

Evaluation of Measuring Input Power for Calibrating the Evacuation Slide Test

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Fire and Cabin Safety Research Conference

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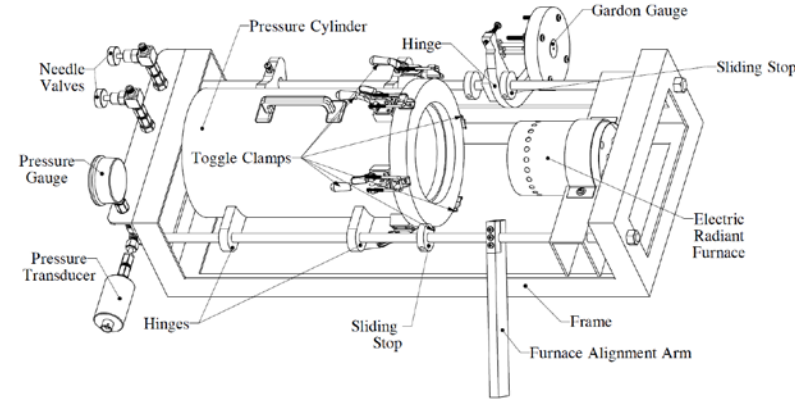
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Federal Aviation
Administration



Introduction



- **FAA previously observed poor correlation in round robin studies in the Evacuation Slide Test**
- **Voltage fluctuations in the radiant heater were studied**
 - Monitored voltage and current throughout whole test instead of setting heat flux and forgetting it
 - Voltage transformer would sometimes need to be adjusted to maintain original setting
 - Then conducted more testing while better maintaining original voltage setting which increased repeatability

Introduction

- **Then testing was completed to determine if the calibration method can be changed from measuring the heat flux at the sample surface to measuring the input power going to the heater**
 - Testing showed good repeatability but was tested with small number of heaters
- **More recently tested this method with larger number of heaters and heat flux gauges to determine if measuring the power will truly increase repeatability and reproducibility**

Power Source Comparison

- **Powerstat Variable Autotransformer uses large imprecise dial for setting voltage**
 - Requires separate voltmeter to get accurate reading
 - Would sometimes need adjustment during testing to maintain voltage
- **Compared with digital Keysight AC Power Source**
 - Maintains voltage automatically
- **Compared both power sources with three different heat flux gauges**
 - Tested with same radiant heater

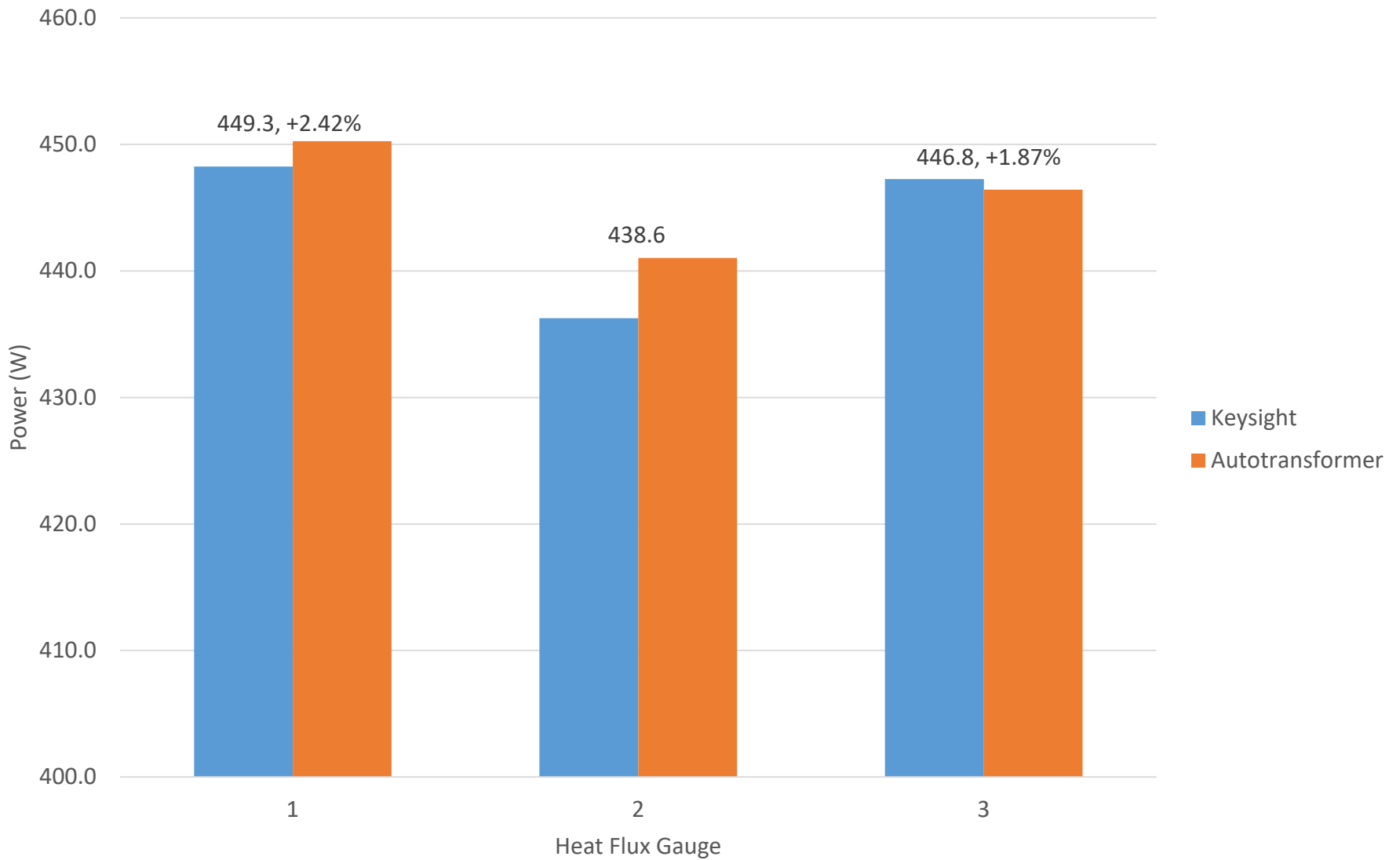


Powerstat Variable Autotransformer



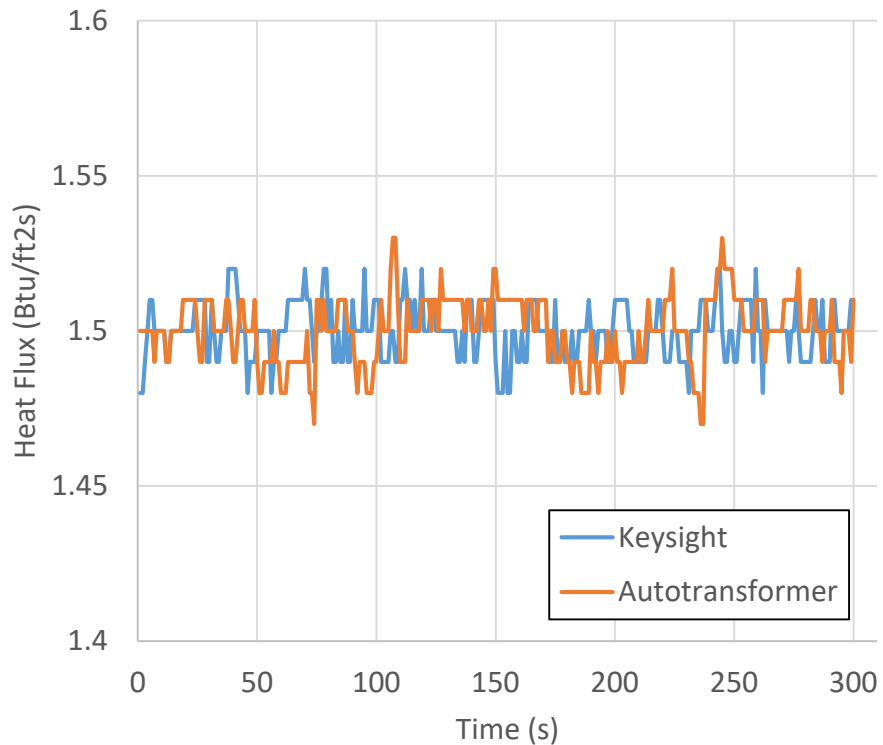
Keysight 6802A AC Power Source

Power Required to Reach 1.50 Btu/ft²s

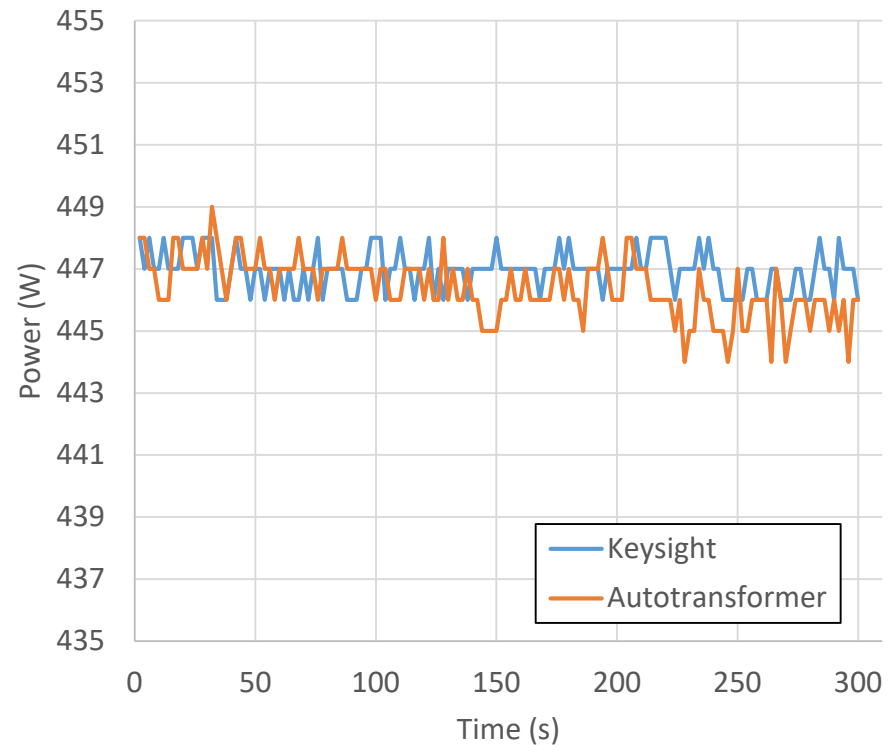


Power Source Comparison

Keysight vs Autotransformer Heat Flux



Keysight vs Autotransformer Power



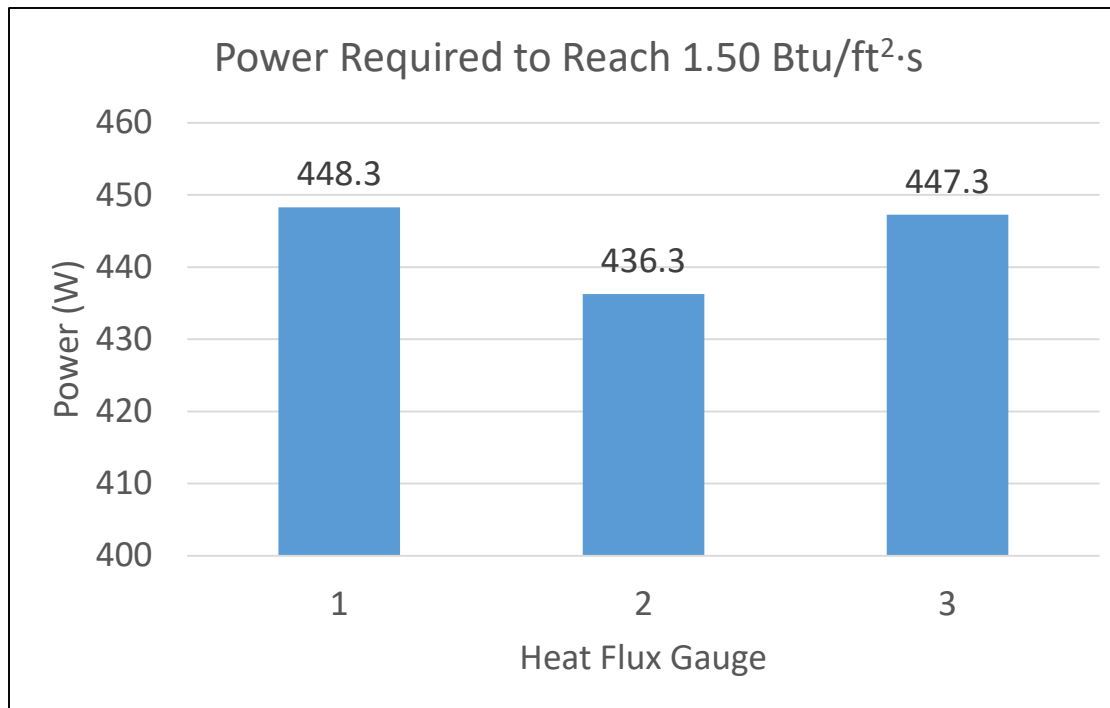
Power Source Comparison

Average Std. Dev.	Heat Flux (Btu/ft ² s)	Power (W)
Keysight	0.0096	0.655
Autotransformer	0.0119	0.919

- **Averaged standard deviation over all tests**
- **Autotransformer had higher standard deviation**
- **Power is much easier to set with Keysight – type in voltage to nearest 0.1V**
- **Voltage dial on autotransformer is much less precise**
- **Used Keysight AC Power Source for all subsequent testing**

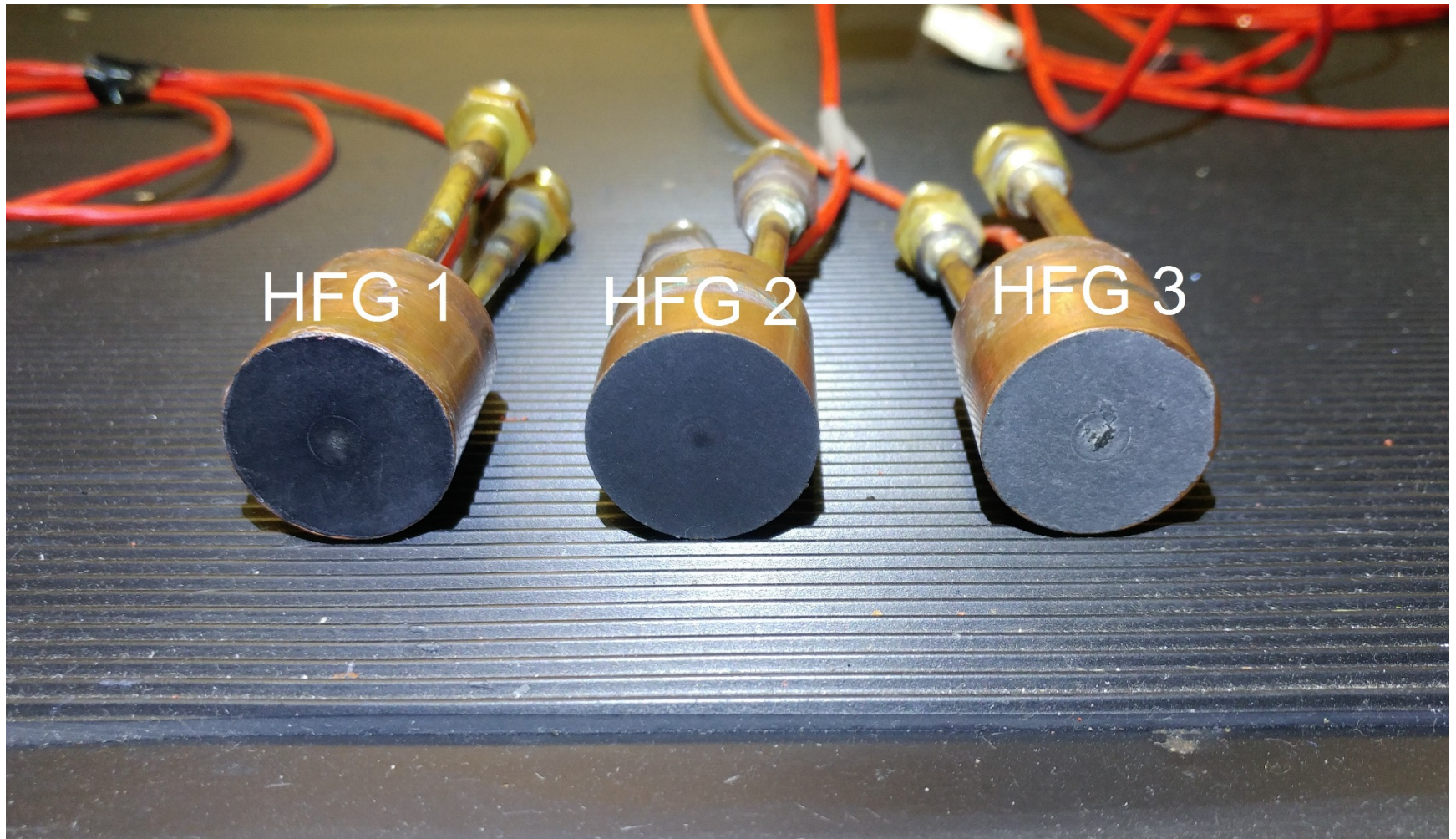
Heat Flux Gauge Comparison

- **Variation between heat flux gauges was too large**
 - All three gauges were calibrated before testing



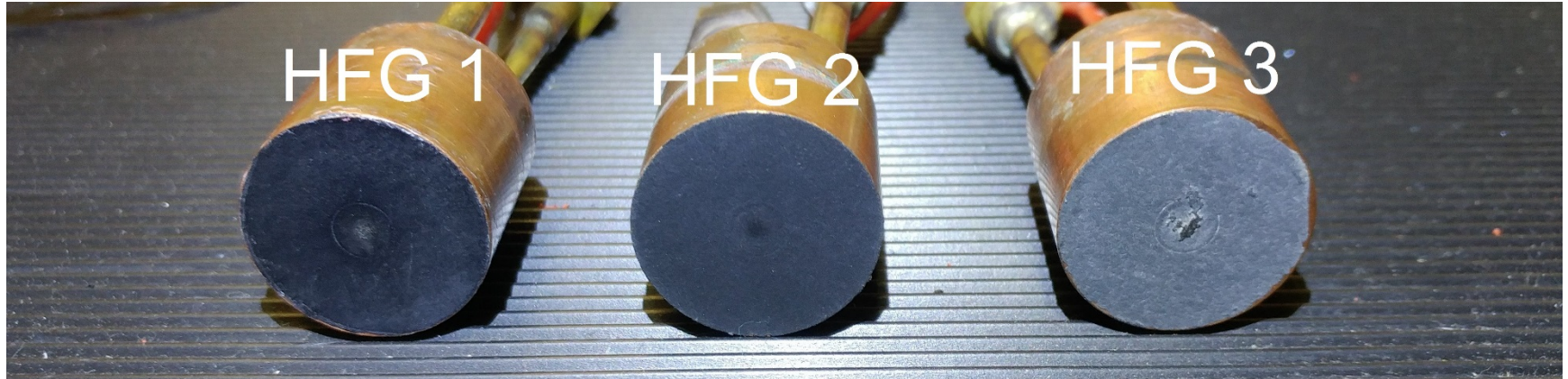
- *Tested with Keysight Digital Power Source*
- *Tested with Solid Coil Heater #1*

Heat Flux Gauge Comparison



Heat Flux Gauge Comparison

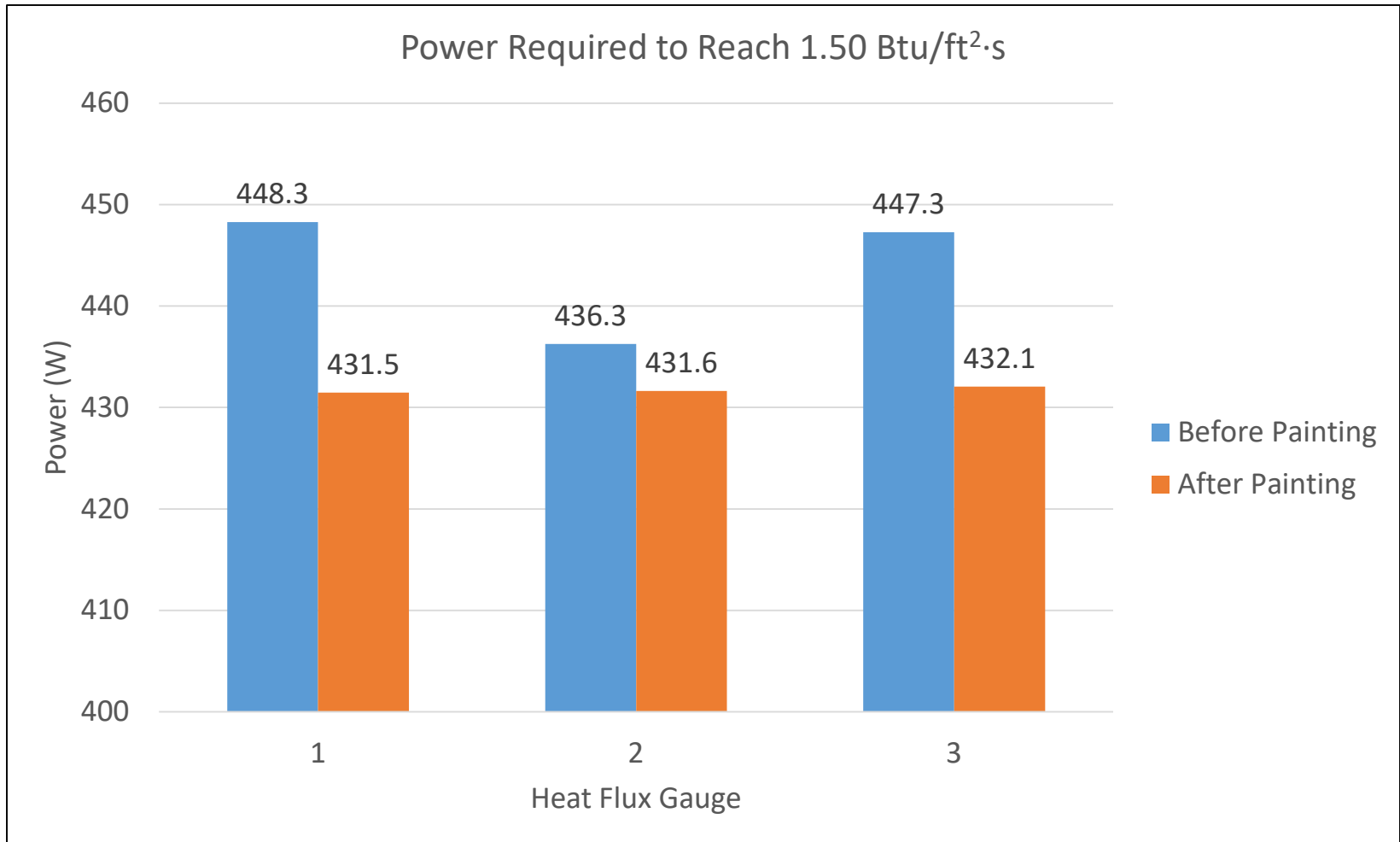
Before Painting:



After Painting:



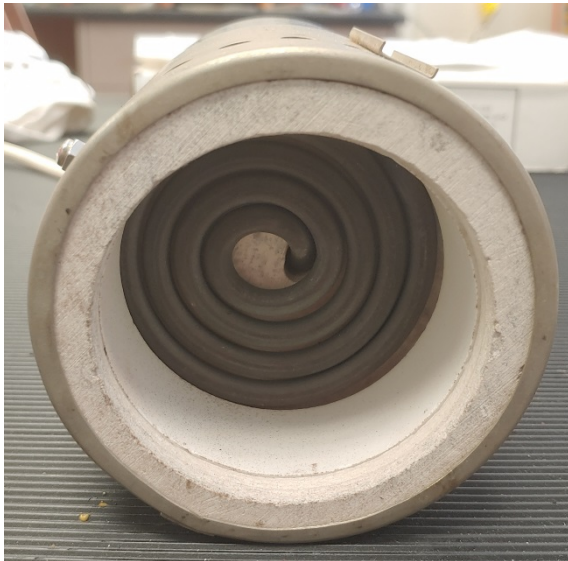
Heat Flux Gauge Comparison



Solid Coil Heater #1

Heater and HFG Comparison

- **Tested 6 heaters and 3 heat flux gauges**
 - 4 solid coil, 2 wire coil

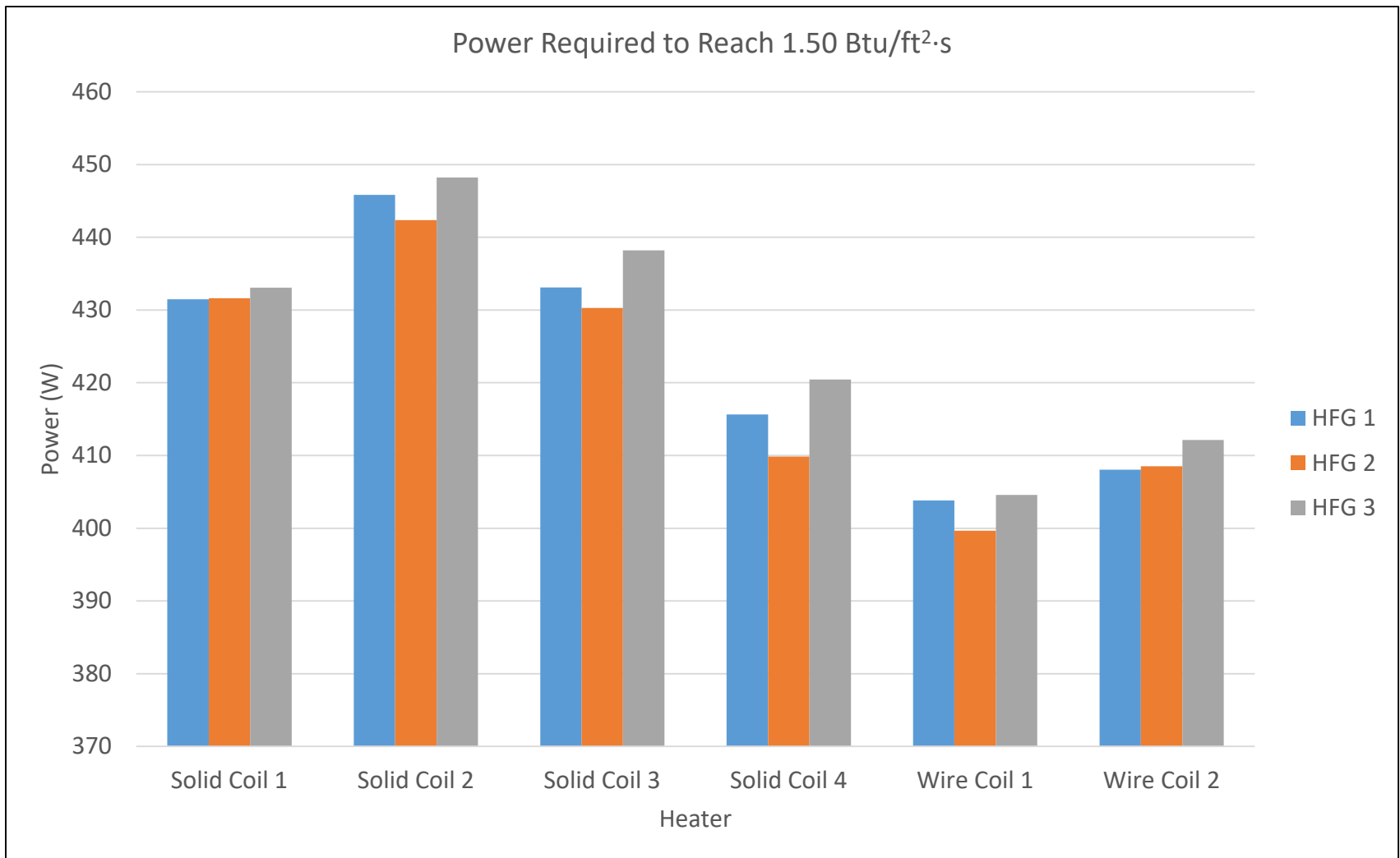


Solid Coil



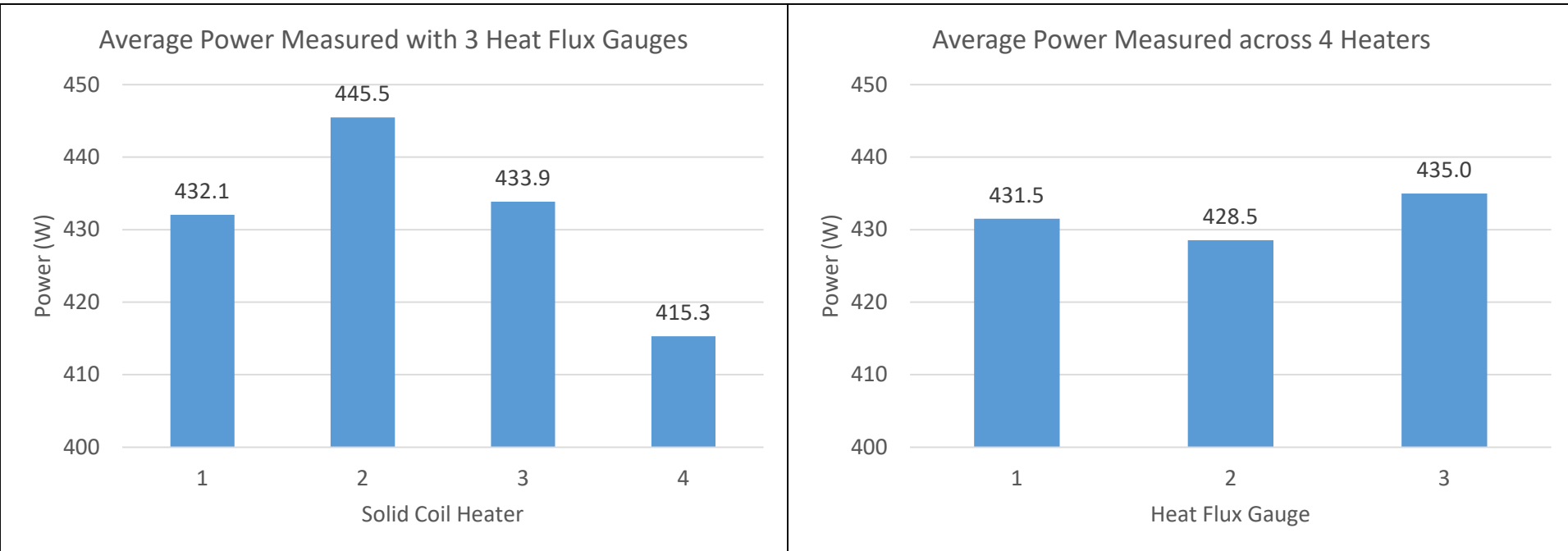
Wire Coil

Heater and HFG Comparison



Heater and HFG Comparison

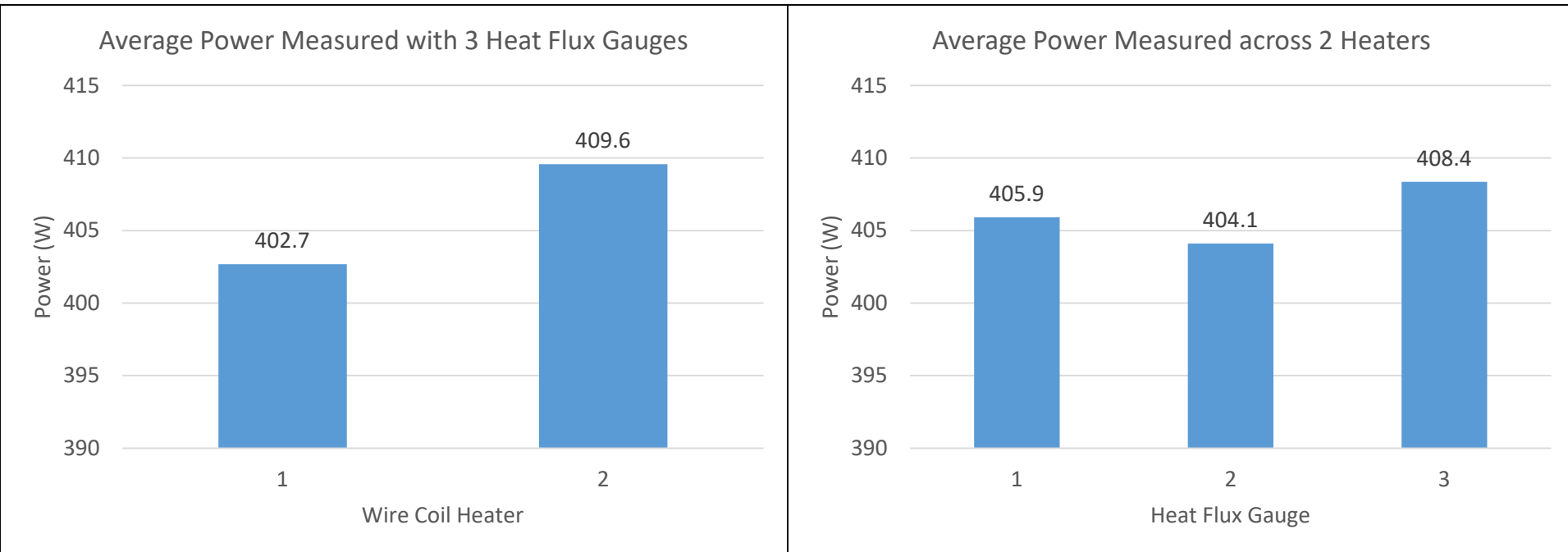
Comparing range of power required for different heaters vs different heat flux gauges to reach 1.50 Btu/ft²·s (Solid Coil Heaters only)



- Different heaters varied from 415 W to 445 W
- Different heat flux gauges varied from 429 W to 435 W

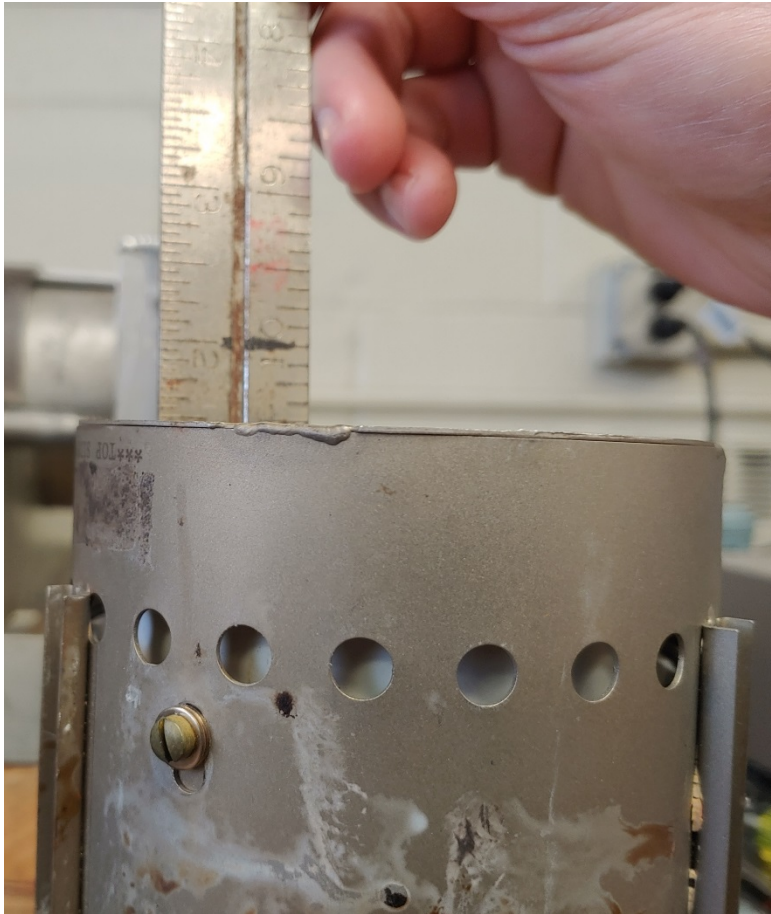
Heater and HFG Comparison

Wire Coil Heater Comparison



- Different heaters varied from 403 W to 410 W
- Different heat flux gauges varied from 404 W to 408 W

Why are the Heaters so Different?

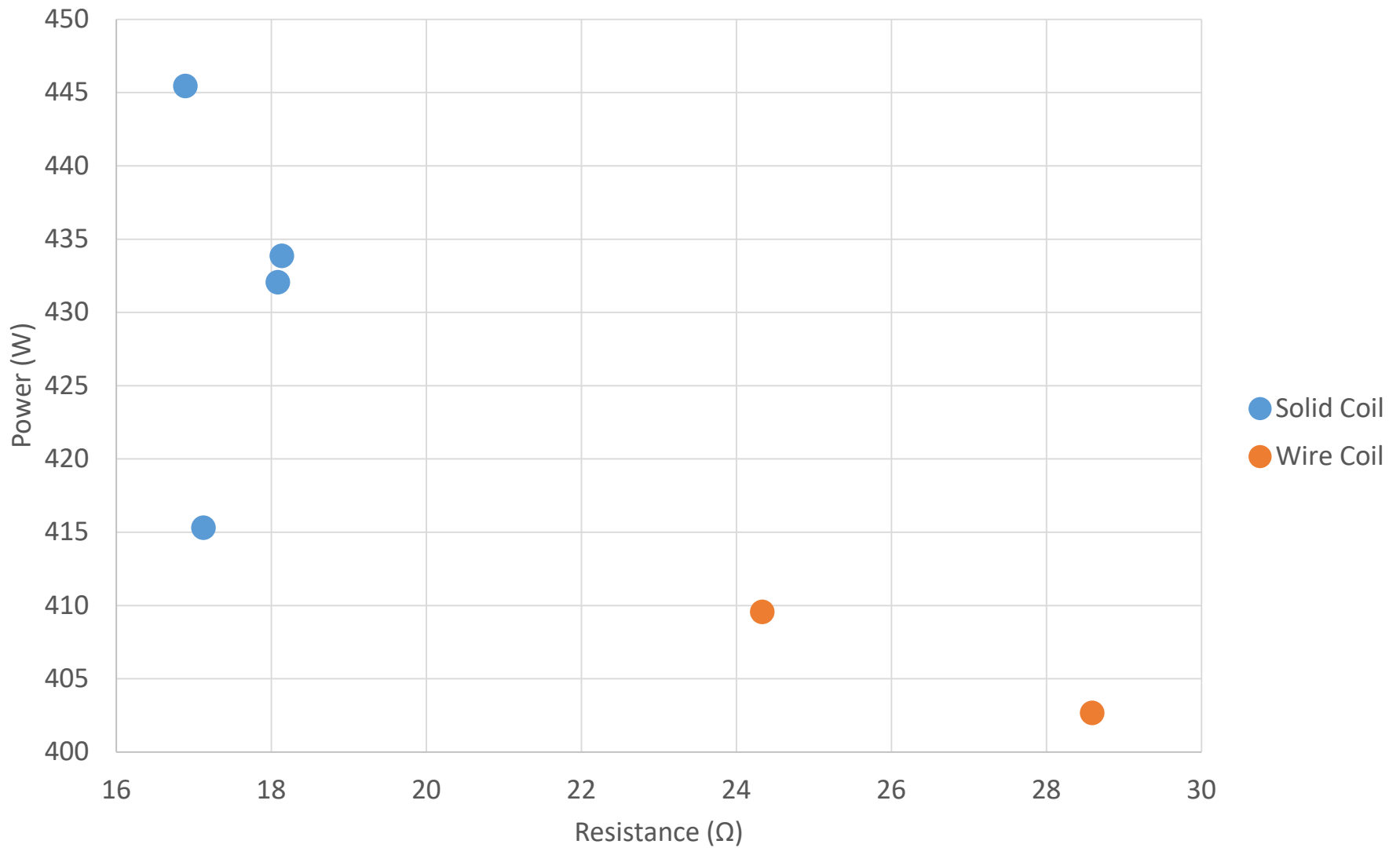


Set coil to 1.5 inch depth



- Coils aren't all on exactly the same plane (Heater 2 varies 3/16")
- Condition of surface could affect emissivity

Heater Internal Resistance vs. Power Required for Calibration



Conclusion

- **Keysight digital power source is more accurate than Variable Autotransformer**
- **Much more repeatable calibrations changing heat flux gauges vs changing heaters**
- **Measuring heat flux produces more accurate calibration than measuring power**
- **Make sure heat flux gauge surface is in good condition and calibration is up to date**
- **NPRM states to calibrate using power measurement**
 - Will be changed back to heat flux

Questions?

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