

Alaska Scientific Crime Detection Laboratory

Controlled Substances Estimate of the Uncertainty of Measurement – Update

Issued: 12/30/2014

Mettler Toledo MS16001L balances

The Controlled Substances discipline weighed check standards on all Mettler Toledo MS16001L model balances utilized in casework. This process is ongoing however the data collected from December 19, 2013 through September 2, 2014 was used for this update report. The ongoing estimation of the uncertainty of measurement test method is documented in the Controlled Substances Analysis Manual in Appendix III. One check standard (powder packaged for suitability) was chosen for the Mettler Toledo MS16001L balances. The check standard is weighted on the balances weekly when the balance is utilized in casework or at a minimum once per month by a member of the Forensic Chemistry discipline.

Changes to previous uncertainty components

Check Standard Reproducibility Data (SD)

A new standard deviation was calculated from check standard data collected from 12/19/13 to 9/2/14. One check standard was used (powder) and measurements were made on both large balances.

$$SD = 0.054796 \text{ g}$$

Display resolution – rounding at zero and at load ($Read_{zero}$ & $Read_{load}$)

No changes were made for these components

Balance Calibration Uncertainty (Cal)

The accredited external calibration laboratory's (Alaska Metrology & Calibration Services) scope of accreditation was updated. Their analytical balance calibration uncertainty for the range "Up to 20 000 g (100 mg)" is reported to be 0.12 g (k=2). Converted to standard uncertainty this is:

$$Cal = 0.12\text{g}/2 = 0.06 \text{ g}$$

Balance Linearity (Lin)

No changes were made for this component.

Reference Value Uncertainty (Ref)

The largest mass used when checking the large balances is 8000 grams. This mass consists of a 1000, 2000, and 5000 gram reference standard put on the balance at the same time. The most recent calibration certificates (Troemner) for these weights were reviewed and the following table summarizes their reported uncertainties (k=2).

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| | 1000 g | 2000 g | 5000 g |
|-------------|----------|---------|----------|
| Unc (mg) | 0.5 | 1 | 2.5 |
| Unc (g) | 0.0005 | 0.001 | 0.0025 |
| Std Unc (g) | 0.00025 | 0.0005 | 0.00125 |
| Std Var (g) | 6.25E-08 | 2.5E-07 | 1.56E-06 |

The reported uncertainties were converted to standard uncertainties (division by k=2) and the combined standard uncertainty was calculated.

$$\begin{aligned} \text{Reference Value Uncertainty (8000 g)} &= \sqrt{0.00025^2 + 0.0005^2 + 0.00125^2} \\ &= 0.001369 \text{ g} \end{aligned}$$

Addition of new uncertainty components

No new uncertainty components were added to the budget.

Combined standard uncertainty using component updates

The following table summarizes changes made to component values and the new estimated combined uncertainty (items that changed are highlighted).

| Uncertainty Component | 2013 | 2014 |
|----------------------------|---------|---------|
| SD | 0.100 | 0.055 |
| Readzero | 0.03 | 0.03 |
| Readload | 0.03 | 0.03 |
| Cal | 0.0007 | 0.0600 |
| Lin | 0.12 | 0.12 |
| Ref | 0.00125 | 0.00137 |
| Combined Uncertainty (k=2) | 0.316 | 0.294 |

Reported uncertainty

The expanded combined standard uncertainty rounded to 1 significant figure is:

$$\text{Expanded Combined Standard Uncertainty} = \pm 0.3 \text{ g}$$

There is no change from the previous expanded combined standard uncertainty from 2013 which is currently being reported.

2014 Uncertainty Update

| Balance ID | Date | 10.0 grams | 100.0 grams | 2000.0 grams | 5000.0 grams | 8000.0 grams | Check STD (grams) | Initials | Weight Set | |
|------------|------------|---------------|----------------|-----------------|-----------------|-----------------|----------------------|----------|---------------|----|
| Styx | 12/19/2013 | 10.0 | 100.0 | 2000.0 | 5000.0 | 8000.0 | 865.4 | AL | II | |
| | 12/23/2013 | 10.0 | 100.0 | 2000.0 | 5000.1 | 7999.9 | 865.4 | AL | II | |
| | 1/6/2014 | 10.1 | 100.0 | 2000.0 | 5000.0 | 8000.0 | 865.5 | AL | II | |
| | 1/30/2014 | 10.0 | 100.0 | 2000.0 | 5000.0 | 8000.0 | 865.4 | JH | II | |
| | 2/5/2014 | 10.1 | 100.0 | 2000.0 | 5000.0 | 8000.0 | 865.4 | CRF | II | |
| | 2/24/2014 | 9.9 | 100.0 | 2000.0 | 4999.9 | 7999.9 | 865.5 | JG | II | |
| | 3/4/2014 | 10.1 | 99.9 | 2000.0 | 5000.0 | 8000.1 | 865.4 | AL | II | |
| | 3/10/2014 | 10.0 | 100.0 | 2000.1 | 5000.1 | 8000.1 | 865.5 | JH | II | |
| | 4/1/2014 | 10.0 | 100.0 | 2000.0 | 4999.9 | 8000.1 | 865.5 | AL | I | |
| | 5/1/2014 | 10.0 | 100.0 | 2000.0 | 4999.9 | 7999.9 | 865.4 | JH | I | |
| | 6/1/2014 | 10.0 | 100.0 | 2000.0 | 5000.0 | 8000.0 | 865.5 | NR | I | |
| | 6/11/2014 | 9.9 | 99.9 | 2000.1 | 5000.0 | 7999.9 | 865.4 | SB | I | |
| | 6/25/2014 | 10.0 | 100.0 | 2000.0 | 5000.0 | 7999.9 | 865.3 | SB | I | |
| | 7/1/2014 | 10.0 | 100.0 | 2000.1 | 4999.9 | 7999.9 | 865.5 | NR | I | |
| | 8/1/2014 | 10.0 | 100.0 | 2000.0 | 5000.0 | 7999.9 | 865.4 | NR | I | |
| | 8/6/2014 | 10.0 | 100.1 | 2000.0 | 5000.0 | 8000.0 | 865.4 | JH | I | |
| | 9/2/2014 | 10.0 | 100.0 | 1999.9 | 5000.0 | 8000.0 | 865.4 | NR | I | |
| | Greed | 12/19/2013 | 10.1 | 100.0 | 2000.0 | 4999.9 | 7999.9 | 865.4 | AL | II |
| | | 12/23/2013 | 10.0 | 100.0 | 2000.0 | 4999.9 | 7999.9 | 865.5 | AL | II |
| 1/6/2014 | | 10.0 | 100.1 | 2000.0 | 5000.0 | 8000.1 | 865.5 | AL | II | |
| 2/5/2014 | | 10.0 | 100.0 | 2000.0 | 5000.0 | 7999.9 | 865.4 | CRF | II | |
| 3/4/2014 | | 10.0 | 100.0 | 2000.1 | 5000.0 | 7999.9 | 865.4 | AL | II | |
| 4/1/2014 | | 10.0 | 100.0 | 2000.0 | 5000.0 | 7999.9 | 865.4 | AL | I | |
| 5/5/2014 | | 10.0 | 100.0 | 2000.0 | 5000.0 | 7999.8 | 865.4 | NR | I | |
| 6/2/2014 | | 10.0 | 100.0 | 2000.0 | 5000.0 | 7999.9 | 865.4 | NR | I | |
| 7/1/2014 | | 10.0 | 100.0 | 2000.0 | 5000.0 | 7999.9 | 865.4 | NR | I | |
| 8/1/2014 | | 10.0 | 100.0 | 2000.0 | 4999.9 | 7999.9 | 865.5 | NR | I | |
| 9/2/2014 | 9.9 | 100.0 | 2000.0 | 5000.0 | 7999.8 | 865.5 | NR | I | | |

| Weight | Mean | SD |
|-----------|--------|----------|
| Check Std | 865.4 | 0.054796 |
| 10 | 10.0 | 0.050787 |
| 100 | 100.0 | 0.03849 |
| 2000 | 2000.0 | 0.041627 |
| 5000 | 5000.0 | 0.054796 |
| 8000 | 7999.9 | 0.084066 |