

U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
Gaithersburg, MD 20899

**REPORT OF TEST
FR 4015**

August 20, 2001

**CALIBRATION OF HEAT FLUX GAGES FOR FORUM HEAT FLUX
MEASUREMENT WORKING GROUP INTERLABORATORY COMPARISON**

William M. Pitts and John R. Shields
Building and Fire Research Laboratory
National Institute of Standards and Technology
Gaithersburg, MD 20899, USA



NIST

National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

This Report of Test summarizes the results of calibrations of two heat flux gages performed in the Building and Fire Research Laboratory at the National Institute of Standards and Technology on April 16, April 18, and May 7, 2001. The calibrations are part of an Interlaboratory comparison of heat flux calibration procedures being carried out by the FORUM Heat Flux Measurement Working Group under the auspices of the Forum for International Cooperation in Fire Research.

The calibrations were performed using the apparatus and procedure summarized in a recent NIST/BFRL Report of Test (Pitts, W. M., Lawson, J. R., and Shields, J. R., "NIST/BFRL Calibration System for Heat-Flux Gages," *Report of Test FR4014*, National Institute of Standards and Technology, Gaithersburg, MD, Aug. 6, 2001).

The results of the calibrations have been fit as a linear equation of the form

$$AHF = a + bV,$$

where AHF is the applied heat flux, V is the voltage output for the gage in mV, and a and b are the intercept and slope for the line. The fit is obtained from a regression analysis available in SIGMAPLOT 6.00. The analysis also returns values of the standard errors for a and b , which are denoted as Δa and Δb , respectively. The square root of the coefficient of determination, R , is used as a measure for the goodness of the fit.

Three independent calibrations were performed on three different days for a 1.27 cm diameter Schmidt-Boelter gage (SN119272) and a 2.54 cm Gardon gage (SN119271) procured from Medtherm, Inc.* Each gage incorporates two thermocouples designed to record the body and surface temperatures. In order to limit biasing of the results, the calibrations of the gages performed by the manufacturer were not available at the time of the measurements reported herein.

The results of the calibrations and heat flux gage temperatures are summarized in the following two tables. Temperatures are reported for individual measurements with dashes indicating missing values. Plots of the applied heat flux versus voltage reading are included for each individual calibration along with a summary plot for each gage. Tables of the numerical results for the two gages are included at the end.

*Certain commercial equipment, instruments, or material are identified in this paper in order to adequately specify the experimental procedure. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment are necessarily the best available for the purpose.

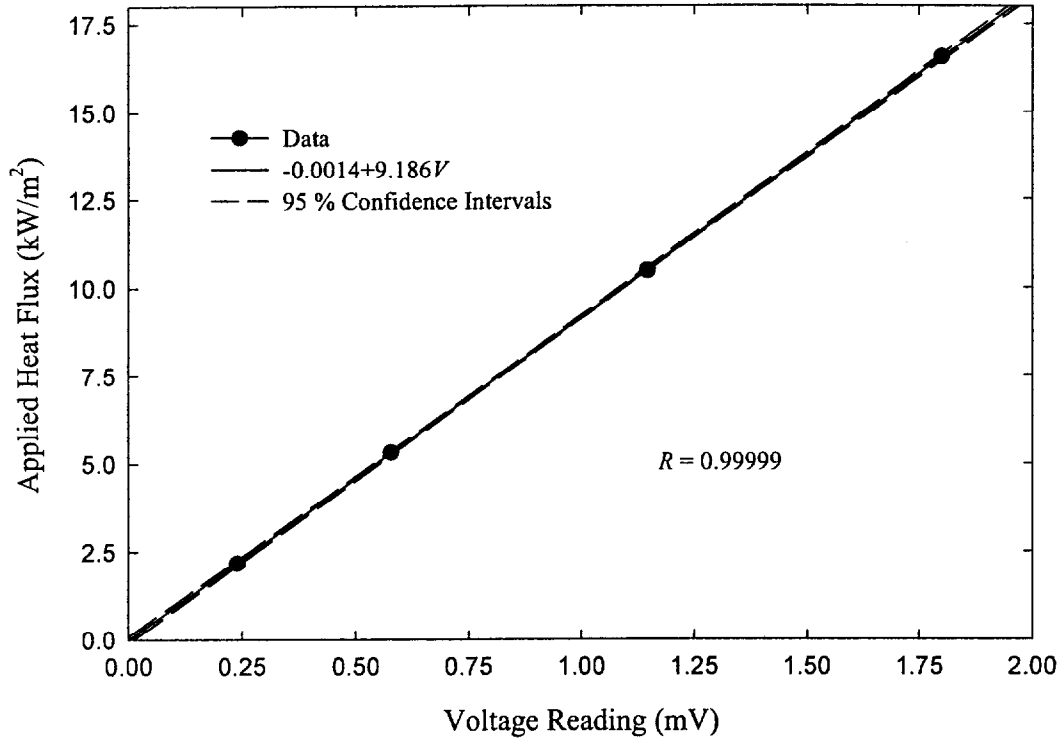
CALIBRATION RESULTS FOR SCHMIDT-BOELTER GAGE (SN119272)

Date	a (kW/m ²)	Δa	b (kW/m ² -mV)	Δb	R	T_{body} (°C)	$T_{surface}$ (°C)
4/16/01	-0.001	0.029	9.186	0.026	0.99999	17.6,18.1,18.4,19.2	18.0,18.8, 20.6,22.2
4/18/01	-0.035	0.018	9.250	0.016	1.00000	19.3,20.8,18.1,17.9	19.7,21.3,19.8,20.5
5/7/01	-0.055	0.044	9.279	0.041	0.99998	22.5,22.7,23.2,23.3	22.9,23.8,25.1,26.0
All Data	-0.029	0.022	9.237	0.020	0.99998	--	--

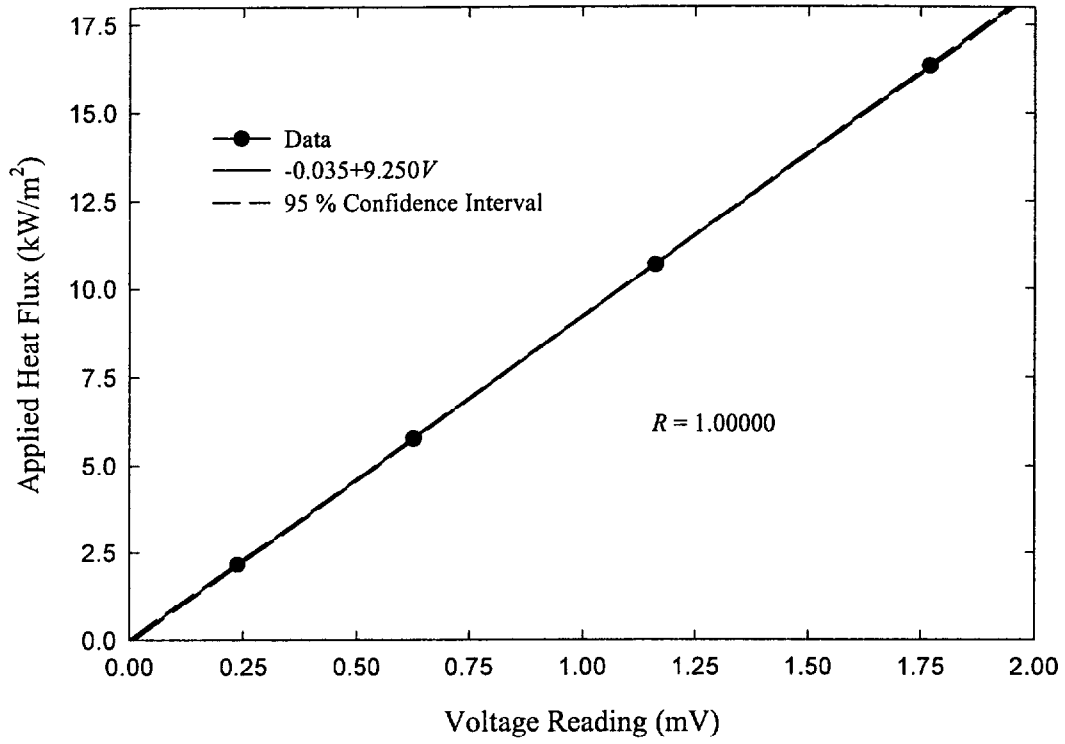
CALIBRATION RESULTS FOR GARDON GAGE (SN119271)

Date	a (kW/m ²)	Δa	b (kW/m ² -mV)	Δb	R	T_{body} (°C)	$T_{surface}$ (°C)
4/16/01	0.069	0.056	12.277	0.068	0.99997	17.1,18.8,19.0,19.2	18.1,18.4, 18.7,18.9
4/18/01	0.035	0.080	12.350	0.096	0.99994	19.4,19.8,--,17.2	19.7,19.6,--,17.0
5/7/01	0.041	0.043	12.206	0.052	0.99998	--,--,22.8,23.0	--,--,22.8,23.0
All Data	0.048	0.040	12.279	0.049	0.99992	--	--

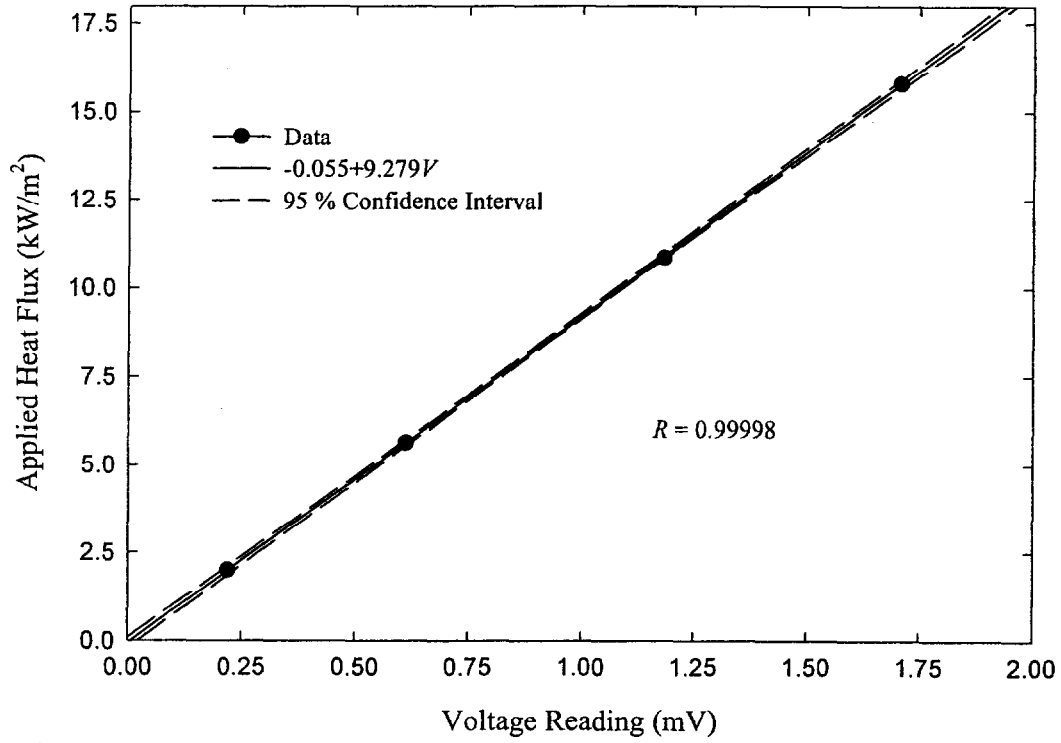
Schmidt-Boelter Gage
Calibration
April 16, 2001



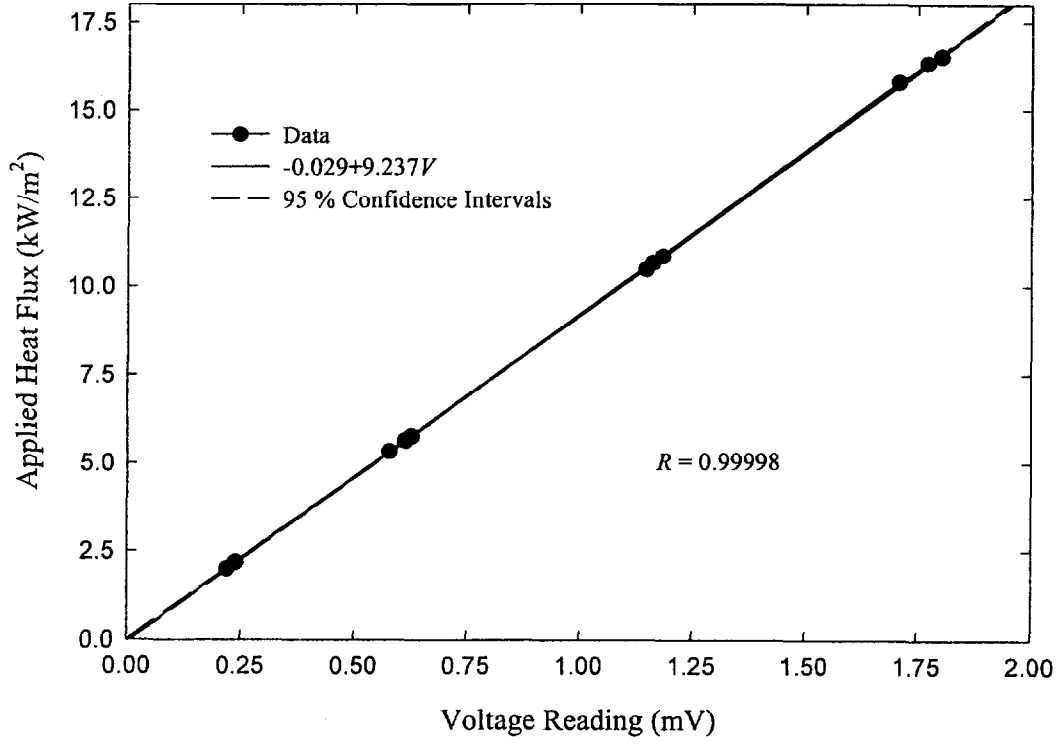
Schmidt-Boelter Gage
Calibration
April 18, 2001



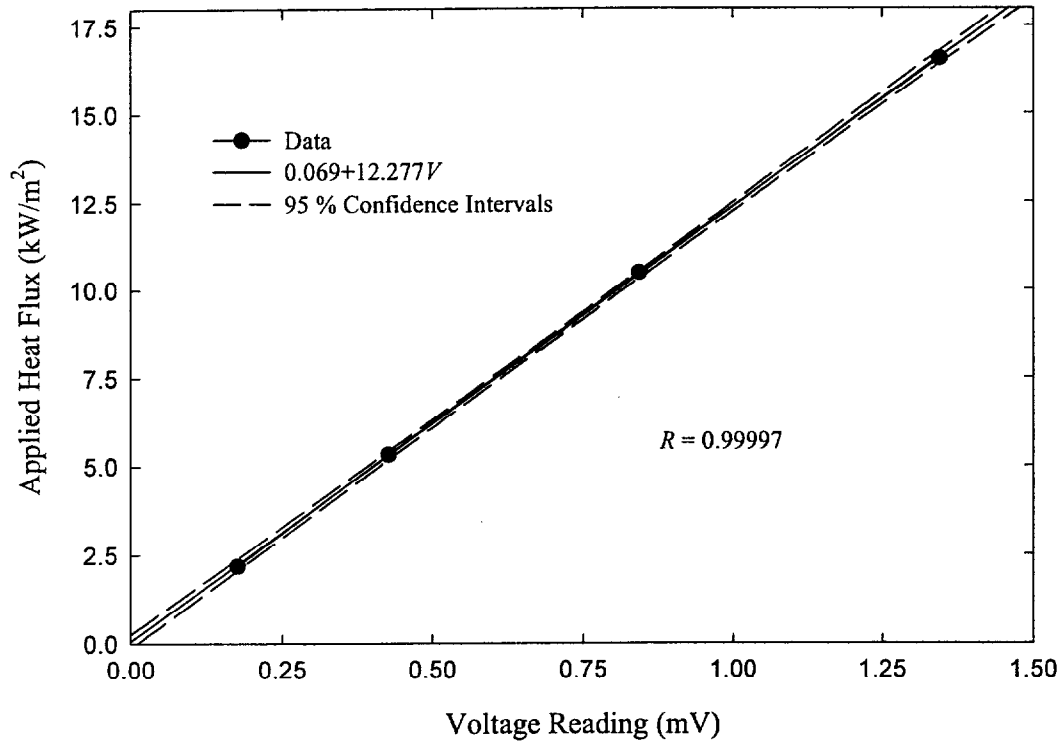
Schmidt-Boelter Gage
Calibration
May 7, 2001



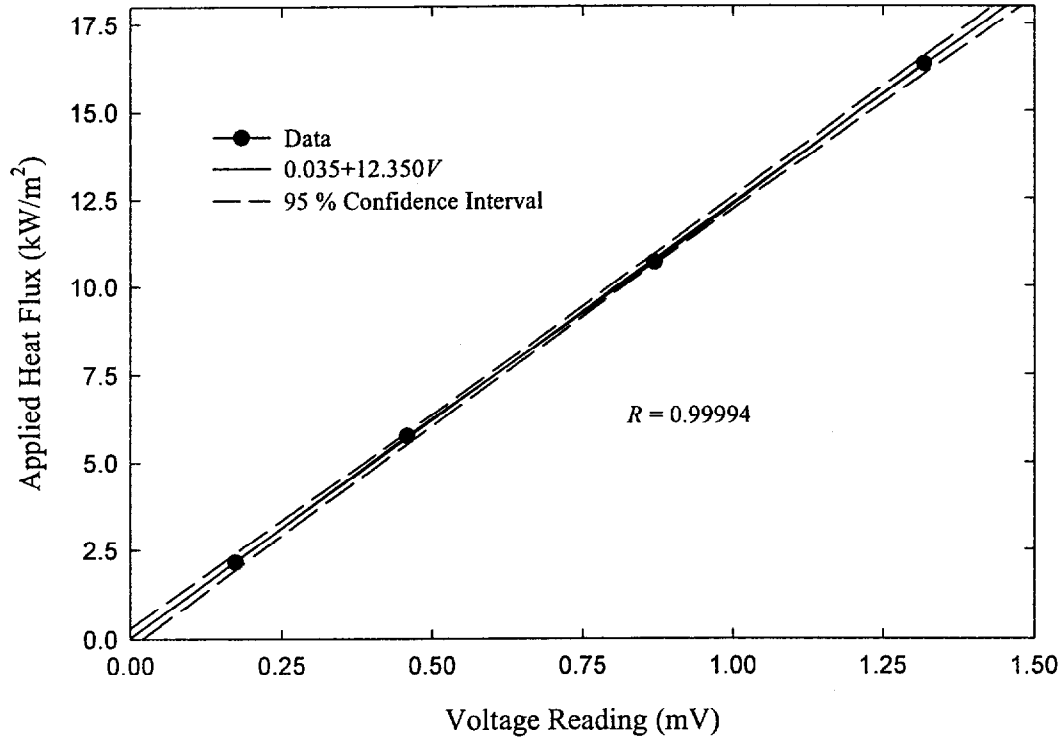
Schmidt-Boelter Gage
Calibration
All Data



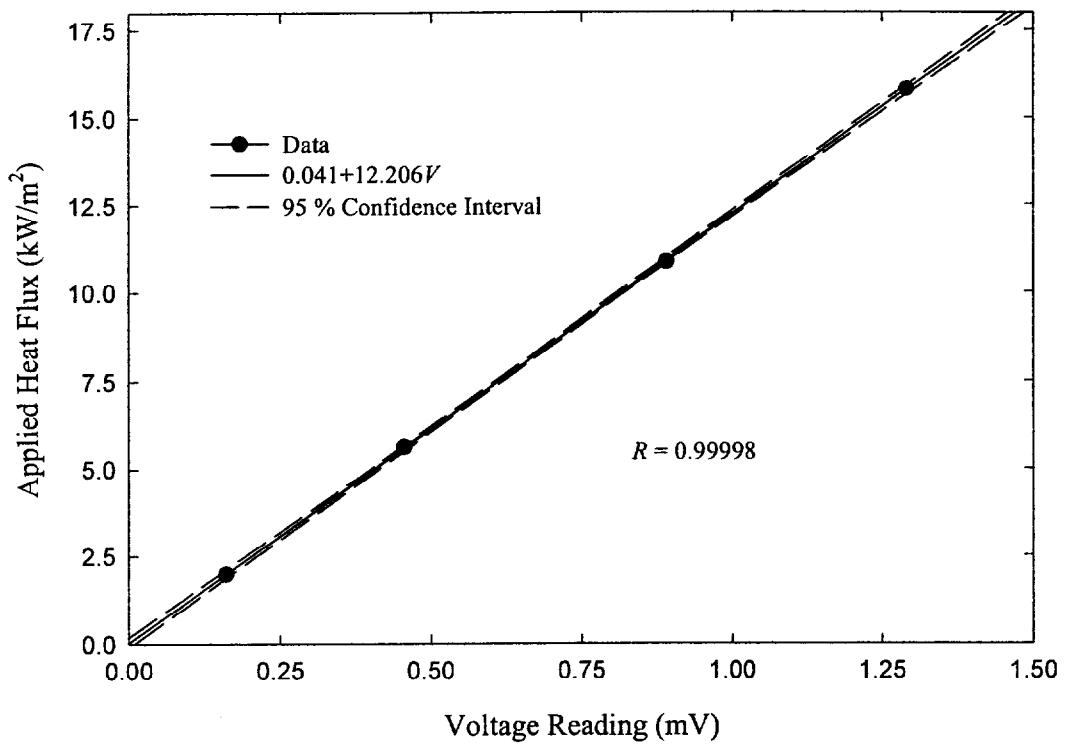
Gardon Gage
Calibration
April 16, 2001



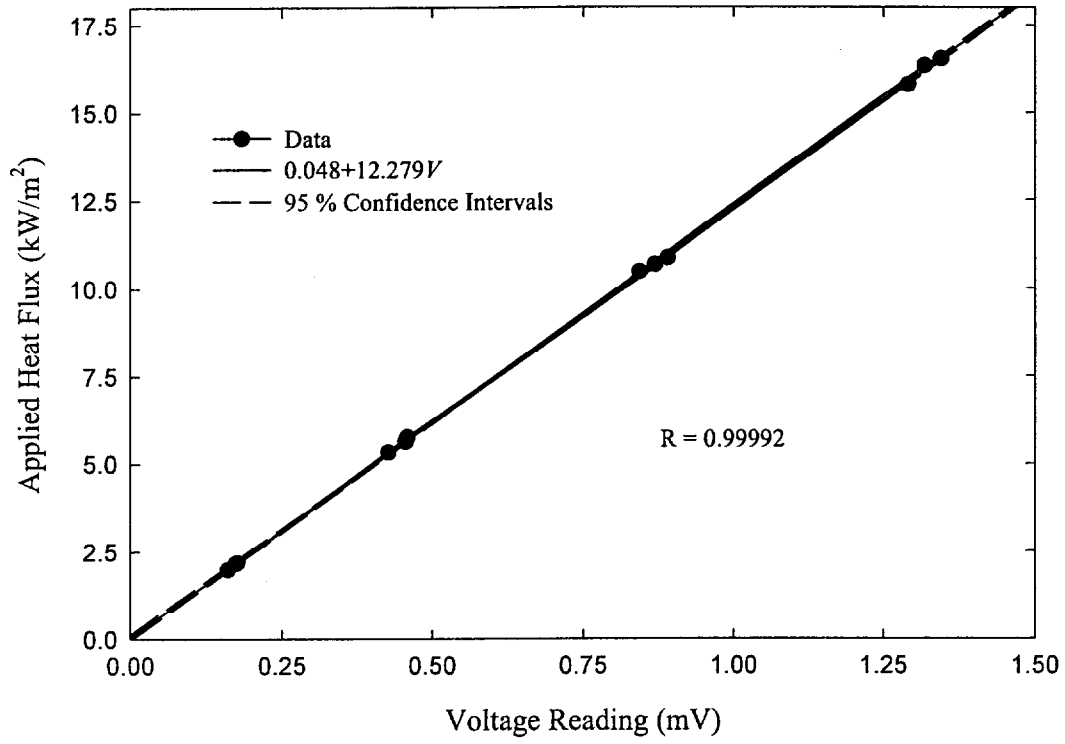
Gardon Gage
Calibration
April 18, 2001



Gardon Gage
Calibration
May 7, 2001



Gardon Gage
Calibration
All Data



Schmidt-Boelter Gage (SN 119272)

Voltage Reading (mV)	Applied Heat Flux (kW/m ²)
0.2390	2.189
0.5779	5.331
1.1457	10.490
1.8000	16.547
0.2368	2.163
0.6266	5.762
1.1610	10.682
1.7700	16.350
0.2190	1.992
0.6126	5.636
1.1825	10.865
1.7060	15.809

Gardon Gage (SN 119271)

Voltage Reading (mV)	Applied Heat Flux (kW/m ²)
0.1761	2.189
0.4270	5.331
0.8436	10.490
1.3454	16.547
0.1735	2.163
0.4584	5.762
0.8693	10.682
1.3180	16.350
0.1606	1.992
0.4555	5.636
0.8906	10.865
1.2901	15.809