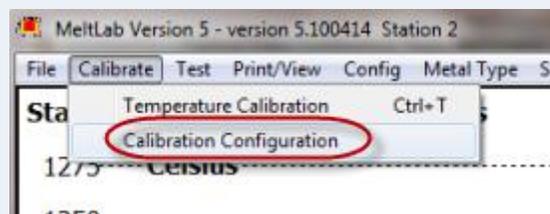


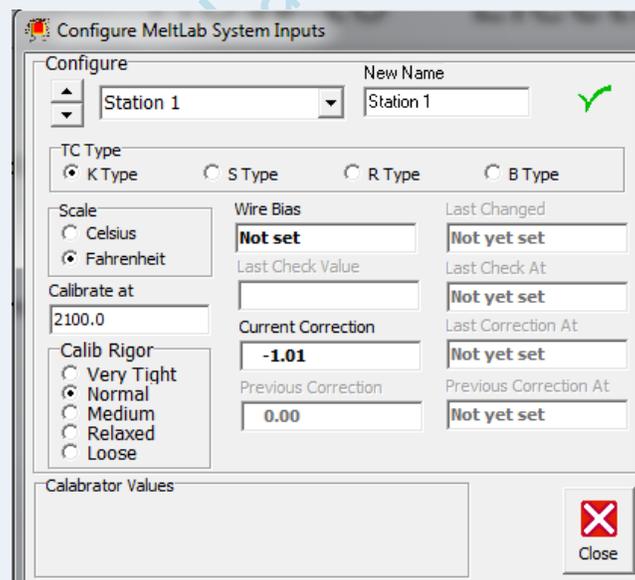
How to – Electrical Calibration

The “How To” series is a discussion on how the MeltLab program works. We will leave the explanation of why to our **Hot Topics** series. One of the obvious messages of these **How To** lessons is the care we at MeltLab Systems have taken to make the MeltLab the most accurate, flexible thermal analysis system in the world.

To prepare for the first time calibration, let’s go to the **Calibration Configuration** menu to make sure we are set up the way we want to be. If the **Calibrate Menu** item is not there, then you need to go to the **Config** menu option and **Unlock Security**. Log on with supervisory rights and the **Calibrate Menu** will be made visible. (See the How To on Security.)



Once you have picked **Calibration Configuration** a window like the one below opens up. In addition there are three help windows with information on the topics of How MeltLab gets a temperature, Wire Bias, and Different Thermal couples. Let’s review those first, and then come back to configuring the different inputs for calibration once we understand those topics.



Converting Millivolts to Temperature

How MeltLab gets a temperature

MeltLab has the ability to read many types of thermal couples. The actual raw readings are in what is called millivolts. This voltage is then corrected for the cold junction temperature and for wire bias for a corrected millivoltage.

This millivoltage is then converted to temperature in Celsius by equations provided by the National Institute of Standards Technology. These complex equations differ based on the type of thermal couple used.

The MeltLab then stores these temperatures as Celsius numbers so that switching between Celsius and Fahrenheit is simplified. This temperature is then corrected finally by the calibration correction, and optionally converted to Fahrenheit for display.

Values entered in for calibration are displayed as either C or F but are stored in Celsius.

Wire Bias Defined

Wire Bias

All thermal couple wire starts off in a foundry as ingots of different chemistry. Some ingots turn out with chemistry closer to target than others. This in turn results in wire that varies in accuracy depending on the ingot and the chemistry it was made from.

The major suppliers of cups and thermal couples buy "special limits" wire that is of a better accuracy than standard. The untold secret is that the manufacturer KNOWS how far off his thermal couples are. Some report this number as a bias value to be added to the reading. This means that there are not sudden shifts in Silicon and other calculations from one batch of wire to the next batch. Simply entering this "Bias" value into MeltLab automatically corrects for wire variation. We wish all manufacturers would do this.

How to – Electrical Calibration

Different types of Thermal Couples and their characteristics

Different Thermal Couples

Type K thermal couples are inexpensive and more accurate than most. They are made from Nickel with chrome additions to one side, and aluminum added to the other side. The name Chromal-Alumal is a trademarked name sometimes used for this TC. Its weakness is that one leg will melt at about 1390 C or 2540 F making it unsuitable for steel based alloys and temperature probes for iron. It is commonly used for iron and aluminum cups.

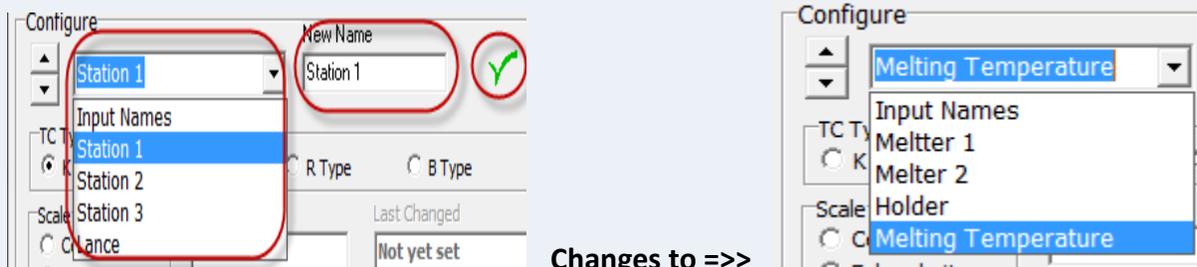
Type S is the least expensive TC for temperatures higher than type K can take. The wire is extremely fine and made from Platinum with one leg containing 10% of the even more expensive element Rhodium. MeltLab uses equations that are most accurate between 1064 C and 1664 C or 1943 F to 3028 F. Platinum melts at 1768 C.

Type R is similar to type S but contains 13% Rhodium and is therefore more expensive. It is an artifact of a historical mistake by the British, and has held on in Europe to today. There are no significant advantages to R TC's other than a thinner wallet.

Type B thermal couples have 6% rhodium on one side and 30% on the other side. Since rhodium melts at a higher temperature than platinum, this gives the benefit of a higher useable temperature range. MeltLab uses equations that are most accurate between 630 and 1820 C or 1166 and 3308 F.

Setting up the MeltLab for Calibration

The MeltLab comes configured with generic names for the different thermal couple inputs. It is a good idea to change these names to something you and your fellow foundry men will recognize. Select one of the stations in the pull down box on the left, then enter a new name, and finally click on the OK check mark on the right. Repeat until all are named. Don't forget to save each new name before moving on to the next name.



Changes to ==>

How to – Electrical Calibration

Thermal Couple type

TC Type
 K Type S Type R Type B Type

Save Cancel

Each input has a specific thermal couple type tied to it. MeltLab reads raw millivolt data from the thermal couple and then uses a specific equation to calculate the actual temperature. K type is typically used in thermal analysis cups for iron and aluminum. S type is typically used in cups for steel, and in most temperature lances for iron and steel. The connector for type S is generally red. R type is uncommon in the USA but often found in Europe. B type is used in high temperature alloys and some steels because it has a little higher temperature range. Its connector is generally purple. Set the type for each input, and don't forget to click the green Ok check for each one before moving to the next input.

Temperatures for Calibration

Scale
 Celsius
 Fahrenheit

Scale
 Celsius
 Fahrenheit

Calibrate at
 2600.0

Calibrate at
 1426.7

Save Cancel

First set the type of scale: Fahrenheit (USA) or Celsius (rest of the world), and then enter the "Calibrate at" and click the green Ok check to tell the computer to save the values. Changing the Scale will automatically change the Calibrate at value to the other scale. You can enter in the calibration temperature to a tenth of a degree to improve accuracy of calibration. See our [Hot Tips on Electrical Calibration](#) to see how and why this could help.

Other Setting

| | |
|------------------------------------|--|
| Wire Bias Not set | Last Changed Not yet set |
| Last Check Value Not set | Last Check At Not yet set |
| Current Correction 2.11 | Last Correction At Not yet set |
| Previous Correction 0.00 | Previous Correction At Not yet set |

Wire Bias is described above and is provided on the outside of each K-type box of thermal analysis cups by Minco and Matix brand cups. ElectroNite has provided this for selected customers that requested it. The MeltLab adds this value to the value received from the thermal couple. Because the millivolt to temperature conversion is not exactly linear, the bias correction "fixes" about 90% of the variation between different batches of thermal couple wire.

Last Check Value is not activated yet. When we designed MeltLab, we included space for some of our future ideas. This is an area for doing quick tests on the calibration.

Current Correction is the temperature correction from the last calibration and is the temperature value being added to the calculated value of each reading. It is in the scale (Celsius or Fahrenheit) that you have selected for

How to – Electrical Calibration

this input. Change the scale and the value changes. You can directly enter this value, but it is better to let the program set the value through the calibration procedure discussed below.

Previous Correction is the value of the previous calibration. When you save a new calibration, the old value is moved down to this position and saved. That way a record is kept of how much the calibration changed.

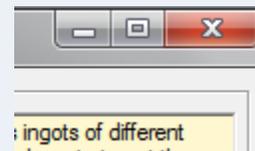
The **Last Changed** dates column to the right of these numbers is for the dates the numbers were last changed.

The Actual Calibration

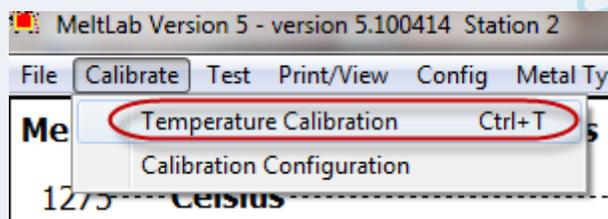
Now we are ready for the actual calibration. Close the window with



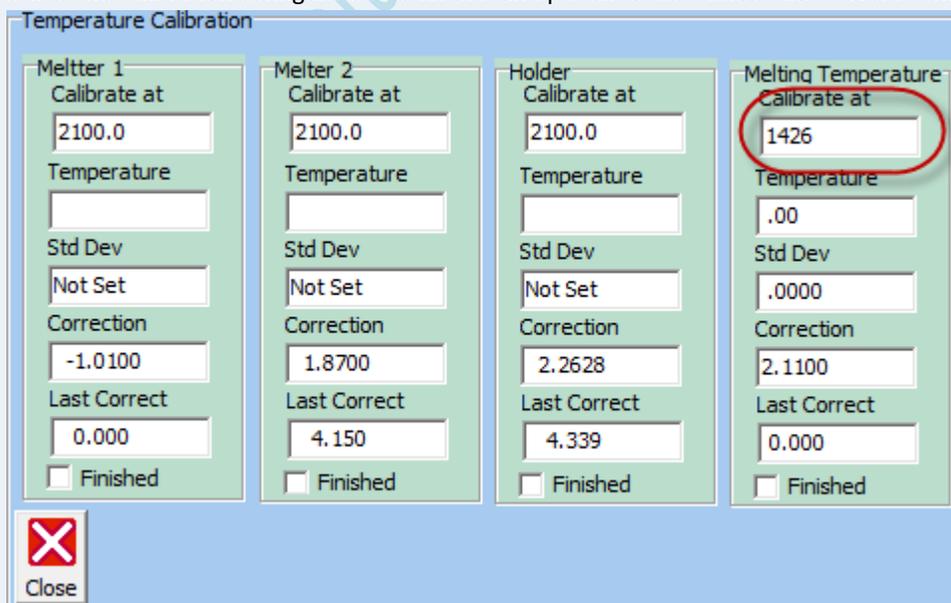
or



and start the calibration window by either pressing **Ctrl T** or selecting the drop down menu item

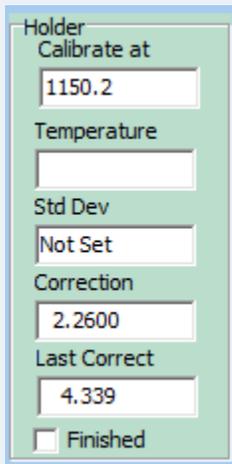


A Window will appear on the screen with a box for each licensed input station: in this case four boxes. Note that the 4th box shows Celsius temperatures and the other three Fahrenheit. Although it will work fine, we recommend that you go back to the calibration configuration to fix that and put all to the same scale to avoid confusion.



| Meltter 1 | Melter 2 | Holder | Melting Temperature |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| Calibrate at: 2100.0 | Calibrate at: 2100.0 | Calibrate at: 2100.0 | Calibrate at: 1426 |
| Temperature: [] | Temperature: [] | Temperature: [] | Temperature: .00 |
| Std Dev: Not Set | Std Dev: Not Set | Std Dev: Not Set | Std Dev: .0000 |
| Correction: -1.0100 | Correction: 1.8700 | Correction: 2.2628 | Correction: 2.1100 |
| Last Correct: 0.000 | Last Correct: 4.150 | Last Correct: 4.339 | Last Correct: 0.000 |
| <input type="checkbox"/> Finished | <input type="checkbox"/> Finished | <input type="checkbox"/> Finished | <input type="checkbox"/> Finished |

How to – Electrical Calibration



Let's look at each area of the calibration boxes in detail. The scale has been changed to Celsius, and a 1150.2 temperature has been entered in as the certification on our calibrator said that when our calibrator is set to 1150, it actually outputs a value 0.2 degrees higher than that.

Our last calibration gave us a correction of 2.26° C, and the one before gave us a correction of 4.339° C. This customer rewired the cup station between calibrations and improved the calibration by 2 degrees (reduced resistance).

The other fields are for the current temperature value – the average of the last 100 readings, the standard deviation of those 100 readings, and the calculated correction based on those readings. The Finished checkbox will be checked when the Std Dev of the readings falls below the required minimum level.

So let's go back to something we left out of the discussion of the calibration configuration screen: the calibration rigor. A standard deviation on the last 100 readings of a stand or lance is calculated and compared against the Calibration rigor setting. Calibration locks on the value once the rigor setting is achieved

- Very Tight means < 0.005 degrees C standard deviation
- Normal means < 0.015 degrees C standard deviation
- Medium means < 0.030 degrees C standard deviation
- Relaxed means < 0.050 degrees C standard deviation
- Loose means < 0.150 degrees C standard deviation



Once the necessary rigor has been met, the calibration window for that input turns green and the correction is locked. You can then move to the next input if you need to.

You have three choices to make. You can save the calibration(s) to disk by clicking the green check mark (OK button), or you can cancel the calibration by closing the calibration window without saving, or you can unclick the checkbox in that window and restart the calibration. Restarting is a good option when you are first setting up because your calibrator may not have stabilized yet. Stabilization occurs when the interior temperature of the calibrator and the cup stand reaches the foundry air temperature. Before that time, the calibration will drift. By repeating the calibration after a few minutes, you can check to see if the correction factor is still moving. Once the movement drops low enough (usually < 0.1 degree), you can then move quickly through calibrating all the other stands.

Please do not forget to click the save check before closing the calibration window. With the system electrically calibrated you are ready to move on to other forms of calibration to perfect the equations used to calculate chemistry or percent of phase.