

Shipboard Analytical Balance: User Guide

Manual Information

Author(s):	H. Barnes
Reviewer(s):	K. Fujine
Manager Approval (Name, Title, Date):	D.J. Houpt, Supervisor of Analytical Systems
Audience:	Shipboard balance users
Origination date:	1/18/09
Current version:	V1.0 8/22/11
Revised:	V1.1 1/7/2014 (IODP-II)
Domain:	Lab, Chemistry
System:	Mass Determination

User Guide Contents

Topic	See page...
<i>Instrument Calibration/Verification</i>	3
<i>Balance Start-Up and Software Login</i>	3
<i>Mettler-Toledo XS204 Balance Operation</i>	6
<i>Cahn Electrobalance Operation</i>	9
<i>Quality Assurance/Quality Control</i>	11
<i>Maintenance</i>	12
<i>Definitions</i>	13

Introduction

This user guide is designed to help onboard laboratory technicians and visiting scientists use the balance program for weighing samples on the ship's Mettler-Toledo (MT) XS204 and Cahn electrobalances. Detailed step-by-step procedures for using the balances with specific types of analyses and workflows are provided in instrument-specific user guides.

The shipboard laboratories have two different motion-compensated balance systems:

- Mettler-Toledo Excellence XS204 dual-analytical balance systems: range = 1–200 g
- Cahn Automatic Electrobalances: range = <1 g

Mettler-Toledo Excellence XS204 Analytical Balance

Onboard, three dual-balance sets of MT XS204 balances are installed, one each in the Core, Chemistry, and X-ray Laboratories. Software developed by IODP uses the two side-by-side balances (one for the unknown and one for a reference mass; *Figure 1*) to determine mass on the moving vessel. These balances can be used for masses ranging from ~1 g (possibly as low as 100 mg) to ~200 g; care should be taken not to overload them.



Figure 1. Mettler-Toledo XS204 Dual Analytical Balance System.

Cahn 29 and Cahn C31 Automatic Electrobalances

The Cahn 29 and C31 Automatic Electrobalances enable weighing of small masses (<1 g); take care not to overload them (*Figure 2*). The in-house motion compensated software enables users to accurately measure a small mass on the moving ship.

Cahn electrobalances are located in the Chemistry and X-Ray Laboratories on the ship.



Figure 2. Cahn C31 Electrobalance.

Instrument Calibration/Verification

To attain accurate results for subsequent measurements, the balance systems must be calibrated and that calibration verified. Calibration verification is run on a routine basis to ensure that the original instrument calibration is still valid. If calibration verification shows a problem in the system, any samples measured on that balance system since the last acceptable calibration verification must be reanalyzed.

Calibration

The balances are calibrated by IODP staff members using the balances' internal calibration routines. This calibration occurs in port when ship motion is minimal, or even on shore if possible.

The MT balance software supports a secondary calibration based on the measurement of multiple mass standards, linear regression, and application of the coefficients to subsequent measurements. This method is based on older balance calibration methods where voltages were converted to masses in a customized system. We currently have no rationale to apply this secondary calibration. Instead, we collect data from standards on a daily basis from the calibration verification process to build a data set over time and through variable sea states to evaluate the performance of MT dual balance system.

Calibration Verification

The user can verify calibration at any time by weighing a mass standard. A protocol of daily calibration verification, carried out by the responsible support staff, will provide the data necessary to make statements about the overall system performance.

To carry out calibration verification (control) measurement, see instructions in *Quality Assurance/Quality Control*.

Balance Start-Up and Software Login

Turning the Balances On/Off

Before turning on the balance:

- Make sure serial cables are connected to both balances and PC.
- Make sure both balance trays are clear and the doors are closed.

Mettler-Toledo XS204

- Press and hold the On/Off button on the terminal until the balances start up or power down.
- To power down the MT balances, the software control program must be turned off.

Cahn Electrobalance

- To power up the Cahn electrobalance, press the power switch on the rear panel.
- Press the power switch on the rear panel to turn the Cahn electrobalance off.

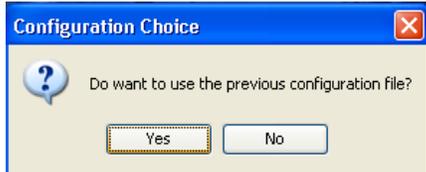
Program Start-Up/Login

1. Start the balance program by clicking on the balance program icon located on the desktop (left: Chem Lab Cahn, Chem Lab M; middle: MT; right: X-ray Lab Cahn, X-ray Lab MT):



Note: The icons may not look exactly like those in above image, but will be appropriately labeled.

2. Enter LIMS user name and password to access the application from the balance interface screen (*Figure 3, Figure 4*). The default LIMS login and password are your last name.
3. Click **Accept** for LIMS authentication.
4. When the software asks for confirmation on a configuration file, answer **Yes**:



The balance configuration file is set up by the IODP technician.

5. Three screens will open to verify balance connection and auto zero the balance. These screens may only appear briefly and disappear; otherwise, click **OK** for each verification screen. Make sure the balance pans are empty because the balance will autozero.
6. After successful start up of either balance system, the *Balance Initialization* screen may appear (*Figure 5*). Enter the number of measurements to be used for measurement initialization (300 is recommended minimum; but generally 1000 is used). If the *Balance Initialization* screen does not automatically appear, click **Test Options** and set counts to the desired amount, and then click **OK** to open the balance software main screen (*Figure 6, Figure 7*).

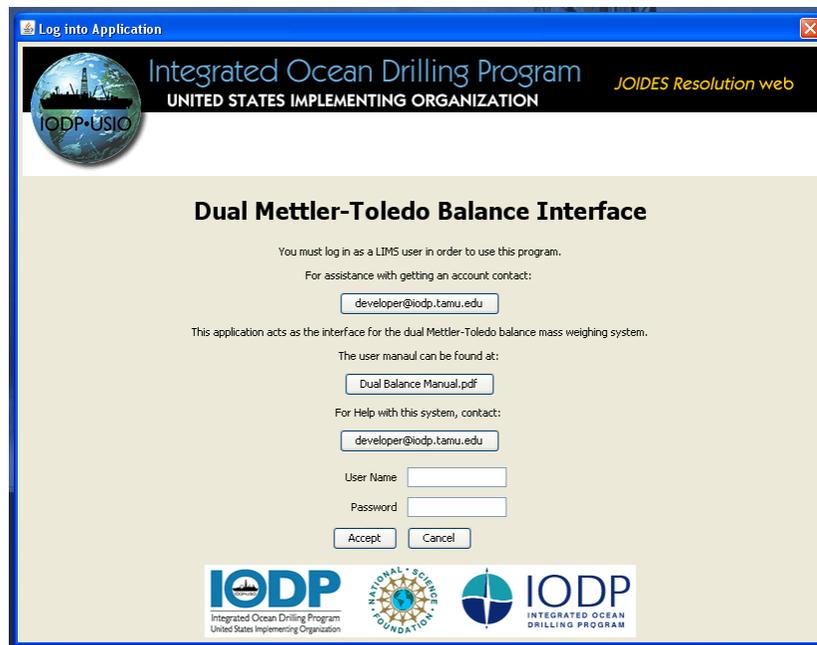


Figure 3. Dual Mettler-Toledo Balance Interface Login.



Figure 4. Cahn Electrobalance Interface Login.

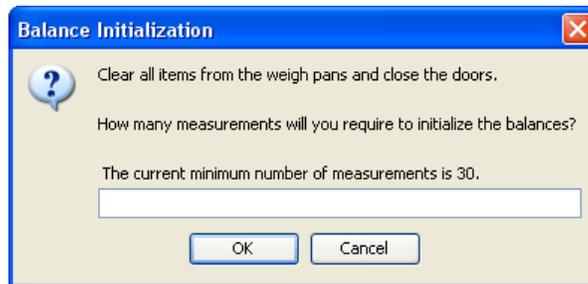


Figure 5. Balance Initialization Screen.

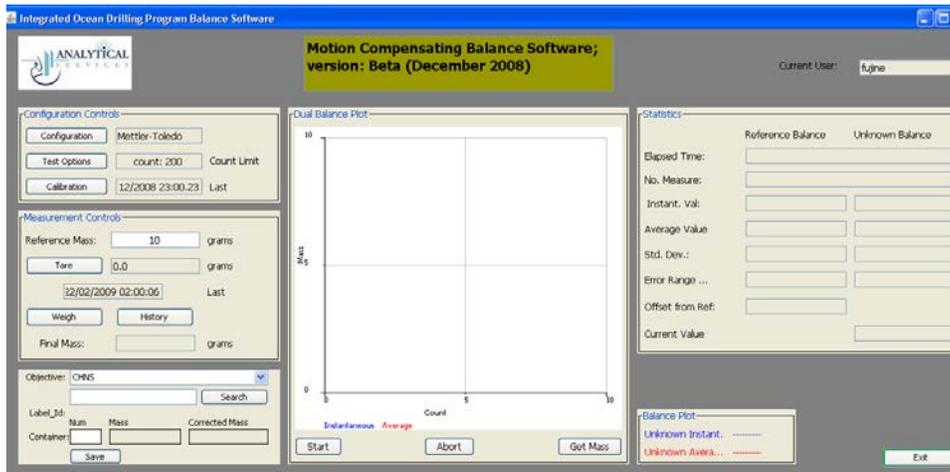


Figure 6. Mettler-Toledo Balance Software Main Screen.

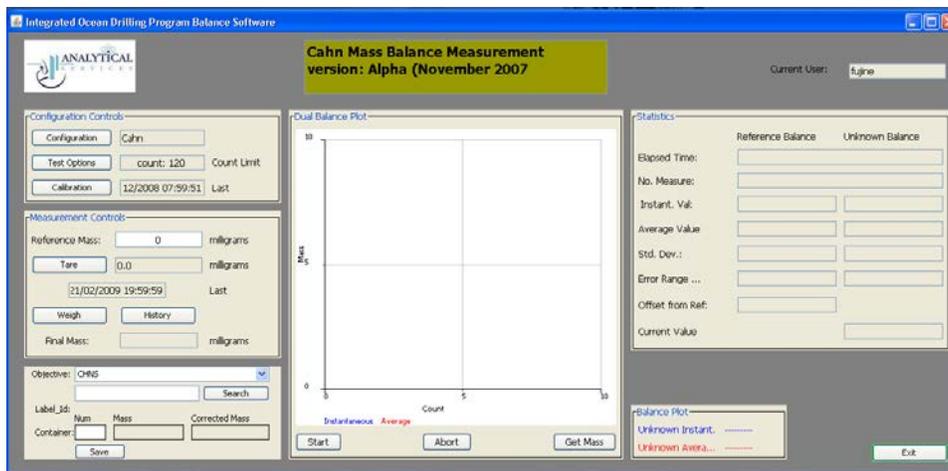


Figure 7. Cahn Electrobalance Software Main Screen.

Mettler-Toledo XS204 Balance Operation

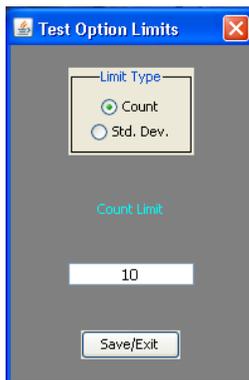
Workflow

The Mettler-Toledo XS204 balance workflow consists of the following procedures:

1. Confirm test options.
2. Tare the balance.
3. Weigh sample or reagent.
4. Assign the mass to a sample or standard.
5. Save mass in LIMS.

Confirming/Changing Test Options (Measurement Count)

1. Click the **Test Options** button in the *Configuration Controls* area of the Mettler-Toledo balance software main screen to open the *Test Option Limits* dialog box (Figure 6).
2. Select **Count** and enter the *Count Limit* value (note 300 is the recommended minimum).



- Click **Save/Exit**.



- Tare the balance after changing test options (see below).

Taring the Balance

- Click the **Tare** button in the *Measurement Controls* area of the balance software main screen (**Figure 8**).
- Make sure that **0** is entered in the *Reference Mass* field and click **Start** at the bottom of the *Dual Balance Plot* area.
- Once the measurement is completed and the value is acceptable, click **Stop** button and then click **Get Mass** at the bottom of the *Dual Balance Plot* area. The mass value is shown in the *Tare* field in the *Measurement Controls* area. **IMPORTANT!** If the **Get Mass** button is not pressed, the balance software will assign the previously obtained result to the sample.

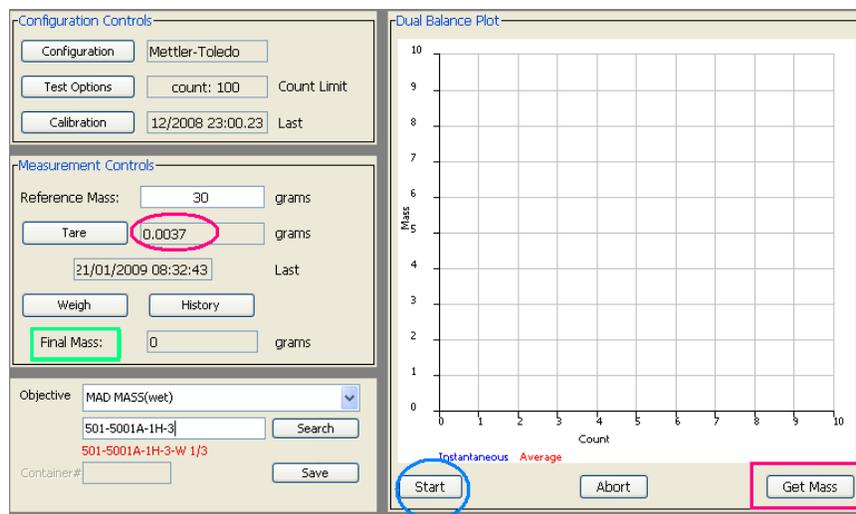


Figure 8. Measurement Controls and Dual Balance Plot Area, Mettler-Toledo Main Screen.

Weighing a Sample (Get Mass)

- Place a reference standard with a similar mass to the sample on the REFERENCE balance pan.
- Enter the mass of the reference standard into the *Reference Mass* field in the *Measurement Controls* area of the balance software main screen.
- Place sample on the UNKNOWN balance pan.
- Click **Weigh** (above the green box).
- Click **Start** (blue oval) at the bottom of the *Dual Balance Plot* area.
- Once the measurement is completed and the value is acceptable, click **Stop** button and then click **Get Mass** (red box) at the bottom of the *Dual Balance Plot* area.
- Confirm that the count value shown on the plot is the same as the value in *Final Mass* (green box).

Selecting a Sample from LIMS

If weighing a reagent or a Loss on Ignition sample, skip this procedure and proceed to *Saving Mass into LIMS*. For Loss on Ignition measurements, you must save the values in an excel spreadsheet. To assign the mass to a sample ID in LIMS, complete the following.

1. On the balance software main screen, select the *Objective* drop-down list (below the green box).
2. Select the analysis for which the sample is being weighed.
3. Enter an additional filter if desired in the field below the *Objective* analysis, then click the **Search** button.
4. A list of all samples logged into LIMS for the analysis in the *Objective* field will display (**Figure 9**). Select the sample that was just weighed and click **Assign**.
5. The *Label_Id* of the selected sample will be shown under the search box (**Figure 10**).
6. Enter a container number in the *Container#* field, if needed (for MAD samples, a container number will be shown in the *Container#* field). A container number will appear along with its mass and the sample mass in the *Corrected Mass* field.

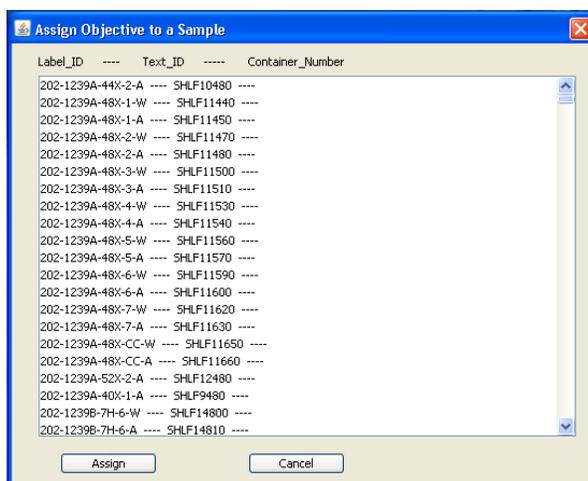


Figure 9. Assign Objective to a Sample from LIMS Screen.

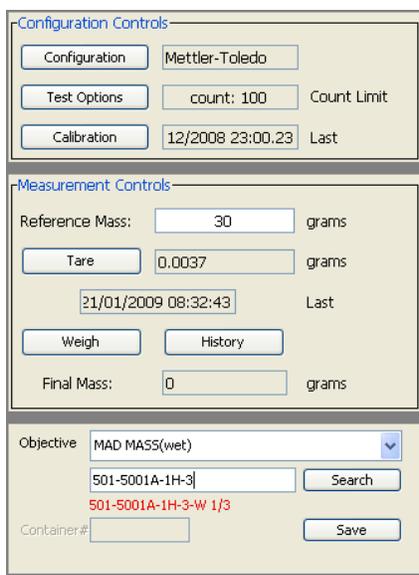


Figure 10. Sample Label ID Filled in.

Saving Mass to LIMS

Click **Save** at bottom left of screen to save the mass with a measurement code into LIMS.

Cahn Electrobalance Operation

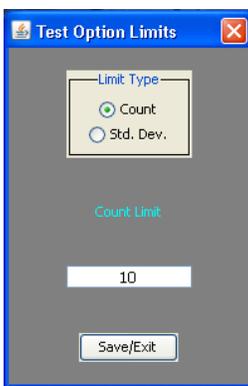
Workflow

The Cahn electrobalance workflow consists of the following procedures:

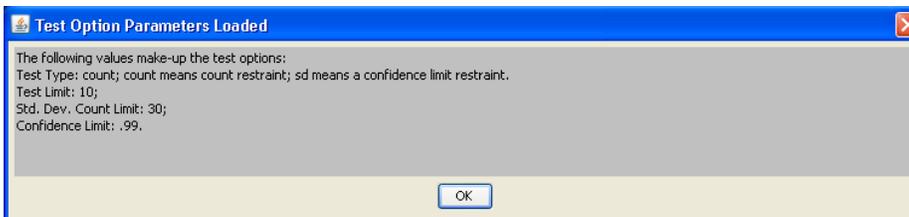
1. Set up test options.
2. Tare balance.
3. Weigh sample or reagent.
4. Assign the mass to a sample.
5. Save mass into the LIMS.

Setting Up Test Options (Measurement Count)

1. Click the **Test Options** button in the *Configuration Controls* area of the Cahn electrobalance software main screen to open the *Test Option Limits* dialog box.



2. Select **Count** and enter *Count Limit* value (>30). Confirm count value with laboratory technicians (range = ~150–300).
3. Click **Save/Exit** to open the *Test Option Parameters Loaded* dialog box.



4. Click **OK** to confirm count change.
5. Tare the balance after changing test options (see below).

Taring the Balance

Before taring the Cahn electrobalance, determine whether to tare with weighing paper or crucible:

Reference Material	Analysis
Weighing paper	CaCO ₃ by Coulometer TOC by SRA ICP sample Reagents (<1g)
Crucible	CHNS

Tare the balance as follows.

1. Put weighing paper or crucible (see above) on both pans.
2. Click **Tare** in the *Measurement Controls* area of the balance software main screen (**Figure 11**).
3. Click **Start** at the bottom of the *Dual Balance Plot* area (**Figure 12**).
4. Once the measurement completes and the value is acceptable, click **Get Mass** below the *Dual Balance Plot* area. The mass value appears in the *Tare* field in the *Measurement Controls* area.

Measurement Controls

Reference Mass: milligrams

milligrams

Last

Final Mass: milligrams

Figure 11. Measurement Control Area of Cahn Main Screen.

Cahn Mass Balance Measurement
version: Alpha (November 2007)

Current User: fujine

Dual Balance Plot

Mass (mg)

Count

Instantaneous Average

Statistics

	Reference Balance	Unknown Balance
Elapsed Time:	<input type="text"/>	<input type="text"/>
No. Measure:	<input type="text"/>	<input type="text"/>
Instant. Val:	<input type="text"/>	<input type="text"/>
Average Value	<input type="text"/>	<input type="text"/>
Std. Dev.:	<input type="text"/>	<input type="text"/>
Error Range ...	<input type="text"/>	<input type="text"/>
Offset from Ref:	<input type="text"/>	
Current Value		<input type="text"/>

Balance Plot

Unknown Instant. -----

Unknown Avera... -.-.-.-

Figure 12. Plot Area of Cahn Main Screen.

Weighing a Sample (Get Mass)

1. Place sample material or reagent on the weighing paper or in the crucible on the left pan.
2. Click **Weigh** in the *Measurement Controls* area of the software main screen (**Figure 11**).
3. Click **Start** at the bottom of the *Dual Balance Plot* area.
4. Once the measurement is completed and value is acceptable, click **Get Mass** at the bottom of the *Dual Balance Plot* area. **IMPORTANT!** If the **Get Mass** button is not pressed, the balance software will assign the previously obtained result to the sample.
5. Confirm that the count value shown on the plot is the same as the value in the *Final Mass* field in the *Measurement Controls* area.

Selecting a Sample from LIMS

If weighing a reagent, skip this procedure and proceed to *Saving Mass into LIMS*. To assign the mass to a sample ID in LIMS, complete the following.

1. On the balance software main screen, select the *Objective* drop-down list.
2. Select the analysis for which the sample is being weighed.
3. If desired, enter any part of a Sample ID (text_ID) in the box below *Objective*, then click **Search**.
4. A list of samples logged into LIMS for the analysis in the *Objective* field will display (**Figure 9**). Select the appropriate sample ID from the search list and click **Assign**.
5. Enter a container number in the *Container* field if needed (e.g., samples for CHNS and SRA).

Saving Mass into LIMS

Click **Save** at bottom left of the screen to save mass with a measurement code into LIMS. To measure samples continuously, go back to *Taring the Balance*.

Quality Assurance/Quality Control

Calibration Verification

Calibration verification of the Mettler-Toledo XS204 balance system is carried out daily by the laboratory technical staff.

Weighing the Standard (Get Mass)

1. Place a reference standard with the same mass as the standard on the REFERENCE balance pan.
2. Enter the mass of the reference standard into the *Reference Mass* field in the *Measurement Controls* area of the balance software main screen.
3. Place a known mass (standard) on the UNKNOWN balance pan.
4. Click **Weigh** and then **Start**.
5. Once the measurement is completed and the value is acceptable, click **Stop** and then click **Get Mass**. **IMPORTANT!** If the **Get Mass** button is not pressed, the balance software will assign the previously obtained result to the sample.
6. Select *mass standard* as the sample.
7. Assign the result to BALANCE_QAQC in LIMS and **Save**.

Maintenance

Mettler-Toledo XS204

Cleaning

- Clean the weighing pan, drip tray, housing, and terminal using a brush.
- Clean the weighing chamber:
 - Swivel the glasses of the draft shield away from the balance and remove from fastenings
 - Raise the front of the weighing pan and lift out of the guide
 - Pull the drip tray away from the balance
- Do not use cleaning agents containing solvents or abrasives
- Do not allow liquids to penetrate into the balance, terminal, or AC adapter

Errors

Error Display	Problem	Resolution
Wide bar with ends facing downward	Overload: weight exceeds balance capacity	Reduce weight on pan
Wide bar with ends facing upward	Underload	Ensure pan is in place, can move freely, and is not in a draft
0.00000 g flashing	Error when switching on or zeroing	Remove items from weighing pan
Timeout	Taring/zeroing aborted - no stable result	Check for drafts or vibration

Specifications

Maximum load (g)	220
Readability (mg)	0.1
Taring range (g)	0–220
Repeatability (sd)	0.1 mg @ 200 g
Linearity (mg)	0.2
Eccentric load deviation	0.3 mg @ 100 g

Cahn Electrobalance

Cleaning

- Immediately clean all spilled material
- Wipe up spills with lintless paper cloth
- Remove stirrups and sample pans from hangdowns inside weighing compartment
- Secure hangdown and press the **Brake** button before moving balance

Specifications

Capacity (mg)	250
Weight range (mg)	200
Sensitivity (µg)	1
Electrical tare (mg)	250
Accuracy (µg)	2
Precision: ultimate (µg)	1.0
Precision: fraction of load (%)	0.001

Additional Information

The following additional information is available upon request:

- Cahn Microbalance Instruction Manual (vendor)
- Mettler-Toledo Advanced User Guide
- Mettler-Toledo XS204 Analytical Balances Operating Instructions (vendor)

Definitions

Accuracy - the agreement of a balance reading with the value as set by a national standard.

Average Value – average value of all values taken by program.

Capacity - the maximum total load (sample + container) that the balance can handle. If load is increased beyond the rated capacity of the balance, the balance may become damaged, reducing accuracy and repeatability.

Configuration (setting) – set of instrument and software parameters set by instrument manufacturer and/ or software developer. For balance user purposes these are not changeable.

Calibration - standardization of measuring instrument: the checking of a measuring instrument against an accurate standard to determine any deviation and correct for error or determination whether or not characteristic of the instrument are within specifications. For Mettler-Toledo and Cahn electrobalance calibration is completed onshore with manufacturer.

Container # - sample container or holder number for particular measurement.

Current Value – net weight of material/sample being weighed.

Elapsed time – time in seconds that has elapsed since measurement started.

Error Range - the size of the error bar for each point.

History - shows a list of tare value or list of final weight (mass) number since last log-in.

Instant. Val. – value each balance is sending at the moment or instant.

NO. Measurement – number of measurements the software uses to determine final mass. Parameter set in Test Options.

Offset from Ref: - difference between the unknown and known balances.

Objective – reason for sample measurement, lists sample types.

Readability - the least significant digit that can be resolved from the readout under normal conditions.

Reference Mass – a known mass that is used to accurately determine unknown mass.

Repeatability - (Precision, as defined by Thermo/Cahn) is the standard deviation of 10 consecutive readings of the same mass under ideal conditions.

Sensitivity - smallest mass difference that can be detected by the balance.

Std. Deviation – standard deviation of all values taken by program

Tare – tells the program to ignore any weight currently on balance and measure new from that weight.

Test Option – sets parameters for current test. Includes number of counts required for measurement. This is how the balance knows when to stop taking measurements. Standard deviation limit and confidence limits are also shown here but are not changeable by the user.

Weigh – lets software know you are in 'weigh' mode, ready to weigh a sample.