



Calibration Error Worksheet

CM3215 Fundamentals of Chemical Engineering Lab
Prof. Faith Morrison

The error es is defined as the "best-case" standard error for a quantity as determined for a brand-new unit by a manufacturer or for a particular device by someone with authority to certify the value. For example, the technical specifications of a device may indicate that it is accurate to a value +/- 2es. Alternatively, a value of a constant (the viscometer constant c, for example) may be provided by the manufacturer with no specific uncertainty. In this case, the rule of thumb method of "least significant digit" is acceptable for evaluating the uncertainty. Finally, a user may take steps to calibrate a meter on site; this determination of error (likely to be greater than the "best case" error) has the advantage of reflecting issues associated with the particular unit in question.

Table with 2 columns: Measured quantity and Representative value. Rows include Rigorous Method (Manufacturer maximum error allowable), Rule of Thumb Method (Least significant digit on provided value), Method 3 (User calibration), and a final row for 95% CI Calibration error.



Table 1: Tolerances for Volumetric Glassware (from Fritz and Schenk, Quantitative Analytical Chemistry, Allyn and Bacon, Inc., Boston, 1987 or www.thomassci.com)

Table with 5 columns: Capacity (ml), Pycnometers (Thomas Scientific), Volumetric flasks, Volumetric Pipets, Burets. Rows list capacities from 5 to 1000 ml.

Table 2: Tolerances for Laboratory Meters

Table with 2 columns: meter and reference. Rows include Thermocouple, Thermocouple special limits, RTD, Honeywell STD924 DP meter, and Honeywell Smart Pressure Transmitter Models.



Reading Error Worksheet

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This worksheet guides the user through the determination of the standard reading error and 95% confidence limits for the reading of a scale or from a digital readout. The standard reading error $e_{s,reading}$ may be used in propagation of error calculations of derived quantities.

Device name:			
Measured Quantity: (give symbol)			
Representative value:		(include units)	Quantity, or Not Applicable
issue	contribution to error		
Reading error, e_R :	<i>Sensitivity</i> (from manufacturer or rule of thumb)	How much signal does it take to cause the reading to change?	1
	<i>Resolution</i> : limitation on marked scale or digital readout	Half smallest division or decimal place	2
	<i>Fluctuations</i> with time of observation	(max-min)/2	3
		Maximum of 1, 2, & 3:	$e_R =$
Standard reading error:		$e_{s,reading} = e_R/\sqrt{3}$	$e_s =$ (units)
		95% Confidence Interval based on reading error:	$\pm 2e_s =$ (units)

Note: If a quantity is supplied by, for example, a manufacturer, with no indication of the uncertainty, we do not use this worksheet. Instead, see the Calibration Error worksheet.

Rule of thumb for sensitivity: 1 (optimistic) or 15 (pessimistic) times the last retained digit. The optimistic choice assumes any minor change is sensed; the pessimistic choice assumes that the manufacturer has displayed two uncertain digits.