Northstar Field Test
NSFT000024
D. Folmer
12-27-20

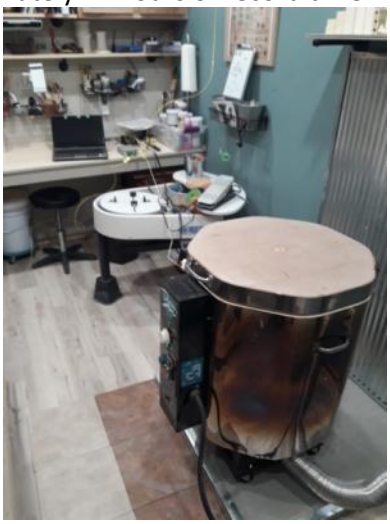
Objective:

The purpose of this test was to record and document a pottery kiln glaze firing run in order to better understand how long it actually takes to reach the proper temperature and how long it remains there. This information can be used to produce better quality pottery in the future.

Equipment:

- Laptop running Dataq acquisition software.
- Dataq Model DI-718B-U data acquisition system.
- 2x DI-8B47K-05 K-type thermocouple amplifiers (32ºF to 932ºF).
- 1x DI-8B47K-13 K-type thermocouple amplifier (-148ºF to 2462ºF).
- Yellow K-type thermocouple wire.
- Duncan Model DA820-2 kiln.
- Special K-type high-temperature kiln thermocouple.
- Kiln cones #5 (2192ºF), #6 (2237ºF) and #7 (2282ºF). These are indicators that sag when they reach their corresponding temperature.
- #6 kiln sitter, which is a small ceramic bar that sags at a specific temperature and allows a switch to trip and shut off the kiln.

Process 1:

- The Dataq system was configured with 3 temperature channels. One channel recorded the internal temperature of the kiln using a special high-temperature thermocouple, one channel recorded the temperature of the studio near the floor, and a final channel recorded the temperature of the studio near the ceiling.
- The floor and ceiling data was taken to see if variability of the ambient temperatures had an effect on the kiln, and also out of safety to make sure that the studio wasn't being overheated.
- The Dataq recorded at a sample rate of 1 sample/second/channel, which allowed for approximately 17 hours of record time.
  - 

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  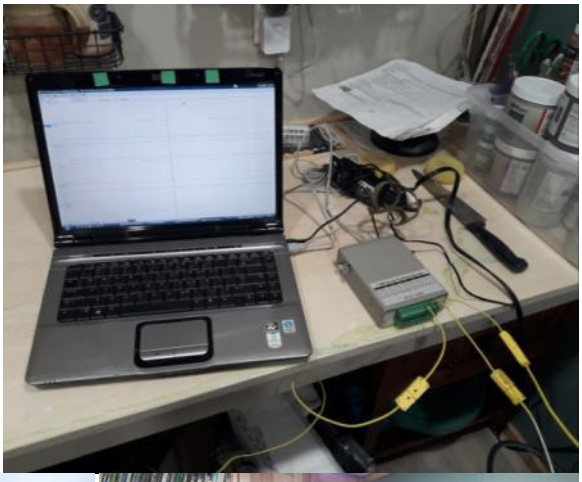
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  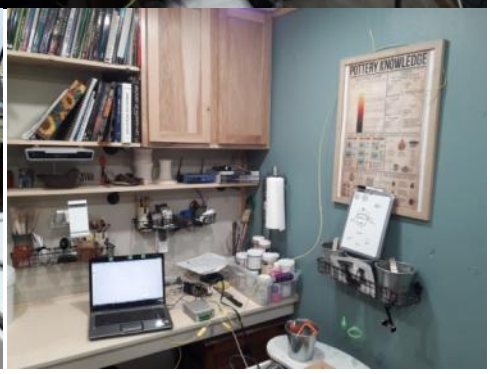

- The kiln was loaded with pottery to be glazed, and a warm-up sequence was started in which the kiln was turned on to begin heating, but the lid was propped open slightly to slow down the process.
- After two hours of warm-up, the lid was closed and the glazing cycle was allowed to resume as normal.
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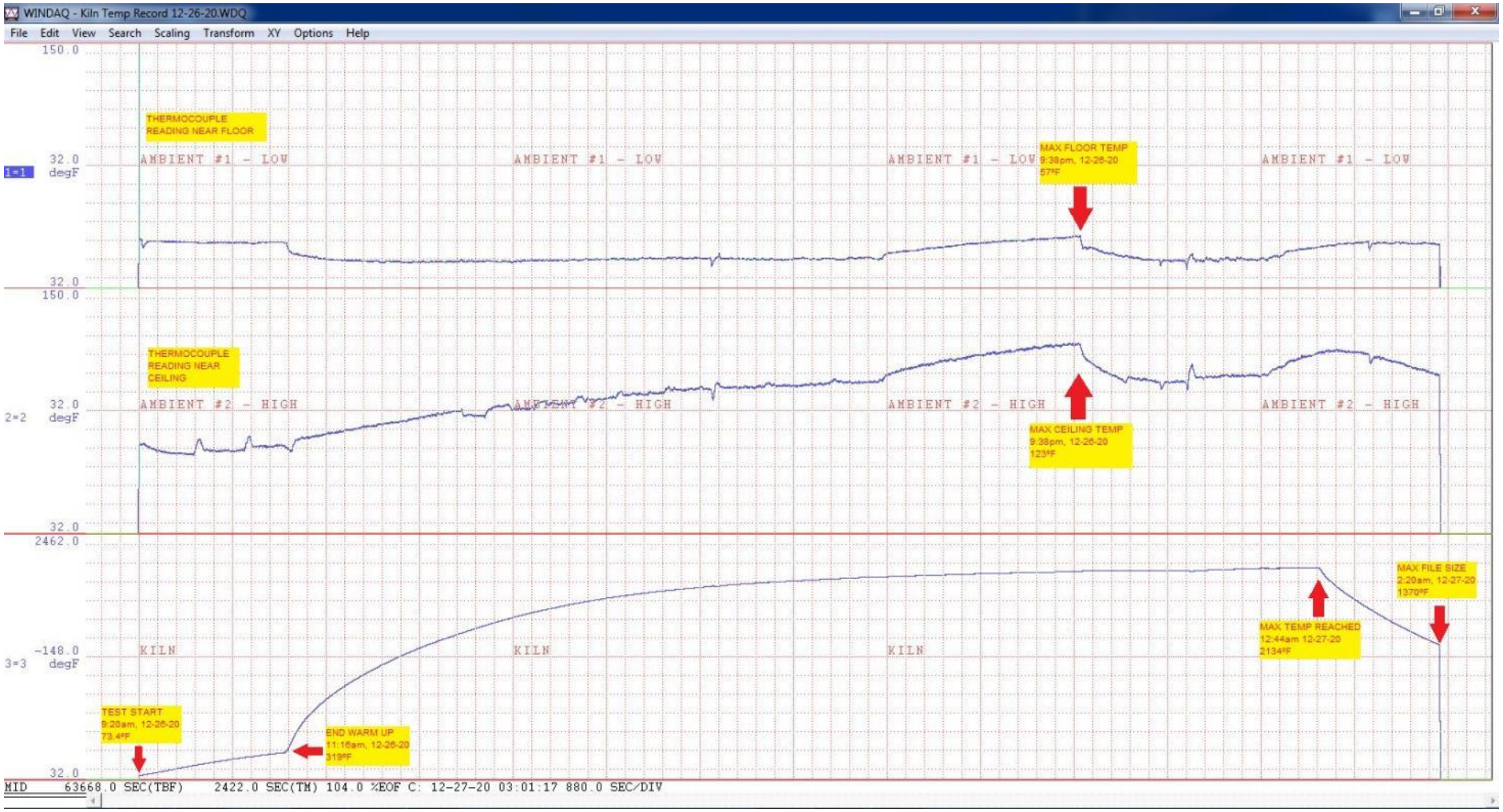

- The data recording shows that it took approximately 13.5 hours for the kiln to reach its maximum temperature after the warm-up period, at which point the kiln sitter tripped and stopped the heating process. The picture below is an example of an non-sagged kiln sitter.
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- The kiln cones also showed that the temperature inside reached the appropriate temperature, demonstrated by the fact that cone #5 is fully sagged, #6 sagged correctly, and #7 was just beginning to sag.
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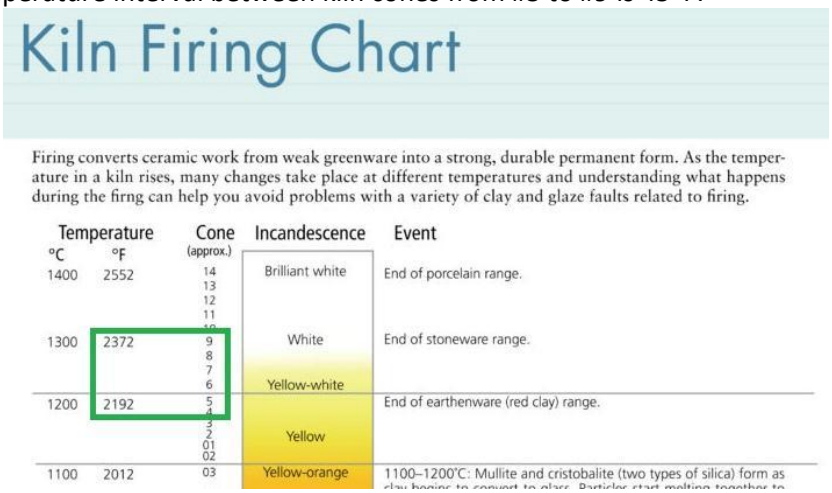
Calculations:

- The temperature interval between kiln cones from #5 to #9 is 45ºF.
  - 

- The maximum temperature reading error is estimated by:
  - (2134-2237)/2237*100 = -4.6%

Conclusion:

The kiln cones and the kiln sitter all showed that the internal temperature reached the correct value of approximately 2237ºF, but the Dataq recording reads lower by roughly 100ºF. This comes out to be an error of almost -5% at the maximum reading value. The beginning kiln temperature reading at the start of the test was 73ºF, which was in line with the other ambient temperature readings, so it would be logical to assume that there is some sort of a non-linearity error associated with this particular thermocouple as it reaches extreme temperatures. In other words, the kiln is firing correctly, but the sensor is slightly off. Knowing that there is a 100ºF offset at maximum temperature is still valuable information, and can be verified with further kiln run testing.

It's difficult at this time to know if the duration is reasonable or not. The kiln volume is relatively small at 2.9 cubic feet, and it was fully loaded, so there was a lot of mass to heat up. The supply voltage is correct at 240vac. There is an exhaust mounted to the bottom of the unit that ran during most of the test until it was shut off at 11:00pm, but this didn't seem to have any effect on the temperature. The unit is at least 25 years old, so that could have some influence as well, and replacing the heating elements is on the project list.

The greatest benefit of this test is that it would appear to eliminate improper kiln firing and outside temperature influences as variables, and other factors can now be pursued to make a more effecting glazing process.

Sources:

www.polarispottery.com