

# Certified Particle Size Standards

## 3000 Series Nanospheres™

## 4000 Series Microspheres

*NIST Traceable Polymer Size Standards*

### Applications:

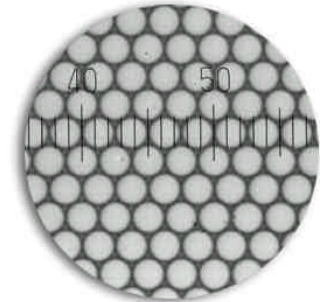
- Calibration of Electron Microscopes, Atomic Force Microscopes, Light Scattering Instruments and other particle measuring equipment
- Excellent for use with any application that requires NIST traceable size standard with a very narrow standard deviation

### Advantages:

- NIST traceable mean diameter
- Extremely uniform size distribution
- Dropper tip bottle

### Benefits:

- Easy to use
- NIST traceable documentation included



**Product Description.** Certified Particle Size Standards from Duke Scientific Corporation are traceable to the Standard Meter through the National Institute of Standards and Technology (NIST). This feature enables laboratories to demonstrate the traceability of their analytical methods as required by ISO 9000, ISO 10012, ANSI/NCSL Z540, GMP/GLP and other standards and regulations. Duke Scientific's particle size standards provide third party traceability of calibration procedures to national and international agencies through an unbroken chain of measurements with specified uncertainties. The products are also used to develop and test new analytical instruments for particle size characterization of materials.

They are available as uniform spheres of polymer in a range of discrete sizes from 20 nanometers (nm) to 1000 micrometers ( $\mu\text{m}$  or microns). The spherical diameters are calibrated with linear dimensions transferred from NIST by methods developed at Duke Scientific Corporation. Spheres are used instead of irregularly shaped particles to minimize shape effects on the response of analytical systems.

Each package of Duke Scientific's standards contains a Certificate of Calibration and Traceability to NIST which includes a description of the calibration method and its uncertainty, and a table of chemical and physical properties. A Material Safety Data Sheet with handling and disposal instructions is also included. Packages are lot-numbered for technical service and support after the sale.

Established in 1971, Duke Scientific has its own engineering, production and metrology facilities for better quality control and response to customer needs. In addition to this line of polymer size standards, we also offer calibration standards in silica (bulletin 118) and glass (bulletin 119) materials. Ask our technical service department for information about specific applications or other product needs not listed here.

*Our Certified Particle Size Standards enable laboratories to demonstrate the traceability of their analytical methods as required by:*

ISO 9000  
ISO 10012  
ANSI/NCSL Z540  
GMP/GLP

*These standards provide third party traceability of calibration procedures to national and international agencies through an unbroken chain of measurements with specified uncertainties.*

*Particle size determined by:*

Photon Correlation Spectroscopy  
Transmission Electron Microscopy (TEM)  
Optical Microscopy

**3000 Series—Nanosphere™ Size Standards—Polymer (Aqueous 20 - 900 nm)**

**Product Description.** Duke Scientific Corporation's Nanosphere Size Standards are highly uniform polystyrene spheres calibrated in billionths of a meter (nanometers) with NIST traceable methodology. One nanometer is 0.001 micrometer (µm) or 10 Angstroms.

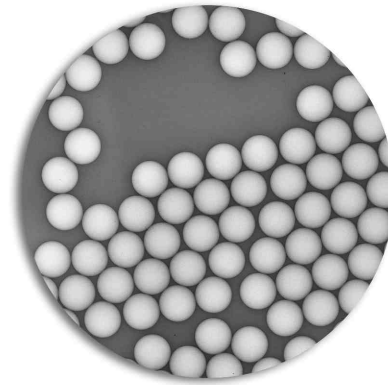
Nanosphere Size Standards are packaged as aqueous suspensions in 15 milliliter (mL) dropper-tipped bottles. The concentrations are optimized for ease of dispersion and colloidal stability. The spheres have a density of 1.05 g/cm<sup>3</sup> and an index of refraction of 1.59 @ 589 nm (25°C).

Nanosphere Size Standards are ideal for the calibration of electron and atomic force microscopes. They are also used in laser light scattering studies and colloidal systems research. The 20 to 900 nm range of diameters is convenient for checking the sizes of bacteria, viruses, ribosomes and sub-cellular components.



**Certified Particle Size Standards  
3000 Series Nanospheres™**

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**Product Attributes**

Particle Composition:	Polystyrene
Particle Density:	1.05 g/cm <sup>3</sup>
Index of Refraction:	1.59 @ 589 nm (25°C)
Bottle Size:	15 mL
Expiration Date:	≥ 24 months
Additives:	Contains trace amount of surfactant
Package Includes:	Material Safety Data Sheet (MSDS) Certificate of Calibration and Traceability to NIST
Storage & Handling:	Store at room temperature or refrigerated. Keep bottle tightly sealed to avoid contamination.

**Ordering Information**

Catalog Number	Nominal Diameter	Certified Mean Diameter	Size Distribution Std. Dev. & CV	Solids Content
<b>Aqueous Suspensions, Calibrated by Photon Correlation Spectroscopy (PCS)</b>				
3020A	20 nm	21 nm ± 1.5 nm	not determined	1%
3030A	30 nm	33 nm ± 1.4 nm	not determined	1%
3040A	40 nm	40 nm ± 1.8 nm	not determined	1%
<b>Aqueous Suspensions, Calibrated by Transmission Electron Microscopy (TEM)</b>				
3050A	50 nm	46 nm ± 2.0 nm	7.2 nm (15.7%)	1%
3060A	60 nm	60 nm ± 2.7 nm	8.0 nm (13.3%)	1%
3070A	70 nm	73 nm ± 2.6 nm	5.7 nm (7.8%)	1%
3080A	80 nm	81 nm ± 2.7 nm	5.8 nm (7.2%)	1%
3090A	90 nm	92 nm ± 3.7 nm	7.0 nm (7.6%)	1%
3100A	100 nm	102 nm ± 3 nm	4.4 nm (4.3%)	1%
3125A	125 nm	125 nm ± 4 nm	5.4 nm (4.3%)	1%
3150A	150 nm	151 nm ± 4 nm	5.1 nm (3.4%)	1%
3200A	200 nm	199 nm ± 6 nm	3.4 nm (1.7%)	1%
3220A	220 nm	220 nm ± 6 nm	4.6 nm (2.1%)	1%
3240A	240 nm	240 nm ± 6 nm	3.7 nm (1.5%)	1%
3269A	270 nm	269 nm ± 6 nm	4.2 nm (1.6%)	1%
3300A	300 nm	299 nm ± 6 nm	4.1 nm (1.4%)	1%
3350A	350 nm	350 nm ± 7 nm	4.7 nm (1.3%)	1%
3400A	400 nm	404 nm ± 4 nm	5.9 nm (1.5%)	1%
3450A	450 nm	453 nm ± 4 nm	6.3 nm (1.4%)	1%
3495A	500 nm	491 nm ± 4 nm	6.3 nm (1.3%)	1%
3500A	500 nm	499 nm ± 5 nm	6.5 nm (1.3%)	1%
3520A	520 nm	519 nm ± 5 nm	5.0 nm (1.0%)	1%
3560A	560 nm	565 nm ± 6 nm	8.6 nm (1.5%)	1%
3600A	600 nm	596 nm ± 6 nm	7.7 nm (1.3%)	1%
3700A	700 nm	701 nm ± 6 nm	9.0 nm (1.3%)	1%
3800A	800 nm	799 nm ± 9 nm	8.3 nm (1.0%)	1%
3900A	900 nm	903 nm ± 9 nm	9.3 nm (1.0%)	1%

Our 3000 series Nanospheres particles represent our most uniform standards up to 900 nm in size. If you require larger particles, please refer to our 4000 series particles found on the next two pages.

**4000 Series—Monosized Microsphere Size Standards—  
Polymer (Aqueous 1 - 160 µm)**

**Product Description.** The mean diameters of these products have been calibrated with Duke Scientific's NIST traceable microscopy methods. Their size distribution and uniformity were measured by electrical resistance analysis or optical microscopy. All of the 4000 Series products on this page are made from polystyrene (PS).

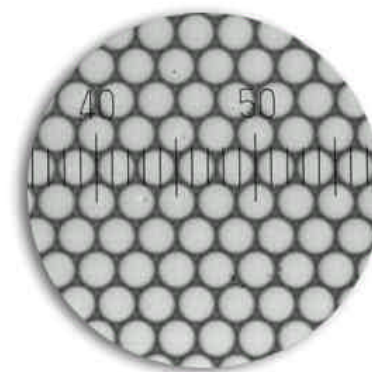
Products from 1 to 160 µm are packaged as aqueous suspensions in 15 mL dropper-tipped bottles, at an optimum concentration for dispersion, handling and dilution. Aqueous materials are listed on this page and our larger, dry material can be found on the next page.



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**Product Attributes**

Particle Composition:	Polystyrene
Particle Density:	1.05 g/cm <sup>3</sup>
Index of Refraction:	1.59 @ 589 nm (25°C)
Bottle Size:	15 mL
Expiration Date:	≥ 24 months
Additives:	Contains trace amount of surfactant
Package Includes:	Material Safety Data Sheet (MSDS) Certificate of Calibration and Traceability to NIST
Storage & Handling:	Store at room temperature or refrigerated. Keep bottle tightly sealed to avoid contamination.

**Ordering Information**

Catalog Number	Nominal Diameter	Certified Mean Diameter	Size Distribution Std. Dev. & C.V.	Solids Content
<i>Aqueous Suspensions, Calibrated by Optical Microscopy</i>				
4009A	1.0 µm	0.993 µm ± 0.021 µm	0.010 µm (1.0%)	1.0%
4010A	1.0 µm	1.020 µm ± 0.022 µm	0.011 µm (1.1%)	1.0%
4011A	1.1 µm	1.101 µm ± 0.023 µm	0.012 µm (1.1%)	1.0%
4013A	1.3 µm	1.361 µm ± 0.024 µm	0.021 µm (1.5%)	1.0%
4016A	1.6 µm	1.587 µm ± 0.025 µm	0.021 µm (1.3%)	1.0%
4018A	1.8 µm	1.745 µm ± 0.025 µm	0.019 µm (1.1%)	1.0%
4202A	2.0 µm	1.998 µm ± 0.022 µm	0.020 µm (1.0%)	0.4%
4025A	2.5 µm	2.504 µm ± 0.025 µm	0.025 µm (1.0%)	0.5%
4203A	3.0 µm	3.063 µm ± 0.027 µm	0.03 µm (1.0%)	0.5%
4204A	4.0 µm	4.000 µm ± 0.033 µm	0.04 µm (1.0%)	0.4%
4205A	5.0 µm	5.010 µm ± 0.035 µm	0.05 µm (1.0%)	0.3%
4206A	6.0 µm	5.990 µm ± 0.045 µm	0.07 µm (1.2%)	0.3%
4207A	7.0 µm	6.992 µm ± 0.050 µm	0.07 µm (1.0%)	0.3%
4208A	8.0 µm	7.979 µm ± 0.055 µm	0.09 µm (1.1%)	0.3%
4209A	9.0 µm	8.956 µm ± 0.056 µm	0.09 µm (1.0%)	0.3%
4210A	10 µm	10.03 µm ± 0.05 µm	0.10 µm (1.0%)	0.2%
4212A	12 µm	12.01 µm ± 0.07 µm	0.12 µm (1.0%)	0.3%
4215A	15 µm	15.02 µm ± 0.08 µm	0.15 µm (1.0%)	0.3%
4220A	20 µm	20.00 µm ± 0.10 µm	0.20 µm (1.0%)	0.3%
4225A	25 µm	25.09 µm ± 0.12 µm	0.38 µm (1.5%)	0.5%
4230A	30 µm	30.10 µm ± 0.22 µm	0.45 µm (1.5%)	0.6%
4240A	40 µm	40.25 µm ± 0.32 µm	0.6 µm (1.5%)	0.7%
4250A	50 µm	49.7 µm ± 0.7 µm	0.8 µm (1.6%)	1.4%
4260A	60 µm	59.1 µm ± 0.9 µm	0.9 µm (1.5%)	1.2%
4270A	70 µm	68.6 µm ± 0.8 µm	0.9 µm (1.3%)	1.7%
4280A	80 µm	79.8 µm ± 1.2 µm	1.1 µm (1.4%)	1.8%
4310A	100 µm	102 µm ± 1.4 µm	1.4 µm (1.4%)	2.2%
4311A	115 µm	113 µm ± 1.6 µm	1.6 µm (1.4%)	2.6%
4314A	140 µm	138 µm ± 2.0 µm	2.2 µm (1.6%)	4.0%
4316A	160 µm	156 µm ± 2.2 µm	2.5 µm (1.6%)	5.0%

Our 4000 series standards continues on the next page with our dry microspheres.

# Certified Particle Size Standards:

## 4000 Series Microspheres

NIST Traceable Polymer Size Standards

### 4000 Series—Monosized Microsphere Size Standards—Polymer (Dry 200 - 1000 µm)

**Product Description.** The mean diameters of these products have been calibrated with Duke Scientific's NIST traceable microscopy methods. Their size distribution and uniformity were measured by electrical resistance analysis or optical microscopy. These 4000 Series products are made from polystyrene crosslinked with divinylbenzene (PSDVB) except for the two largest products, which are made from polymethylmethacrylate (PMMA).

Diameters of 200 µm and larger are packaged as dry spheres.

#### Product Attributes

Particle Composition:	Polystyrene Divinylbenzene (PSDVB) Cat.#: 4320A to 4365A Polymethylmethacrylate (PMMA) Cat.#: 4375A to 4400A
Particle Density:	1.05 g/cm <sup>3</sup> (PSDVB); 1.19 g/cm <sup>3</sup> (PMMA)
Index of Refraction:	1.59 @ 589 nm 25°C (PSDVB); 1.49 @ 589 nm 25°C, (PMMA)
Bottle Content:	1 gram
Expiration Date:	≥ 24 months
Additives:	None
Package Includes:	Material Safety Data Sheet (MSDS) Certificate of Calibration and Traceability to NIST
Storage & Handling:	Store at room temperature. Keep bottle tightly sealed to avoid contamination.

#### Ordering Information

Catalog Number	Nominal Diameter	Certified Mean Diameter	Size Distribution Std. Dev. & C.V.	# per gram
<b>Uniform Dry Spheres--Calibrated by Optical Microscopy -- PSDVB</b>				
4320A	200 µm	200 µm ± 4.0 µm	9.0 µm (4.5%)	2.3 x 10 <sup>5</sup>
4324A	240 µm	239 µm ± 4.8 µm	9.0 µm (3.8%)	1.3 x 10 <sup>5</sup>
4328A	280 µm	279 µm ± 5.6 µm	13.5 µm (4.8%)	8.3 x 10 <sup>4</sup>
4330A	300 µm	300 µm ± 6.0 µm	11.9 µm (4.0%)	6.8 x 10 <sup>4</sup>
4340A	400 µm	398 µm ± 8.0 µm	13.5 µm (3.4%)	2.8 x 10 <sup>4</sup>
4350A	500 µm	497 µm ± 10 µm	24.0 µm (4.8%)	1.5 x 10 <sup>4</sup>
4355A	550 µm	552 µm ± 11 µm	27.0 µm (4.9%)	1.1 x 10 <sup>4</sup>
4365A	650 µm	644 µm ± 13 µm	24.8 µm (3.9%)	6.8 x 10 <sup>3</sup>
<b>Dry Spheres -- Calibrated by Optical Microscopy -- PMMA</b>				
4375A	750 µm	773 µm ± 15 µm	33.3 µm (4.3%)	3.5 x 10 <sup>3</sup>
4400A	1000 µm	1004 µm ± 20 µm	37.2 µm (3.7%)	1.6 x 10 <sup>3</sup>

For more information on our NIST traceable methodology, the following technical notes can be found on our website:

- **TN-002 Calibration of Spherical Particles by Light Scattering**
- **TN-010 Internal Standard Method for Size Calibration of Sub-Micrometer Spherical Particles by Electron Microscope**
- **TN-018 Improved Array Method for Size Calibration of Monodisperse Spherical Particles by Optical Microscope**

Due to minor variations between batches, size ranges may change slightly from batch to batch. For further information, please see website Ordering Information or contact Customer Service.

All products are manufactured and packaged at our ISO 9001:2000 registered facility in Palo Alto. Please feel free to contact our technical service department if you have any questions about these products or have a special material requirement not listed here.

**LIMITED WARRANTY:** These products are intended for laboratory research use by trained scientific personnel. Determination of their suitability for specific end use is solely the responsibility of the user, who assumes all liability for loss or damage arising out of the use of the product. Duke Scientific Corporation's warranty is limited to replacement of defective products if returned with our authorization within 60 days of purchase date.

### Duke Scientific Corporation

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