

Calibration System For Stopwatches

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Stopwatches and other similar timing display devices can be calibrated using three methods: the direct comparison, the totalize method and the time base method¹. In the time base method, the frequency of the time base of the stopwatch, typically a quartz oscillator is measured directly. The time base method has a smaller measurement uncertainty than the other two methods.

In 2012, NML, SIRIM Berhad has developed an in-house designed calibration system for timing devices with displays that have digital seven segment characters on its display. The new system is based on an optical sensor and a dual counter.

An optical sensor (Fig.1) is directed to one of the seven segment characters of the LCD timing display of the stopwatch. When the stopwatch is free running, the counters will flip-flop and take turns on counting the pulses of the 10 kHz reference frequency. The counted pulses are displayed in seconds.

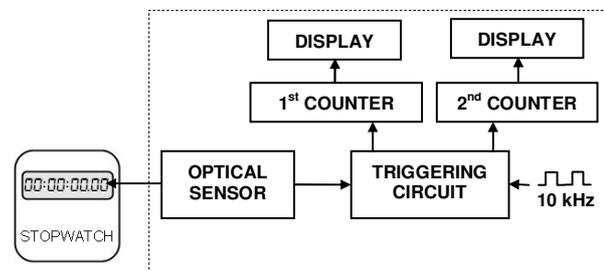


Fig. 1. Stopwatch calibration setup at NML, SIRIM

To evaluate the performance of the NML's calibration system, the method used and the technical competence on stopwatch calibration, a bilateral comparison was organized with the national metrology institute from the Netherlands, VSL. The comparison protocol, traveling standards and evaluation results were prepared by the VSL.

VSL uses a commercial instrument based on the timebase method. The sensor of the stopwatch calibrator (Fig.2) is sensitive to radiation that is commonly emitted from stopwatches. This radiation can be 32.768 kHz (internal oscillator), 32 Hz (LCD display) or 1 Hz (motor). The calibrator is calibrated by applying a known frequency signal derived from a reference standard.

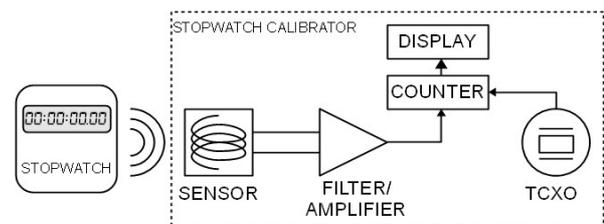


Fig. 2. Stopwatch calibration set-up at VSL

The transfer standards used in this comparison were an electronic stopwatch with LCD display and an electronic wristwatch with LCD display.

The results of the comparison show that there is a good agreement between the two laboratories within the combined relative uncertainty of 0.3 μ s/s on a 1 day interval

¹ Jeff C. Gust, Robert M. Graham and Michael A. Lombardi, "Stopwatch and Timer Calibration (2009 edition),"NIST Special Publication 960-12, 66 pages, January 2009