

TAG Heuer CP520 Timebase

TIMEBASE OVERVIEW

The CP520 is a time-of-day-based stand-alone timing calculator and recorder. Once its internal clock has been started, the CP520 can capture timestamps for start and finish events on separate input channels (1 & 2). In “auto-numbering” mode, the CP520 attempts to assign expected racer numbers to the captured start and finish times-of-day. Elapsed times are calculated by subtracting paired start and finish times.

The CP520 features an LCD (display) and also a thermal printer, which is inkless and produces smudge & water-proof print. The printer can be used to continuously record the events of the race as they happen. An internal flash memory will store up to 8000 captured times and retain them after the power has been turned off. If desired, the contents of the memory can be dumped out, either to a PC or to the printer (be aware of paper-usage if you do this).

The CP520 is designed to work properly down to -20C (-4F), but should be kept from getting wet.

TIME-OF-DAY BASICS

In time-of-day based timing, a clock is started and is kept running through the duration of the race. For every start event that occurs, a snapshot time is captured for it from this clock. Likewise, a time is captured for every finish event that occurs. Elapsed times are derived by simply subtracting paired start and finish times.

The FIS standard is to measure start and finish times to 1/1000th resolution, combine them and truncate the result to 1/100th resolution. For example:

Start time of racer #10: 1:34:56.136
Finish time of racer #10: 1:35:59.354
RESULT: 1:03.21

(Note: The actual subtraction of 1:03.218 was truncated down to the nearest 1/100th.)

Any racers that end up with the same time to 1/100th resolution, using the above method, are considered tied. This is true even if timing information is available to 1/1000th resolution that might otherwise appear to differentiate the racers.

The CP520 has several timing style and resolution modes. The one that corresponds to the given FIS standard is “CHRONO” = Net time and “PRECISION” = 1/100 sec.

The CP520 timebase records start events on its channel one and finish events on channel two. In auto-numbering mode, it will assign expected racer numbers to any start/finish events that are detected. It is the job of timing officials to monitor the assignment of these racer numbers to the captured start and finish events and either accept or overrule them to ensure they are correct. The CP520 allows easy override and/or correction of racer numbers as necessary.

POWER INFORMATION

The CP520 is powered by 5 AA batteries, located in the bottom of the box. When inserting batteries, make sure they are straight and properly seated. I recommend “rolling” the batteries to help ensure good contact and to check that the retaining springs are well-centered on the battery terminals.

The printer is the biggest power consumer. When power is low, the CP520 will first automatically operate the printer at a slower speed. When the power is very low, the printer will eventually turn itself off, which is equivalent to a low battery indication. At this point, there are about two hours of timing capacity left, using the LCD screen only. All results captured during this time automatically get printed out once the batteries are replaced.

To maximize battery life, proper attention should be given to use of the printer. While it is certainly ok to keep the printer turned on continuously during racing, unnecessary printing of “rank results” or “dumping” of race events to the printer should be avoided. It is important to note that power will be consumed by the thermal head of the printer even when it is not actually printing. Once the CP520 clock has been initialized before the race, make sure the printer is OFF until racing starts (which could be some time later). The printer should also be turned off between runs, and during extended race down times. The ON/OFF control for the printer is an item in the Functions menu.

Turning off the box or replacing the batteries will cause loss of the running clock time! To avoid this having to happen in mid-race, it is recommended that a fresh set of batteries be installed for each race day. In practice, it has been found that a single set of batteries is easily sufficient for two runs of about 100 racers each, if reasonable attention is paid to use of the printer. High quality batteries such as Duracell Ultra are recommended.

HOOK UPS

All hook ups to the CP520 are made at the front end of the box. The inputs marked “1” are for the impulses from the start gate. When the radio is used to transmit start signals to the finish, the green & black “A” outputs from the radio receiver are connected to the green & black “1” inputs of the CP520. Alternately, when using a hard-wired start-to-finish connection (not using the radio), the two output wires from the start gate are simply connected directly to the “1” inputs. It is advised to observe the green & black polarity of the start gate outputs by establishing and maintaining the identity of the wires that connect to the start gate.

The inputs marked “2” receive impulses from the finish line. The green & black outputs of the Tag Heuer strobe box are plugged into the green & black “2” inputs of the CP520.

The “computer” plug can be connected either to a PC or to an electronic display.

The “power” plug allows connection to external power, if available, through a 12V DC adapter (which we did not buy).

We will not be using the “ST/SP/RS” plug. This is an alternate start/stop/reset port for inputting timing data.

TURNING THE BOX ON & OFF

The CP520 is turned ON by pressing and holding the ON button for several seconds. To prevent accidental shutting off of the box, there is no OFF button. The box is turned off from within the Function menu.

When the box is powered on, it will display the status of its internal settings (called “parameters”). If the printer has been enabled, this information comes out on paper. For Metro races, if parameters are set properly, the information appearing after the “CHRONOPRINTER 520 VERSION 1.7.e” header should look like this:

	-- Which means:
CHRONO: NET TIME	(FIS style of time-of-day timing)
PRECISION: 1/100 SEC.	(Resolution of the calculated elapsed times)
NUMBERING: AUT. UP	(Automatic incrementing of bib numbers)
LOCK TIME START: 1.0	(dead time, in seconds, after an initial input)
LOCK TIME FINISH: 1.0	(““““)
OUTPUT TO: DISPLAY	(enable transmission to the electronic display)
DISPLAY DELAY: 10 SEC.	(The duration that a finish time is shown on the electronic display before reverting to the running time again-- note, this is a separate setting from the “LCD delay”)

If the printer has not been enabled on power-on, the parameter settings can be displayed on the LCD screen by pressing the key that is indicated.

Any parameters that differ from above can and should be reset from within the Function menu.

After the parameter settings are given, the box will indicate the number of the run and the amount of remaining memory storage (max. 8000). The memory should be cleared (erased) if the remaining storage is less than 1000, to make sure you have enough for two runs.

OVERVIEW of KEYBOARD

ON	Turns on the box (press it until the LCD goes active).
F	Gets you to the FUNCTION menu.
E1	For entry or querying of channel one (start) information.
E2	For entry or querying of channel two (finish) information.
R	The Recall button, used in conjunction with E1 or E2.
*	A cancel key used in conjunction with E1 or E2. Also can act as an enter/confirmation key or a character erase key.
#	An “enter” key to confirm entries.
green “1”	Manual entry of channel one impulses.
green “2”	Manual entry of channel two impulses.
left red	Blocks or unblocks channel 1 input impulses.
right red	Blocks or unblocks channel 2 input impulses.
green down key	Disidentifies the racer number expected at the start. Also acts as a display scroll key.
green up key	Disidentifies the racer number expected at the finish. Also acts as a display scroll key.
up-arrow key	Advances the printer paper (you can also just manually pull the paper up without causing any harm to the device).

SETTING THE CLOCK

After powering on, the CP520 will ask you to input the start time for the running clock. Some race organizations will set this to be the same as “wall clock” time, which is a very practical point of reference. We will be using the default start time of 00:00 (in hours:minutes), to enable easiest synchronization with our stopwatches, which are limited to a start time of 00.00 by design.

PRESS the # key to accept 00:00 as the start time.

The CP520 display will now indicate “Ready for Synchro”.

The clock will start running once an impulse is received on either channel “1” or “2”. The easiest way to accomplish this is by pressing the green “1” or “2” manual input buttons. This should be done simultaneously with the starting of the stopwatches. It is desirable for the manual handtime stopwatches (which are also time-of-day based) to be synchronized as closely as possible with the electronic timing clock. If both the electronic and manual clocks are on the same timing basis, this allows them to be used as a reference for each other. This can help resolve any confusion that may arise during the race in operating either set of clocks.

STARTING AND RUNNING THE RACE

Once the clock has been started, it will be shown continuously running at the top of the LCD screen. The on-deck racer number is always shown on the second line, on the left-hand side. For a fresh run in auto-numbering mode, the number would start at “1”. This can be changed by simply entering the desired racer number, followed by “E1”.

When dashed lines appear to the left & right sides of the running clock, this means that the start (left) and finish (right) channels are blocked from receiving input impulses. These input blocks are turned on and off using the left and right red buttons on the bottom of the keyboard. This blocking function should be applied whenever you do not want extraneous inputs to get captured by the CP520, such as when start gate and finish strobe are being set up, or in between runs, when people may be freely crossing the finish line. Be sure to turn the input blocks OFF when you are ready to test the equipment setup or run racers! If the inputs are unintentionally blocked during the race, you will miss capturing an electronic time for a racer!

To easily distinguish the forerunners from the rest of the racers and to capture and retain a record of their results, enter “1001 + E1” as the starting number. When foreruns are complete, key in the correct initial number for the first racer.

(Note: Per OISRA & Metro rules, the times for forerunners should not be announced or published. Be sure to have the electronic display turned off for the forerunners.)

When a racer starts, his/her number will be popped to the bottom left of the LCD screen, with the running time to the right. Note that the on-deck racer number automatically increments by one. If a second racer starts, the number and running time will be displayed above the first racer on course. There is room for two on-course racers to be shown on the LCD screen, although the CP520 can track many more simultaneous racers than that. The running time of the next racer expected to finish will always be shown on the bottom line. Note that each time there is a start event, the racer number and time-of-day timestamp gets printed.

When a racer finishes, the racer number, current rank and the calculated elapsed time are displayed on the bottom line of the LCD. This lasts for a selectable duration (usually set to seven seconds), after which the running time of the racer next-expected to finish is reverted to. If the electronic display is used, the elapsed time is transmitted to it and retained for the specified “Output Delay” (metro has selected 10 seconds duration for this). Each time there is a finish event, the racer number and time-of-day timestamp also generate a printed line to paper. The current rank number and calculated elapsed time get printed on the following line.

Note that with “Net Time” chrono mode and “1/100” precision, the times-of-day on the printed strip will be in 1/1000 resolution, and the elapsed times will be given to 1/100.

BASIC RACER NUMBERING and CONTROL

In auto-up numbering mode, the CP520 assumes that the on-deck racer uses the next available unused number that is above the last racer that started. The start numbering is easily controlled by entering “racer number” + E1 (prior to a racer starting). For example:

	<u>Action</u>
The first racer is number 1:	enter 1 + E1
The next two racers come in order (2 & 3)	do nothing
The next racer is number 5	enter 5 + E1
The next 4 racers are 4, 6, 7 & 8	enter 4 + E1 (do nothing for others)
Racer 9 is DNR, next one is 10	enter 10 + E1
Following racers are in order after that	do nothing

All of these actual start numbers need to be radioed from the start line to the finish line for entry into the CP520. The timing official at the finish line should always compare the on-deck bib number announced by the starter with that displayed by the CP520, before the racer is released, and correct it as needed.

If the above racer sequence were to proceed uninterrupted and in order through the finish, no further CP520 entries would be required. The times-of-day captured for all finish events would automatically be associated with the correct racer numbers, as long as they occurred in the same sequence that they started.

COMMON RACE OVERRIDE EVENTS

- > Start wand gets tripped by accident (as in a false start):
 - Enter => * + E1 (this backs out the last start event)
- > Out-of-order bib number at start line:
 - Enter => Number + E1
- > Finish line gets crossed by a non-contestant, while racer is on course:
 - Enter => * + E2 (this backs out the last (false) finish event)
- > Finish line gets crossed by non-contestant when no one is on-course:
 - => No action needed. A finish time-of-day will be captured, but it is not attached to any racer number and is harmless.
- > Racer is DNF:
 - Hit Green-2 (this manually finishes the racer-- a quick way to get them “off course”)

The above cases are simple ones that can (and should) easily be corrected as a race is in progress. There are more complicated things that can go wrong during a race, of course, where the timing operator may get confused enough to not be able to quickly fix them. The important thing to remember is that as long as a valid electronic start and finish timestamp is identifiably captured for a racer, an electronic elapsed time will always be available for that racer (even if the start/finish timestamps need to be manually subtracted to get it)! The only time a handtime should be necessary is if the electronic start or finish event is not captured at all, or if for some reason, an electronic start/finish event cannot be associated with a racer with certainty.

In the case of complicated and confusing racing mix-ups, how to “fix” them can become a question. Although it is possible to remedy virtually anything in the electronic timing record, particularly using the manual timing information as a reference, the best advice when something amiss is noted in the race sequence is to first focus on ensuring that the record for the current racer (the one next expected to finish) is going to be captured correctly.

While the electronic record can be reconstructed and corrected for earlier racers, often the most expedient way to handle things is to not bother with this and simply make written edits on the paper tape (accompanied by a separate page of explanatory race notes). Such edits can be as simple as crossing out an incorrect racer number and writing in the correct one. Don’t expend a lot of effort trying to clean up the electronic record. It is unnecessary and only adds clutter to the paper tape (every timestamp entry, manual or otherwise, always gets recorded on the tape, along with associated “correction” and “subtraction” notations). It is also difficult to make complicated corrections to the electronic record while the race is in progress. It is easy to make mistakes under pressure and damage the electronic record rather than improve it.

The reason it doesn’t matter that the electronic record in the CP520 is “perfect” is because our data handling procedures (in metro) call for transferring the raw timing info into a separate timing processing program (Skimaster) where it is reviewed, cleaned up and the final results are generated. Of course, the cleaner the CP520 record is, then the more useful that features such as the automatic “rank list” become. But, the minimum and sufficient requirement is that electronic start & finish times have been captured and can ultimately be identified with the proper racers or, in lieu of this, that manual handtimes are available.

A run should not be considered finished unless it is certain that a valid electronic or handtime has been acquired for every racer that finishes!

It is possible that a confusing race sequence can occur that is difficult to comprehend and account for with hand-written notes on a paper tape. When this happens, it is recommended to halt the race momentarily until the confusion can be sorted out (using the manual handtimes as a reference, as necessary). Another reason for doing this is that whenever you are making lengthy race number or timing changes in the function menu, it will interrupt whatever is being shown on the electronic display (such as the running time for the current racer).

Following are some more complicated examples of race sequence confusion, along with how they could be electronically “fixed” by the timing operator. Again, it is recommended that complicated corrections are not necessary to attempt during a race, so these are given mainly for reference and to demonstrate some of the capabilities of the CP520. These are not necessarily the only ways to respond to the given events.

> Racer #1 is DNF, but it is not realized at the finish line in time. Racer #2 finishes, but the time gets captured as Racer #1:

Enter => 1 + R + E2, (this recalls the finish time for racer #1)

then 2 + # (this assigns it to racer #2)

Enter => 1 + R + 0 (this cancels times for racer #1, the DNF, from the record)

Note: in this case, the initial elapsed time that gets displayed for racer #2 at the finish will be incorrect, since it would get matched with the start time for racer #1. If you had been able to manually finish racer #1 before racer #2 finished (with Green-2 button), you could avoid this.

- > Racer #48 finishes with start and finish times captured under that number, then you realize it was really Racer #43:
 - Enter => 48 + R + E1, then 43 + # (this assigns start time from 48 to 43)
 - Enter => 48 + R + E2, then 43 + # (this assigns finish time from 48 to 43)
- > Racer is approaching finish, but you're not sure of the bib number
 - Enter => green up-arrow (this captures the next finish time under no bib number, to be later assigned to the correct bib)

To recall the list of timestamps not associated with any bib numbers:

- Enter => R + E1 (this displays the list of any unassociated start times)
- Enter => R + E2 (this displays the list of any unassociated finish times)

When the lists are displayed, you can attach racer numbers to them, if needed.

For manual entry of times (the ultimate in timing control):

- Enter => F (function menu)
- Select "Insert time" + #
- Select "Start" or "Finish" + #
- Enter => Racer number
- Type in the complete time-of-day + racer #.
- (A scenario where this might come into play is to restore, from the paper tape record, an electronic timestamp that had been accidentally deleted.)
- Note: "*" will let you erase and re-enter time entries.

DATA / RUN MANAGEMENT

** Quick Rank Printout **

At any time during the run, a quick printout of the current racer rankings and elapsed times for the active run can be generated by pressing F (function) + "#". Note that if there are errors or missing entries in the recorded race sequence, the rank printout will be accordingly inaccurate.

** Starting a new run **

- Enter F for function menu
- Select "New Run" + #
- Confirm selection with "*" (yes)
- Specify "No Change" to timing mode by entering "#"

==> This starts up a new run while maintaining an already established time-of-day clock.

** Print out of rank for a specified run or two runs combined **

Enter F for function menu
Select “Ranking Run Nr” + #, and respond to instructions

MISCELLANEOUS HINTS & ADVICE

* Radio Interference *

During the 2002 season, interference from our voice radios was observed to cause the CP520 to shut off, specifically if a radio was keyed in closed proximity (within a couple of feet) to the box. When this happened, the box not only ceased to capture events, but also lost the internal time-of-day clock reference that was established prior to the race. While this is very inconvenient, fortunately the inadvertent shut-off had no adverse effect on timing events that were already collected and stored in memory.

In the off season, Metro’s CP520 boxes were upgraded by Tag Heuer with a shielding fix to make them more immune to radiation at typical voice radio frequencies in the U.S. While improvement is expected, it is difficult to prove and it is not guaranteed that the fix will be 100% effective. To be on the safe side, it is generally recommended to avoid transmitting with voice radios when working close to the CP520s.

Note: No radio-induced CP520 shutdowns were observed during the 2003 season.

* Re-starting the CP520 during mid-race *

If the CP520 is shut down or loses power during the race, the running time-of-day reference will be lost. While this may sound like a disaster, you should be able to confine the damage only to the loss of electronic times for any racer(s) on course at the time. It is possible to reestablish the time-of-day in the field by simply using one of the handtime stopwatches. Prior to the race, the stopwatches and CP520 start out with a synchronized time-of-day clock. To recover, re-power up the CP520 (after changing batteries, if necessary) and instead of accepting 00:00 as the start time, enter in the next upcoming hour/minute from the stopwatch. Then, you will be in “Ready for Synchro” mode. Have someone count down the seconds from the stopwatch and press the green-1 button just as you reach the full minute mark. By following this simple procedure, the electronic & manual time systems will be back in sync just as they were before the start of the race. The main inconvenience you will suffer is dealing with any lost times (the remedy would be reruns for the affected racers or accepting handtimes for them). Timing events after that point will also be collected in a separate run number, nullifying use of the rank list feature.

* Lock Times *

“Lock Times” are a programmable duration of time where either the start or finish input channels will ignore stimulus after an initial trigger has been received. For the start channel, this feature would be useful for masking out spurious inputs from wand bounce (which is unlikely to occur with the manual-close wand that we use). For the finish channel, this would prevent multiple timestamps from being captured for a finishing racer (i.e., one for the pole, another for the leg). We use 1 second as a lock time for both start and finish channels. It should be noted that in the event of two racers finishing within one second of each other, the time for the second racer would not be captured.

Note also that the strobe box has its own lock time dial as well. This dial should be set at a time less than one second to allow the CP520 lock time value to control the response at the finish line.

* Missing Start Times *

Using radio transmission from the start gate to the finish, it is possible to occasionally not receive a start impulse at the CP520 (often for reasons unknown). If this happens, the electronic time for that racer is not recoverable and a manual time must be used. The first duty of the timing operator should be to check with the starter and confirm that good start times have been captured and recorded by the manual handtimers. Likewise, a confirmation of good manual times should be made when that racer crosses the finish line.

Electronically, the timing operator can respond to a missing start time event by blocking the finish strobe (channel 2) as that racer approaches the finish line. This prevents an unpaired finish event from being captured and possibly being matched up with another racer on the course. If you do attempt to block the finish strobe input, be alert and be sure to unblock it as soon as the racer has finished, or you will needlessly miss the time for a subsequent racer!

Note: Radio-related missing start impulses are typically isolated incidents. When one occurs, it is recommended to do a test-start, and proceed with the race if successful. If multiple electronic start impulses are being missed, the timing operator should make sure that wire connections are rechecked at both start and finish. Antenna placements should be adjusted if needed.

* Missed Finish Times *

An electronic finish time can be missed if a racer crosses the finish line when the strobe beam has been knocked out of alignment. If this happens, the same thinking applies as to a missing start time-- the timing operator must confirm that good times have been recorded by all manual handtimers at both start and finish line.

* Spurious Finish Times *

It is not uncommon for spurious finish timestamps to be captured. This can happen if the strobe box gets bumped, or if blowing snow triggers the electronic beam. To avoid the latter case, it is advised to never exceed a strobe/reflector spacing of 10m. (A 10m string is provided to measure the distance.) If false strobe triggering happens while a racer is on course, the CP520 will think the racer has "finished". If you are quick enough, you may be able to remedy the technical problem in time to capture a good electronic finish timestamp for that racer. You might not be quick enough to fix the expected bib number before the racer crosses the line, but this doesn't matter (other than that the electronic display result will be incorrect). An electronic elapsed time is still derivable by manually associating the unmarked finish timestamp with the correct racer number. Just mark some edits on the paper tape, and add an explanation to your race notes.

If you have spurious strobe triggering problems while a racer is approaching or crossing the finish line, it may be impossible to identify the correct timestamp as the actual finish event for the racer. In this case, there is no alternative other than to confirm that good handtimes have been captured for that racer at both start and finish lines.

When strobe misalignment develops, it often manifests itself as marginal alignment, and can cause a rapid sequence of finish triggers. If this occurs, be ready to block the finish input channel! This will avoid capturing a bunch of false timestamps and prevent wasting too much paper.

*** Manual Vs Electronic Times ***

During those situations where it is appropriate to artificially “finish” a racer (such as in a DNF), that finish event should NEVER be induced by having someone trip the electronic strobe beam. Instead, the timing operator should manually finish the racer by using the Green-2 button. This ensures that the timestamp will be marked with an “M” on the paper tape, which highlights it as an operator-entered event.

If a racer ends up with only an unpaired electronic start time or electronic finish time available, this time is ultimately unusable. It must not be paired up with a manual hand timestamp to derive the elapsed time. An elapsed time has to be derived either from a pair of valid start and finish electronic timestamps or a pair of valid start and finish hand timestamps. (Note: Handtime usage also involves a separate manual-to-electronic adjustment procedure.)

*** Electronic Display ***

When used, the electronic display will indicate whatever the CP520 tells it to, whether it is correct or not. Although racers, coaches and parents are supposed to know that these times are preliminary and unofficial, it is common for people to treat them as final, since most of the time the displayed results are indeed accurate. The timing operator needs to be aware when electronic display results are going to be missing or incorrect and must let the finish referee know. This way, the racer and other interested parties can be informed on the spot. This courtesy can help avoid confusion about posted results later on.

*** Paper Record ***

The paper tape is an important permanent record of what happened during the race and how any corrections were made to the timing data. You can mark clear, simple corrections on the paper to help keep track of unusual occurrences. Also, write notes on a separate piece of paper to record things that may not be clear from the paper tape, such as “racer such-and-such needs to use handtime”. Your goal should be to leave a record that is possible for the Skimaster data-entry person to interpret without you having to be there to explain it. It is better to write too much rather than too little.

At first, the paper tape record may seem confusing, particularly if unusual race events have occurred or if there have been corrections to race events. A line of data (at least) will be printed for every event, correction or override that takes place. A shorthand code exists to identify different types of actions:

“M1” = The given timestamp was manually triggered by the green-1 button.

“M2” = The given timestamp was manually triggered by the green-2 button.

“C” = The given time was canceled and is erased from the CP520 memory.

“-“ = A disassociated time (such as a backed-out false start or finish impulse)

“*” = Indicates a manually modified racer number.

“+” = Indicates a manually inserted timestamp (should be a rare-to-never event)

8/29/02

Following is a technical discussion of timing precision issues, including some examples justifying the procedure of capturing timestamps to 1/1000th resolution and truncating results to 1/100th.

In the FIS Alpine timing booklet (see www.fis-ski.com), the methods for electronic timing calculations are spelled out in section 611.2.1:

“All time of day times must be immediately and automatically sequentially recorded on printed strips to at least 1/1000th (0.001) precision. (Both) systems must allow for the calculation of net times by the mathematical comparison of each racer’s start time to finish time. The final result for each skier’s run is then expressed to 1/100th (0.01) precision by truncating the calculated net time on course.”

An obvious question to ask would be why not take advantage of the 1/1000 accuracy that is seemingly available, rather than throw it away?

To answer this, the following discussion is presented in defense of timing measurements taken at 1/1000 precision, in order to generate results at 1/100 resolution.

First, a premise: For any measurement made by a timing device, at any resolution, the reported time will by nature be a truncated one. For example, if a stopwatch can report time to a resolution of 1 second, a reported time of 11 seconds would represent an actual time ranging anywhere between 11 and 11.99999999+.... In other words, as long as the next timing increment has not yet been reached, the next lower increment will be reported.

Building on this premise, a practical example using time-of-day methods can be constructed. The timing device in question has the ability to report times to 1/1000 resolution (such as a CP520 timer).

(Case 1)	Measured times reported to 1/1000 resolution	Some actual times that could be the basis of these measurements
start	49.999	49.9999
finish	<u>60.000</u>	<u>60.0001</u>
elapsed	10.001	10.0002

In the above example, a start time-of-day of 49.999 has been reported based on an actual time of 49.9999, which is just below the threshold of being reported at the next increment (50.000). The finish time-of-day of 60.000 has been reported based on an actual time of 60.0001, which barely exceeds the threshold of the reported value of 60.000.

An actual elapsed time calculation yields 10.0002. A calculation using the reported (truncated) times, yields 10.001. In this case, it is seen that by combining the truncated times at the same resolution as they are displayed results in over reporting the time for the given racer--> 10.001 versus the quicker actual time of 10.0002.

This phenomenon is a quirk of calculating elapsed times from time-of-day timestamps, and also of selecting “actual” times that happen to be in proximity to timing boundaries.

Another choice of times shows how a different racer with a slower actual elapsed time could have a faster elapsed time calculated from the reported (truncated) times:

(Case 2)	Measured times reported to 1/1000 resolution	Some actual times that could be the basis of these measurements
start	50.000	50.0002
finish	<u>60.000</u>	<u>60.0009</u>

elapsed 10.000 10.0007

This racer has a slower actual elapsed time than the Case 1 racer (10.0002), but a subtraction taken directly from the reported (truncated) times yields 10.000. Note that the racer in Case 1 had an elapsed time of 10.001, when derived by a direct subtraction of the reported (truncated) times-of-day.

The methodology adopted to avoid this situation is to combine (subtract) the times-of-day at the best reported resolution, and then to truncate the calculated result by one decimal place.

In the example above:

Case 1: $60.000 - 49.999 = 10.001 \implies$ truncates to 10.00

Case 2: $60.000 - 50.000 = 10.000 \implies$ truncates to 10.00

Both racers end up with the same elapsed race time reported at 0.01 resolution. Although this method is unable to distinguish the actual slower racer, it avoids unfairly favoring the slower racer by at least forcing a tie. But, the information that would be needed to identify the true slower racer, namely timing data beyond 1/1000 resolution, is not available.

The need for timing truncation could be considered the one drawback of using time-of-day methodology, since the need arises from taking time snapshots against an already running clock versus directly generating an elapsed time from a zero-point start trigger.

Note that it would be logical to consider that time-of-day based stopwatches are subject to the same drawback of the given example. But, in the FIS timing booklet, section 611.2.2, it also states: "Stopwatches ... that are installed at both the start and finish and capable of expressing times to 1/10th or 1/100th precision qualify as proper hand timing devices." No provision is mentioned regarding truncation of elapsed times calculated from handtimes, although specifications are given regarding the referencing and adjustment of directly calculated handtimes to generate a proper electronic equivalent. I do not know if this apparent inconsistency is by intention or accident.