sheet timing", "random timing", used to insure that times and runners were properly matched (circle one) YES NO

3. What system for recording the place order of finishers (bib-numbers) did you employ at the finish (e.g., place card, pull-tag/spindle, manual recording at end of chutes, all runners were "selected", etc.)

   ____

4. How many finish lines did you use? ________ (Men/Women separate?)
   (Please complete timing section C for each finish line separately)

   How many processing chutes for each finish line? ______________________

5. Were you able to time each finisher individually (circle one)? Yes No

6. If you were not able to time each finisher individually and you interpolated some of the non-winning times reported, please indicate the range of times affected.

   from ____ : ____ : ____ to ____ : ____ : ____

   (If possible, please identify those times which represent actual times as distinguished from interpolated times on the submitted results.)

7. If a complete set of finish results is not available, please indicate the number of official starters (or entrants) and finishers.

   ________ finished ________ started (entered)

____
(signature of Chief Scorer)

E. COURSE MONITORING

1. Was the course monitored to prevent "course cutting?" YES NO

   NOT NEEDED (explain) ______________________

2. Is a video-tape record of the conduct of the race available? YES NO

3. Were any competitors disqualified for cheating? YES NO

   If yes, please list disqualified individuals and the reasons for their disqualification on a separate sheet.

I, the undersigned, hereby attest that, to the best of my knowledge, all the listed finishers did run the course as prescribed, in accordance with TAC Rule 65.10

____
(signature of Chief Inspector)

VERIFICATION OF PERFORMANCES

Cheating in road races is more common than most people realize. The more attractive the awards or the greater the attention "winners" receive, the more incentives there are for cheating. Cheating is easier to get away with in a large race vs. a small race where everyone knows everyone else.

Types of Cheating

Cheaters can be highly original and may show considerable imagination. The dumb cheaters are easily caught; the 2:16 marathon by a 60 year old for example. The smart cheaters can be hard to catch. We can only look at a few of the more common types of cheating.

Course Cutting

Course cutting may simply involve the runner ducking down a side street to join the race and "saving" some distance. Out-and-back courses have serious problems in this regard. It is very easy for the out-going runner to join the returning stream of runners.

Course cutting may involve a runner "dropping" out of the race at perhaps 25 km, only to "rejoin" the race at 35 km. The intervening distance is often covered by automobile but runners have been known to use city buses and subways.

It is often rather difficult to distinguish between runners who have taken a legitimate toilet stop from those who are cheating. You may wish to assign monitors to locations on the course where you have porta-johns. The cheater may enter via your porta-john, entering the race as he/she leaves the porta-john, just like any real runner.

One imaginative course cutter was accompanied by his friend riding a bicycle. Every five miles or so, they would trade places AND shirts. He managed to "improve" his time sufficiently to qualify for Boston. Note that he was "checked" thru each checking station along the way! Video-tape could have caught this cheater if the time were taken to check the video-tape that carefully. This was only found out much later when the "story" was related by a runner who observed one of the switches.

Failure to Start at the Start

The easiest way to cut the course is simply skip the first part of the race. How many marathoners just run the last few miles of the race? You've seen them, the ones that aren't sweaty, bouncing along coming into the finish as though they're out for a stroll.

The dumb cheater doesn't know when to "enter" the race. This gives you the 2:16 marathon by the 60 year old. The smart cheater figures he/she can run 7 minutes per mile for a couple miles. The runners finishing just under three hours are usually doing 7's for the last couple miles. They measure back from the finish, two miles.

They wait for 2:45 on their watch and jump in when the time is right. They run their two miles in 14 minutes, finishing in 2:59. They don't stand out since they are running the same pace as the other finishers. The dumb cheaters are getting passed by runners doing 5:30's while they are doing 8's.

Wave starts are highly conducive to cheating and need to be monitored VERY closely. Otherwise, the runner can "improve" by starting with an earlier group. Color-coded and number blocked bib-numbers PLUS lots of monitors help here.

Impersonation

Impersonation may be one person running for another or simply a person misrepresenting his/her age to take advantage of weaker age group competition.

Inadvertent number switching, e.g., husband and wife, occurs quite frequently. When handing out two or more race packets to the same individual, use magic markers to clearly mark the envelopes e.g., "HIS" and "HERS." Different colored bib-numbers for men and women AND separate finish lines help reduce this problem.

Pre-registered runners may choose, for whatever reason, not to run the race. The temptation is there for a second runner to compete WITHOUT paying an entry fee by "borrowing" the registered runner's bib-number. The impersonator may simply show up and pick up the bib-number for the runner who is registered and run with that bib-number. You may wish to request identification or signatures from runners as they pick up their registration packets to reduce this problem.

You also may wish to permit reassignment of a bib-number for a minimal fee. In this way, you can preserve the integrity of your coding system for the awards search and the integrity of your race results by correctly identifying the runners.

Course Monitoring

The first step is to identify potential problem areas on your course. If you run the same loop three or more times, you will need to record times for each runner for each loop. If you have an out-and-back course, you will need to record turn-around times for all the runners. If your course has inter-connecting or nearly connecting loops, points of intersection between different streams of runners present intractable problems. Intersecting streams of runners should be AVOIDED. Change your course.

Points where you have spotted potential problems should be monitored. At least one monitor should be assigned simply to record bib-numbers for any runners observed leaving the course in the vicinity. If you record the bib-number and the time the runner was observed leaving the course, knowing the location allows you to check against their finish time (if they finished) to see if they "speeded up" unduly.

The best way to monitor a course is by video-taping at certain check points along the course. Choose a section where the runners are making a right angle turn. As runners make such a turn, they will tend to "line up" so each can run a shorter path around the corner. Station the video-camera outside the corner and film as the runners round the corner, in effect presenting their bib-number to you.

The 1984 San Francisco Marathon video-taped their turn-around point at 30 km. The first 100 finishers were checked. Ten were disqualified for not passing through the check station.

Another way of checking is to use a standard voice tape recorder and read bib-numbers as the runners pass by. If another worker is reading times every 5 or 10 seconds AND the split is a standard distance, e.g., half way in a marathon, you will have split times recorded for many of your runners. This is a nice addition to your race results, plus a good method for verifying performances.

A method you might consider for large race where prize money is awarded to masters runners is to create a "prize money" classification. You might charge a dollar extra to be in this "special" group but allow anyone to enter who wishes. Give this group bib-numbers of a distinctive color that may be easily spotted and distinguished from the normal bib-number. Have a number of teams along the course to spot and record these "special" numbers as they pass by. This will give you a much smaller list when you verify award winning performances.

Start Check-In Procedures

One way to prevent your runners from starting your marathon at the 40 km mark is to have a start check-in and controlled holding area until the starting gun. The Honolulu Marathon checks runners off on master lists as being present at the start. Bar-code scanning as runners enter the starting area is another method used by the New York City Marathon.

The Tucson Marathon has used a dual pull-tag system, one pull-tag is collected when the runners enter the starting area; the other is collected at the finish. One year, eight of 500 "finishers" failed to check in at the start and were disqualified.

Bay-to-Breakers also has a cordoned off starting area that seeded runners may enter but may not leave until the starting gun goes off. As runners enter, a worker with a special color water-proof marker makes a colored check or 'X' on the runner's bib-number to indicate that they were are the start.

Video-Tape the Finish

Video-taping the finish not only provides answers to who-finished-in-what-order questions but also serves to identify runners visually as they finish. Many errors result when runners use another runner's bib-number. The video-tape usually can tell you if a man ran with a woman's number or a 25 year old ran with a 60 year old's number.

Awards and Disqualifications

If you give awards that have commercial value or are cash awards, you should ANNOUNCE the award at the ceremony but MAIL the award after you have had a day or two to check to determine if the performance is valid. One marathon disqualified three award winners. Unfortunately, the trophies had already been given out.

If you disqualify a runner, you may expect problems. Some are honest enough to admit they cheated (although dishonest enough in the first place to cheat) and return trophies, etc. Roughly 10% of the cheaters will try to out-bluff you. Even in the face of documented evidence that they cheated, they will still maintain their innocence and will threaten to sue you.

The methods you use to substantiate cheating need to be pretty solid. If you have teams recording bib-numbers, the runner may claim his/her number was covered at the time or the recorders simply missed it because he/she was running in a pack. The same is true for voice tape recording.

Even video-taping can be questioned. If you do not have a built-in record of the time on the video-tape, the runner could argue that the recorder was not operating when he/she passed and therefore you missed him/her. With a time record, you can document the video-tape record and, if need be, use it in a court of law.

If you disqualify a runner, BE SURE he/she cheated. If you KNOW the runner cheated, be sure you DISQUALIFY that runner. If no action is taken against cheating, your awards will go to the cheaters and the sport suffers. Remember that the cheater is cheating someone else of something that is rightfully theirs. There is no such things as a "recreational" cheater or "cheat-for-fun" because cheating demeans the entire sport and everyone is the worse for it.

APPENDIX A
TAC RULES OF COMPETITION

These rules have been reproduced directly from the 1985-1986 Competition Rules for Athletics published by The Athletics Congress. The complete text is available from TAC/USA Book Order Department, P.O. Box 120, Indianapolis, IN 46206 for $6. The text includes Rules of Competition for men and women for Track and Field, Long Distance Running, and Race Walking — Senior, Junior, Youth Athletics, and Masters — and World and American Records. The rules listed here pertain directly to the sport of road racing and are referred to in the body of the text.

Many of the rules cited may seem to pertain only to track events and, indeed, they were so intended. In lieu of specific rules governing road races in many of these cases, the cited rules serve as the authority for procedures and decisions. Study these rules and imagine how the INTENT of these rules can be applied to road racing.

In particular, note Rule 60 regarding the start. There are provisions you could find useful in a road race should you need to deal with a disruptive runner at the start. If you can disqualify such a competitor, ACCORDING TO THE RULES, you will be in better shape than if you simply threw him/her out of the race.

RULE 34
JUDGES AT FINISH

1. (a) There shall be four or more judges at the finish, one of whom shall be designated as Chief Finish Judge, who shall decide the order in which the competitors finish in their competition. The Chief Finish Judge shall only observe the finishes and his decision shall be given only in the case of a tie vote on the part of the other judges. In case of a disagreement, the majority of the judges concerned with the disputed place or places shall decide, and if there is a tie vote on the part of such judges, the Chief Finish Judge shall decide.

   (b) Where an approved photographic device is properly used at the finish of an event, the film or photograph must be referred to a Photo Finish Panel for review of the finishes before a final decision as to the order of finish is arrived at. No announcement as to the order of finish should be made prior to such review.

2. The decision of the judges as to the order in which the competition finished shall be final and without appeal unless the photograph of an approved photographic device is referred for review and determination to a photo finish panel.

3. When possible, judges and timers shall stand at least sixteen feet back from and in line with the finish and where possible, on an elevated platform.

RULE 37
TIMERS

1. Two methods of timing are official, hand timing and fully automatic timing as set forth in Rule 38. A timing device which operates automatically at either the start or finish, but not at both, shall be considered to produce neither hand times or fully automatic times and should not be used to obtain official times.
2. Hand times shall be taken by using either stopwatches or manually operated electronic devices with digital readouts.
3. At every meet, a certified official shall be designated by the Games Committee as Chief Timer.
4. The Chief Timer, among other things, shall:
   (a) Determine that all running and walking events are timed in accordance with these rules.
   (b) Assign to timers their assignments.
   (c) Supervise the recording of all times taken.
   (d) Acquaint himself with the records for the events to be timed, so an immediate check can be made in the event of record performances.
   (e) In the event of a record performance, inspect the watches of the timers involved and to certify on the official record application form the times recorded by such timers, who shall also sign the record application form.
   (f) When feasible, examine all watches, prior to competition, to determine their accuracy.
5. There shall be three Official Timers and one or two Alternate Timers, who shall time the winner of each event. The time recorded by the Alternate Timers shall not be considered unless one or more of the Official Timers' watches fails properly to record the time, in which event the Alternate Timers shall be called upon in such order as previously determined, so that, if possible, in all races three watches shall have recorded the official winning time. When feasible, additional timers should record times for the second and subsequent places, lap times in races of 800 meters and over and times at every 1000 meters in races 3000 meters and over.
6. The time shall be taken from the flash/smoke of the pistol or approved apparatus to the moment at which any part of the competitor's body (i.e., the "torso," as distinguished from the head, neck, arms, hands, legs or feet) reaches the perpendicular plane of the nearer edge of the finish line.
7. If two of the Official Timers' watches agree and the third dis-

agrees, the time shown by the two shall be the official time. If all three watches disagree, the time shown by the watch recording the middle time (not the average of all three) shall be the official time. If for any reason only two watches record the time of an event, and they fail to agree, the longer time of the two shall be accepted as the official time.

8. (a) For all hand-timed races on the track, the times shall be returned to 1/10th second. The times for races partly or entirely outside the stadium shall be converted and recorded to the next longer full second, i.e., for the Marathon 2h.09:44.3 shall be recorded as 2:09:45.
   (b) If the hand of the watch stops between two lines indicating the time, the longer time shall be accepted.
   (c) If a 1/100th second watch or an electronic manually operated digital timer is used, all times not ending in zero in the second decimal shall be rounded to the next longer 1/10th second, i.e., 1:45.21 shall be read and recorded as 1:45.3

RULE 60
METHOD OF STARTING

(excerpts)

1. The start of a race shall be indicated by a line marked on the track not more than 2 inches wide (51 millimeters). When starting, all competitors must be behind the starting line and they must not touch the starting line or the surface in front of it with their hands or feet.
2. Except for time handicap races, all running and walking events shall be started by the report of a pistol or any similar device fired upward after all competitors are steady.
3. . . . . In races longer than 440 yards in outdoor competition and 600 yards in indoor competition, the commands shall be "On your marks" and when all competitors are still, the pistol shall be fired. In time handicap races, the command "Go" may be used.
4. Prior to each running event, the starter shall give instructions to competitors concerning the commands to be used.
5. Where a pistol is used, it should be of not less than 32 calibre, with powder giving a distinct flash/smoke, and so held as to provide a background against which the flash is clearly discernible.
6. All questions regarding the start shall be decided by the Starter.
9. If a competitor after the command "On your marks," disturbs other competitors in the race through sound or otherwise, it may be considered a false start.
10. On the command "On your marks" or "Set" as the case may be,

all competitors shall at once and without delay assume their full and final "set" position. Failure to comply with this command after a reasonable time shall constitute a false start.

11. (Note that it is deemed impractical to comply with the intent of this rule in road racing.)
12. No penalty shall be imposed for the first false start but the Starter shall, except in the combined events, disqualify the offender or offenders on the second false start.
14. Should the Starter have occasion to warn the competitors on any point, or is not satisfied that all is not ready to proceed after the competitors are on their marks, he shall order the competitors to "stand up."
15. The Starter will forthwith report to the Referee any misconduct by any contestant at the start. The Referee shall have authority to disqualify or otherwise punish such contestant.

RULE 64
THE FINISH LINE

1. The finish line shall be a line drawn across the track surface from finish post to finish post.
2. For the purpose of aiding the judges, but not as a finish line, there shall be stretched across the track at the finish, 1.22 meters (4 feet) above the ground and directly over the finish line, a worsted string or thread or tape of material which will not tend to injure the runners when broken by them. This worsted string or finish tape shall be held by officials other than the judges or by releasing clamps fastened to the finish post on either side, so that it will be always at right angles to the course and parallel to the ground. It is recommended, that when there is fully automatic timing, that the worsted string or tape not be used.
3. The finish posts shall be of rigid construction, 1.37 meters (about 4 feet 6 inches) in height, 7 centimeters (about 3 inches) in width- and by width is meant the direction at right angles with the track- and 2 centimeters (about ¾ inch) in thickness.
4. The finish line on the track surface, while theoretically of no appreciable width, must actually have some width, to the end that the same may be more readily observed. This line should have a width of 5 centimeters (2 inches).

RULE 65
THE COMPETITION
(excerpts)

4. Any competitor jostling, running across, or obstructing another competitor so as to impede his progress shall be liable to disqualification. . . . .

5. (a) Except as provided in road races (Rule 132) and in long distance walking events (Rule 150), during the progress of an event, a competitor who shall receive any assistance whatsoever from any person may be disqualified by the Referee. "Assistance" includes giving help or conveying help to an athlete by any means including a technical device. It also includes pacing in running or walking events by persons not participating in the event or by lapped competitors or by any kind of technical device.

   NOTE: Effective 1985, pace setting by a person placed in an event for that purpose is no longer prohibited.

   (b) A hands-on medical examination during the progress of an event by officially designated medical personnel shall not be considered unfair aid or assistance.

6. Medical personnel, authorized by the Games Committee of Referee to do so, has authorization or the authority to examine any athlete who appears in distress, and, in that official's opinion it is in the athlete's health and welfare, may remove the athlete from the competition.

7. In a track event, any competitor competing to lose or to coach another competitor shall forfeit his right to be the competition and shall be disqualified.

10. (c) In international qualifying road races and all race walking events of 20,000 meters or more, a competitor may leave the road or track with the permission and under the control of a judge or other authorized official, provided that by going off or returning to the course he does not lessen the distance to be covered.

11. Any competitor who shall refuse to obey the directions of the Referee or other proper official, or who shall conduct himself in an unsportsmanlike manner, or who is offensive by action or language to the officials, spectators or competitors at any competition conducted, may be disqualified by the Referee from future competition at the meet, and if the Referee thinks the offense worthy of additional action he shall promptly make detailed statement of the offense to the appropriate Registration Committee.

RULE 72
NUMBERS
(excerpts)

1. Every competitor must be provided with numbers which must be conspicuously worn by competitors when competing. No athlete shall be permitted to participate in any competition without the appropriate number or numbers.

4. In cross country, long distance runs and race walks, the compet-

itors must wear a number on the front and should also wear a number on the back. The front number must be visible at all check points and at the finish line.

6. Once a number has been assigned to a competitor, no other competitor may use it.

APPENDIX B
GLOSSARY OF TERMS

Alternate Watch: a watch which is designated as a back-up for an official watch in the event the official watch fails (see TAC Rule 37.5).

Arrival Rate: the rate at which runners arrive at the finish line (in runners per minute).

Automatic Timing: any method of timing that does not rely on human reflexes to produce time, i.e., both the start and finish must be automatic.

Auxiliary Watch: any timing device which is not an "official" or "alternate" watch (see Official Watch).

Awards Search: any system designed to identify those runners qualifying for awards.

Bar Code: standard set of vertical lines used to convey bib-number information directly to a computer.

Batch (of runners): a group of runners that finishes and enters the same processing chute between successive switches in the multi-plex system.

Bib-Number: aka "competitor" number, that number worn as identification by a runner which should be worn on the runner's FRONT.

Card: any hand-carried item, not intended to be peeled or spindled, that carries finish order information, e.g., a place card.

Chute Build-Up: the build-up of runners waiting to be processed in the finish area (in numbers of runners).

Chute Captain: worker assigned to direct the opening and closing of processing chutes in the multi-plex system.

Chute Cards or Tags: used for opening (Chute Open Card or Tag) or closing (Chute Closing Card or Tag) processing chutes between switches in the mulit-plex system.

Chute Card Director: worker assigned to hand Chute Open Card to Chute Plug.

Chute Monitor: workers assigned specifically to insure that runners do not change positions in the processing chutes before the proper finish order has been recorded.

Chute Plug: worker assigned to "plug" the entrance to closed processing chutes and, when that chute is opened, to carry the "chute open" tag or card down the chute, leading the runners through the chute.

Color Coding: a system of assigning different color identifications to each age/sex division to assist in the "awards search".

Deceleration Zone: aka "funnel" area, the zone between the finish line and the head of the processing chutes in which runners slow from their running speed to a walking speed as they enter the processing chutes.

Digital Display Clock: an electronic timing device which displays times in the form of 6 to 9 inch high numerals suitable for viewing from a distance, usually battery operated.

Digital Watch: an electronic timing device in the form of a hand-held watch or a wrist watch which provides a digital time display, usually as a liquid crystal display (LCD).

Electronic Timing Device: any timing device which relies on an electronic circuit (quartz crystal) to provide times.

Entry Blank: that part of the entry form to be filled out by the entrant.

Entry Roster: list of race entrants in either alphabetical or bib-number order.

Finish Line Back-Up: when the queue of runners awaiting processing extends back to and across the finish line (to be avoided).

Finish Line Sub-System: that part of a finish line system that is designed to provide a specific set of information, e.g., a list of places and finish times.

Finishing Speed: the speed at which a runner finishes the race (in meters per minute).

Hand-Out System: any system for recording finish order that relies on "handing" something to the runner.

Hand Timing: any method of timing that relies on human reflexes to produce finish times.

Ideal Chute Length: that chute length required to keep the finishers walking past the recording station at the same rate they are being recorded.

Interloper: aka "unregistered runner," aka "turkey," aka "bandit," a term used to refer to a runner who "participates" in a race without officially entering the race.

Interpolated Time: a time assigned to a finisher that does not represent a time actually recorded at the finish line.

Lap Time: the time elapsed since the last "lap," i.e., each time a lap time is displayed, the running watch automatically resets to zero. Note that digital display watches that offer only "split" times may erroneously refer to split times as lap times. (see Split Time).

Late Registration: refers to registration just prior to the race which is not early enough to prepare race packets for as in "pre-registration".

Letter Coding: a system of assigning letter/number codes to each age/sex division to assist in the "awards search".

Mechanical Watch: any timing device which relies on mechanical movements such as a pendulum driven by a wound spring.

Mega-Race: a term used to describe any very large race, usually with more than 10,000 entrants.

Mixed Race: a race in which both men and women compete.

Modulating Rope: a moveable rope used in the pre-finish area to modulate the number of runners choosing different finish lines in the "toll-booth" method.

Multi-Plex Method: any finish system that uses more than a single processing chute for a given finish line.

Normal Distribution: aka "bell-shaped" distribution, a convenient description of the number of runners finishing as a function of finish time.

Number Blocking: a system of assigning bib-numbers according to the age/sex division to assist in the "awards search".

Official Timer: any of the two or three persons designated to operate an official watch.

Official Watch: any one of the two or three watches designated as official PRIOR to the start of the race and started at the race start OR the designated alternate in the event of failure of a designated official watch.

Official Winning Time: the time reported by the slower of two official watches or the middle watch of three for the winner, in accordance with TAC Rule 37.7.

Pace Sign: a sign used at the start of large races to help runners line up by estimated finish time, keeping the fastest runners at the starting line and progressively slower runners toward the rear.

Packet Pickup: refers to that place and time where pre-registered runners may pick up their "race packet".

Parallel Processing: any method of processing two or more streams of runners simultaneously.

Peak Arrival Rate: the highest arrival rate or rate that runners cross the finish line that occurs in a race (in runners per minute).

Place Card: a 3x5 card with the finish place written or printed on it, usually handed to each runner as they finish.

Place Board: a large, rigid board with pre-marked boxes on which place cards are affixed for the awards search and/or results display.

Place Stick: a tongue depressor on which the finish place has been written, usually handed to each runner as they finish.

Position Shifting: when one runner passes another runner AFTER finishing the race but BEFORE the proper finish sequence has been recorded.

Pre-Race Registration: refers to those runners who register in advance, usually by mail, for whom race packets are prepared.

Primary Timing System: that system used to time the majority of your runners.

Printing Timer: an electronic timing device with printed output which documents places and times in response to manually depressing a remote timing button. Some models are capable of timing multiple finish lines and print the place and time for each finish line as well as the overall place.

Processing Chute: a chute in the finish area used to control runners before and while their finish order is being recorded.

Processing Rate: the rate at which runners are "processed" in the finish area (in runners per minute) which may include timing or recording.

Pseudo-Starting Line: a "fake" starting line, prominantly marked 5 to 30 meters BEHIND the true starting line, used to help manage the start in large races.

Pull-Tag: any "tag" designed to be "pulled" or taken from the runner which is usually attached to or a part of the bib-number.

Race Flyer: that part of the entry form which contains the information you wish to convey to prospective entrants.

Race Packet: the envelope containing a runner's bib-number and other items to be distributed to the runner prior to the race.

Real Times: as opposed to "interpolated" times, those times actually recorded at the finish line.

Reliability: a term used to describe the accuracy of the information that is being recorded.

Robustness: a term used to describe how well the information gathered at the race finish will survive normal errors and accidents.

Running Time: any time that is read from a "running" watch whose display is not "frozen" to permit reading of fractions of seconds.

Secondary Rope: a moveable rope located in the deceleration zone used to open and close processing chutes (but not used for switching) in the multi-plex system.

Seeded Runner: a "top" runner for whom you may wish to provide a place on or just behind the starting line.

Seeding: a process of segregating runners on the basis of projected or estimated finish times PRIOR to the race.

Select Timing: aka "synch" timing, aka "tic-sheet" timing, aka "random" timing, aka "check" timing, any system of timing that directly matches finish times with specific runners (by name or by bib-number).

Select Timing Only: a method of timing only selected finishers and then "interpolating" times for the rest of the finishers.

Sequential Processing: any method of processing runners that is limited to processing them one-at-a-time in their order of finish (not the same as sequential timing).

Sex Separator: a worker assigned in the pre-finish area to direct male and female runners to different finish lines.

Single-Sex Race: a race in which EITHER men or women compete but not both.

Spindle: a device used to hold the tags gathered at the end of the processing chutes, in their proper sequence.

Split Time: aka cumulative split time, refers to a time for which the display is frozen but the option to return to the "running" time is available. Note that digital watches may offer both a "lap" time and a "split" time. In this case, the split time may be referred to as a "cum" time.

Stanchion: a sturdy support post, roughly one meter in height, used to define the deceleration zone and processing chutes.

Starting Pistol or Horn: that pistol or noise-making device used to start the runners.

Stopped Time: any time taken where the watch is actually stopped, i.e., the display is frozen AND the running time is stopped.

Substitute Runner: a worker who takes the place of a runner requiring medical attention or a wheel-chair finisher.

Substitute Tag: tag used to identify registered runners who for whatever reason do not have a pull-tag.

Switching Rope: a moveable rope located in the deceleration zone used to switch runners from one processing chute to another in the mulit-plex system.

Tag: any item designed to be "spindled" or peeled and affixed to something else, e.g., to a place card.

Take-From System: any system for recording finish order that does not hand something to the runner but rather takes something attached to the runner.

Tic Sheet: a sheet used for timing that is arranged in columns with a space for "tic" marks or "bib-numbers" next to each numbered second.

Time Tag: a tag on which a finish time has been written, to be spindled in sequence with the finish order.

Toll-Booth Method: any finish line system that employs two or more finish lines with a SINGLE processing chute for each finish line.

Walk-Thru Rate: the rate at which runners can WALK THRU or walk past a given point (in runners per minute).

Walk-Thru Speed: the speed at which runners can WALK THRU or walk past a given point (in meters per minute).

Wave Start: a starting system which employs several sequential starts, each start comprising a fraction of the total field of runners in the race.

Worker Lane: a lane, one to two meters in width, located between processing chutes for the chute workers to stand or sit.

THE *lowest cost* SOURCE FOR

RACING BIBS

We Supply the Major Shoe Manufacturers, the Major Race Directors, and Especially the Hundreds of Individual Races Held Each Week Around the World.

in a JAM?

We're Quick. ***And,*** *we save you money!*

Call *STEVEN* at

1-800-442-2677

In Oregon call: (503) 228-7373

RACE SYSTEMS MARKETING

1410 NW JOHNSON · PORTLAND, OREGON 97209 · 503 228-7373