National Institute of Standards & Technology

BAM Bundesanstalt für Materialforschung und -prüfung

**Standard Reference Material®**
**NIST SRM 1917**

**Certified Reference Material**
**CRM BAM-P127**

# CERTIFICATE

## Mercury Porosimetry Standard

This SRM/CRM jointly developed and certified by NIST and BAM is intended for use in calibrating and monitoring the performance of mercury porosimeters. The SRM/CRM unit consists of a single bottle containing approximately 10 g of alumina beads.

### Certified properties:

**A)** **Pressure-volume curve (mercury intrusion curve) between 0.1 MPa and 400 MPa (see Fig. A1 and A2 in Annex 2 and Table in Annex 3 for values at each data point)**

**B)** **Diameter-volume curve (cumulative pore volume curve) between 3.7 nm and 14708 nm (see Fig. A3 and A4 in Annex 2 and Table in Annex 3 for values at each data point)**

**C)** **(i) Pore volume values at selected intrusion pressure points; (ii) Values for the pore diameter (see Table 1)**

**Table 1.** Certified Pore Volume Values at selected intrusion pressures and Certified Pore Diameter

| Property | $\bar{\bar{x}}$ | U | 2s | Unit |
|---|---|---|---|---|
| Specific Pore Volume at 50 MPa | 69.4 | 1.5 | 8.0 | $mm^3 \cdot g^{-1}$ |
| Specific Pore Volume at 100 MPa | 625.4 | 2.5 | 13.6 | $mm^3 \cdot g^{-1}$ |
| Specific Pore Volume at 195 MPa | 637.1 | 2.6 | 14.4 | $mm^3 \cdot g^{-1}$ |
| Specific Pore Volume at 395 MPa | 638.6 | 3.9 | 21.6 | $mm^3 \cdot g^{-1}$ |
| Mean Pore Diameter $d_{50}$ | 24.2 | 0.2 | 1.0 | nm |
| Most Frequent Pore Diameter $d_{p,m}$ | 23.9 | 0.5 | 2.8 | nm |

$\bar{\bar{x}}$ - mean of the laboratory means (certified value)

U - expanded uncertainty (coverage factor 2) $U = 2u$ with $u = s / \sqrt{N}$ u - standard error of the certified value

N - number of laboratory means (= 30) s - standard deviation of the certified value

Note: all certified pore volumes are normalized values $V'_p = V_p(p_{Hg}) - V_p(0.1\ MPa)$

**Table 2.** Information Values (noncertified)

| Property | Value | Unit |
|---|---|---|
| Density (by He Pycnometry) | 3.41 | $g \cdot cm^{-3}$ |
| Bulk Density (by Mercury Porosimetry) | 1.07 | $g \cdot cm^{-3}$ |
| Total Sample Porosity (by Mercury Porosimetry) | 70 | % |

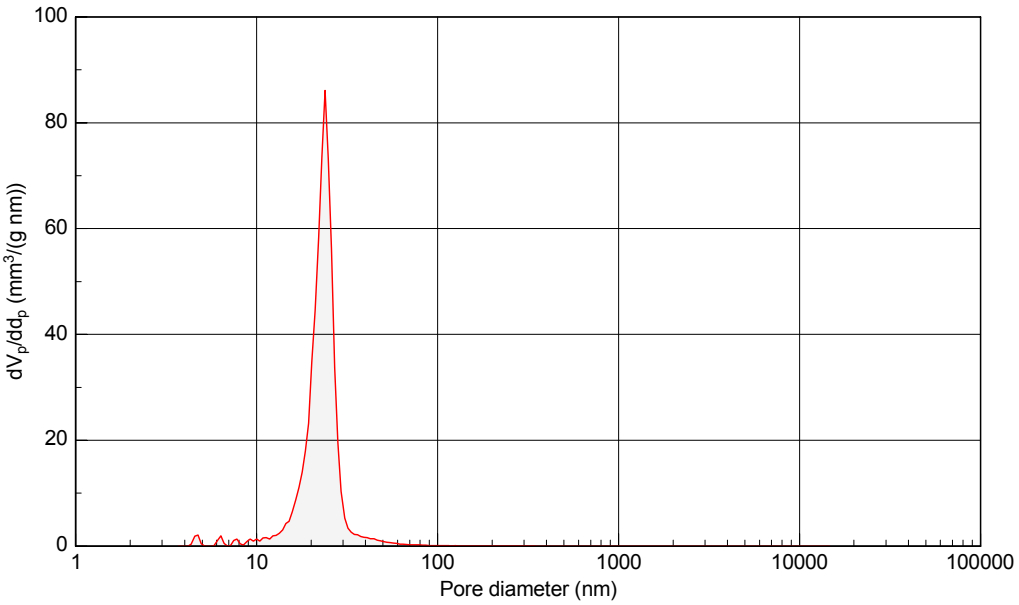


**Figure 1**. Pore size distribution of NIST SRM 1917 / CRM BAM-P127 (noncertified)

## DESCRIPTION OF THE SAMPLE

The material consists of alumina beads. The primary particles of the material form stable agglomerates. With mercury porosimetry, the pores within the agglomerates are measured.

## INSTRUCTION FOR USE

This SRM/CRM is intended for use in the calibration and checking the performance of high pressure mercury porosimeters in the pressure range between 0.1 MPa and 400 MPa.

After first use, the bottle should be kept tightly capped and in a cool storage facility at 20 °C ± 5 °C. The material need not be kept under vacuum during normal storage conditions.

The recommended minimum sample intake is 0.3 g.

Use mercury with a purity of 99.9999 % (outgassed) or better.

Prior to the analysis, a heating procedure for drying the sample is necessary. Heat the reference material for 3 h at 105 °C.

Because of the volume between the particles of the sample (intergranular volume with a more or less random character), the mercury filling procedure of the penetrometer (dilatometer) should be carried out with caution.

## DATA EVALUATION

In order to obtain the certified values of the pore volume, the intergranular volume recorded during the filling procedure has to be subtracted from the intrusion curve at the beginning of the data evaluation. The transformation of the intrusion pressure data $p_{Hg}$ into pore diameter values $d_p$ according to the Washburn equation $d_p = 4\ \gamma \cos\theta\ /\ p_{Hg}$ (assuming a cylindrical pore model) has to be carried out using the following values of the parameters: $\gamma$ = 0.48 N $m^{-1}$ (surface tension of mercury ) and $\theta$ = 140° (contact angle of mercury). The most frequent pore diameter is the maximum of the pore size distribution curve $dv_p/dd_p$ (see Fig. 1)

## SHELF LIFE

The certification of this SRM/CRM is considered valid until **01 October 2010**, within the measurement uncertainties specified, provided the SRM/CRM is handled and stored in accordance with the Instructions for Use section of this certificate.

## EXPIRY DATE

The certification is nullified **24 months after the SRM/CRM bottle is first opened** by the SRM/CRM user, or immediately if the SRM/CRM is contaminated or otherwise modified.

## REFERENCES


| | |
|---|---|
| J. K. Taylor | Standard Reference Materials, Handbook for SRM Users<br>NIST Special Publication 260-100 |
| BAM (1997) | Guidelines for the Production and Certification of BAM Reference Materials |
| ASTM D 4284-92 | Standard test method for determining pore volume distribution of catalysts by mercury intrusion porosimetry |
| BS 7591-1 (1992) | Porosity and pore size distribution of materials. Method of evaluation by mercury porosimetry |
| DIN 66133 (1993) | Bestimmung der Porenvolumenverteilung und der spezifischen Oberflaeche von Feststoffen durch Quecksilberintrusion (Determination of the pore volume distribution and the specific surface area of solids by mercury intrusion) |


**Gaithersburg, MD, United States of America and Berlin, Germany**
**Certificate Issue Date: 22 August 2002**


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# ANNEX 1: COORDINATION, STATISTICS AND PARTICIPATING LABORATORIES

**Coordination of the Interlaboratory Testing**

| | |
|---|---|
| P. Klobes | Bundesanstalt für Materialforschung und -prüfung (BAM) |
| D.B. Minor | NIST Ceramics Division |

**Statistical Analysis**

| | |
|---|---|
| S.D. Leigh, A.N. Heckert | NIST Statistical Engineering Division |

**Participants in the Interlaboratory Testing**

Bayer AG, Feststoffverfahrenstechnik / Partikelcharakterisierung, Leverkusen, DE

Bundesanstalt für Materialforschung und -prüfung (BAM), FG I.1 Anorganisch-chemische Analytik; Referenzmaterialien, Berlin, DE

Bundesanstalt für Materialforschung und -prüfung (BAM), FG VII.1 Baustoffe, Berlin, DE

CISP at Pennsylvania State University, University Park, PA, US

Chevron Corporation, Geotechnical Center, San Ramon, CA, US

Chevron Research and Technology Corporation, Richmond, CA, US

Condea Vista-Sasol North America, Austin, US

Corning Incorporation, Corning, NY, US

Eastman Kodak, Rochester, NY, US

Eidgenössische Materialprüfungs- und Forschungsanstalt (EMPA), Dübendorf, CH

Engelhard Corporation, Attapulugus, GA, US

Engelhard Corporation, Iselin, NJ, US

Exxon Mobil Research Engineering, Paulsboro, NJ, US

Hermsdorfer Institut für Technische Keramik e.V., Hermsdorf, DE

IKO Minerals, Industriemineralien und Kohlenstoffe GmbH & Co. KG, Marl, DE

Infracor GmbH, Marl, DE

Micromeritics GmbH, Mönchengladbach, DE

NIST, Ceramics Division, Gaithersburg, MD, US

Oerlikon Stationary Batteries LTD, Aesch, CH

Oil Dri Corporation, Vernon Hills, IL, US

POROTEC GmbH Applikationslabor, Hofheim, DE

Quantachrome Corporation, Boynton Beach, FL, US

Quantachrome GmbH, Odelzhausen, DE

Shima Technology Center, San Jose, CA, US

Technische Universität Hamburg-Harburg, Arbeitsbereich Bauphysik und Werkstoffe im Bauwesen, Hamburg, DE

ThermoQuest Italia S.p.A., Rodano, Milan, IT

Thiele Kaolin Company, Sandersville, GA, US

Universität Kassel, Institut für Thermische Energietechnik, Kassel, DE

University of Amsterdam, Department of Chemical Engineering, Amsterdam, NL

University of California-Berkeley, Department of Chemistry, Berkeley, CA, US

University of Michigan, Ann Arbor, MI, US

Washington State University, Mechanical and Materials Engineering, Pullman, WA, US

## ANNEX 2: CERTIFIED CURVES

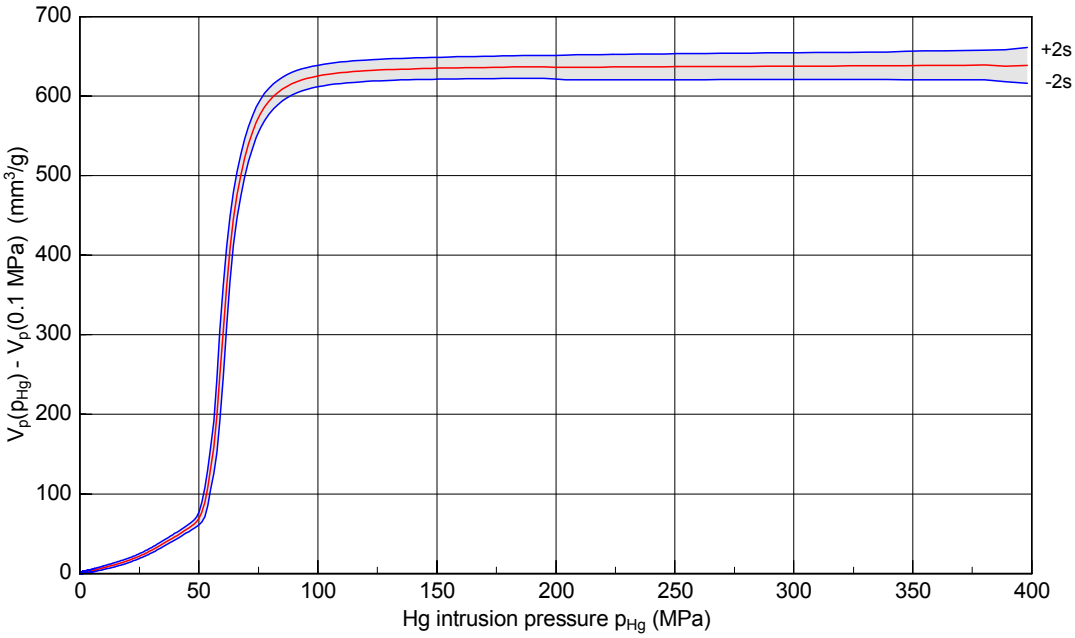


**Figure A1.** Certified mercury intrusion curve with uncertainty interval ± 2s (whole range)

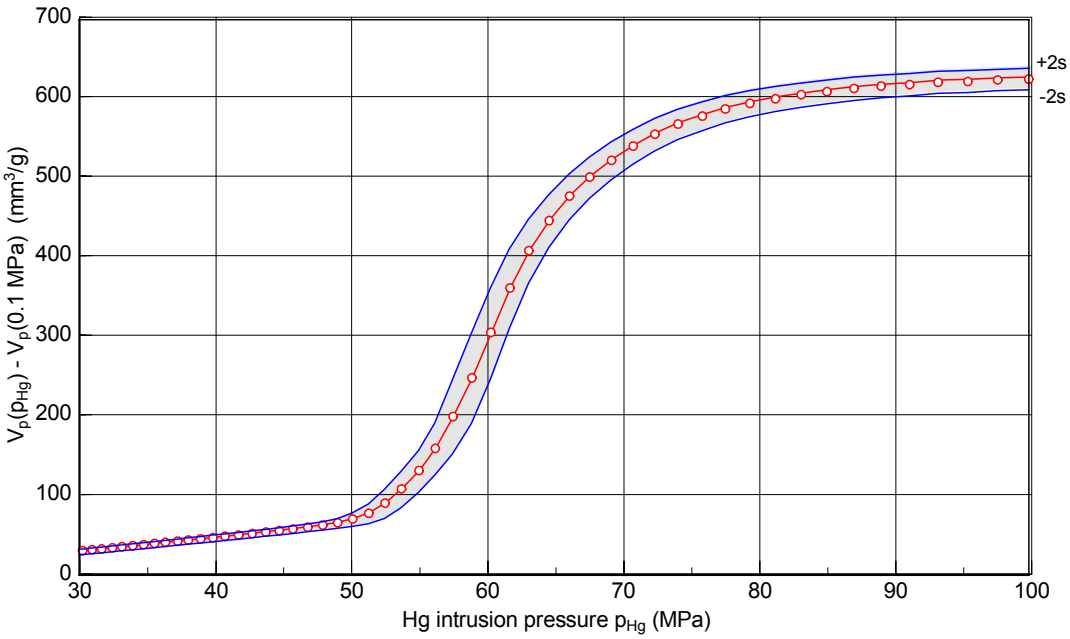


**Figure A2.** Certified mercury intrusion curve with uncertainty interval ± 2s (detail between 30 MPa and 100 MPa)

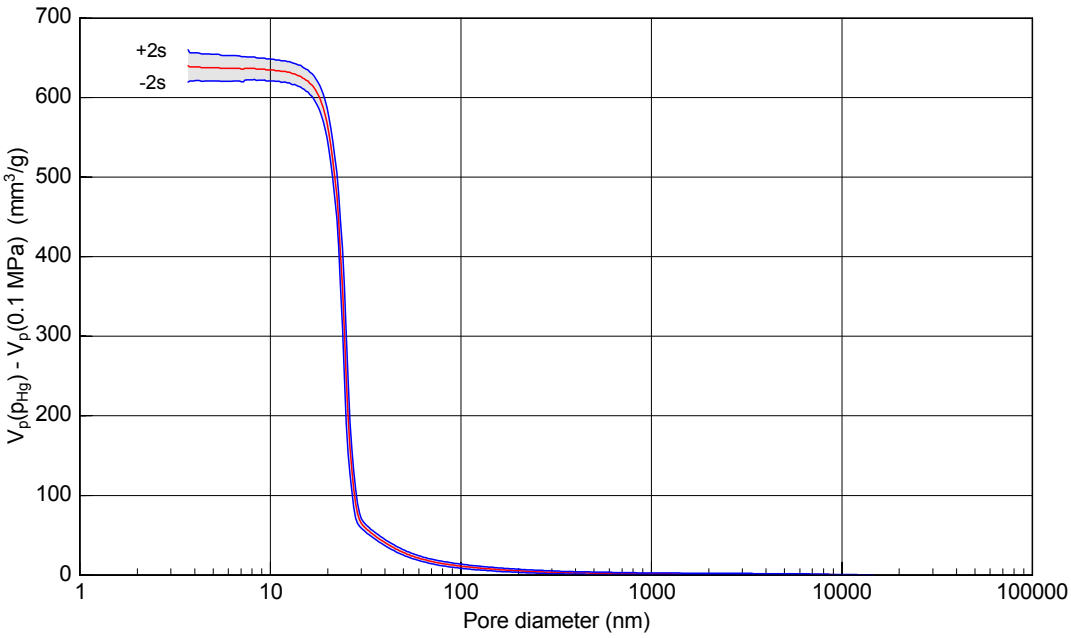


**Figure A3.** Certified curve of the cumulative pore volume with uncertainty interval ± 2s (whole range, logarithmic p-axis)

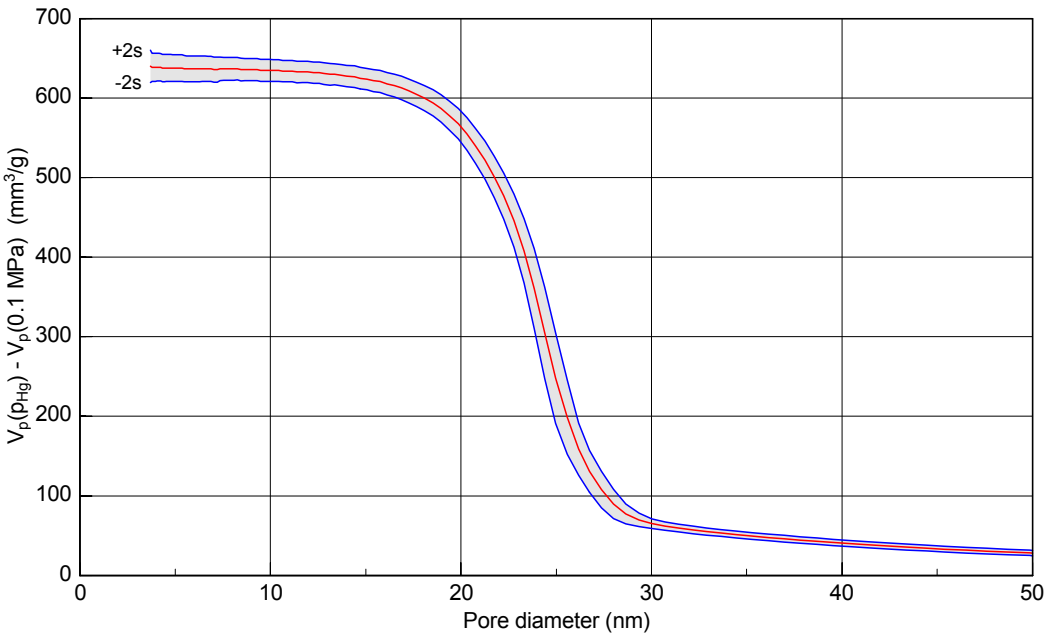


**Figure A4.** Certified curve of the cumulative pore volume with uncertainty interval ± 2s (detail between 3.7 nm and 50 nm, linear p-axis)

# ANNEX 3: DATA POINTS FOR THE CERTIFIED CURVES

## NIST SRM 1917 / CRM BAM-P127

### Certified values for the pressure/volume and the diameter/volume curves at each data point

$p_{Hg}$ -mercury intrusion pressure

$d_p$ -pore diameter

$V'_p$ - normalized specific pore volume
$V'_p = V_p(p_{Hg}) - V_p(0.1\ MPa)$

U -expanded uncertainty (coverage factor 2)

u -standard error of the certified value

s - standard deviation of the certified value
$U = 2\ u$ with $u = s / \sqrt{N}$ (N laboratories)

| Data point No. | $p_{Hg}$ (MPa) | $d_p$ (nm) | $V'_p$ ($mm^3/g$) | U ($mm^3/g$) | 2s ($mm^3/g$) |
|---|---|---|---|---|---|
| 1 | 0.100 | 14708.053 | 0.00 | 0.00 | 0.00 |
| 2 | 0.102 | 14373.257 | 0.06 | 0.01 | 0.05 |
| 3 | 0.105 | 14046.082 | 0.10 | 0.02 | 0.11 |
| 4 | 0.107 | 13726.354 | 0.14 | 0.02 | 0.11 |
| 5 | 0.110 | 13413.904 | 0.17 | 0.03 | 0.16 |
| 6 | 0.112 | 13108.566 | 0.21 | 0.04 | 0.22 |
| 7 | 0.115 | 12810.179 | 0.23 | 0.04 | 0.22 |
| 8 | 0.117 | 12518.584 | 0.26 | 0.05 | 0.27 |
| 9 | 0.120 | 12233.626 | 0.28 | 0.05 | 0.27 |
| 10 | 0.123 | 11955.155 | 0.31 | 0.05 | 0.27 |
| 11 | 0.126 | 11683.022 | 0.33 | 0.06 | 0.33 |
| 12 | 0.129 | 11417.084 | 0.36 | 0.06 | 0.33 |
| 13 | 0.132 | 11157.199 | 0.38 | 0.06 | 0.33 |
| 14 | 0.135 | 10903.231 | 0.41 | 0.07 | 0.38 |
| 15 | 0.138 | 10655.043 | 0.42 | 0.07 | 0.38 |
| 16 | 0.141 | 10412.504 | 0.44 | 0.07 | 0.38 |
| 17 | 0.145 | 10175.487 | 0.47 | 0.08 | 0.44 |
| 18 | 0.148 | 9943.864 | 0.49 | 0.08 | 0.44 |
| 19 | 0.151 | 9717.514 | 0.51 | 0.08 | 0.44 |
| 20 | 0.155 | 9496.317 | 0.53 | 0.09 | 0.49 |
| 21 | 0.158 | 9280.154 | 0.56 | 0.09 | 0.49 |
| 22 | 0.162 | 9068.912 | 0.58 | 0.09 | 0.49 |
| 23 | 0.166 | 8862.479 | 0.60 | 0.10 | 0.55 |
| 24 | 0.170 | 8660.744 | 0.62 | 0.10 | 0.55 |
| 25 | 0.174 | 8463.601 | 0.60 | 0.10 | 0.55 |
| 26 | 0.178 | 8270.946 | 0.58 | 0.09 | 0.49 |
| 27 | 0.182 | 8082.676 | 0.60 | 0.09 | 0.49 |
| 28 | 0.186 | 7898.692 | 0.60 | 0.10 | 0.55 |
| 29 | 0.191 | 7718.896 | 0.62 | 0.10 | 0.55 |
| 30 | 0.195 | 7543.193 | 0.63 | 0.10 | 0.55 |
| 31 | 0.200 | 7371.489 | 0.65 | 0.10 | 0.55 |
| 32 | 0.204 | 7203.693 | 0.66 | 0.10 | 0.55 |
| 33 | 0.209 | 7039.717 | 0.68 | 0.11 | 0.60 |
| 34 | 0.214 | 6879.473 | 0.70 | 0.11 | 0.60 |
| 35 | 0.219 | 6722.877 | 0.72 | 0.11 | 0.60 |
| 36 | 0.224 | 6569.846 | 0.73 | 0.12 | 0.66 |
| 37 | 0.229 | 6420.298 | 0.75 | 0.12 | 0.66 |
| 38 | 0.234 | 6274.154 | 0.77 | 0.12 | 0.66 |
| 39 | 0.240 | 6131.337 | 0.80 | 0.13 | 0.71 |
| 40 | 0.245 | 5991.771 | 0.84 | 0.13 | 0.71 |
| 41 | 0.251 | 5855.381 | 0.87 | 0.14 | 0.77 |
| 42 | 0.257 | 5722.097 | 0.89 | 0.14 | 0.77 |
| 43 | 0.263 | 5591.846 | 0.90 | 0.15 | 0.82 |
| 44 | 0.269 | 5464.560 | 0.91 | 0.15 | 0.82 |
| 45 | 0.275 | 5340.171 | 0.89 | 0.15 | 0.82 |
| 46 | 0.282 | 5218.614 | 0.91 | 0.15 | 0.82 |
| 47 | 0.288 | 5099.824 | 0.92 | 0.16 | 0.88 |
| 48 | 0.295 | 4983.738 | 0.94 | 0.16 | 0.88 |
| 49 | 0.302 | 4870.294 | 0.95 | 0.16 | 0.88 |
| 50 | 0.309 | 4759.433 | 0.96 | 0.16 | 0.88 |

## NIST SRM 1917 / CRM BAM-P127

### Certified values for the pressure/volume and the diameter/volume curves at each data point

$p_{Hg}$ -mercury intrusion pressure

$d_p$ -pore diameter

$V'_p$ - normalized specific pore volume
$V'_p = V_p(p_{Hg}) - V_p(0.1\ MPa)$

U -expanded uncertainty (coverage factor 2)

u -standard error of the certified value

s - standard deviation of the certified value
$U = 2\ u$ with $u = s / \sqrt{N}$ (N laboratories)

| Data point No. | $p_{Hg}$ (MPa) | $d_p$ (nm) | $V'_p$ ($mm^3/g$) | U ($mm^3/g$) | 2s ($mm^3/g$) |
|---|---|---|---|---|---|
| 51 | 0.316 | 4651.095 | 0.98 | 0.16 | 0.88 |
| 52 | 0.324 | 4545.223 | 0.99 | 0.16 | 0.88 |
| 53 | 0.331 | 4441.761 | 1.01 | 0.17 | 0.93 |
| 54 | 0.339 | 4340.654 | 1.02 | 0.17 | 0.93 |
| 55 | 0.347 | 4241.849 | 1.03 | 0.17 | 0.93 |
| 56 | 0.355 | 4145.293 | 1.04 | 0.17 | 0.93 |
| 57 | 0.363 | 4050.934 | 1.05 | 0.17 | 0.93 |
| 58 | 0.372 | 3958.724 | 1.06 | 0.17 | 0.93 |
| 59 | 0.380 | 3868.612 | 1.06 | 0.17 | 0.93 |
| 60 | 0.389 | 3780.552 | 1.07 | 0.17 | 0.93 |
| 61 | 0.398 | 3694.496 | 1.08 | 0.17 | 0.93 |
| 62 | 0.407 | 3610.399 | 1.08 | 0.17 | 0.93 |
| 63 | 0.417 | 3528.216 | 1.09 | 0.17 | 0.93 |
| 64 | 0.427 | 3447.904 | 1.10 | 0.17 | 0.93 |
| 65 | 0.437 | 3369.420 | 1.11 | 0.17 | 0.93 |
| 66 | 0.447 | 3292.723 | 1.12 | 0.17 | 0.93 |
| 67 | 0.457 | 3217.771 | 1.13 | 0.17 | 0.93 |
| 68 | 0.468 | 3144.526 | 1.14 | 0.18 | 0.99 |
| 69 | 0.479 | 3072.948 | 1.15 | 0.18 | 0.99 |
| 70 | 0.490 | 3002.999 | 1.16 | 0.18 | 0.99 |
| 71 | 0.501 | 2934.642 | 1.17 | 0.18 | 0.99 |
| 72 | 0.513 | 2867.842 | 1.17 | 0.18 | 0.99 |
| 73 | 0.525 | 2802.562 | 1.18 | 0.18 | 0.99 |
| 74 | 0.537 | 2738.768 | 1.19 | 0.18 | 0.99 |
| 75 | 0.550 | 2676.426 | 1.20 | 0.18 | 0.99 |
| 76 | 0.562 | 2615.503 | 1.21 | 0.18 | 0.99 |
| 77 | 0.575 | 2555.967 | 1.22 | 0.18 | 0.99 |
| 78 | 0.589 | 2497.786 | 1.22 | 0.18 | 0.99 |
| 79 | 0.603 | 2440.929 | 1.23 | 0.18 | 0.99 |
| 80 | 0.617 | 2385.367 | 1.24 | 0.18 | 0.99 |
| 81 | 0.631 | 2331.069 | 1.25 | 0.18 | 0.99 |
| 82 | 0.646 | 2278.008 | 1.26 | 0.18 | 0.99 |
| 83 | 0.661 | 2226.154 | 1.27 | 0.18 | 0.99 |
| 84 | 0.676 | 2175.481 | 1.28 | 0.18 | 0.99 |
| 85 | 0.692 | 2125.961 | 1.29 | 0.18 | 0.99 |
| 86 | 0.708 | 2077.568 | 1.30 | 0.18 | 0.99 |
| 87 | 0.724 | 2030.277 | 1.32 | 0.19 | 1.04 |
| 88 | 0.741 | 1984.062 | 1.33 | 0.19 | 1.04 |
| 89 | 0.759 | 1938.899 | 1.34 | 0.19 | 1.04 |
| 90 | 0.776 | 1894.764 | 1.35 | 0.19 | 1.04 |
| 91 | 0.794 | 1851.634 | 1.36 | 0.19 | 1.04 |
| 92 | 0.813 | 1809.486 | 1.37 | 0.19 | 1.04 |
| 93 | 0.832 | 1768.297 | 1.38 | 0.19 | 1.04 |
| 94 | 0.851 | 1728.046 | 1.40 | 0.19 | 1.04 |
| 95 | 0.871 | 1688.710 | 1.41 | 0.19 | 1.04 |
| 96 | 0.891 | 1650.271 | 1.42 | 0.19 | 1.04 |
| 97 | 0.912 | 1612.706 | 1.43 | 0.19 | 1.04 |
| 98 | 0.933 | 1575.996 | 1.44 | 0.19 | 1.04 |
| 99 | 0.955 | 1540.122 | 1.45 | 0.19 | 1.04 |
| 100 | 0.977 | 1505.065 | 1.46 | 0.19 | 1.04 |

## NIST SRM 1917 / CRM BAM-P127

### Certified values for the pressure/volume and the diameter/volume curves at each data point

$p_{Hg}$ -mercury intrusion pressure

$d_p$ -pore diameter

$V'_p$ - normalized specific pore volume
$V'_p = V_p(p_{Hg}) - V_p(0.1\ MPa)$

U -expanded uncertainty (coverage factor 2)

u -standard error of the certified value

s - standard deviation of the certified value
$U = 2\ u$ with $u = s / \sqrt{N}$ (N laboratories)

| Data point No. | $p_{Hg}$ (MPa) | $d_p$ (nm) | $V'_p$ ($mm^3/g$) | U ($mm^3/g$) | 2s ($mm^3/g$) |
|---|---|---|---|---|---|
| 101 | 1.000 | 1470.805 | 1.47 | 0.19 | 1.04 |
| 102 | 1.023 | 1437.326 | 1.48 | 0.19 | 1.04 |
| 103 | 1.047 | 1404.608 | 1.49 | 0.20 | 1.10 |
| 104 | 1.072 | 1372.635 | 1.51 | 0.20 | 1.10 |
| 105 | 1.096 | 1341.390 | 1.52 | 0.20 | 1.10 |
| 106 | 1.122 | 1310.857 | 1.53 | 0.20 | 1.10 |
| 107 | 1.148 | 1281.018 | 1.54 | 0.20 | 1.10 |
| 108 | 1.175 | 1251.858 | 1.56 | 0.20 | 1.10 |
| 109 | 1.202 | 1223.363 | 1.57 | 0.20 | 1.10 |
| 110 | 1.230 | 1195.515 | 1.59 | 0.20 | 1.10 |
| 111 | 1.259 | 1168.302 | 1.60 | 0.20 | 1.10 |
| 112 | 1.288 | 1141.708 | 1.61 | 0.20 | 1.10 |
| 113 | 1.318 | 1115.720 | 1.63 | 0.21 | 1.15 |
| 114 | 1.349 | 1090.323 | 1.64 | 0.21 | 1.15 |
| 115 | 1.380 | 1065.504 | 1.65 | 0.21 | 1.15 |
| 116 | 1.413 | 1041.250 | 1.66 | 0.21 | 1.15 |
| 117 | 1.445 | 1017.549 | 1.68 | 0.21 | 1.15 |
| 118 | 1.479 | 994.386 | 1.69 | 0.21 | 1.15 |
| 119 | 1.514 | 971.751 | 1.71 | 0.21 | 1.15 |
| 120 | 1.549 | 949.632 | 1.73 | 0.21 | 1.15 |
| 121 | 1.585 | 928.015 | 1.75 | 0.21 | 1.15 |
| 122 | 1.622 | 906.891 | 1.77 | 0.21 | 1.15 |
| 123 | 1.660 | 886.248 | 1.79 | 0.22 | 1.20 |
| 124 | 1.698 | 866.074 | 1.81 | 0.22 | 1.20 |
| 125 | 1.738 | 846.360 | 1.83 | 0.22 | 1.20 |
| 126 | 1.778 | 827.095 | 1.85 | 0.22 | 1.20 |
| 127 | 1.820 | 808.268 | 1.87 | 0.22 | 1.20 |
| 128 | 1.862 | 789.869 | 1.90 | 0.22 | 1.20 |
| 129 | 1.905 | 771.890 | 1.92 | 0.22 | 1.20 |
| 130 | 1.950 | 754.319 | 1.95 | 0.23 | 1.26 |
| 131 | 1.995 | 737.149 | 1.97 | 0.23 | 1.26 |
| 132 | 2.042 | 720.369 | 2.00 | 0.23 | 1.26 |
| 133 | 2.089 | 703.972 | 2.02 | 0.23 | 1.26 |
| 134 | 2.138 | 687.947 | 2.04 | 0.23 | 1.26 |
| 135 | 2.188 | 672.288 | 2.07 | 0.23 | 1.26 |
| 136 | 2.239 | 656.985 | 2.09 | 0.23 | 1.26 |
| 137 | 2.291 | 642.030 | 2.12 | 0.23 | 1.26 |
| 138 | 2.344 | 627.415 | 2.14 | 0.24 | 1.31 |
| 139 | 2.399 | 613.134 | 2.17 | 0.24 | 1.31 |
| 140 | 2.455 | 599.177 | 2.20 | 0.24 | 1.31 |
| 141 | 2.512 | 585.538 | 2.23 | 0.24 | 1.31 |
| 142 | 2.570 | 572.210 | 2.26 | 0.24 | 1.31 |
| 143 | 2.630 | 559.185 | 2.29 | 0.25 | 1.37 |
| 144 | 2.692 | 546.456 | 2.32 | 0.25 | 1.37 |
| 145 | 2.754 | 534.017 | 2.36 | 0.25 | 1.37 |
| 146 | 2.818 | 521.861 | 2.40 | 0.25 | 1.37 |
| 147 | 2.884 | 509.982 | 2.43 | 0.26 | 1.42 |
| 148 | 2.951 | 498.374 | 2.46 | 0.26 | 1.42 |
| 149 | 3.020 | 487.029 | 2.49 | 0.26 | 1.42 |
| 150 | 3.090 | 475.943 | 2.53 | 0.26 | 1.42 |

## NIST SRM 1917 / CRM BAM-P127

### Certified values for the pressure/volume and the diameter/volume curves at each data point

$p_{Hg}$ -mercury intrusion pressure

$d_p$ -pore diameter

$V'_p$ - normalized specific pore volume
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U -expanded uncertainty (coverage factor 2)

u -standard error of the certified value

s - standard deviation of the certified value
$U = 2\ u$ with $u = s / \sqrt{N}$ (N laboratories)

| Data point No. | $p_{Hg}$ (MPa) | $d_p$ (nm) | $V'_p$ ($mm^3/g$) | U ($mm^3/g$) | 2s ($mm^3/g$) |
|---|---|---|---|---|---|
| 151 | 3.162 | 465.109 | 2.56 | 0.26 | 1.42 |
| 152 | 3.236 | 454.522 | 2.60 | 0.26 | 1.42 |
| 153 | 3.311 | 444.176 | 2.64 | 0.27 | 1.48 |
| 154 | 3.388 | 434.065 | 2.68 | 0.27 | 1.48 |
| 155 | 3.467 | 424.185 | 2.73 | 0.27 | 1.48 |
| 156 | 3.548 | 414.529 | 2.78 | 0.27 | 1.48 |
| 157 | 3.631 | 405.093 | 2.83 | 0.28 | 1.53 |
| 158 | 3.715 | 395.872 | 2.88 | 0.28 | 1.53 |
| 159 | 3.802 | 386.861 | 2.93 | 0.28 | 1.53 |
| 160 | 3.890 | 378.055 | 2.99 | 0.28 | 1.53 |
| 161 | 3.981 | 369.450 | 3.05 | 0.29 | 1.59 |
| 162 | 4.074 | 361.040 | 3.11 | 0.29 | 1.59 |
| 163 | 4.169 | 352.822 | 3.16 | 0.29 | 1.59 |
| 164 | 4.266 | 344.790 | 3.22 | 0.30 | 1.64 |
| 165 | 4.365 | 336.942 | 3.29 | 0.30 | 1.64 |
| 166 | 4.467 | 329.272 | 3.35 | 0.31 | 1.70 |
| 167 | 4.571 | 321.777 | 3.42 | 0.31 | 1.70 |
| 168 | 4.677 | 314.453 | 3.48 | 0.31 | 1.70 |
| 169 | 4.786 | 307.295 | 3.55 | 0.32 | 1.75 |
| 170 | 4.898 | 300.300 | 3.63 | 0.32 | 1.75 |
| 171 | 5.012 | 293.464 | 3.70 | 0.32 | 1.75 |
| 172 | 5.129 | 286.784 | 3.78 | 0.33 | 1.81 |
| 173 | 5.248 | 280.256 | 3.86 | 0.33 | 1.81 |
| 174 | 5.370 | 273.877 | 3.94 | 0.33 | 1.81 |
| 175 | 5.495 | 267.643 | 4.03 | 0.34 | 1.86 |
| 176 | 5.623 | 261.550 | 4.14 | 0.34 | 1.86 |
| 177 | 5.754 | 255.597 | 4.24 | 0.34 | 1.86 |
| 178 | 5.888 | 249.779 | 4.34 | 0.34 | 1.86 |
| 179 | 6.026 | 244.093 | 4.44 | 0.35 | 1.92 |
| 180 | 6.166 | 238.537 | 4.54 | 0.35 | 1.92 |
| 181 | 6.310 | 233.107 | 4.67 | 0.35 | 1.92 |
| 182 | 6.457 | 227.801 | 4.79 | 0.35 | 1.92 |
| 183 | 6.607 | 222.615 | 4.89 | 0.35 | 1.92 |
| 184 | 6.761 | 217.548 | 5.02 | 0.35 | 1.92 |
| 185 | 6.918 | 212.596 | 5.15 | 0.36 | 1.97 |
| 186 | 7.079 | 207.757 | 5.27 | 0.36 | 1.97 |
| 187 | 7.244 | 203.028 | 5.39 | 0.36 | 1.97 |
| 188 | 7.413 | 198.406 | 5.51 | 0.37 | 2.03 |
| 189 | 7.586 | 193.890 | 5.65 | 0.37 | 2.03 |
| 190 | 7.762 | 189.476 | 5.79 | 0.37 | 2.03 |
| 191 | 7.943 | 185.163 | 5.92 | 0.38 | 2.08 |
| 192 | 8.128 | 180.949 | 6.05 | 0.38 | 2.08 |
| 193 | 8.318 | 176.830 | 6.17 | 0.38 | 2.08 |
| 194 | 8.511 | 172.805 | 6.31 | 0.38 | 2.08 |
| 195 | 8.710 | 168.871 | 6.45 | 0.39 | 2.14 |
| 196 | 8.913 | 165.027 | 6.59 | 0.39 | 2.14 |
| 197 | 9.120 | 161.271 | 6.76 | 0.40 | 2.19 |
| 198 | 9.333 | 157.600 | 6.92 | 0.40 | 2.19 |
| 199 | 9.550 | 154.012 | 7.09 | 0.41 | 2.25 |
| 200 | 9.772 | 150.506 | 7.26 | 0.41 | 2.25 |

## NIST SRM 1917 / CRM BAM-P127

### Certified values for the pressure/volume and the diameter/volume curves at each data point

$p_{Hg}$ -mercury intrusion pressure

$d_p$ -pore diameter

$V'_p$ - normalized specific pore volume
$V'_p = V_p(p_{Hg}) - V_p(0.1\ MPa)$

U -expanded uncertainty (coverage factor 2)

u -standard error of the certified value

s - standard deviation of the certified value
$U = 2\ u$ with $u = s / \sqrt{N}$ (N laboratories)

| Data point No. | $p_{Hg}$ (MPa) | $d_p$ (nm) | $V'_p$ ($mm^3/g$) | U ($mm^3/g$) | 2s ($mm^3/g$) |
|---|---|---|---|---|---|
| 201 | 10.000 | 147.081 | 7.43 | 0.41 | 2.25 |
| 202 | 10.233 | 143.733 | 7.62 | 0.41 | 2.25 |
| 203 | 10.471 | 140.461 | 7.81 | 0.41 | 2.25 |
| 204 | 10.715 | 137.264 | 8.00 | 0.42 | 2.30 |
| 205 | 10.965 | 134.139 | 8.20 | 0.42 | 2.30 |
| 206 | 11.220 | 131.086 | 8.39 | 0.43 | 2.36 |
| 207 | 11.482 | 128.102 | 8.60 | 0.43 | 2.36 |
| 208 | 11.749 | 125.186 | 8.82 | 0.43 | 2.36 |
| 209 | 12.023 | 122.336 | 9.04 | 0.44 | 2.41 |
| 210 | 12.303 | 119.552 | 9.25 | 0.45 | 2.46 |
| 211 | 12.589 | 116.830 | 9.50 | 0.45 | 2.46 |
| 212 | 12.882 | 114.171 | 9.73 | 0.46 | 2.52 |
| 213 | 13.183 | 111.572 | 9.95 | 0.46 | 2.52 |
| 214 | 13.490 | 109.032 | 10.21 | 0.47 | 2.57 |
| 215 | 13.804 | 106.550 | 10.47 | 0.48 | 2.63 |
| 216 | 14.125 | 104.125 | 10.72 | 0.48 | 2.63 |
| 217 | 14.454 | 101.755 | 11.02 | 0.48 | 2.63 |
| 218 | 14.791 | 99.439 | 11.29 | 0.49 | 2.68 |
| 219 | 15.136 | 97.175 | 11.61 | 0.49 | 2.68 |
| 220 | 15.488 | 94.963 | 11.91 | 0.49 | 2.68 |
| 221 | 15.849 | 92.802 | 12.21 | 0.50 | 2.74 |
| 222 | 16.218 | 90.689 | 12.56 | 0.50 | 2.74 |
| 223 | 16.596 | 88.625 | 12.89 | 0.50 | 2.74 |
| 224 | 16.982 | 86.607 | 13.24 | 0.51 | 2.79 |
| 225 | 17.378 | 84.636 | 13.60 | 0.51 | 2.79 |
| 226 | 17.783 | 82.709 | 13.97 | 0.51 | 2.79 |
| 227 | 18.197 | 80.827 | 14.37 | 0.51 | 2.79 |
| 228 | 18.621 | 78.987 | 14.80 | 0.51 | 2.79 |
| 229 | 19.055 | 77.189 | 15.25 | 0.51 | 2.79 |
| 230 | 19.498 | 75.432 | 15.70 | 0.51 | 2.79 |
| 231 | 19.953 | 73.715 | 16.16 | 0.51 | 2.79 |
| 232 | 20.417 | 72.037 | 16.65 | 0.51 | 2.79 |
| 233 | 20.893 | 70.397 | 17.16 | 0.51 | 2.79 |
| 234 | 21.380 | 68.795 | 17.67 | 0.51 | 2.79 |
| 235 | 21.878 | 67.229 | 18.23 | 0.52 | 2.85 |
| 236 | 22.387 | 65.698 | 18.77 | 0.53 | 2.90 |
| 237 | 22.909 | 64.203 | 19.36 | 0.53 | 2.90 |
| 238 | 23.442 | 62.742 | 20.01 | 0.54 | 2.96 |
| 239 | 23.988 | 61.313 | 20.65 | 0.55 | 3.01 |
| 240 | 24.547 | 59.918 | 21.36 | 0.55 | 3.01 |
| 241 | 25.119 | 58.554 | 22.10 | 0.56 | 3.07 |
| 242 | 25.704 | 57.221 | 22.86 | 0.57 | 3.12 |
| 243 | 26.303 | 55.918 | 23.67 | 0.58 | 3.18 |
| 244 | 26.915 | 54.646 | 24.54 | 0.59 | 3.23 |
| 245 | 27.542 | 53.402 | 25.46 | 0.60 | 3.29 |
| 246 | 28.184 | 52.186 | 26.40 | 0.60 | 3.29 |
| 247 | 28.840 | 50.998 | 27.37 | 0.62 | 3.40 |
| 248 | 29.512 | 49.837 | 28.43 | 0.63 | 3.45 |
| 249 | 30.200 | 48.703 | 29.53 | 0.63 | 3.45 |
| 250 | 30.903 | 47.594 | 30.63 | 0.66 | 3.61 |

## NIST SRM 1917 / CRM BAM-P127

### Certified values for the pressure/volume and the diameter/volume curves at each data point

$p_{Hg}$ -mercury intrusion pressure

$d_p$ -pore diameter

$V'_p$ - normalized specific pore volume
$V'_p = V_p(p_{Hg}) - V_p(0.1\ MPa)$

U -expanded uncertainty (coverage factor 2)

u -standard error of the certified value

s - standard deviation of the certified value
$U = 2\ u$ with $u = s / \sqrt{N}$ (N laboratories)

| Data point No. | $p_{Hg}$ (MPa) | $d_p$ (nm) | $V'_p$ ($mm^3/g$) | U ($mm^3/g$) | 2s ($mm^3/g$) |
|---|---|---|---|---|---|
| 251 | 31.623 | 46.511 | 31.80 | 0.67 | 3.67 |
| 252 | 32.359 | 45.452 | 33.07 | 0.67 | 3.67 |
| 253 | 33.113 | 44.418 | 34.37 | 0.67 | 3.67 |
| 254 | 33.884 | 43.407 | 35.78 | 0.67 | 3.67 |
| 255 | 34.674 | 42.418 | 37.23 | 0.68 | 3.72 |
| 256 | 35.481 | 41.453 | 38.67 | 0.68 | 3.72 |
| 257 | 36.308 | 40.509 | 40.10 | 0.69 | 3.78 |
| 258 | 37.154 | 39.587 | 41.58 | 0.71 | 3.89 |
| 259 | 38.019 | 38.686 | 43.05 | 0.72 | 3.94 |
| 260 | 38.905 | 37.806 | 44.58 | 0.73 | 4.00 |
| 261 | 39.811 | 36.945 | 46.23 | 0.74 | 4.05 |
| 262 | 40.738 | 36.104 | 47.88 | 0.76 | 4.16 |
| 263 | 41.687 | 35.282 | 49.59 | 0.77 | 4.22 |
| 264 | 42.658 | 34.479 | 51.37 | 0.78 | 4.27 |
| 265 | 43.652 | 33.694 | 53.28 | 0.79 | 4.33 |
| 266 | 44.668 | 32.927 | 55.24 | 0.82 | 4.49 |
| 267 | 45.709 | 32.178 | 57.34 | 0.84 | 4.60 |
| 268 | 46.774 | 31.445 | 59.61 | 0.87 | 4.77 |
| 269 | 47.863 | 30.729 | 62.14 | 0.95 | 5.20 |
| 270 | 48.978 | 30.030 | 65.29 | 1.12 | 6.13 |
| 271 | 50.119 | 29.346 | 69.87 | 1.49 | 8.16 |
| 272 | 51.286 | 28.678 | 77.30 | 2.26 | 12.38 |
| 273 | 52.481 | 28.026 | 89.89 | 3.35 | 18.35 |
| 274 | 53.703 | 27.388 | 108.29 | 4.20 | 23.00 |
| 275 | 54.954 | 26.764 | 131.31 | 4.81 | 26.35 |
| 276 | 56.234 | 26.155 | 158.98 | 5.99 | 32.81 |
| 277 | 57.544 | 25.560 | 198.55 | 8.53 | 46.72 |
| 278 | 58.884 | 24.978 | 248.36 | 10.41 | 57.02 |
| 279 | 60.256 | 24.409 | 305.32 | 10.50 | 57.51 |
| 280 | 61.660 | 23.854 | 361.01 | 9.20 | 50.39 |
| 281 | 63.096 | 23.311 | 408.27 | 7.40 | 40.53 |
| 282 | 64.565 | 22.780 | 445.99 | 6.11 | 33.47 |
| 283 | 66.069 | 22.262 | 476.59 | 5.27 | 28.86 |
| 284 | 67.608 | 21.755 | 501.14 | 4.77 | 26.13 |
| 285 | 69.183 | 21.260 | 522.12 | 4.37 | 23.94 |
| 286 | 70.795 | 20.776 | 539.88 | 4.04 | 22.13 |
| 287 | 72.444 | 20.303 | 555.01 | 3.75 | 20.54 |
| 288 | 74.131 | 19.841 | 567.51 | 3.50 | 19.17 |
| 289 | 75.858 | 19.389 | 577.96 | 3.30 | 18.07 |
| 290 | 77.625 | 18.948 | 586.70 | 3.14 | 17.20 |
| 291 | 79.433 | 18.516 | 593.84 | 3.00 | 16.43 |
| 292 | 81.283 | 18.095 | 599.96 | 2.89 | 15.83 |
| 293 | 83.176 | 17.683 | 605.00 | 2.79 | 15.28 |
| 294 | 85.114 | 17.280 | 609.25 | 2.72 | 14.90 |
| 295 | 87.096 | 16.887 | 612.83 | 2.66 | 14.57 |
| 296 | 89.125 | 16.503 | 615.89 | 2.62 | 14.35 |
| 297 | 91.201 | 16.127 | 618.43 | 2.58 | 14.13 |
| 298 | 93.325 | 15.760 | 620.56 | 2.54 | 13.91 |
| 299 | 95.499 | 15.401 | 622.42 | 2.52 | 13.80 |
| 300 | 97.724 | 15.051 | 624.05 | 2.49 | 13.64 |

## NIST SRM 1917 / CRM BAM-P127

### Certified values for the pressure/volume and the diameter/volume curves at each data point

$p_{Hg}$ -mercury intrusion pressure

$d_p$ -pore diameter

$V'_p$ - normalized specific pore volume
$V'_p = V_p(p_{Hg}) - V_p(0.1\ MPa)$

U -expanded uncertainty (coverage factor 2)

u -standard error of the certified value

s - standard deviation of the certified value
$U = 2\ u$ with $u = s / \sqrt{N}$ (N laboratories)

| Data point No. | $p_{Hg}$ (MPa) | $d_p$ (nm) | $V'_p$ ($mm^3/g$) | U ($mm^3/g$) | 2s ($mm^3/g$) |
|---|---|---|---|---|---|
| 301 | 100.000 | 14.708 | 625.44 | 2.48 | 13.58 |
| 302 | 102.329 | 14.373 | 626.66 | 2.47 | 13.53 |
| 303 | 104.713 | 14.046 | 627.76 | 2.46 | 13.47 |
| 304 | 107.152 | 13.726 | 628.68 | 2.45 | 13.42 |
| 305 | 109.648 | 13.414 | 629.53 | 2.45 | 13.42 |
| 306 | 112.202 | 13.109 | 630.28 | 2.46 | 13.47 |
| 307 | 114.815 | 12.810 | 630.97 | 2.46 | 13.47 |
| 308 | 117.490 | 12.519 | 631.57 | 2.47 | 13.53 |
| 309 | 120.226 | 12.234 | 632.08 | 2.47 | 13.53 |
| 310 | 123.027 | 11.955 | 632.53 | 2.47 | 13.53 |
| 311 | 125.893 | 11.683 | 632.97 | 2.47 | 13.53 |
| 312 | 128.825 | 11.417 | 633.37 | 2.48 | 13.58 |
| 313 | 131.826 | 11.157 | 633.72 | 2.48 | 13.58 |
| 314 | 134.896 | 10.903 | 634.03 | 2.48 | 13.58 |
| 315 | 138.038 | 10.655 | 634.34 | 2.48 | 13.58 |
| 316 | 141.254 | 10.413 | 634.63 | 2.49 | 13.64 |
| 317 | 144.544 | 10.175 | 634.86 | 2.49 | 13.64 |
| 318 | 147.911 | 9.944 | 635.07 | 2.50 | 13.69 |
| 319 | 151.356 | 9.718 | 635.30 | 2.50 | 13.69 |
| 320 | 154.882 | 9.496 | 635.50 | 2.51 | 13.75 |
| 321 | 158.489 | 9.280 | 635.70 | 2.53 | 13.86 |
| 322 | 162.181 | 9.069 | 635.88 | 2.54 | 13.91 |
| 323 | 165.959 | 8.862 | 636.06 | 2.55 | 13.97 |
| 324 | 169.824 | 8.661 | 636.24 | 2.56 | 14.02 |
| 325 | 173.780 | 8.464 | 636.40 | 2.57 | 14.08 |
| 326 | 177.828 | 8.271 | 636.56 | 2.58 | 14.13 |
| 327 | 181.970 | 8.083 | 636.70 | 2.60 | 14.24 |
| 328 | 186.209 | 7.899 | 636.84 | 2.61 | 14.30 |
| 329 | 190.546 | 7.719 | 636.97 | 2.62 | 14.35 |
| 330 | 194.984 | 7.543 | 637.10 | 2.63 | 14.41 |
| 331 | 199.526 | 7.371 | 636.61 | 2.68 | 14.68 |
| 332 | 204.174 | 7.204 | 636.29 | 2.87 | 15.72 |
| 333 | 208.930 | 7.040 | 636.40 | 2.88 | 15.77 |
| 334 | 213.796 | 6.879 | 636.50 | 2.89 | 15.83 |
| 335 | 218.776 | 6.723 | 636.60 | 2.91 | 15.94 |
| 336 | 223.872 | 6.570 | 636.71 | 2.92 | 15.99 |
| 337 | 229.087 | 6.420 | 636.81 | 2.93 | 16.05 |
| 338 | 234.423 | 6.274 | 636.92 | 2.94 | 16.10 |
| 339 | 239.883 | 6.131 | 637.01 | 2.96 | 16.21 |
| 340 | 245.471 | 5.992 | 637.12 | 2.97 | 16.27 |
| 341 | 251.189 | 5.855 | 637.21 | 2.98 | 16.32 |
| 342 | 257.040 | 5.722 | 637.29 | 2.99 | 16.38 |
| 343 | 263.027 | 5.592 | 637.37 | 3.00 | 16.43 |
| 344 | 269.153 | 5.465 | 637.46 | 3.01 | 16.49 |
| 345 | 275.423 | 5.340 | 637.55 | 3.03 | 16.60 |
| 346 | 281.838 | 5.219 | 637.64 | 3.04 | 16.65 |
| 347 | 288.403 | 5.100 | 637.74 | 3.05 | 16.71 |
| 348 | 295.121 | 4.984 | 637.83 | 3.06 | 16.76 |
| 349 | 301.995 | 4.870 | 637.92 | 3.07 | 16.82 |
| 350 | 309.030 | 4.759 | 638.03 | 3.09 | 16.92 |

## NIST SRM 1917 / CRM BAM-P127

### Certified values for the pressure/volume and the diameter/volume curves at each data point

$p_{Hg}$ -mercury intrusion pressure

$d_p$ -pore diameter

$V'_p$ - normalized specific pore volume
$V'_p = V_p(p_{Hg}) - V_p(0.1\ MPa)$

U - xpanded uncertainty (coverage factor 2)

u -standard error of the certified value

s - standard deviation of the certified value
$U = 2\ u$ with $u = s / \sqrt{N}$ (N laboratories)

| Data point No. | $p_{Hg}$ (MPa) | $d_p$ (nm) | $V'_p$ ($mm^3/g$) | U ($mm^3/g$) | 2s ($mm^3/g$) |
|---|---|---|---|---|---|
| 351 | 316.228 | 4.651 | 638.14 | 3.10 | 16.98 |
| 352 | 323.594 | 4.545 | 638.25 | 3.11 | 17.03 |
| 353 | 331.131 | 4.442 | 638.34 | 3.13 | 17.14 |
| 354 | 338.844 | 4.341 | 638.42 | 3.14 | 17.20 |
| 355 | 346.737 | 4.242 | 638.52 | 3.31 | 18.13 |
| 356 | 354.813 | 4.145 | 638.65 | 3.33 | 18.24 |
| 357 | 363.078 | 4.051 | 638.78 | 3.36 | 18.40 |
| 358 | 371.535 | 3.959 | 638.92 | 3.39 | 18.57 |
| 359 | 380.189 | 3.869 | 639.15 | 3.42 | 18.73 |
| 360 | 389.045 | 3.781 | 638.12 | 3.66 | 20.05 |
| 361 | 398.107 | 3.694 | 638.81 | 4.08 | 22.35 |