



CERTIFICATE NUMBER [REDACTED]

INSTRUMENTATION & SPECIALTY CONTROLS DIVISION
11 Commerce Blvd. | Middleboro, MA 02346
P: 508.946.6200 | F: 508.946.6262

CERTIFICATE OF MASTER VISCOMETER CALIBRATION

MODEL [REDACTED] **SERIAL NUMBER** [REDACTED] **CALIBRATION DATE**
12/4/2017

CALIBRATION OF THIS INSTRUMENT WILL BE ACCURATE TO WITHIN +/- 0.4% OF ITS FULL SCALE RANGE WHEN OPERATED ACCORDING TO CALIBRATION CONDITIONS AS SPECIFIED IN THE BROOKFIELD VISCOMETER INSTRUCTION MANUAL. THIS INSTRUMENT HAS BEEN INSPECTED AND FOUND TO CONFORM TO THE CALIBRATION SPECIFICATIONS FOR THE BROOKFIELD VISCOMETER. CALIBRATION HAS BEEN DETERMINED AGAINST A PRIMARY VISCOSITY STANDARD, TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY. TEMPERATURE AND HUMIDITY WERE CONTROLLED WITHIN NORMAL LABORATORY LIMITS. THIS INSTRUMENT IS FREE FROM MECHANICAL DEFECTS AND IS IN PROPER OPERATING CONDITION.

REFERENCE EQUIPMENT USED TO CALIBRATE THIS MASTER VISCOMETER

<u>CERTIFIED VISCOSITY REFERENCE STANDARD</u>	<u>SERIAL NUMBER</u>	<u>CALIBRATION DATE</u>	<u>CALIBRATION DUE DATE</u>
R1260(25C)	160711	7/14/2016	7/31/2018
<u>THERMOMETER READOUT MODEL</u>	<u>SERIAL NUMBER</u>	<u>CALIBRATION DATE</u>	<u>CALIBRATION DUE DATE</u>
1504	A88654	10/22/2016	10/22/2018
<u>THERMISTOR PROBE</u>	<u>SERIAL NUMBER</u>	<u>CALIBRATION DATE</u>	<u>CALIBRATION DUE DATE</u>
5641	3145	10/19/2016	10/19/2018

NIST TRACE # RVR206885_120417.pdf

All reference equipment used to calibrate the instrument listed upon this certificate have calibrations that are traceable to the National Institute of Standards and Technology (NIST).

APPROVAL SIGNATURE

PATRICIA ELLIS, QUALITY MANAGER

CALIBRATION PERFORMED BY GHA

CERTIFICATE OF ANALYSIS

CANNON® CERTIFIED VISCOSITY REFERENCE STANDARD					
Viscosity Standard: R1260(25C)			Lot Number: 160711		
Certification/Issue Date: 07/14/2016			Expiry Date: 07/31/2018		
Temperature		Kinematic Viscosity	Dynamic Viscosity	Density	
° C	° F	mm ² /s (cSt)	mPa·s (cP)	g/cm ³ (g/mL)	
24.50	76.10	4442	3877	0.8729	
25.00	77.00	4239	3699	0.8726	
25.50	77.90	4071	3551	0.8723	
Tested and certified in the U.S.A.					

This Certificate of Analysis shall not be reproduced, except in full, without the written approval of CANNON Instrument Company.



USAGE INFORMATION¹

Intended Use and Instructions: This CANNON® Certified Viscosity Reference Standard is intended for but not restricted to the calibration and performance verification of various types of viscometers or density measurement equipment. Consult user's manual and test methods specific to your equipment for operating instructions and procedures.

Storage and Handling: This CANNON® Certified Viscosity Reference Standard should be stored in the original container with the lid tightly closed, away from direct light, and at ambient temperatures and normal laboratory conditions. The standard was prepared in accordance with CANNON® Standard Laboratory Operating Procedures to ensure homogeneity and therefore mixing is unnecessary before use and no minimum sample volume is required.

Composition and Product Safety: This CANNON® Certified Viscosity Reference Standard is composed of: *Poly-Butene (100%)* [CAS#(s) 9003-29-6]. Consult MSDS for complete product safety information.

Expiration of Certification: The certification of this CANNON® Certified Viscosity Reference Standard is valid, within the stated measurement uncertainty, until the expiry date that appears on this certificate, provided the material is stored and handled as stated. This certification is deemed null and void if the standard is modified or contaminated. The shelf life was determined empirically through a historical evaluation of material stability. If substantive technical changes occur to the product which affects the certification before the expiry date, CANNON Instrument Company will contact the purchaser.

 ISO/IEC 17025 ACCREDITED Calibration Laboratory CERT#1262.01	 ISO Guide 34 ACCREDITED Reference Material Producer CERT#1262.02
<p><i>The inclusion of the A2LA and ILAC MRA logos does not imply certification/approval of the products calibrated or tested.</i></p>	
<p>ISO 9001 Registered by UL-DQS #10002540 QM</p>	



Certification Under
 Supervision of: D.B. Trowbridge, Ph.D.
 J.T. Mastropierro
 M.T. Zubler

BOTTLED BY
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DISCUSSION OF DATA¹

Derivation of Certified Values: CANNON Instrument Company certifies that the kinematic viscosities were determined by the Master Viscometer technique reported in the Journal of Research of the National Bureau of Standards, (Vol. 52, No. 3, March 1954, Research Paper 2479) using CANNON® Laboratory Standard viscometers. All temperature measurements were conducted according to The International Temperature Scale of 1990 (ITS-90) using SPRTs with fixed point calibrations. The provided viscosity data are based upon the primary standard, water at 20 °C, with a kinematic viscosity of 1.0034 mm²/s and an assigned accuracy of ± 0.17% as per ISO 3666. See also ASTM methods D2162, D445, D446, D2161, and ISO methods 3104 and 3105.

Kinematic viscosity (ν) measurements in mm²/s at temperatures of 20, 25, 37.78, and 40 °C were generally made using CANNON® and/or Cannon-Ubbelohde (long capillary) Master viscometers, as described in ASTM methods D2162, D445, and D446. Measurements at other temperatures have been made using Cannon-Ubbelohde Laboratory Standard viscometers.

Density (ρ) in g/cm³ (g/mL) was generally determined through measurement in an oscillating U-tube digital density meter or modified Bingham pycnometer. See ASTM methods D4052, D1480, and D1217.

Dynamic viscosity (η) in mPa·s was generally determined by measuring the kinematic viscosity and multiplying it by the density at the same temperature [$\eta = \nu \cdot \rho$]. In some cases, dynamic viscosity was measured directly using Cannon-Manning Vacuum Laboratory Standard viscometers. See ASTM method D2171.

Where appropriate, the kinematic viscosity, dynamic viscosity, or density at certain temperatures was determined through regression of all measured data using industry standard equations. These equations include the linear or quadratic viscosity/density-temperature equation derived from the ASTM viscosity-temperature charts for petroleum products as well as the NBS viscosity-temperature equation for petroleum products. See ASTM method D341 and NBS equation.

Saybolt viscosity in Saybolt Universal Seconds (SUS) and in Saybolt Furol Seconds (SFS) was determined through mathematical conversion of measured kinematic viscosities in mm²/s. See ASTM method D2161.

Traceability: All data are traceable to intrinsic standards and National Institute of Standards and Technology (NIST) calibration or calculated by ASTM or NIST methods. Kinematic viscosity values are traceable to the viscosity of water. Temperature measurements were conducted with SPRTs that have NIST traceable fixed-point calibrations. A complete traceability statement is available for purchase from CANNON Instrument Company.

Measurement Uncertainty: CANNON Instrument Company has determined and reported the measurement uncertainty of its laboratory capabilities. The expanded uncertainties of the laboratory measurements summarized at the 95% confidence interval are as follows:

Kinematic Viscosity (- 40 °C to + 150 °C)

Range of Kinematic Viscosity (mm ² /s)	Expanded Uncertainty* (%) at Temperatures:		
	<15°C	15 to 45°C	>45°C
<10	0.21	0.16	0.21
10-100	0.26	0.22	0.26
100-1000	0.32	0.29	0.32
1000-10,000	0.47	0.38	0.38
10,000-100,000	0.53	0.44	0.48

Density (- 56 °C to + 150 °C)

Range of Density (g/cm ³)	Expanded Uncertainty* (kg/m ³)
0.7 – 1.2	0.05

* An expanded uncertainty U is determined by multiplying the combined standard uncertainty u_c by a coverage factor k : $U = k u_c$, where $k=2$. See NIST Technical Note 1297, 1994 edition, Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results.

The expanded uncertainty for dynamic viscosity can be considered equivalent to the expanded uncertainty for kinematic viscosity since the uncertainty contribution of the density measurement is deemed negligible in the calculation of the total expanded uncertainty.

CANNON Instrument Company 2139 High Tech Road State College, PA 16803 USA 814 353-8000 • 800 676-6232 • FAX 814 353-8007	Laboratory Technical Director: D.B. Trowbridge, Ph.D. Deputy Laboratory Technical Director: J.T. Mastropiero Director of Quality Assurance: M.T. Zubler
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¹ Consult www.cannoninstrument.com for additional information.

Certificate of Calibration
Fluke Calibration, American Fork
Primary Temperature Laboratory

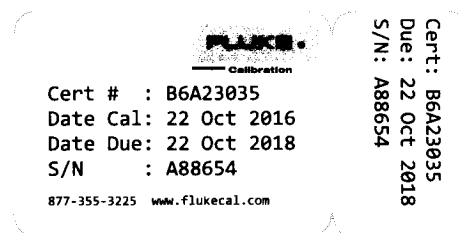
Description:	Readout, Digital Thermometer	Certificate Number:	B6A23035
Manufacturer:	Fluke	Date of Calibration:	22 Oct 2016
Model:	1504	Date Due:	22 Oct 2018
Serial Number:	A88654	Temperature:	21.0 to 25.0 °C
Status:	As-Found: In Tolerance As-Left: In Tolerance	Relative Humidity:	15 to 60 %RH
Calibration:	Full	Pressure:	83.5 to 88.5 kPa
Procedure:	HCT106 - 1	Issue Date:	23 Oct 2016
Customer:	BROOKFIELD AMETEK MIDDLEBORO, MA, 02346, US	RMA/SO Number:	31094826
PO Number:	2210006653		

This calibration is traceable to the SI through recognized national measurement institutes, radiometric techniques, or natural physical constants and is in compliance with ISO17025:2005 and ANSI/NCSL Z540.1. The calibration has been completed in accordance with the Fluke Calibration Quality System document QSD 111.0. Calibration certificates without signatures are not valid. This certificate applies to only the item identified and shall not be reproduced other than in full, without the specific written approval by Fluke Corporation. This certificate shall not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

This calibration certificate may contain data that is not covered by the Scope of Accreditation. The unaccredited test points, where applicable, are indicated by an asterisk (*), or confined to clearly marked sections. Functional tests are not accredited.

Measurement uncertainties at the time of test are given where applicable. They are calculated in accordance with the method described in the ISO Guide to the Expression of Uncertainty in Measurement. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95 %.

Comments:



[Signature]
Approved Signatory

Standards Used

Description	Serial Number	Due-Date
749A Standard Resistor Set	A53002	16-Dec-2016
5610 Thermistor Probe	A1C2704	09-Dec-2016
1529-R Digital Thermometer	A6B320	06-Jun-2017
N/A Test Station	4	NCR

Quality Manuals

This calibration has been completed in accordance with:

- The Fluke Corporate Quality Manual, QSD 111.0, Revision 118, Dated August, 2014 and/or
- The Fluke 17025 Quality Manual, QSD 111.41, Revision 005, Dated Sept. 2014

The instrument described herein was calibrated by one or more of the following methods. Resistance measurements were calibrated by direct measurement of laboratory reference resistors. Ratio measurements were calibrated by comparison to ratio test sets. Thermocouple measurements were calibrated by precision voltage excitation and reference junction compensation measurements. The calibration data, internal calibration constants, and calibration uncertainties are shown on the following page(s) of this report. The calibration uncertainties are shown at a coverage factor of 2 ($k=2$). All known significant sources of uncertainty have been considered. Any limitations or remarks pertaining to this instrument and/or calibration are shown below. Additionally, out of tolerance indications, if any, are identified along with the corresponding data on the following page(s) of this report.

Calibration uncertainties have been taken into account in the determination of tolerance status using risk analysis algorithms. When using the instrument in a calibration process, it is recommended that the instrument specifications be used as the contribution of the instrument rather than the calibration uncertainties. The instrument tolerances are shown on the report at a confidence interval of 95%.

Certificate of Calibration

Model: 1504

Serial No.: A88654

Certificate No: B6A23035

As Found Data

Calibration Constants		Test Data				Data ID: 6296094940		
CAL0	0.04							
CAL10	-0.60							
CAL100	0.7							
		Nominal Ω	Actual	Measured	Error	Calibration Tolerance	Uncertainty	Pass/Fail
		0	0.00	0.05	0.05	± 0.50	± 0.10	P
		4K	3.99992	3.99998	0.00006	± 0.00050	± 0.00010	P
		10K	10.0002	10.0003	0.0001	± 0.0010	± 0.00020	P
		40K	39.9989	39.9991	0.0002	± 0.0040	± 0.00045	P
		100K	100.001	100.000	-0.001	± 0.010	± 0.0022	P
		1M	0.99711	0.99719	0.00008	± 0.00030	± 0.000073	P

As Left Data

Calibration Constants		Test Data				Data ID: 6296094940		
CAL0	-0.01							
CAL10	-0.70							
CAL100	1.0							
		Nominal Ω	Actual	Measured	Error	Calibration Tolerance	Uncertainty	Pass/Fail
		0	0.00	-0.04	-0.04	± 0.50	± 0.10	P
		4K	3.99992	3.99992	0.00000	± 0.00050	± 0.00010	P
		10K	10.0002	10.0002	0.0000	± 0.0010	± 0.00020	P
		40K	39.9989	39.9989	0.0000	± 0.0040	± 0.00045	P
		100K	100.001	100.001	0.000	± 0.010	± 0.0022	P
		1M	0.99711	0.99722	0.00011	± 0.00030	± 0.000073	P

**Fluke Calibration, American Fork
 Primary Temperature Lab
 Report of Calibration**



Model: 5641	Description: Thermistor Probe	Customer: BROOKFIELD AMETEK MIDDLEBORO, MA, 02346, US	
Serial No.: 3145	Manufacturer: Thermometrics		
As Found Condition: Recalibration	As Left Condition: Calibrated	Calibration Model: 1725-B	Calibration Instruction: AFC110 Revision 001

The above referenced thermistor was calibrated by comparison over the temperature range specified. Uncertainties (k=2) for the calibration are given in the table below. Accounted for in the uncertainty evaluation are all known influence quantities present at the time of calibration including long-term behavior of the calibration system, measurement noise, bath uniformity, bath stability and mathematical fit. The value of current used in the calibration was 0.010 mA unless stated otherwise in the special notes section. Care should be taken to use the same current in order to minimize self-heating effects. To improve the quality of the calibration more than the minimum number points were included in the calibration resulting in an overdetermined fit and fitting residuals. Limits placed on the allowable magnitude of the fitting residuals help to ensure the quality of the calibration. Shown below are the calibration points, corresponding measurement results and fitting residuals for the above referenced thermistor calibration.

CALIBRATION POINT		TEMPERATURE	MEASURED RESISTANCE	RESIDUAL	Uncertainty (k=2)
(point)	(type)	t90 (°C)	(ohms)	t90 (°C)	t90 (mk)
0.000	Comp	-0.007	11870.3578	0.0002	2.0
10.000	Comp	9.985	7582.9099	-0.0007	2.0
20.000	Comp	19.986	4970.7310	0.0004	2.0
30.000	Comp	29.972	3339.6814	0.0004	2.0
40.000	Comp	39.973	2292.8855	-0.0001	2.0
50.000	Comp	49.971	1607.0560	-0.0006	2.0
60.000	Comp	59.959	1148.4140	0.0004	2.0

The following reference standards and measurement equipment were used in the course of this calibration.

Instrument	Model	Serial No.	Recall Date
Digital Thermometer	1590	8C030	07/26/2017
Platinum Resistance Thermometer	5683	4318	05/06/2018

Environmental Conditions:
 Temperature: 23.2°C
 Humidity: 36.4% RH
 Calibration Date: 10/19/2016
 Calibration Due: 10/19/2018
 PO Number: 2210006653
 Report Number: B6A14021
 Page: 1 of 6

Approved by: 

**Frank Liebmann
 Metrology Engineer**

Fluke Calibration, American Fork
Primary Temperature Lab
Report of Calibration

Extrapolation of the calibration beyond the specified temperature range is not intended and will cause a loss of traceability in the extrapolated measurement results. The calibration data were fitted by the method of least squares to obtain coefficients for the accepted third order functions of the form shown below. Equation (1) describes the temperature as a function of resistance for direct conversion, and equation (2) describes resistance as a function of temperature for generation of the interpolation table.

$$(1) \frac{1}{T} = A_0 + A_1 * \ln(R) + A_2 * \ln(R)^2 + A_3 * \ln(R)^3 \quad (2) \ln(R) = B_0 + \frac{B_1}{T} + \frac{B_2}{T^2} + \frac{B_3}{T^3}$$

Where: R = resistance in Ohms and T = temperature in Kelvin

A0 = 1.1385012 E-03	B0 = -4.6515620 E00
A1 = 2.6131701 E-04	B1 = 4.0414752 E03
A2 = -6.3240557 E-07	B2 = -8.8325557 E03
A3 = 1.5334344 E-07	B3 = -1.3132833 E07

The attached interpolation table was generated from the coefficients listed above. The table is given in terms of resistance versus temperature. These tables may be used in cases where the readout instrument does not have the capability of computing temperature directly from the coefficients or as a check that the coefficients have been entered into the readout or computer program correctly. The following steps are used to compute temperature from measured resistance using the table. (1) Determine the resistance at the temperature in question. (2) On the table, locate the two resistance values which surround the measured resistance. (3) Subtract the lower of the two table values from the measured value. (4) Divide the result by the dR/dT value in the adjacent column. (5) Add the product of this computation to the temperature which corresponds to the lower of the two table values in step (2).

This calibration is traceable to NIST and ratiometric techniques as shown in traceability diagram HCQ004. This document is available from Fluke Calibration, American Fork if required. This calibration is compliant to NCSL/ISO/IEC 17025:2005 and ANSI/NCSL Z540-1-1994. This calibration report applies only to the item described. It shall not be used to claim product endorsement by NVLAP or any agency of the U.S. Government. Calibration reports without signatures are not valid.

Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)
0.00	11866.403	-548.50235	5.70	9159.3317	-408.91416	11.40	7132.2520	-307.66908
0.10	11811.696	-545.63896	5.80	9118.5438	-406.84660	11.50	7101.5605	-306.16178
0.20	11757.275	-542.79212	5.90	9077.9620	-404.79064	11.60	7071.0194	-304.66270
0.30	11703.137	-539.96173	6.00	9037.5853	-402.74621	11.70	7040.6277	-303.17178
0.40	11649.282	-537.14768	6.10	8997.4124	-400.71324	11.80	7010.3847	-301.68896
0.50	11595.707	-534.34988	6.20	8957.4422	-398.69166	11.90	6980.2896	-300.21422
0.60	11542.412	-531.56822	6.30	8917.6737	-396.68140	12.00	6950.3416	-298.74748
0.70	11489.393	-528.80260	6.40	8878.1056	-394.68238	12.10	6920.5399	-297.28872
0.80	11436.651	-526.05291	6.50	8838.7368	-392.69455	12.20	6890.8836	-295.83788
0.90	11384.182	-523.31907	6.60	8799.5663	-390.71782	12.30	6861.3720	-294.39491
1.00	11331.986	-520.60096	6.70	8760.5929	-388.75215	12.40	6832.0044	-292.95976
1.10	11280.061	-517.89849	6.80	8721.8155	-386.79744	12.50	6802.7798	-291.53240
1.20	11228.406	-515.21156	6.90	8683.2331	-384.85365	12.60	6773.6976	-290.11277
1.30	11177.018	-512.54007	7.00	8644.8444	-382.92070	12.70	6744.7570	-288.70083
1.40	11125.897	-509.88393	7.10	8606.6486	-380.99853	12.80	6715.9572	-287.29654
1.50	11075.041	-507.24304	7.20	8568.6444	-379.08707	12.90	6687.2975	-285.89984
1.60	11024.448	-504.61731	7.30	8530.8308	-377.18625	13.00	6658.7770	-284.51069
1.70	10974.117	-502.00663	7.40	8493.2068	-375.29602	13.10	6630.3951	-283.12905
1.80	10924.046	-499.41093	7.50	8455.7712	-373.41630	13.20	6602.1509	-281.75488
1.90	10874.235	-496.83009	7.60	8418.5232	-371.54703	13.30	6574.0438	-280.38812
2.00	10824.680	-494.26403	7.70	8381.4615	-369.68816	13.40	6546.0731	-279.02874
2.10	10775.381	-491.71266	7.80	8344.5852	-367.83961	13.50	6518.2379	-277.67670
2.20	10726.337	-489.17588	7.90	8307.8932	-366.00133	13.60	6490.5375	-276.33194
2.30	10677.546	-486.65361	8.00	8271.3846	-364.17324	13.70	6462.9712	-274.99442
2.40	10629.006	-484.14575	8.10	8235.0582	-362.35530	13.80	6435.5384	-273.66411
2.50	10580.716	-481.65222	8.20	8198.9132	-360.54743	13.90	6408.2382	-272.34096
2.60	10532.675	-479.17292	8.30	8162.9484	-358.74958	14.00	6381.0699	-271.02493
2.70	10484.881	-476.70776	8.40	8127.1629	-356.96168	14.10	6354.0329	-269.71597
2.80	10437.333	-474.25666	8.50	8091.5557	-355.18369	14.20	6327.1265	-268.41405
2.90	10390.029	-471.81953	8.60	8056.1259	-353.41552	14.30	6300.3499	-267.11912
3.00	10342.968	-469.39629	8.70	8020.8723	-351.65714	14.40	6273.7024	-265.83114
3.10	10296.149	-466.98684	8.80	7985.7941	-349.90847	14.50	6247.1834	-264.55008
3.20	10249.571	-464.59110	8.90	7950.8903	-348.16946	14.60	6220.7922	-263.27588
3.30	10203.231	-462.20898	9.00	7916.1599	-346.44005	14.70	6194.5280	-262.00852
3.40	10157.128	-459.84041	9.10	7881.6020	-344.72018	14.80	6168.3903	-260.74794
3.50	10111.262	-457.48530	9.20	7847.2156	-343.00980	14.90	6142.3782	-259.49412
3.60	10065.631	-455.14355	9.30	7812.9997	-341.30884	15.00	6116.4912	-258.24700
3.70	10020.233	-452.81510	9.40	7778.9535	-339.61726	15.10	6090.7286	-257.00656
3.80	9975.0674	-450.49986	9.50	7745.0759	-337.93499	15.20	6065.0897	-255.77275
3.90	9930.1326	-448.19774	9.60	7711.3662	-336.26197	15.30	6039.5738	-254.54553
4.00	9885.4274	-445.90867	9.70	7677.8232	-334.59816	15.40	6014.1804	-253.32487
4.10	9840.9505	-443.63256	9.80	7644.4462	-332.94350	15.50	5988.9086	-252.11073
4.20	9796.7005	-441.36934	9.90	7611.2342	-331.29793	15.60	5963.7580	-250.90306
4.30	9752.6762	-439.11892	10.00	7578.1863	-329.66140	15.70	5938.7278	-249.70183
4.40	9708.8763	-436.88122	10.10	7545.3017	-328.03384	15.80	5913.8174	-248.50701
4.50	9665.2995	-434.65618	10.20	7512.5793	-326.41522	15.90	5889.0262	-247.31855
4.60	9621.9446	-432.44370	10.30	7480.0183	-324.80548	16.00	5864.3535	-246.13642
4.70	9578.8104	-430.24371	10.40	7447.6179	-323.20455	16.10	5839.7987	-244.96058
4.80	9535.8955	-428.05614	10.50	7415.3771	-321.61240	16.20	5815.3612	-243.79099
4.90	9493.1987	-425.88090	10.60	7383.2951	-320.02896	16.30	5791.0403	-242.62763
5.00	9450.7189	-423.71793	10.70	7351.3710	-318.45419	16.40	5766.8354	-241.47044
5.10	9408.4547	-421.56714	10.80	7319.6040	-316.88803	16.50	5742.7460	-240.31941
5.20	9366.4050	-419.42846	10.90	7287.9931	-315.33043	16.60	5718.7714	-239.17448
5.30	9324.5686	-417.30182	11.00	7256.5376	-313.78134	16.70	5694.9109	-238.03562
5.40	9282.9443	-415.18715	11.10	7225.2366	-312.24071	16.80	5671.1640	-236.90281
5.50	9241.5308	-413.08436	11.20	7194.0892	-310.70849	16.90	5647.5301	-235.77600
5.60	9200.3270	-410.99339	11.30	7163.0946	-309.18463	17.00	5624.0086	-234.65516

Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)
17.10	5600.5989	-233.54026	22.80	4433.2521	-178.77290	28.50	3536.1777	-137.95804
17.20	5577.3004	-232.43125	22.90	4415.4160	-177.94970	28.60	3522.4127	-137.34181
17.30	5554.1125	-231.32811	23.00	4397.6620	-177.13074	28.70	3508.7092	-136.72865
17.40	5531.0346	-230.23080	23.10	4379.9897	-176.31599	28.80	3495.0669	-136.11856
17.50	5508.0661	-229.13930	23.20	4362.3987	-175.50541	28.90	3481.4854	-135.51150
17.60	5485.2065	-228.05355	23.30	4344.8885	-174.69900	29.00	3467.9645	-134.90748
17.70	5462.4552	-226.97354	23.40	4327.4587	-173.89672	29.10	3454.5038	-134.30646
17.80	5439.8116	-225.89922	23.50	4310.1090	-173.09855	29.20	3441.1031	-133.70844
17.90	5417.2752	-224.83058	23.60	4292.8389	-172.30448	29.30	3427.7620	-133.11340
18.00	5394.8453	-223.76756	23.70	4275.6480	-171.51447	29.40	3414.4803	-132.52132
18.10	5372.5215	-222.71014	23.80	4258.5359	-170.72850	29.50	3401.2577	-131.93219
18.20	5350.3031	-221.65829	23.90	4241.5021	-169.94655	29.60	3388.0938	-131.34598
18.30	5328.1896	-220.61198	24.00	4224.5464	-169.16860	29.70	3374.9884	-130.76268
18.40	5306.1805	-219.57117	24.10	4207.6683	-168.39463	29.80	3361.9412	-130.18229
18.50	5284.2752	-218.53583	24.20	4190.8674	-167.62461	29.90	3348.9518	-129.60477
18.60	5262.4732	-217.50593	24.30	4174.1432	-166.85852	30.00	3336.0201	-129.03012
18.70	5240.7739	-216.48144	24.40	4157.4955	-166.09634	30.10	3323.1457	-128.45832
18.80	5219.1767	-215.46233	24.50	4140.9238	-165.33805	30.20	3310.3284	-127.88936
18.90	5197.6812	-214.44857	24.60	4124.4278	-164.58362	30.30	3297.5678	-127.32321
19.00	5176.2868	-213.44012	24.70	4108.0070	-163.83304	30.40	3284.8636	-126.75987
19.10	5154.9930	-212.43696	24.80	4091.6610	-163.08628	30.50	3272.2157	-126.19931
19.20	5133.7993	-211.43905	24.90	4075.3896	-162.34332	30.60	3259.6237	-125.64153
19.30	5112.7050	-210.44637	25.00	4059.1923	-161.60414	30.70	3247.0873	-125.08651
19.40	5091.7098	-209.45888	25.10	4043.0686	-160.86871	30.80	3234.6063	-124.53423
19.50	5070.8131	-208.47655	25.20	4027.0184	-160.13703	30.90	3222.1803	-123.98468
19.60	5050.0143	-207.49937	25.30	4011.0411	-159.40906	31.00	3209.8092	-123.43784
19.70	5029.3130	-206.52729	25.40	3995.1365	-158.68479	31.10	3197.4927	-122.89370
19.80	5008.7087	-205.56028	25.50	3979.3040	-157.96419	31.20	3185.2304	-122.35224
19.90	4988.2008	-204.59833	25.60	3963.5435	-157.24725	31.30	3173.0222	-121.81345
20.00	4967.7889	-203.64139	25.70	3947.8545	-156.53395	31.40	3160.8676	-121.27732
20.10	4947.4724	-202.68944	25.80	3932.2366	-155.82425	31.50	3148.7666	-120.74383
20.20	4927.2508	-201.74245	25.90	3916.6895	-155.11815	31.60	3136.7188	-120.21297
20.30	4907.1237	-200.80040	26.00	3901.2128	-154.41563	31.70	3124.7239	-119.68471
20.40	4887.0906	-199.86325	26.10	3885.8062	-153.71666	31.80	3112.7818	-119.15906
20.50	4867.1509	-198.93098	26.20	3870.4694	-153.02122	31.90	3100.8920	-118.63599
20.60	4847.3042	-198.00356	26.30	3855.2019	-152.32930	32.00	3089.0545	-118.11548
20.70	4827.5500	-197.08096	26.40	3840.0034	-151.64088	32.10	3077.2688	-117.59754
20.80	4807.8879	-196.16315	26.50	3824.8736	-150.95593	32.20	3065.5349	-117.08214
20.90	4788.3172	-195.25011	26.60	3809.8121	-150.27444	32.30	3053.8523	-116.56926
21.00	4768.8377	-194.34181	26.70	3794.8186	-149.59638	32.40	3042.2209	-116.05890
21.10	4749.4487	-193.43823	26.80	3779.8927	-148.92175	32.50	3030.6405	-115.55104
21.20	4730.1499	-192.53932	26.90	3765.0341	-148.25051	32.60	3019.1107	-115.04567
21.30	4710.9407	-191.64508	27.00	3750.2425	-147.58265	32.70	3007.6313	-114.54277
21.40	4691.8207	-190.75547	27.10	3735.5175	-146.91816	32.80	2996.2020	-114.04234
21.50	4672.7894	-189.87047	27.20	3720.8588	-146.25701	32.90	2984.8227	-113.54435
21.60	4653.8465	-188.99004	27.30	3706.2660	-145.59918	33.00	2973.4931	-113.04879
21.70	4634.9913	-188.11417	27.40	3691.7388	-144.94466	33.10	2962.2129	-112.55566
21.80	4616.2235	-187.24283	27.50	3677.2769	-144.29343	33.20	2950.9819	-112.06494
21.90	4597.5426	-186.37599	27.60	3662.8800	-143.64547	33.30	2939.7998	-111.57661
22.00	4578.9481	-185.51363	27.70	3648.5477	-143.00076	33.40	2928.6665	-111.09066
22.10	4560.4397	-184.65572	27.80	3634.2798	-142.35929	33.50	2917.5816	-110.60709
22.20	4542.0168	-183.80224	27.90	3620.0758	-141.72103	33.60	2906.5450	-110.12587
22.30	4523.6791	-182.95316	28.00	3605.9354	-141.08597	33.70	2895.5563	-109.64700
22.40	4505.4261	-182.10845	28.10	3591.8585	-140.45409	33.80	2884.6155	-109.17045
22.50	4487.2573	-181.26809	28.20	3577.8445	-139.82538	33.90	2873.7222	-108.69623
22.60	4469.1723	-180.43207	28.30	3563.8933	-139.19981	34.00	2862.8762	-108.22432
22.70	4451.1707	-179.60034	28.40	3550.0045	-138.57737	34.10	2852.0772	-107.75469

Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)
34.20	2841.3251	-107.28736	39.90	2299.0166	-84.055115	45.60	1872.6817	-66.322154
34.30	2830.6197	-106.82229	40.00	2290.6288	-83.701384	45.70	1866.0631	-66.051086
34.40	2819.9606	-106.35948	40.10	2282.2762	-83.349323	45.80	1859.4715	-65.781264
34.50	2809.3477	-105.89891	40.20	2273.9588	-82.998924	45.90	1852.9068	-65.512680
34.60	2798.7808	-105.44058	40.30	2265.6764	-82.650178	46.00	1846.3689	-65.245329
34.70	2788.2595	-104.98447	40.40	2257.4287	-82.303076	46.10	1839.8577	-64.979204
34.80	2777.7838	-104.53057	40.50	2249.2157	-81.957610	46.20	1833.3730	-64.714300
34.90	2767.3533	-104.07887	40.60	2241.0372	-81.613771	46.30	1826.9148	-64.450610
35.00	2756.9679	-103.62936	40.70	2232.8929	-81.271551	46.40	1820.4828	-64.188128
35.10	2746.6274	-103.18202	40.80	2224.7828	-80.930942	46.50	1814.0771	-63.926847
35.20	2736.3315	-102.73685	40.90	2216.7067	-80.591935	46.60	1807.6974	-63.666763
35.30	2726.0799	-102.29382	41.00	2208.6644	-80.254521	46.70	1801.3437	-63.407868
35.40	2715.8726	-101.85294	41.10	2200.6557	-79.918693	46.80	1795.0158	-63.150157
35.50	2705.7093	-101.41419	41.20	2192.6806	-79.584443	46.90	1788.7136	-62.893623
35.60	2695.5897	-100.97755	41.30	2184.7388	-79.251762	47.00	1782.4371	-62.638261
35.70	2685.5137	-100.54302	41.40	2176.8302	-78.920641	47.10	1776.1860	-62.384066
35.80	2675.4810	-100.11059	41.50	2168.9546	-78.591074	47.20	1769.9602	-62.131030
35.90	2665.4915	-99.680238	41.60	2161.1119	-78.263052	47.30	1763.7597	-61.879148
36.00	2655.5449	-99.251962	41.70	2153.3019	-77.936567	47.40	1757.5843	-61.628415
36.10	2645.6411	-98.825747	41.80	2145.5245	-77.611610	47.50	1751.4340	-61.378824
36.20	2635.7797	-98.401584	41.90	2137.7796	-77.288175	47.60	1745.3085	-61.130370
36.30	2625.9607	-97.979460	42.00	2130.0669	-76.966253	47.70	1739.2079	-60.883047
36.40	2616.1837	-97.559367	42.10	2122.3863	-76.645837	47.80	1733.1319	-60.636850
36.50	2606.4487	-97.141292	42.20	2114.7376	-76.326918	47.90	1727.0805	-60.391772
36.60	2596.7554	-96.725225	42.30	2107.1208	-76.009489	48.00	1721.0535	-60.147809
36.70	2587.1036	-96.311156	42.40	2099.5357	-75.693543	48.10	1715.0509	-59.904954
36.80	2577.4931	-95.899073	42.50	2091.9821	-75.379071	48.20	1709.0725	-59.663202
36.90	2567.9237	-95.488967	42.60	2084.4598	-75.066067	48.30	1703.1182	-59.422548
37.00	2558.3953	-95.080827	42.70	2076.9688	-74.754521	48.40	1697.1879	-59.182985
37.10	2548.9075	-94.674643	42.80	2069.5089	-74.444428	48.50	1691.2816	-58.944509
37.20	2539.4603	-94.270404	42.90	2062.0799	-74.135780	48.60	1685.3990	-58.707114
37.30	2530.0534	-93.868099	43.00	2054.6817	-73.828569	48.70	1679.5401	-58.470795
37.40	2520.6866	-93.467720	43.10	2047.3141	-73.522787	48.80	1673.7048	-58.235546
37.50	2511.3598	-93.069255	43.20	2039.9771	-73.218428	48.90	1667.8930	-58.001361
37.60	2502.0727	-92.672695	43.30	2032.6704	-72.915484	49.00	1662.1045	-57.768237
37.70	2492.8252	-92.278029	43.40	2025.3939	-72.613948	49.10	1656.3393	-57.536166
37.80	2483.6170	-91.885248	43.50	2018.1475	-72.313812	49.20	1650.5972	-57.305145
37.90	2474.4480	-91.494342	43.60	2010.9311	-72.015070	49.30	1644.8782	-57.075167
38.00	2465.3181	-91.105300	43.70	2003.7445	-71.717714	49.40	1639.1821	-56.846228
38.10	2456.2269	-90.718114	43.80	1996.5875	-71.421738	49.50	1633.5089	-56.618322
38.20	2447.1744	-90.332772	43.90	1989.4601	-71.127134	49.60	1627.8584	-56.391445
38.30	2438.1603	-89.949266	44.00	1982.3621	-70.833895	49.70	1622.2306	-56.165591
38.40	2429.1845	-89.567586	44.10	1975.2933	-70.542014	49.80	1616.6253	-55.940754
38.50	2420.2467	-89.187723	44.20	1968.2536	-70.251484	49.90	1611.0424	-55.716931
38.60	2411.3469	-88.809666	44.30	1961.2429	-69.962299	50.00	1605.4819	-55.494115
38.70	2402.4847	-88.433407	44.40	1954.2611	-69.674451	50.10	1599.9436	-55.272303
38.80	2393.6601	-88.058936	44.50	1947.3080	-69.387934	50.20	1594.4274	-55.051488
38.90	2384.8729	-87.686243	44.60	1940.3835	-69.102741	50.30	1588.9332	-54.831666
39.00	2376.1228	-87.315319	44.70	1933.4874	-68.818864	50.40	1583.4610	-54.612832
39.10	2367.4098	-86.946156	44.80	1926.6197	-68.536299	50.50	1578.0106	-54.394981
39.20	2358.7335	-86.578743	44.90	1919.7801	-68.255037	50.60	1572.5820	-54.178109
39.30	2350.0940	-86.213072	45.00	1912.9686	-67.975072	50.70	1567.1750	-53.962210
39.40	2341.4909	-85.849134	45.10	1906.1850	-67.696397	50.80	1561.7895	-53.747279
39.50	2332.9241	-85.486919	45.20	1899.4293	-67.419007	50.90	1556.4255	-53.533312
39.60	2324.3934	-85.126418	45.30	1892.7012	-67.142894	51.00	1551.0828	-53.320304
39.70	2315.8987	-84.767624	45.40	1886.0007	-66.868052	51.10	1545.7614	-53.108251
39.80	2307.4398	-84.410525	45.50	1879.3275	-66.594474	51.20	1540.4611	-52.897147

Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)
51.30	1535.1819	-52.686987	57.00	1266.2213	-42.128508
51.40	1529.9237	-52.477768	57.10	1262.0166	-41.965908
51.50	1524.6864	-52.269484	57.20	1257.8281	-41.804016
51.60	1519.4698	-52.062131	57.30	1253.6558	-41.642828
51.70	1514.2739	-51.855704	57.40	1249.4995	-41.482342
51.80	1509.0986	-51.650199	57.50	1245.3593	-41.322553
51.90	1503.9438	-51.445611	57.60	1241.2350	-41.163459
52.00	1498.8095	-51.241936	57.70	1237.1266	-41.005055
52.10	1493.6954	-51.039169	57.80	1233.0339	-40.847339
52.20	1488.6016	-50.837305	57.90	1228.9571	-40.690308
52.30	1483.5279	-50.636341	58.00	1224.8959	-40.533957
52.40	1478.4743	-50.436271	58.10	1220.8503	-40.378285
52.50	1473.4406	-50.237092	58.20	1216.8202	-40.223286
52.60	1468.4268	-50.038798	58.30	1212.8056	-40.068960
52.70	1463.4328	-49.841387	58.40	1208.8064	-39.915301
52.80	1458.4585	-49.644852	58.50	1204.8225	-39.762307
52.90	1453.5038	-49.449191	58.60	1200.8539	-39.609975
53.00	1448.5687	-49.254398	58.70	1196.9005	-39.458301
53.10	1443.6529	-49.060470	58.80	1192.9622	-39.307283
53.20	1438.7565	-48.867401	58.90	1189.0390	-39.156917
53.30	1433.8794	-48.675189	59.00	1185.1308	-39.007200
53.40	1429.0215	-48.483829	59.10	1181.2375	-38.858129
53.50	1424.1826	-48.293316	59.20	1177.3591	-38.709701
53.60	1419.3628	-48.103646	59.30	1173.4956	-38.561913
53.70	1414.5619	-47.914816	59.40	1169.6467	-38.414762
53.80	1409.7798	-47.726821	59.50	1165.8126	-38.268244
53.90	1405.0165	-47.539657	59.60	1161.9931	-38.122357
54.00	1400.2718	-47.353321	59.70	1158.1881	-37.977098
54.10	1395.5458	-47.167807	59.80	1154.3976	-37.832464
54.20	1390.8383	-46.983112	59.90	1150.6216	-37.688452
54.30	1386.1491	-46.799233	60.00	1146.8599	-37.545058
54.40	1381.4784	-46.616164			
54.50	1376.8259	-46.433902			
54.60	1372.1916	-46.252444			
54.70	1367.5754	-46.071785			
54.80	1362.9772	-45.891921			
54.90	1358.3970	-45.712848			
55.00	1353.8346	-45.534563			
55.10	1349.2900	-45.357062			
55.20	1344.7632	-45.180341			
55.30	1340.2539	-45.004396			
55.40	1335.7622	-44.829223			
55.50	1331.2881	-44.654819			
55.60	1326.8313	-44.481180			
55.70	1322.3918	-44.308303			
55.80	1317.9696	-44.136182			
55.90	1313.5645	-43.964816			
56.00	1309.1766	-43.794200			
56.10	1304.8057	-43.624330			
56.20	1300.4517	-43.455203			
56.30	1296.1146	-43.286816			
56.40	1291.7943	-43.119164			
56.50	1287.4907	-42.952245			
56.60	1283.2038	-42.786054			
56.70	1278.9335	-42.620588			
56.80	1274.6797	-42.455844			
56.90	1270.4423	-42.291819			