

summary:

This test is designed to observe and understand the effect of temperature on the load cells in Brewbot. A test rig was placed in the oven and studied at constant load under varying temperatures.

documentation:

The table to the right summarizes the deviation (in grams) from ambient temperature caused by heating the load cells.

The graph below shows the load change (blue line) caused by temperature increase.

Change in weight (g) at various temperatures			
Temp (°C)	No Load	10 kg	20 kg
30	0	0	0
40	-67	-192	-33
55	-83	-283	-92
85	-508	-475	-142

observations:

At constant weight, all three runs showed the same result: As the temperature increases, the raw value given by the load cells decreases by a significant amount. At higher temperatures, these discrepancies in the weight can be up to 500 g from the actual weight.

The 10 kg and 20 kg runs did not have the thermistor running, so further analysis could not have been done.

Because the calibration constant was not known for the 10 kg and 20 kg runs, the gram error values may not be correct for those runs.

There are multiple spikes in the load cell data throughout this test.

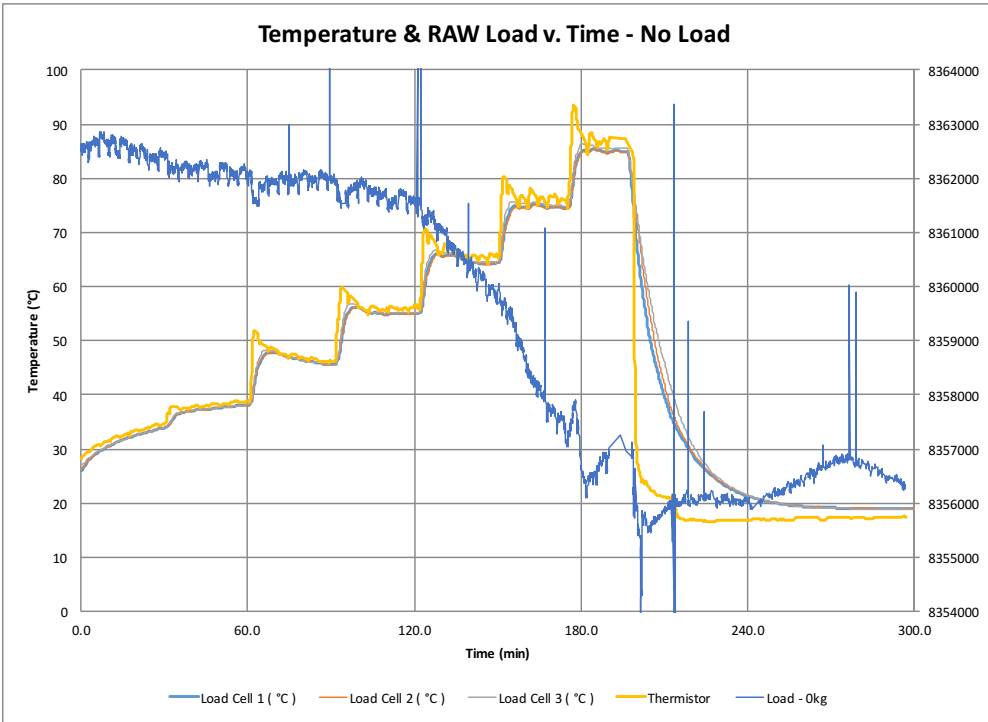
The results of TEST-HAR-0013-01 Internal Electronics Temperature Test show that the load cells can reach over 55 °C when measuring sparge water, and upwards of ~78 °C during the boil (when measurements aren't taken, but volume is displayed by the iOS app.) Errors at 55 °C topped out at 283 g during this test.

During the next iteration of this test, it is suggested that some delicious german sausages are slow cooked in the oven on a lower rack, so to have a tasty snack as a reward at the end of the test.

conclusions:

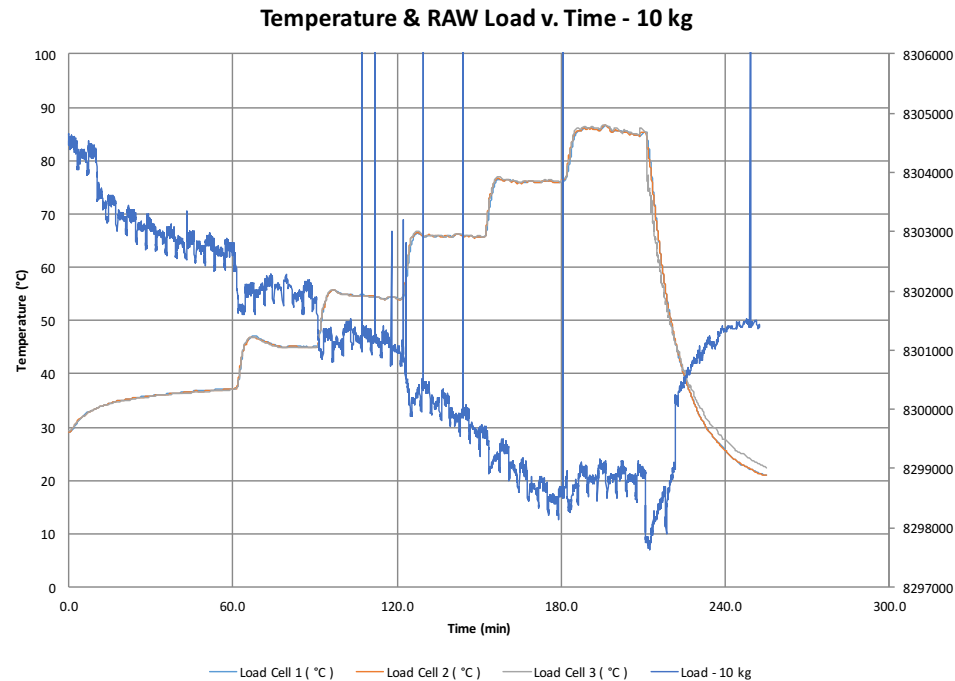
There is not enough data to know the true error caused by the increase in temperature. It is recommended to re-run this test 3 more times to ensure accurate results. These results do show that there is reason for concern regarding inner temperature affecting the load cells.

It is also suggested that the spikes in the load cell data be investigated.



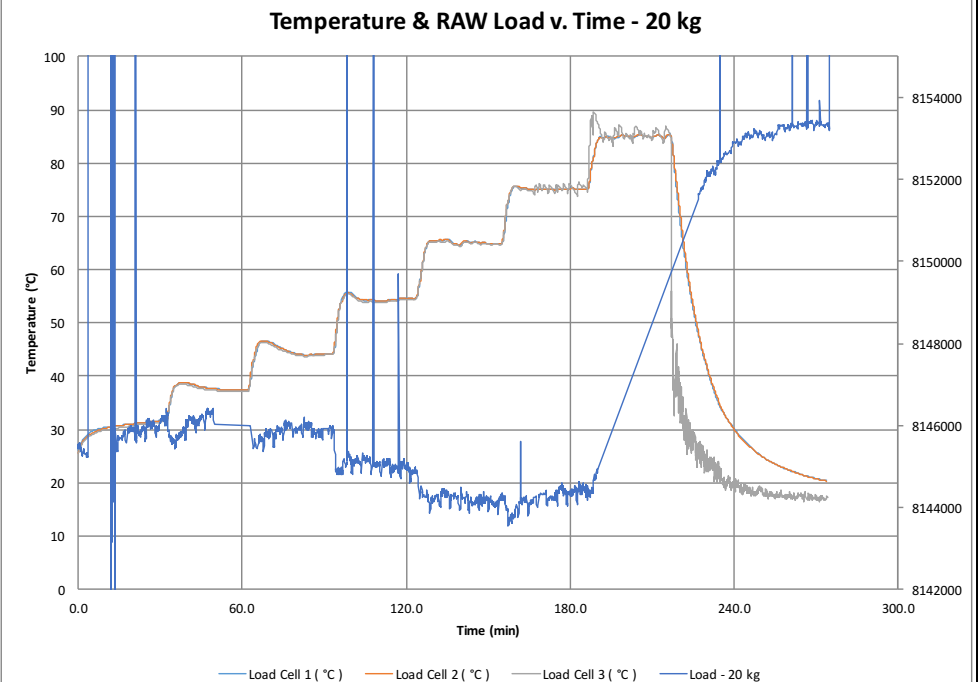
additional information:

Load Cell Heat Test



As with the "No Load" case on the previous page, the 10 kg and the 20 kg cases both depict similar results. It can be seen that the 20 kg case has dirtier data; load cell spikes and loss of WiFi are suspected.

In both of these cases, the jump in the load near the end of the test is likely due to the fact that the unit was removed from the oven, and the load cells were jarred. For the next run of tests, it is recommended that the rig not be disturbed during the cooling period. If cooling needs to happen faster, a fan can be used.



Procedure:

Load Cell Heat Test

Load Cell Heat Test

Purpose

This test is designed to observe and understand the effect of temperature on the load cells in Brewbot.

Equipment

- 3 micro load cells, part number: 3135_0 - CZL635
 - Wired in parallel to a molex connector.
 - Attached to test rig at 10 ft-lbs.
- 1 load cell amplifier, part number: HX-711.
- Photon on board.
- Thermistor on board.
- Test rig that fits in our oven.
- Thermocouples and thermocouple data logger.

Procedure

Set Up

1. Calibrate load cells and record calibration constant.
2. Attach thermocouple to each load cell, directly on Aluminum.
3. Keep one thermocouple to measure ambient temperature in the oven.
4. Steadily place test rig in oven at ambient temperature. Make sure that Photon & board and the HX-711 boards are outside of the oven when the door closes.
5. Place thermistor in free area of oven, ideally near the ambient thermocouple.

Test

1. Set up data logging for the Photon before beginning the test. Record load cell input and thermistor input.
2. Set up data logging for the thermocouples before beginning the test.
3. Start both data logging systems at the same time.
4. With no weights (other than the plate, (or "sink"), step the oven temperature up from 20°C to 90°C in increments of 10°C for 30 minutes at each step.
5. Turn oven off and open door. Let naturally cool to ambient temperature.
6. Repeat steps 1 - 9 with 10 kg and 20 kg weight on the load cells.

Acceptance Criteria

This test is simply for characterizing the load cells, therefore no acceptance criteria is needed. Change in load due to temperature change should be included in the analysis.