Speed Accuracy

RoadPod® VT is a time-stamping traffic monitor. The unit contains two pneumatic sensors, and simply logs the time of detected air pulses. The resulting raw data has no concept of vehicles. This provides the MTE® analysis software with unrestricted flexibility.

During data analysis, MTE scans the axle stream extracting groups of axles that belong to a single vehicle. The speed of the vehicle is calculated from the first matching A and B sensor hits, using the simple formula:

$$speed = \frac{sensor\ spacing}{|time\ of\ first\ A\ hit - time\ of\ first\ B\ hit|}\ m/s$$

Measuring uncertainty

When measuring vehicle speed, the uncertainty of error in measurement can be introduced from several sources. Many sources are independent of the RoadPod unit itself and will vary from one survey site to the next. There are two types of uncertainty in the measurement of individual vehicle speed: Random Errors, such as inherent timing uncertainty of the RoadPod VT unit, or Systematic Errors, such as sensor lengths and spacing.

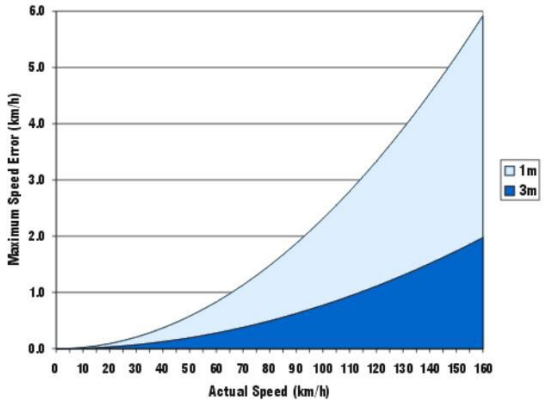
Random Errors occur in any physical measure, usually due to the finite resolution of the measuring device. A large survey approach sample forms a normal distribution around the true value. As the number of samples increases, the average value reaches the true value and the average error approaches zero.

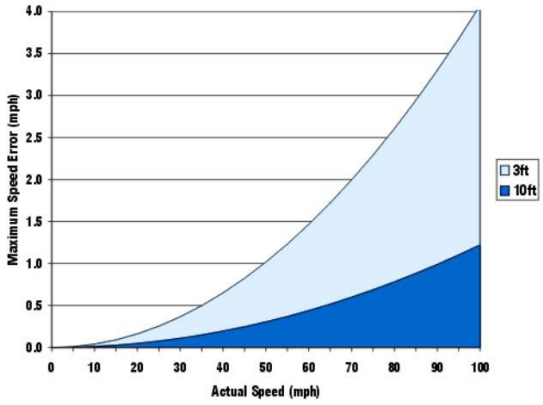
Systematic Errors contribute a fixed error or offset. Gross systematic errors can often be detected, and manually compensated for in the analysis software.

RoadPod VT - Inherent Timing Resolution

Given an ideal sensor installation, the accuracy limiting factor for an individual vehicle is the inherent timing uncertainty of the RoadPod counter. Based on the speed calculation used, the maximum inherent error of an individual vehicle varies with its actual speed.

The RoadPod VT time-stamps each sensor hit with a resolution of 688 microseconds. The graphs below show the effect of this uncertainty on the difference between calculated speed and true vehicle speed, for the given sensor spacings.





At slow vehicle speed, the 688µs of uncertainty is only a very small percentage of the sensor traversal time (between first A and B hits), giving a very small error. Similarly, the traversal time increases along with sensor spacing, thus decreasing timing uncertainty.

MetroCount®

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Systematic Error sources

Given careful site selection and ideal sensor installation, the combined effect of the systematic errors described below can be better than 1%.

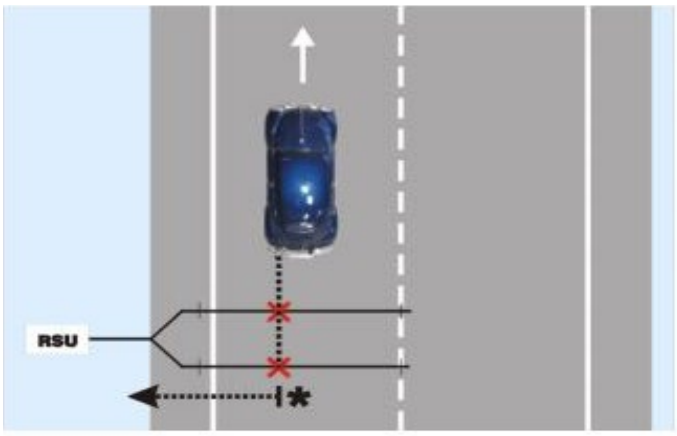
Sensor space

Precise sensor spacing is critical to accurate RoadPod VT operation. If the actual sensor spacing differs from that indicated when setting up the counter, the calculated speeds will be incorrect. This will also affect axle positions within the rest of the vehicle and potentially cause classification errors.

The speed error produced is proportional to the error in sensor spacing. For example, an actual spacing of 10% higher than indicated at setup, will result in speed calculations 10% lower than actual vehicle speed.

Sensor length

Inside pneumatic tubes, air-pulses travel at the finite speed of sound. Thus, a difference in sensor length, between where the vehicle hits the tube and the counter, introduces an additional delay into one channel. The effect on calculated speed is asymmetrical, meaning vehicles travelling in one direction will be too slow, and vehicles travelling in the other direction will be too fast.



Sensor length from the wheel-hit to the Roadside Unit (RSU) must be equal on both sensors.

Relative sensor angle

If the sensors are not parallel to each other, the calculated speed will vary according to the position of the wheel-hit. For example, if the sensors are closer at the curbside, then the calculated speed will be faster for vehicles closer to the curb. Again, percentage error is proportional to the percentage error in the spacing at the position of the wheel-hit.

Angle of vehicle incidence

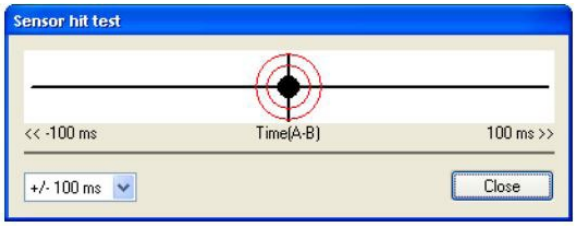
Ideally, vehicles should travel perpendicular to the sensors. If vehicles cross at an angle, the calculated speed value will be less than the actual vehicle speed. An angle of incidence less than 10° gives a maximum error of 1%.

Calibration: survey site

The RoadPod VT is a scientific instrument. Its inherent accuracy, combined with a careful installation, provide an adequate level of precision in measuring travelling speed. However, when the instantaneous vehicle speed is of interest, the installation should be calibrated. Common site calibration methods include radar guns or calibrated vehicle speedometers.

Calibration: RoadPod VT counter

In MTE, the *Sensor Hit Test* provides a simple, yet precise performance evaluation of the unit. Start by attaching the tube to both sensors and then strike their mid-points with a mallet. This should result in a simultaneous hit on both sensors. Any timing discrepancy may indicate a problem with the unit.



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