Duke Scientific Corporation

2463 Faber Place
P.O. Box 50005
Palo Alto, CA 94303

Toll Free: 800-334-3883
or: 415-424-1177

FAX: 415-424-1158

email: echae@dukesci.com

DATE: 6/11/97
FAX #: 412 349-8610
COMPANY: Biocontrol Technology
ATTN: Jeremy Grata
FROM: Liz Chae
RE: Particle Size Stds., Research Microspheres
Total Pages: 9

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Duke Scientific Corporation

Bulletin 92J
February 15, 1997

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Toll Free (800) 334-3883 or (415) 424-1177, Fax (415) 424-1158

CERTIFIED PARTICLE SIZE STANDARDS

Certified Particle Size Standards from Duke Scientific Corporation enable laboratories to demonstrate the traceability of their analytical methods, as required by ISO 9000, ISO/DIS 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 or 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, silica and glass, in a range of discrete sizes from 20 nanometers (nm) to 2000 micrometers (µm or microns). Spheres are used instead of irregularly shaped particles to minimize shape effects on the response of analytical systems. The spheres are calibrated with linear dimensions transferred from NIST by methods developed at Duke Scientific Corporation.*

Each package of Duke standards contains a certificate of traceability to NIST, a description of the calibration method and its uncertainty, a table of chemical and physical properties, and a material safety data sheet with handling and disposal instructions. Packages are also 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 response to customer needs and control of product quality. In addition to this line of size standards for materials laboratories, the company also offers calibration standards for particle counters in the pharmaceutical, semiconductor, and drinking water industries.

**National Institute of Standards and Technology*

A. 3000 Series—Nanosphere™ Size Standards—Polymer

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 Angstrom units.

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 1.05g/ml and an index of refraction of 1.59 @ 589nm (23°C).

Methods used by Duke Scientific to calibrate the diameter of the Nanospheres include adaptations of photon correlation spectroscopy (PCS) and transmission electron microscopy. PCS correlates the fluctuations of scattered laser light with the Brownian motion and diameter of suspended particles. PCS is also referred to as quasi-elastic light scattering or dynamic light scattering.

Nanosphere Size Standards are ideal for the calibration of electron and atomic force microscopes, aerosol and liquid particle counters and hydrodynamic chromatography columns. They are also used in laser light-scattering studies, and colloidal systems research. The 20 to 1000nm range of diameters is convenient for checking the sizes of bacteria, viruses, ribosomes and sub-cellular components.

Catalog Number	Nominal Diameter	Description	Certified Mean Diameter	Solids Content
Aqueous Suspensions, Calibrated by Photon Correlation Spectroscopy (PCS)				
3020A	20nm	Nanosphere Size Standards	19nm ± 1.5nm	1%
3030A	30nm	Nanosphere Size Standards	32nm ± 1.3nm	1%
3040A	40nm	Nanosphere Size Standards	41nm ± 1.8nm	1%
Aqueous Suspensions, Calibrated by Transmission Electron Microscopy				
3050A	50nm	Nanosphere Size Standards	50nm ± 2.0nm	1%
3060A	60nm	Nanosphere Size Standards	60nm ± 2.5nm	1%
3070A	70nm	Nanosphere Size Standards	73nm ± 2.6nm	1%
3080A	80nm	Nanosphere Size Standards	83nm ± 2.7nm	1%
3090A	90nm	Nanosphere Size Standards	96nm ± 3.1nm	1%

Price: $135.00/15ml

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A. 3000 Series—Nanosphere™ Size Standards—Polymer—continued

Catalog Number	Nominal Diameter	Description	Certified Mean Diameter	Size Distribution Std. Dev. & C.V.	Solids Content
		Aqueous Suspensions, Calibrated by Transmission Electron Microscopy			
3100A	100nm	Nanosphere Size Standards	102nm ± 3nm	7.6nm (7.5%)	1%
3125A	125nm	Nanosphere Size Standards	126nm ± 3nm	4.4nm (3.5%)	1%
3150A	150nm	Nanosphere Size Standards	155nm ± 4nm	3.1nm (2.0%)	1%
3200A	200nm	Nanosphere Size Standards	204nm ± 6nm	3.1nm (1.5%)	1%
3220A	220nm	Nanosphere Size Standards	220nm ± 6nm	3.5nm (1.6%)	1%
3240A	240nm	Nanosphere Size Standards	240nm ± 6nm	3.3nm (1.4%)	1%
3269A	270nm	Nanosphere Size Standards	269nm ± 7nm	4.9nm (1.8%)	1%
3300A	300nm	Nanosphere Size Standards	304nm ± 6nm	4.5nm (1.5%)	1%
3350A	350nm	Nanosphere Size Standards	343nm ± 9nm	3.5nm (1.0%)	1%
3400A	400nm	Nanosphere Size Standards	404nm ± 4nm	5.9nm (1.5%)	1%
3450A	450nm	Nanosphere Size Standards	453nm ± 4nm	6.3nm (1.4%)	1%
3495A	500nm	Nanosphere Size Standards	494nm ± 4nm	5.6nm (1.1%)	1%
3500A	500nm	Nanosphere Size Standards	503nm ± 4nm	6.3nm (1.3%)	1%
3520A	520nm	Nanosphere Size Standards	519nm ± 5nm	5.0nm (1.0%)	1%
3600A	600nm	Nanosphere Size Standards	600nm ± 5nm	6.6nm (1.1%)	1%
3700A	700nm	Nanosphere Size Standards	701nm ± 6nm	9.0nm (1.3%)	1%
3800A	800nm	Nanosphere Size Standards	802nm ± 6nm	9.6nm (1.2%)	1%
3895A	900nm	Nanosphere Size Standards	895nm ± 8nm	9.1nm (1.0%)	1%

Price: $135.00/15ml

B. 4000 Series—Monosized Microsphere Size Standards—Polymer

These are some of the most uniform spheres available in this size range. Their mean diameters have been calibrated with Duke Scientific Corporation's NIST traceable microscopy methods. Their size distribution and uniformity were measured by electrical resistance analysis or electron microscopy.

Products from 1 to 160µm are packaged as aqueous suspensions in dropper-tipped bottles, at an optimum concentration for dispersion, handling and dilution. Diameters of 200µm and larger are packaged as dry spheres, composed of polystyrene or other polymers. The spheres have a density of 1.05g/ml and an index of refraction of 1.59 @ 589nm (23°C).

Catalog Number	Nominal Diameter	Description	Certified Mean Diameter	Size Distribution Std. Dev. & C.V.	Solids Content
		Aqueous Suspensions, Calibrated by Optical Microscopy			
4009A	1.0µm	Microsphere Size Standards	0.993µm ± 0.021µm	0.010µm (1.0%)	1.0%
4010A	1.0µm	Microsphere Size Standards	1.034µm ± 0.020µm	0.010µm (1.0%)	1.0%
4011A	1.1µm	Microsphere Size Standards	1.112µm ± 0.022µm	0.011µm (1.0%)	1.0%
4013A	1.3µm	Microsphere Size Standards	1.335µm ± 0.022µm	0.027µm (2.0%)	1.0%
4016A	1.6µm	Microsphere Size Standards	1.588µm ± 0.025µm	0.016µm (1.0%)	1.0%
4202A	2.0µm	Microsphere Size Standards	2.013µm ± 0.025µm	0.022µm (1.1%)	0.5%
4025A	2.5µm	Microsphere Size Standards	2.504µm ± 0.025µm	0.025µm (1.0%)	0.5%
4203A	3.0µm	Microsphere Size Standards	3.063µm ± 0.027µm	0.03µm (1.0%)	0.5%
4204A	4.0µm	Microsphere Size Standards	4.000µm ± 0.033µm	0.04µm (1.0%)	0.4%
4205A	5.0µm	Microsphere Size Standards	4.991µm ± 0.035µm	0.06µm (1.2%)	0.3%
4206A	6.0µm	Microsphere Size Standards	6.038µm ± 0.045µm	0.07µm (1.2%)	0.3%
4207A	7.0µm	Microsphere Size Standards	6.992µm ± 0.050µm	0.07µm (1.0%)	0.3%
4210A	10µm	Microsphere Size Standards	9.975µm ± 0.061µm	0.09µm (0.9%)	0.2%
4215A	15µm	Microsphere Size Standards	15.03µm ± 0.07µm	0.15µm (1.0%)	0.3%
4220A	20µm	Microsphere Size Standards	20.00µm ± 0.10µm	0.20µm (1.0%)	0.3%
4225A	25µm	Microsphere Size Standards	25.09µm ± 0.12µm	0.38µm (1.5%)	0.5%
4230A	30µm	Microsphere Size Standards	30.10µm ± 0.22µm	0.45µm (1.5%)	0.6%
4240A	40µm	Microsphere Size Standards	40.25µm ± 0.32µm	0.6µm (1.5%)	0.7%
4250A	50µm	Microsphere Size Standards	50.4µm ± 1.0µm	1.6µm (3.2%)	1.4%
4260A	60µm	Microsphere Size Standards	59.8µm ± 1.0µm	2.0µm (3.3%)	1.2%
4270A	70µm	Microsphere Size Standards	68.0µm ± 1.4µm	3.2µm (4.7%)	1.7%
4280A	80µm	Microsphere Size Standards	81.3µm ± 1.6µm	3.6µm (4.4%)	1.8%
4310A	100µm	Microsphere Size Standards	100µm ± 2.0µm	4.2µm (4.2%)	2.2%
4311A	115µm	Microsphere Size Standards	116µm ± 2.3µm	5.4µm (4.7%)	2.6%
4314A	140µm	Microsphere Size Standards	139µm ± 2.8µm	6.5µm (4.7%)	4.0%
4316A	160µm	Microsphere Size Standards	158µm ± 1.0µm	5.5µm (3.5%)	5.0%

Price: $195.00/15ml

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B. 4000 Series—Monosized Microsphere Size Standards—Polymer—continued

Catalog Number	Nominal Diameter	Description	Certified Mean Diameter	Size Distribution Std. Dev. & C.V.	Count per gram
Monosized Dry Spheres—Calibrated by Optical Microscopy					
4320A	200µm	Microsphere Size Standards	200µm ± 4.0µm	5.8µm (2.9%)	2.3×10^5
4324A	240µm	Microsphere Size Standards	239µm ± 4.8µm	9.0µm (3.8%)	1.3×10^5
4328A	280µm	Microsphere Size Standards	279µm ± 5.6µm	13.5µm (4.8%)	8.3×10^4
4330A	300µm	Microsphere Size Standards	301µm ± 6.0µm	11.0µm (3.7%)	6.7×10^4
4340A	400µm	Microsphere Size Standards	400µm ± 8.0µm	15.2µm (3.8%)	2.8×10^4
4350A	500µm	Microsphere Size Standards	497µm ± 10µm	24.0µm (4.8%)	1.5×10^4
4355A	550µm	Microsphere Size Standards	548µm ± 11µm	27.0µm (4.9%)	1.1×10^4
4365A	650µm	Microsphere Size Standards	646µm ± 13µm	24.8µm (3.8%)	6.7×10^3
4375A	750µm	Microsphere Size Standards	773µm ± 15µm	33.3µm (4.3%)	3.9×10^3
4400A	1000µm	Microsphere Size Standards	1005µm ± 20µm	39.2µm (3.9%)	1.6×10^3

Price: $195.00/gram

C. 8000 Series—Particle Size Standards—Silica

This series is designed for applications requiring monodisperse *inorganic* spheres. Like glass, silica has a much higher density than polystyrene and the opaque spheres provide more contrast than polymer particles in optical and electron beams. They are calibrated and certified by NIST traceable procedures and are suitable for a wide variety of particle measurement applications. They are packaged as aqueous suspensions in 15ml dropper-tipped bottles at a concentration of 2% solids. The silica spheres have a density of 1.8-2.2g/ml and a index of refraction of 1.40-1.46 @ 589nm (23°C).

Catalog Number	Nominal Diameter	Description	Certified Mean Diameter	Size Distribution Std. Dev. & C.V.	Solids Content
Aqueous Suspensions—Calibrated by Transmission Electron or Optical Microscopy					
8050	0.5µm	Silica Particle Size Standards	0.46µm ± 0.03µm	0.02µm (4.3%)	2%
8070	0.7µm	Silica Particle Size Standards	0.71µm ± 0.04µm	0.03µm (4.2%)	2%
8100	1.0µm	Silica Particle Size Standards	0.99µm ± 0.05µm	0.02µm (2.0%)	2%
8150	1.6µm	Silica Particle Size Standards	1.58µm ± 0.06µm	0.04µm (2.5%)	2%

Price: $135.00/15ml

D. 9000 Series—Particle Size Standards— Borosilicate Glass

Small borosilicate glass microspheres have fewer spherical imperfections and inclusions than other glass microspheres. They also have a better tolerance to chemicals and solvents in addition to higher mechanical and thermal stability. This series has been calibrated with NIST traceable methods of optical microscopy. They are packaged as one gram of dry spheres in screw-topped bottles. The borosilicate spheres have a density of 2.5-2.55g/ml and an index of refraction of 1.56 @ 589nm (23°C).

Catalog Number	Replaces Catalog #	Nominal Diameter	Description	Certified Mean Diameter	Size Distribution Std. Dev. & C.V.	Count per gram
Uniform Borosilicate Glass Dry Spheres—Calibrated by Optical Microscopy						
9002	257	2µm	Glass Particle Size Standards	2.5µm ± 0.5µm	1.0µm (40%)	4.8×10^{10}
9005	—	5µm	Glass Particle Size Standards	5.1µm ± 0.5µm	0.8µm (16%)	5.8×10^9
9008	146	8µm	Glass Particle Size Standards	8.2µm ± 0.8µm	1.0µm (12%)	1.4×10^9
9010	364	10µm	Glass Particle Size Standards	10.4µm ± 1.0µm	1.0µm (9.6%)	6.7×10^8
9015	366	15µm	Glass Particle Size Standards	15.4µm ± 1.1µm	2.2µm (14%)	2.1×10^8
9020	147	20µm	Glass Particle Size Standards	20.2µm ± 1.4µm	1.7µm (8.4%)	9.2×10^7

Price: $135.00/gram

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E. 9000 Series—Particle Size Standards—Soda Lime Glass

This series is widely used as NIST traceable calibrants or controls for instruments requiring a higher density and more contrast to incident radiation than that provided by the polymer microspheres. The microspheres are made of soda-lime glass which has trace amounts of metallic elements. This makes them easily detectable by X-ray methods and improves their contrast and reflectivity in optical, ultrasonic and electron beam detection methods.

The spheres have been processed to remove non-spherical and broken particles, assuring a high percentage of perfect spheres. They are packaged as one gram of dry spheres in screw-topped bottles. The soda lime microspheres have a density of 2.4-2.5g/ml and an index of refraction of 1.51 @ 589nm, the softening temperature is 720°C, and the dielectric constant is 7.3 @ 1 KHz and 20°C.

Catalog Number	Replaces Catalog #	Nominal Diameter	Description	Certified Mean Diameter	Size Distribution Std. Dev. & C.V.	Count per gram
			Uniform Soda Lime Glass Spheres—Calibrated by Optical Microscopy			
9030	148	30µm	Glass Particle Size Standards	31.9µm ± 2.2µm	2.4µm (7.4%)	2.4×10^7
9040	298	40µm	Glass Particle Size Standards	40.0µm ± 2.8µm	2.4µm (6.0%)	1.2×10^7
9050	299	50µm	Glass Particle Size Standards	50.8µm ± 3.0µm	2.1µm (4.1%)	6.0×10^6
9060	368	60µm	Glass Particle Size Standards	59.6µm ± 3.6µm	2.4µm (4.0%)	3.7×10^6
9070	369	70µm	Glass Particle Size Standards	73.0µm ± 4.4µm	3.65µm (5.0%)	2.0×10^6
9080	422	80µm	Glass Particle Size Standards	80.2µm ± 4.0µm	3.0µm (3.7%)	1.5×10^6
9090	370	90µm	Glass Particle Size Standards	90.0µm ± 4.5µm	3.2µm (3.6%)	1.1×10^6
9100	371	100µm	Glass Particle Size Standards	98.7µm ± 4.9µm	3.7µm (3.7%)	8.1×10^5
9110	372	110µm	Glass Particle Size Standards	112µm ± 5.6µm	4.2µm (3.8%)	5.6×10^5
9120	150	120µm	Glass Particle Size Standards	124µm ± 6.2µm	5.1µm (4.1%)	4.1×10^5
9140	373	140µm	Glass Particle Size Standards	139µm ± 7.0µm	5.0µm (3.6%)	2.9×10^5
9170	374	170µm	Glass Particle Size Standards	168µm ± 8.4µm	7.5µm (4.5%)	1.7×10^5
9200	375	200µm	Glass Particle Size Standards	200µm ± 6.0µm	6.1µm (3.1%)	1.0×10^5
9230	151	230µm	Glass Particle Size Standards	234µm ± 7.0µm	7.5µm (3.2%)	6.2×10^4
9280	376	280µm	Glass Particle Size Standards	278µm ± 8.3µm	11.1µm (4.0%)	3.6×10^4
9330	152	330µm	Glass Particle Size Standards	331µm ± 10µm	14.8µm (4.5%)	2.2×10^4
9400	153	400µm	Glass Particle Size Standards	398µm ± 12µm	9.5µm (2.4%)	1.3×10^4
9480	377	480µm	Glass Particle Size Standards	483µm ± 14µm	24.2µm (5.0%)	7000
9550	154	550µm	Glass Particle Size Standards	540µm ± 16µm	24.2µm (4.5%)	5010
9650	155	650µm	Glass Particle Size Standards	655µm ± 20µm	29.0µm (4.4%)	2800
9750	351	750µm	Glass Particle Size Standards	756µm ± 23µm	22.7µm (3.0%)	1825
9950	352	950µm	Glass Particle Size Standards	940µm ± 28µm	39.7µm (4.2%)	950
91000	438	1000µm	Glass Particle Size Standards	1008µm ± 30µm	37.1µm (3.7%)	770
92000	439	2000µm	Glass Particle Size Standards	2022µm ± 40µm	63.8µm (3.2%)	95

Price: $135.00/gram

Custom packaging at different concentrations (particles/ml) can be produced with many of the aqueous particle size standards. Please contact our marketing department for additional information.

ORDERING INFORMATION: Order directly from Duke Scientific Corporation. Prices are f.o.b. Palo Alto. We routinely ship via 2nd Day UPS, freight prepaid and added to invoice. We can also ship via Federal Express with all charges collect; please provide your account number. We reserve the right to revise specifications or prices without notice.

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.

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3020A	20nm	Nanosphere Size Standards	19nm ± 1.5nm	1%
3030A	30nm	Nanosphere Size Standards	32nm ± 1.3nm	1%
3040A	40nm	Nanosphere Size Standards	41nm ± 1.8nm	1%
Aqueous Suspensions, Calibrated by Transmission Electron Microscopy				
3050A	50nm	Nanosphere Size Standards	50nm ± 2.0nm	1%
3060A	60nm	Nanosphere Size Standards	60nm ± 2.5nm	1%
3070A	70nm	Nanosphere Size Standards	73nm ± 2.6nm	1%
3080A	80nm	Nanosphere Size Standards	83nm ± 2.7nm	1%
3090A	90nm	Nanosphere Size Standards	96nm ± 3.1nm	1%

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— Continued

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4011A	1.1µm	Microsphere Size Standards	1.112µm ± 0.022µm	0.011µm (1.0%)	1.0%
4013A	1.3µm	Microsphere Size Standards	1.335µm ± 0.022µm	0.027µm (2.0%)	1.0%
4016A	1.6µm	Microsphere Size Standards	1.588µm ± 0.025µm	0.016µm (1.0%)	1.0%
4202A	2.0µm	Microsphere Size Standards	2.013µm ± 0.025µm	0.022µm (1.1%)	0.5%
4025A	2.5µm	Microsphere Size Standards	2.504µm ± 0.025µm	0.025µm (1.0%)	0.5%
4203A	3.0µm	Microsphere Size Standards	3.063µm ± 0.027µm	0.03µm (1.0%)	0.5%
4204A	4.0µm	Microsphere Size Standards	4.000µm ± 0.033µm	0.04µm (1.0%)	0.4%
4205A	5.0µm	Microsphere Size Standards	4.991µm ± 0.035µm	0.06µm (1.2%)	0.3%
4206A	6.0µm	Microsphere Size Standards	6.038µm ± 0.045µm	0.07µm (1.2%)	0.3%
4207A	7.0µm	Microsphere Size Standards	6.992µm ± 0.050µm	0.07µm (1.0%)	0.3%
4210A	10µm	Microsphere Size Standards	9.975µm ± 0.061µm	0.09µm (0.9%)	0.2%
4215A	15µm	Microsphere Size Standards	15.03µm ± 0.07µm	0.15µm (1.0%)	0.3%
4220A	20µm	Microsphere Size Standards	20.00µm ± 0.10µm	0.20µm (1.0%)	0.3%
4225A	25µm	Microsphere Size Standards	25.09µm ± 0.12µm	0.38µm (1.5%)	0.5%
4230A	30µm	Microsphere Size Standards	30.10µm ± 0.22µm	0.45µm (1.5%)	0.6%
4240A	40µm	Microsphere Size Standards	40.25µm ± 0.32µm	0.6µm (1.5%)	0.7%
4250A	50µm	Microsphere Size Standards	50.4µm ± 1.0µm	1.6µm (3.2%)	1.4%
4260A	60µm	Microsphere Size Standards	59.8µm ± 1.0µm	2.0µm (3.3%)	1.2%
4270A	70µm	Microsphere Size Standards	68.0µm ± 1.4µm	3.2µm (4.7%)	1.7%
4280A	80µm	Microsphere Size Standards	81.3µm ± 1.6µm	3.6µm (4.4%)	1.8%
4310A	100µm	Microsphere Size Standards	100µm ± 2.0µm	4.2µm (4.2%)	2.2%
4311A	115µm	Microsphere Size Standards	116µm ± 2.3µm	5.4µm (4.7%)	2.6%
4314A	140µm	Microsphere Size Standards	139µm ± 2.8µm	6.5µm (4.7%)	4.0%
4316A	160µm	Microsphere Size Standards	158µm ± 1.0µm	5.5µm (3.5%)	5.0%

Price: $195.00/15ml

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— Continued

B. 4000 Series—Monosized Microsphere Size Standards—Polymer—continued

Catalog Number	Nominal Diameter	Description	Certified Mean Diameter	Size Distribution Std. Dev. & C.V.	Count per gram
Monosized Dry Spheres—Calibrated by Optical Microscopy					
4320A	200µm	Microsphere Size Standards	200µm ± 4.0µm	5.8µm (2.9%)	2.3×10^5
4324A	240µm	Microsphere Size Standards	239µm ± 4.8µm	9.0µm (3.8%)	1.3×10^5
4328A	280µm	Microsphere Size Standards	279µm ± 5.6µm	13.5µm (4.8%)	8.3×10^4
4330A	300µm	Microsphere Size Standards	301µm ± 6.0µm	11.0µm (3.7%)	6.7×10^4
4340A	400µm	Microsphere Size Standards	400µm ± 8.0µm	15.2µm (3.8%)	2.8×10^4
4350A	500µm	Microsphere Size Standards	497µm ± 10µm	24.0µm (4.8%)	1.5×10^4
4355A	550µm	Microsphere Size Standards	548µm ± 11µm	27.0µm (4.9%)	1.1×10^4
4365A	650µm	Microsphere Size Standards	646µm ± 13µm	24.8µm (3.8%)	6.7×10^3
4375A	750µm	Microsphere Size Standards	773µm ± 15µm	33.3µm (4.3%)	3.9×10^3
4400A	1000µm	Microsphere Size Standards	1005µm ± 20µm	39.2µm (3.9%)	1.6×10^3

Price: $195.00/gram

C. 8000 Series—Particle Size Standards—Silica

This series is designed for applications requiring monodisperse *inorganic* spheres. Like glass, silica has a much higher density than polystyrene and the opaque spheres provide more contrast than polymer particles in optical and electron beams. They are calibrated and certified by NIST traceable procedures and are suitable for a wide variety of particle measurement applications. They are packaged as aqueous suspensions in 15ml dropper-tipped bottles at a concentration of 2% solids. The silica spheres have a density of 1.8-2.2g/ml and a index of refraction of 1.40-1.46 @ 589nm (23°C).

Catalog Number	Nominal Diameter	Description	Certified Mean Diameter	Size Distribution Std. Dev. & C.V.	Solids Content
Aqueous Suspensions—Calibrated by Transmission Electron or Optical Microscopy					
8050	0.5µm	Silica Particle Size Standards	0.46µm ± 0.03µm	0.02µm (4.3%)	2%
8070	0.7µm	Silica Particle Size Standards	0.71µm ± 0.04µm	0.03µm (4.2%)	2%
8100	1.0µm	Silica Particle Size Standards	0.99µm ± 0.05µm	0.02µm (2.0%)	2%
8150	1.6µm	Silica Particle Size Standards	1.58µm ± 0.06µm	0.04µm (2.5%)	2%

Price: $135.00/15ml

D. 9000 Series—Particle Size Standards— Borosilicate Glass

Small borosilicate glass microspheres have fewer spherical imperfections and inclusions than other glass microspheres. They also have a better tolerance to chemicals and solvents in addition to higher mechanical and thermal stability. This series has been calibrated with NIST traceable methods of optical microscopy. They are packaged as one gram of dry spheres in screw-topped bottles. The borosilicate spheres have a density of 2.5-2.55g/ml and an index of refraction of 1.56 @ 589nm (23°C).

Catalog Number	Replaces Catalog #	Nominal Diameter	Description	Certified Mean Diameter	Size Distribution Std. Dev. & C.V.	Count per gram
Uniform Borosilicate Glass Dry Spheres—Calibrated by Optical Microscopy						
9002	257	2µm	Glass Particle Size Standards	2.5µm ± 0.5µm	1.0µm (40%)	4.8×10^{10}
9005	—	5µm	Glass Particle Size Standards	5.1µm ± 0.5µm	0.8µm (16%)	5.8×10^9
9008	146	8µm	Glass Particle Size Standards	8.2µm ± 0.8µm	1.0µm (12%)	1.4×10^9
9010	364	10µm	Glass Particle Size Standards	10.4µm ± 1.0µm	1.0µm (9.6%)	6.7×10^8
9015	366	15µm	Glass Particle Size Standards	15.4µm ± 1.1µm	2.2µm (14%)	2.1×10^8
9020	147	20µm	Glass Particle Size Standards	20.2µm ± 1.4µm	1.7µm (8.4%)	9.2×10^7

Price: $135.00/gram

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E. 9000 Series—Particle Size Standards—Soda Lime Glass

This series is widely used as NIST traceable calibrants or controls for instruments requiring a higher density and more contrast to incident radiation than that provided by the polymer microspheres. The microspheres are made of soda-lime glass which has trace amounts of metallic elements. This makes them easily detectable by X-ray methods and improves their contrast and reflectivity in optical, ultrasonic and electron beam detection methods.

The spheres have been processed to remove non-spherical and broken particles, assuring a high percentage of perfect spheres. They are packaged as one gram of dry spheres in screw-topped bottles. The soda lime microspheres have a density of 2.4-2.5g/ml and an index of refraction of 1.51 @ 589nm, the softening temperature is 720°C, and the dielectric constant is 7.3 @ 1 KHz and 20°C.

Catalog Number	Replaces Catalog #	Nominal Diameter	Description	Certified Mean Diameter	Size Distribution Std. Dev. & C.V.	Count per gram
			Uniform Soda Lime Glass Spheres—Calibrated by Optical Microscopy			
9030	148	30µm	Glass Particle Size Standards	31.9µm ± 2.2µm	2.4µm (7.4%)	2.4×10^7
9040	298	40µm	Glass Particle Size Standards	40.0µm ± 2.8µm	2.4µm (6.0%)	1.2×10^7
9050	299	50µm	Glass Particle Size Standards	50.8µm ± 3.0µm	2.1µm (4.1%)	6.0×10^6
9060	368	60µm	Glass Particle Size Standards	59.6µm ± 3.6µm	2.4µm (4.0%)	3.7×10^6
9070	369	70µm	Glass Particle Size Standards	73.0µm ± 4.4µm	3.65µm (5.0%)	2.0×10^6
9080	422	80µm	Glass Particle Size Standards	80.2µm ± 4.0µm	3.0µm (3.7%)	1.5×10^6
9090	370	90µm	Glass Particle Size Standards	90.0µm ± 4.5µm	3.2µm (3.6%)	1.1×10^6
9100	371	100µm	Glass Particle Size Standards	98.7µm ± 4.9µm	3.7µm (3.7%)	8.1×10^5
9110	372	110µm	Glass Particle Size Standards	112µm ± 5.6µm	4.2µm (3.8%)	5.6×10^5
9120	150	120µm	Glass Particle Size Standards	124µm ± 6.2µm	5.1µm (4.1%)	4.1×10^5
9140	373	140µm	Glass Particle Size Standards	139µm ± 7.0µm	5.0µm (3.6%)	2.9×10^5
9170	374	170µm	Glass Particle Size Standards	168µm ± 8.4µm	7.5µm (4.5%)	1.7×10^5
9200	375	200µm	Glass Particle Size Standards	200µm ± 6.0µm	6.1µm (3.1%)	1.0×10^5
9230	151	230µm	Glass Particle Size Standards	234µm ± 7.0µm	7.5µm (3.2%)	6.2×10^4
9280	376	280µm	Glass Particle Size Standards	278µm ± 8.3µm	11.1µm (4.0%)	3.6×10^4
9330	152	330µm	Glass Particle Size Standards	331µm ± 10µm	14.8µm (4.5%)	2.2×10^4
9400	153	400µm	Glass Particle Size Standards	398µm ± 12µm	9.5µm (2.4%)	1.3×10^4
9480	377	480µm	Glass Particle Size Standards	483µm ± 14µm	24.2µm (5.0%)	7000
9550	154	550µm	Glass Particle Size Standards	540µm ± 16µm	24.2µm (4.5%)	5010
9650	155	650µm	Glass Particle Size Standards	655µm ± 20µm	29.0µm (4.4%)	2800
9750	351	750µm	Glass Particle Size Standards	756µm ± 23µm	22.7µm (3.0%)	1825
9950	352	950µm	Glass Particle Size Standards	940µm ± 28µm	39.7µm (4.2%)	950
91000	438	1000µm	Glass Particle Size Standards	1008µm ± 30µm	37.1µm (3.7%)	770
92000	439	2000µm	Glass Particle Size Standards	2022µm ± 40µm	63.8µm (3.2%)	95

Price: $135.00/gram

Custom packaging at different concentrations (particles/ml) can be produced with many of the aqueous particle size standards. Please contact our marketing department for additional information.

ORDERING INFORMATION: Order directly from Duke Scientific Corporation. Prices are f.o.b. Palo Alto. We routinely ship via 2nd Day UPS, freight prepaid and added to invoice. We can also ship via Federal Express with all charges collect; please provide your account number. We reserve the right to revise specifications or prices without notice.

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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Toll Free (800) 334-3883 or (415) 424-1177, Fax (415) 424-1158

BIOCLEAN™ FLUORESCENT MICROSPHERES

Bioclean fluorescent microspheres were developed by Duke Scientific Corporation for biotechnology applications. Available in a range of sizes from 0.05 to 2.0μm and in green, red, and blue fluorescent colors, the new microspheres are prepared without surfactants or preservatives and are packaged in highly filtered, deionized water. *—continued*

Catalog Number		Nominal	Measured Values		Solids	Particle Surface Area	Typical Antib. Adsorption
7ml	50ml	Diameter	Mean Diam.	Uniformity	Content	Per ml	(Bovine IgG)
			Bioclean Microspheres—Green Fluorescent				
AG50	AG50B	0.05μm	0.057μm	<10%CV	1%	9987cm^2	0.18μg/cm^2
AG100	AG100B	0.1μm	0.096μm	<10%CV	1%	5527cm^2	0.23μg/cm^2
AG125	AG125B	0.125μm	0.128μm	<10%CV	1%	4447cm^2	0.26μg/cm^2
AG150	AG150B	0.15μm	0.145μm	<10%CV	1%	3926cm^2	0.26μg/cm^2
AG200	AG200B	0.2μm	0.202μm	<5%CV	1%	2818cm^2	0.15μg/cm^2
AG300	AG300B	0.3μm	0.294μm	<3%CV	1%	1936cm^2	0.24μg/cm^2
AG500	AG500B	0.5μm	0.501μm	<3%CV	1%	1136cm^2	0.27μg/cm^2
AG580	AG580B	0.58μm	0.577μm	<3%CV	1%	987cm^2	0.27μg/cm^2
AG600	AG600B	0.6μm	0.601μm	<3%CV	1%	947cm^2	0.31μg/cm^2
AG780	AG780B	0.8μm	0.778μm	<3%CV	1%	732cm^2	0.20μg/cm^2
AG0100	AG0100B	1.0μm	1.01μm	<5%CV	1%	564cm^2	0.20μg/cm^2
AG0210	AG0210B	2.0μm	2.12μm	<5%CV	1%	269cm^2	0.24μg/cm^2
AG0220	AG0220B	2.0μm	2.21μm	<5%CV	1%	258cm^2	0.21μg/cm^2
			Bioclean Microspheres—Red Fluorescent				
AR50	AR50B	0.05μm	0.053μm	<10%CV	1%	10741cm^2	0.15μg/cm^2
AR100	AR100B	0.1μm	0.105μm	<10%CV	1%	5422cm^2	0.24μg/cm^2
AR200	AR200B	0.2μm	0.205μm	<5%CV	1%	2777cm^2	0.25μg/cm^2
AR300	AR300B	0.3μm	0.311μm	<3%CV	1%	1830cm^2	0.18μg/cm^2
AR530	AR530B	0.5μm	0.534μm	<3%CV	1%	1066cm^2	0.15μg/cm^2
AR600	AR600B	0.6μm	0.617μm	<3%CV	1%	923cm^2	0.33μg/cm^2
AR770	AR770B	0.8μm	0.775μm	<3%CV	1%	735cm^2	0.23μg/cm^2
AR0100	AR0100B	1.0μm	1.04μm	<5%CV	1%	550cm^2	0.19μg/cm^2
AR0200	AR0200B	2.0μm	1.95μm	<5%CV	1%	292cm^2	0.22μg/cm^2
			Bioclean Microspheres—Blue Fluorescent				
AB100	AB100B	0.1μm	0.095μm	<10%CV	1%	5992cm^2	0.22μg/cm^2
AB150	AB150B	0.15μm	0.153μm	<10%CV	1%	3721cm^2	0.22μg/cm^2
AB200	AB200B	0.2μm	0.201μm	<5%CV	1%	2832cm^2	0.23μg/cm^2
AB300	AB300B	0.3μm	0.308μm	<3%CV	1%	1848cm^2	0.25μg/cm^2
AB500	AB500B	0.5μm	0.520μm	<3%CV	1%	1095cm^2	0.27μg/cm^2
AB675	AB675B	0.67μm	0.673μm	<3%CV	1%	846cm^2	0.26μg/cm^2
AB830	AB830B	0.8μm	0.829μm	<3%CV	1%	687cm^2	0.18μg/cm^2
AB0100	AB0100B	1.0μm	1.0μm	<5%CV	1%	569cm^2	0.22μg/cm^2
AB0180	AB0180B	1.8μm	1.84μm	<5%CV	1%	309cm^2	0.25μg/cm^2

Prices:

Package Size	Nominal Diameter (μm) 0.05-0.49	0.5-0.99	1.0-2.99
7ml	$ 95.00	$115.00	$132.00
50ml	$445.00	$535.00	$615.00

Duke Scientific Corporation

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2463 Faber Place, P.O. Box 50005, Palo Alto, California 94303
Toll Free (800) 334-3883 or (415) 424-1177, Fax (415) 424-1158

RESEARCH MICROSPHERES AND PARTICLES

Microspheres and particles of known size and composition are widely used as experimental models and size controls by scientific and industrial laboratories. They are available from Duke Scientific Corporation in a range of sizes from 0.028 to 750 micrometers (μm), and a variety of materials including polystyrene and glass.

These products can be used as particle-size controls for checking repeatability of measurement systems. They can also be used as tracers in fluid-mechanics investigations, test particles for evaluating filter media, and wave-scattering models for acoustical or optical radiation studies.

If you need NIST-traceable calibration particles please refer to Bulletin 92, our list of Certified Particle Size Standards. See other Duke Scientific literature for fluorescent microspheres or biomedical latex for covalent coupling of antibodies.

A. Uniform Latex Microspheres

Our line of low-priced latex particle suspensions can be used for a variety of procedures requiring highly uniform polymer spheres in the colloidal size range. Particles of this size are of special interest for light-scattering studies, microporous filter checking, and aerosol particle generation.

The polystyrene microparticles have a specific gravity of 1.05 g/ml and a refractive index of 1.59 @ 589nm (25°C). Particles were sized by optical or electron microscopy and photon correlation spectroscopy. The latex microspheres are packaged as aqueous suspensions at 10% solids. Liter and gallon quantities are available.

Catalog Numbers		Mean Diam.		Size Uniformity
15ml	100ml	(μm)	Description	Std. Dev. & C.V.
5003A	5003B	0.028	Polystyrene Latex Particles	0.0031μm (11%)
5006A	5006B	0.064	Polystyrene Latex Particles	0.0096μm (15%)
5008A	5008B	0.087	Polystyrene Latex Particles	0.0035μm (4%)
5009A	5009B	0.091	Polystyrene Latex Particles	0.0058μm (6.4%)
5010A	5010B	0.107	Polystyrene Latex Particles	0.0060μm (5.6%)
5011A	5011B	0.110	Polystyrene Latex Particles	0.0047μm (4.3%)
5012A	5012B	0.121	Polystyrene Latex Particles	0.0050μm (4.1%)
5014A	5014B	0.135	Polystyrene Latex Particles	0.0057μm (4.2%)
5016A	5016B	0.162	Polystyrene Latex Particles	0.0044μm (2.8%)
5017A	5017B	0.173	Polystyrene Latex Particles	0.0054μm (3.1%)
5020A	5020B	0.197	Polystyrene Latex Particles	0.0035μm (1.8%)
5022A	5022B	0.222	Polystyrene Latex Particles	0.0038μm (1.7%)
5024A	5024B	0.241	Polystyrene Latex Particles	0.0039μm (1.6%)
5026A	5026B	0.261	Polystyrene Latex Particles	0.0031μm (1.2%)
5030A	5030B	0.304	Polystyrene Latex Particles	0.0067μm (2.2%)
5031A	5031B	0.305	Polystyrene Latex Particles	0.0067μm (2.2%)
5033A	5033B	0.320	Polystyrene Latex Particles	0.0040μm (1.3%)
5036A	5036B	0.360	Polystyrene Latex Particles	0.0054μm (1.5%)
5043A	5043B	0.426	Polystyrene Latex Particles	0.0087μm (2.0%)
5045A	5045B	0.451	Polystyrene Latex Particles	0.0113μm (2.5%)
5048A	5048B	0.482	Polystyrene Latex Particles	0.0049μm (1.0%)
5049A	5049B	0.494	Polystyrene Latex Particles	0.0093μm (1.9%)
5050A	5050B	0.497	Polystyrene Latex Particles	0.0094μm (1.9%)

Prices: (0.03 to 0.49μm): $110.00/15ml, 515.00/100ml

—Continued

A. Uniform Latex Microspheres—Continued

Catalog Numbers 15ml	Catalog Numbers 100ml	Mean Diam. (μm)	Description	Size Uniformity Std. Dev. & C.V.
5051A	5051B	0.519	Polystyrene Latex Particles	0.0050μm (1.0%)
5052A	5052B	0.523	Polystyrene Latex Particles	0.0110μm (2.1%)
5060A	5060B	0.596	Polystyrene Latex Particles	0.0077μm (1.3%)
5065A	5065B	0.652	Polystyrene Latex Particles	0.0048μm (0.7%)
5067A	5067B	0.672	Polystyrene Latex Particles	0.0128μm (1.9%)
5072A	5072B	0.720	Polystyrene Latex Particles	0.0053μm (0.7%)
5081A	5081B	0.806	Polystyrene Latex Particles	0.0113μm (1.4%)
5085A	5085B	0.845	Polystyrene Latex Particles	0.0085μm (1.0%)
5088A	5088B	0.878	Polystyrene Latex Particles	0.0123μm (1.4%)
5090A	5090B	0.913	Polystyrene Latex Particles	0.0059μm (0.6%)
5095A	5095B	0.966	Polystyrene Latex Particles	0.0126μm (1.3%)
Prices: (0.50 to 0.99μm): $125.00/15ml, 585.00/100ml				
5100A	5100B	1.07	Polystyrene Latex Particles	0.014μm (1.3%)
5110A	5110B	1.11	Polystyrene Latex Particles	0.011μm (1.0%)
5126A	5126B	1.24	Polystyrene Latex Particles	0.013μm (1.0%)
5153A	5153B	1.53	Polystyrene Latex Particles	0.018μm (1.2%)
5200A	5200B	2.04	Polystyrene Latex Particles	0.044μm (2.2%)
5300A	5300B	2.92	Polystyrene Latex Particles	0.081μm (2.8%)
5312A	5312B	3.12	Polystyrene Latex Particles	0.156μm (5.0%)
5370A	5370B	3.7	Polystyrene Latex Particles	0.167μm (4.5%)
Prices: (1.0 to 4.0μm): $140.00/15ml, 650.00/100ml				

B. Large Polymer Microspheres

Suspensions of large polymer microspheres are useful as model systems for fluid-mechanics experiments, as microcarriers for cell-culture and other biology experiments, and as challenge particles for large pore-size filtration systems. They are also useful as particle-size controls for acoustical and optical analytical systems. Their chemical composition is polystyrene polymer, cross-linked with 4 to 8% divinylbenzene (DVB). The beads are chemically inert; they can be washed with alcohol, vacuum or air dried, and autoclaved. The polymer density is 1.05 g/ml and the index of refraction is 1.59 @ 540nm (25°C). They are packaged as aqueous suspensions at 10% solids. Larger packages are available.

Catalog Numbers 15ml	Catalog Numbers 100ml	Mean Diam. (μm)	Description	Size Uniformity Std. Dev. & C.V.
7503A	7503B	3.2	Polystyrene DVB Spheres	1.4μm (43%)
7504A	7504B	3.4	Polystyrene DVB Spheres	0.8μm (23%)
7505A	7505B	5.3	Polystyrene DVB Spheres	1.2μm (22.7%)
7508A	7508B	8.7	Polystyrene DVB Spheres	1.5μm (17.2%)
7510A	7510B	10.2	Polystyrene DVB Spheres	1.5μm (14.7%)
7516A	7516B	15.9	Polystyrene DVB Spheres	2.3μm (14.5%)
7520A	7520B	21.7	Polystyrene DVB Spheres	3.2μm (14.7%)
7525A	7525B	23.8	Polystyrene DVB Spheres	3.0μm (12.6%)
7545A	7545B	44.2	Polystyrene DVB Spheres	7.0μm (15.8%)
7550A	7550B	51.1	Polystyrene DVB Spheres	7.0μm (13.7%)
7575A	7575B	74.5	Polystyrene DVB Spheres	8.5μm (11.4%)
7590A	7590B	88.2	Polystyrene DVB Spheres	10.2μm (11.6%)
7602A	7602B	99.0	Polystyrene DVB Spheres	13μm (13.1%)
7640A	7640B	144	Polystyrene DVB Spheres	13.5μm (9.4%)
7725A	7725B	220	Polystyrene DVB Spheres	16.5μm (7.5%)
Prices: $115.00/15ml, 600.00/100ml				

C. Spherical Polymer Materials

These spherical polymers have the same physical and chemical properties as the large polymer microspheres (Section B), except the spheres are more economical and have a wider size distribution. They are useful for preparation of special size ranges (using sieves), or as experimental materials for chemical engineering studies. They are packaged as dry spheres.

Description	Size Range (μm)	Catalog Numbers and Prices			
Polystyrene DVB Spheres	1-15	444	$90.00/20g	444B	$330.00/100g
Polystyrene DVB Spheres	1-35	445	90.00/20g	445B	330.00/100g
Polystyrene DVB Spheres	2-120	431	90.00/25g	431B	330.00/125g
Polystyrene DVB Spheres	100-500	434	90.00/100g	434B	330.00/500g
Polystyrene DVB Spheres	250-750	433	90.00/100g	433B	330.00/500g

D. Spherical Glass Materials

Spherical glass beads are useful as models for analytical, sedimentation, and separation applications. Other uses for glass beads are as spacers, insulators and reflectors. Their specific gravity is 2.45 g/ml, refractive index is 1.51 @ 589nm, softening temperature is 720°C, and dielectric constant is 7.3 @ 1KHz and 20°C. They are packaged as dry spheres.

Description	Size Range (μm)	Catalog Numbers and Prices			
Glass Beads	1-40	414*	$90.00/2g	414B*	$330.00/10g
Glass Beads	5-60	424	90.00/100g	424B	330.00/500g
Glass Beads	10-95	425	90.00/100g	425B	330.00/500g
Glass Beads	40-60	426	90.00/10g	426B	330.00/50g
Glass Beads	64-106	443	90.00/2g	443B	330.00/10g
Glass Beads	95-120	427	90.00/10g	427B	330.00/50g
Glass Beads	140-165	428	90.00/10g	428B	330.00/50g
Glass Beads	200-230	429	90.00/10g	429B	330.00/50g
Glass Beads	380-515	410	90.00/50g	410B	330.00/250g
Glass Beads, Hollow	10-130	417	90.00/50ml	417B	330.00/250ml

*Size distribution provided

E. Spherical Pollens and Spores

This selection provides model specimens for analyzing and controlling a common industrial contaminant. Pollens can also be used as controls for test systems, or as models of biological cells when stained with cytochemical dyes. They are packaged as dry powders; the pollens will swell to a spherical shape after immersion in aqueous solutions for a few minutes. The size data pertains to the hydrated spherical condition.

Description	Size Range (μm)	Catalog Numbers and Prices			
Bermuda Grass Smut Spores	5.6-8.4	419	$63.00/1g	419B	$215.00/5g
Johnson Grass Smut Spores	5.8-9.0	420	63.00/1g	420B	215.00.00/5g
Paper Mulberry Pollen	10.4-14.4	213	63.00/1g	213B	215.00/5g
Ragweed Pollen	18.0-23.6	214	63.00/1g	214B	215.00/5g
Bermuda Grass Pollen	24.8-34.6	395	63.00/1g	395B	215.00/5g
Lycopodium Spores	25-35	215	63.00/10ml	215B	215.00/50ml
Black Walnut Pollen	28.6-40.6	396	63.00/1g	396B	215.00/5g
Pecan Pollen	41.7-54.9	217	63.00/1g	217B	215.00/5g
Corn Pollen	69-87	397	63.00/2g	397B	215.00/10g

Duke Scientific Corporation

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F. Metal and Mineral Particles and Spheres

This series of particles and spheres meets the need for an assortment of materials for chemical, metallurgical and engineering studies. The stainless steel and nickel spheres are paramagnetic.

Description	Size Range (μm)	Specific Gravity (g/ml)	Catalog Numbers and Prices	
AC Fine Test Dust	1–80	2.6	415	$85.00/50g
AC Coarse Test Dust	1–200	2.6	416	85.00/50g
Aluminum Oxide Particles	1.2–4.6	3.9	347	85.00/5g
Aluminum Oxide Particles	0.3–10	3.9	421	85.00/5g
Aluminum Oxide Particles	0.5–20	3.9	423	85.00/5g
Aluminum Silicate Particles	0.2–6.0	2.6	235	85.00/20g
Antimony Oxide Particles	0.2–3.0	5.7	418	85.00/20g
Calcium Carbonate Particles	0.1–8.0	2.7	437	85.00/20g
Cerium Oxide Particles	0.5–6.0	3.4	348	85.00/20g
Nickel Spheres	4–24	8.9	136	85.00/20g
Nickel Particles	40–80	8.9	358	85.00/5g
Nickel Particles	60–90	8.9	359	85.00/10g
Silicon Carbide Particles	0.7–7.0	3.2	349	85.00/20g
Stainless Steel Spheres, Type 316	10–65	8.0	435	85.00/25g
Stainless Steel Spheres, Type 316	60–125	8.0	436	85.00/100g
Stainless Steel Spheres, Type 316	64–76	8.0	451	85.00/2g
Walnut Shell Particles	3–30	1.35	356	85.00/25g

G. Powders with Measured Surface Areas

These powders with measured surface areas are useful as controls for checking the reproducibility of specific surface area measurements using the nitrogen or krypton adsorption methods.

Description	Surface Area (m^2 per gram) Nominal	N_2 Adsorption	Kr Adsorption	Catalog Numbers and Prices	
Zinc Oxide Particles	0.6	0.62 ± 0.04	0.63 ± 0.03	208	$95.00/5g
Zinc Oxide Particles	1.2	1.22 ± 0.10	1.37 ± 0.11	385	95.00/5g
Alumina Particles	1.4	1.39 ± 0.12	1.24 ± 0.11	355	95.00/5g
Alumina Particles	3.0	4.94 ± 0.25	4.68 ± 0.25	386	95.00/5g
Titanium Dioxide Particles	7.0	7.05 ± 0.7		204	95.00/5g
Alumina Particles	14	14.0 ± 0.6		387	95.00/5g
Silica Particles	24	24.3 ± 1.1		209	95.00/2g
Alumina Particles	81	82.5 ± 6.2		388	95.00/5g
Carbon Black Particles	110	110 ± 7		344	95.00/2g
Alumina Particles	265	265 ± 11		398	95.00/5g
Silica-alumina Particles	467	467 ± 21		389	95.00/5g

ORDERING INFORMATION: Order directly from Duke Scientific Corporation. Prices are f.o.b. Palo Alto. We routinely ship via 2nd Day UPS, freight prepaid and added to invoice. We can also ship via Federal Express with all charges collect; please provide your account number. We reserve the right to revise specifications or prices without notice.

LIMITED WARRANTY: These products are intended for research use by trained scientific personnel. Their suitability for use as diagnostic reagents, particle-size standards, or other specific uses must be determined and validated by the customer. Our warranty is limited to replacement of defective merchandise if returned with our [illegible] within 60 days of purchase date.

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Fax (415) 424-1158

June 11, 1997

Jeremy Grata
Biocontrol Technology
300 Indian Springs Road
Indiana, PA 15701

Dear Mr. Grata:

Thank you for your interest in our particle size standards and reference materials. We offer a large assortment of sizes and materials for calibration, research and quality control applications.

Our product offering includes:

* ***Certified Particle Size Standards*** Includes Nanosphere™ Size Standards, calibrated in billionths of a meter (nanometers) from 20 to 900nm, and a complete selection of glass and polymer microspheres from 1 to 2000µm in diameter. All are certified for mean diameter with calibration methods traceable to the National Institute of Standards and Technology (formerly NBS).

* ***Fluorescent Microspheres*** Distinctive colors provide extra sensitivity and detectability for use in flow tracing, microcirculation studies, membrane filter testing, fluorescence microscopy and flow cytometry research.

* ***Research Microspheres and Particles*** Includes uniform latex particles and a selection of other spherical particles for research and testing applications. Useful for light scattering studies, filter checking, fluid mechanics, aerosol generation and latex agglutination research.

* ***Exotic Particles and Powders*** Includes pollens, spores, metals, minerals and powders with measured surface areas.

Our standards and particles are used by more than 3000 industrial and scientific laboratories throughout the world. Established in 1971, Duke Scientific has the experience to assist you with your applications and problems.

Please call us and let us know how we may be of service.

Sincerely,

E. Chae

Elizabeth Chae
Technical Services

The chemically clean surfaces of the microspheres permit strong adsorption of proteins, including antibodies, by hydrophobic interaction. The bright fluorescent dyes permit a variety of detection and assay methods including flow cytometry, fluorometry, and epifluorescence microscopy. Applications for protein coated microspheres include cell surface receptor marking, phagocytic cell studies, non-radioactive in vivo tracing, drug targeting, and immunodiagnostic research.

Antibody labeled Bioclean spheres have more fluorescence intensity and are easier to detect and observe than antibody conjugated dyes, especially by epifluorescence microscopy.

Bioclean microspheres can be suspended in aqueous buffers without affecting the dye; however, excessive pH levels or ionic concentrations can promote clumping of the particles. The monodisperse spheres are made of polystyrene and can be used for any application requiring polystyrene latex particles. Polystyrene has a density of 1.05g/ml; the index of refraction is 1.59 @ 590nm and 25°C. Unlike conventional latex, neither the bead surfaces nor the suspension media require cleanup procedures for most applications.

The color guide below will help you select the right fluorescence parameters for your experiments. Dye compositions and production methods are proprietary information.

Bioclean Fluorescent Microspheres reflect Duke Scientific's experience in particle technology applied to biological research problems. Our product lines include particle size standards, non-fluorescent latex particles and a wide variety of research particles.

SPECTRAL PROPERTIES OF BIOCLEAN™ MICROSPHERES IN DEIONIZED WATER

Specified Color	Excitation Maxima (nm)	Emission Maxima (nm)	Stokes Shift (nm)
Green	469 (blue)	509 (green)	40
Red	541 (green)	611 (red)	70
Blue	365 (UV) 388 (UV-violet) 412 (violet)	446 (blue) 446 (blue) 473 (blue)	81 58 61

Authorized Distributor:

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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

Bulletin 94E
January 1, 1994

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BIOCLEAN™ FLUORESCENT MICROSPHERES

Bioclean fluorescent microspheres were developed by Duke Scientific Corporation for biotechnology applications. Available in a range of sizes from 0.05 to 2.0μm and in green, red, and blue fluorescent colors, the new microspheres are prepared without surfactants or preservatives and are packaged in highly filtered, deionized water. *—continued*

Catalog Number		Nominal	Measured Values		Solids	Particle Surface Area	Typical Antib. Adsorption
7ml	50ml	Diameter	Mean Diam.	Uniformity	Content	Per ml	(Bovine IgG)
			Bioclean Microspheres—Green Fluorescent				
AG50	AG50B	0.05μm	0.057μm	<10%CV	1%	9987cm^2	0.18μg/cm^2
AG100	AG100B	0.1μm	0.096μm	<10%CV	1%	5527cm^2	0.23μg/cm^2
AG125	AG125B	0.125μm	0.128μm	<10%CV	1%	4447cm^2	0.26μg/cm^2
AG150	AG150B	0.15μm	0.145μm	<10%CV	1%	3926cm^2	0.26μg/cm^2
AG200	AG200B	0.2μm	0.202μm	<5%CV	1%	2818cm^2	0.15μg/cm^2
AG300	AG300B	0.3μm	0.294μm	<3%CV	1%	1936cm^2	0.24μg/cm^2
AG500	AG500B	0.5μm	0.501μm	<3%CV	1%	1136cm^2	0.27μg/cm^2
AG580	AG580B	0.58μm	0.577μm	<3%CV	1%	987cm^2	0.27μg/cm^2
AG600	AG600B	0.6μm	0.601μm	<3%CV	1%	947cm^2	0.31μg/cm^2
AG780	AG780B	0.8μm	0.778μm	<3%CV	1%	732cm^2	0.20μg/cm^2
AG0100	AG0100B	1.0μm	1.01μm	<5%CV	1%	564cm^2	0.20μg/cm^2
AG0210	AG0210B	2.0μm	2.12μm	<5%CV	1%	269cm^2	0.24μg/cm^2
AG0220	AG0220B	2.0μm	2.21μm	<5%CV	1%	258cm^2	0.21μg/cm^2
			Bioclean Microspheres—Red Fluorescent				
AR50	AR50B	0.05μm	0.053μm	<10%CV	1%	10741cm^2	0.15μg/cm^2
AR100	AR100B	0.1μm	0.105μm	<10%CV	1%	5422cm^2	0.24μg/cm^2
AR200	AR200B	0.2μm	0.205μm	<5%CV	1%	2777cm^2	0.25μg/cm^2
AR300	AR300B	0.3μm	0.311μm	<3%CV	1%	1830cm^2	0.18μg/cm^2
AR530	AR530B	0.5μm	0.534μm	<3%CV	1%	1066cm^2	0.15μg/cm^2
AR600	AR600B	0.6μm	0.617μm	<3%CV	1%	923cm^2	0.33μg/cm^2
AR770	AR770B	0.8μm	0.775μm	<3%CV	1%	735cm^2	0.23μg/cm^2
AR0100	AR0100B	1.0μm	1.04μm	<5%CV	1%	550cm^2	0.19μg/cm^2
AR0200	AR0200B	2.0μm	1.95μm	<5%CV	1%	292cm^2	0.22μg/cm^2
			Bioclean Microspheres—Blue Fluorescent				
AB100	AB100B	0.1μm	0.095μm	<10%CV	1%	5992cm^2	0.22μg/cm^2
AB150	AB150B	0.15μm	0.153μm	<10%CV	1%	3721cm^2	0.22μg/cm^2
AB200	AB200B	0.2μm	0.201μm	<5%CV	1%	2832cm^2	0.23μg/cm^2
AB300	AB300B	0.3μm	0.308μm	<3%CV	1%	1848cm^2	0.25μg/cm^2
AB500	AB500B	0.5μm	0.520μm	<3%CV	1%	1095cm^2	0.27μg/cm^2
AB675	AB675B	0.67μm	0.673μm	<3%CV	1%	846cm^2	0.26μg/cm^2
AB830	AB830B	0.8μm	0.829μm	<3%CV	1%	687cm^2	0.18μg/cm^2
AB0100	AB0100B	1.0μm	1.0μm	<5%CV	1%	569cm^2	0.22μg/cm^2
AB0180	AB0180B	1.8μm	1.84μm	<5%CV	1%	309cm^2	0.25μg/cm^2

Prices:

Package Size	Nominal Diameter (μm) 0.05-0.49	0.5-0.99	1.0-2.99
7ml	$ 95.00	$115.00	$132.00
50ml	$445.00	$535.00	$615.00

Duke Scientific Corporation

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June 1, 1994

2463 Faber Place, P.O. Box 50005, Palo Alto, California 94303
Toll Free (800) 334-3883 or (415) 424-1177, Fax (415) 424-1158

RESEARCH MICROSPHERES AND PARTICLES

Microspheres and particles of known size and composition are widely used as experimental models and size controls by scientific and industrial laboratories. They are available from Duke Scientific Corporation in a range of sizes from 0.028 to 750 micrometers (μm), and a variety of materials including polystyrene and glass.

These products can be used as particle-size controls for checking repeatability of measurement systems. They can also be used as tracers in fluid-mechanics investigations, test particles for evaluating filter media, and wave-scattering models for acoustical or optical radiation studies.

If you need NIST-traceable calibration particles please refer to Bulletin 92, our list of Certified Particle Size Standards. See other Duke Scientific literature for fluorescent microspheres or biomedical latex for covalent coupling of antibodies.

A. Uniform Latex Microspheres

Our line of low-priced latex particle suspensions can be used for a variety of procedures requiring highly uniform polymer spheres in the colloidal size range. Particles of this size are of special interest for light-scattering studies, microporous filter checking, and aerosol particle generation.

The polystyrene microparticles have a specific gravity of 1.05 g/ml and a refractive index of 1.59 @ 589nm (25°C). Particles were sized by optical or electron microscopy and photon correlation spectroscopy. The latex microspheres are packaged as aqueous suspensions at 10% solids. Liter and gallon quantities are available.

Catalog Numbers		Mean Diam.		Size Uniformity
15ml	100ml	(μm)	Description	Std. Dev. & C.V.
5003A	5003B	0.028	Polystyrene Latex Particles	0.0031μm (11%)
5006A	5006B	0.064	Polystyrene Latex Particles	0.0096μm (15%)
5008A	5008B	0.087	Polystyrene Latex Particles	0.0035μm (4%)
5009A	5009B	0.091	Polystyrene Latex Particles	0.0058μm (6.4%)
5010A	5010B	0.107	Polystyrene Latex Particles	0.0060μm (5.6%)
5011A	5011B	0.110	Polystyrene Latex Particles	0.0047μm (4.3%)
5012A	5012B	0.121	Polystyrene Latex Particles	0.0050μm (4.1%)
5014A	5014B	0.135	Polystyrene Latex Particles	0.0057μm (4.2%)
5016A	5016B	0.162	Polystyrene Latex Particles	0.0044μm (2.8%)
5017A	5017B	0.173	Polystyrene Latex Particles	0.0054μm (3.1%)
5020A	5020B	0.197	Polystyrene Latex Particles	0.0035μm (1.8%)
5022A	5022B	0.222	Polystyrene Latex Particles	0.0038μm (1.7%)
5024A	5024B	0.241	Polystyrene Latex Particles	0.0039μm (1.6%)
5026A	5026B	0.261	Polystyrene Latex Particles	0.0031μm (1.2%)
5030A	5030B	0.304	Polystyrene Latex Particles	0.0067μm (2.2%)
5031A	5031B	0.305	Polystyrene Latex Particles	0.0067μm (2.2%)
5033A	5033B	0.320	Polystyrene Latex Particles	0.0040μm (1.3%)
5036A	5036B	0.360	Polystyrene Latex Particles	0.0054μm (1.5%)
5043A	5043B	0.426	Polystyrene Latex Particles	0.0087μm (2.0%)
5045A	5045B	0.451	Polystyrene Latex Particles	0.0113μm (2.5%)
5048A	5048B	0.482	Polystyrene Latex Particles	0.0049μm (1.0%)
5049A	5049B	0.494	Polystyrene Latex Particles	0.0093μm (1.9%)
5050A	5050B	0.497	Polystyrene Latex Particles	0.0094μm (1.9%)

Prices: (0.03 to 0.49μm): $110.00/15ml, 515.00/100ml

—Continued

A. Uniform Latex Microspheres—Continued

Catalog Numbers 15ml	Catalog Numbers 100ml	Mean Diam. (μm)	Description	Size Uniformity Std. Dev. & C.V.
5051A	5051B	0.519	Polystyrene Latex Particles	0.0050μm (1.0%)
5052A	5052B	0.523	Polystyrene Latex Particles	0.0110μm (2.1%)
5060A	5060B	0.596	Polystyrene Latex Particles	0.0077μm (1.3%)
5065A	5065B	0.652	Polystyrene Latex Particles	0.0048μm (0.7%)
5067A	5067B	0.672	Polystyrene Latex Particles	0.0128μm (1.9%)
5072A	5072B	0.720	Polystyrene Latex Particles	0.0053μm (0.7%)
5081A	5081B	0.806	Polystyrene Latex Particles	0.0113μm (1.4%)
5085A	5085B	0.845	Polystyrene Latex Particles	0.0085μm (1.0%)
5088A	5088B	0.878	Polystyrene Latex Particles	0.0123μm (1.4%)
5090A	5090B	0.913	Polystyrene Latex Particles	0.0059μm (0.6%)
5095A	5095B	0.966	Polystyrene Latex Particles	0.0126μm (1.3%)
Prices: (0.50 to 0.99μm): $125.00/15ml, 585.00/100ml				
5100A	5100B	1.07	Polystyrene Latex Particles	0.014μm (1.3%)
5110A	5110B	1.11	Polystyrene Latex Particles	0.011μm (1.0%)
5126A	5126B	1.24	Polystyrene Latex Particles	0.013μm (1.0%)
5153A	5153B	1.53	Polystyrene Latex Particles	0.018μm (1.2%)
5200A	5200B	2.04	Polystyrene Latex Particles	0.044μm (2.2%)
5300A	5300B	2.92	Polystyrene Latex Particles	0.081μm (2.8%)
5312A	5312B	3.12	Polystyrene Latex Particles	0.156μm (5.0%)
5370A	5370B	3.7	Polystyrene Latex Particles	0.167μm (4.5%)
Prices: (1.0 to 4.0μm): $140.00/15ml, 650.00/100ml				

B. Large Polymer Microspheres

Suspensions of large polymer microspheres are useful as model systems for fluid-mechanics experiments, as microcarriers for cell-culture and other biology experiments, and as challenge particles for large pore-size filtration systems. They are also useful as particle-size controls for acoustical and optical analytical systems. Their chemical composition is polystyrene polymer, cross-linked with 4 to 8% divinylbenzene (DVB). The beads are chemically inert; they can be washed with alcohol, vacuum or air dried, and autoclaved. The polymer density is 1.05 g/ml and the index of refraction is 1.59 @ 540nm (25°C). They are packaged as aqueous suspensions at 10% solids. Larger packages are available.

Catalog Numbers 15ml	Catalog Numbers 100ml	Mean Diam. (μm)	Description	Size Uniformity Std. Dev. & C.V.
7503A	7503B	3.2	Polystyrene DVB Spheres	1.4μm (43%)
7504A	7504B	3.4	Polystyrene DVB Spheres	0.8μm (23%)
7505A	7505B	5.3	Polystyrene DVB Spheres	1.2μm (22.7%)
7508A	7508B	8.7	Polystyrene DVB Spheres	1.5μm (17.2%)
7510A	7510B	10.2	Polystyrene DVB Spheres	1.5μm (14.7%)
7516A	7516B	15.9	Polystyrene DVB Spheres	2.3μm (14.5%)
7520A	7520B	21.7	Polystyrene DVB Spheres	3.2μm (14.7%)
7525A	7525B	23.8	Polystyrene DVB Spheres	3.0μm (12.6%)
7545A	7545B	44.2	Polystyrene DVB Spheres	7.0μm (15.8%)
7550A	7550B	51.1	Polystyrene DVB Spheres	7.0μm (13.7%)
7575A	7575B	74.5	Polystyrene DVB Spheres	8.5μm (11.4%)
7590A	7590B	88.2	Polystyrene DVB Spheres	10.2μm (11.6%)
7602A	7602B	99.0	Polystyrene DVB Spheres	13μm (13.1%)
7640A	7640B	144	Polystyrene DVB Spheres	13.5μm (9.4%)
7725A	7725B	220	Polystyrene DVB Spheres	16.5μm (7.5%)
Prices: $115.00/15ml, 600.00/100ml				

C. Spherical Polymer Materials

These spherical polymers have the same physical and chemical properties as the large polymer microspheres (Section B), except the spheres are more economical and have a wider size distribution. They are useful for preparation of special size ranges (using sieves), or as experimental materials for chemical engineering studies. They are packaged as dry spheres.

Description	Size Range (μm)	Catalog Numbers and Prices			
Polystyrene DVB Spheres	1-15	444	$90.00/20g	444B	$330.00/100g
Polystyrene DVB Spheres	1-35	445	90.00/20g	445B	330.00/100g
Polystyrene DVB Spheres	2-120	431	90.00/25g	431B	330.00/125g
Polystyrene DVB Spheres	100-500	434	90.00/100g	434B	330.00/500g
Polystyrene DVB Spheres	250-750	433	90.00/100g	433B	330.00/500g

D. Spherical Glass Materials

Spherical glass beads are useful as models for analytical, sedimentation, and separation applications. Other uses for glass beads are as spacers, insulators and reflectors. Their specific gravity is 2.45 g/ml, refractive index is 1.51 @ 589nm, softening temperature is 720°C, and dielectric constant is 7.3 @ 1KHz and 20°C. They are packaged as dry spheres.

Description	Size Range (μm)	Catalog Numbers and Prices			
Glass Beads	1-40	414*	$90.00/2g	414B*	$330.00/10g
Glass Beads	5-60	424	90.00/100g	424B	330.00/500g
Glass Beads	10-95	425	90.00/100g	425B	330.00/500g
Glass Beads	40-60	426	90.00/10g	426B	330.00/50g
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Johnson Grass Smut Spores	5.8-9.0	420	63.00/1g	420B	215.00.00/5g
Paper Mulberry Pollen	10.4-14.4	213	63.00/1g	213B	215.00/5g
Ragweed Pollen	18.0-23.6	214	63.00/1g	214B	215.00/5g
Bermuda Grass Pollen	24.8-34.6	395	63.00/1g	395B	215.00/5g
Lycopodium Spores	25-35	215	63.00/10ml	215B	215.00/50ml
Black Walnut Pollen	28.6-40.6	396	63.00/1g	396B	215.00/5g
Pecan Pollen	41.7-54.9	217	63.00/1g	217B	215.00/5g
Corn Pollen	69-87	397	63.00/2g	397B	215.00/10g

Duke Scientific Corporation

2463 Faber Place, P.O. Box 50005, Palo Alto, California 94303
Toll Free (800) 334-3883 or (415) 424-1177, Fax (415) 424-1158

F. Metal and Mineral Particles and Spheres

This series of particles and spheres meets the need for an assortment of materials for chemical, metallurgical and engineering studies. The stainless steel and nickel spheres are paramagnetic.

Description	Size Range (μm)	Specific Gravity (g/ml)	Catalog Numbers and Prices	
AC Fine Test Dust	1–80	2.6	415	$85.00/50g
AC Coarse Test Dust	1–200	2.6	416	85.00/50g
Aluminum Oxide Particles	1.2–4.6	3.9	347	85.00/5g
Aluminum Oxide Particles	0.3–10	3.9	421	85.00/5g
Aluminum Oxide Particles	0.5–20	3.9	423	85.00/5g
Aluminum Silicate Particles	0.2–6.0	2.6	235	85.00/20g
Antimony Oxide Particles	0.2–3.0	5.7	418	85.00/20g
Calcium Carbonate Particles	0.1–8.0	2.7	437	85.00/20g
Cerium Oxide Particles	0.5–6.0	3.4	348	85.00/20g
Nickel Spheres	4–24	8.9	136	85.00/20g
Nickel Particles	40–80	8.9	358	85.00/5g
Nickel Particles	60–90	8.9	359	85.00/10g
Silicon Carbide Particles	0.7–7.0	3.2	349	85.00/20g
Stainless Steel Spheres, Type 316	10–65	8.0	435	85.00/25g
Stainless Steel Spheres, Type 316	60–125	8.0	436	85.00/100g
Stainless Steel Spheres, Type 316	64–76	8.0	451	85.00/2g
Walnut Shell Particles	3–30	1.35	356	85.00/25g

G. Powders with Measured Surface Areas

These powders with measured surface areas are useful as controls for checking the reproducibility of specific surface area measurements using the nitrogen or krypton adsorption methods.

Description	Surface Area (m^2 per gram) Nominal	N_2 Adsorption	Kr Adsorption	Catalog Numbers and Prices	
Zinc Oxide Particles	0.6	0.62 ± 0.04	0.63 ± 0.03	208	$95.00/5g
Zinc Oxide Particles	1.2	1.22 ± 0.10	1.37 ± 0.11	385	95.00/5g
Alumina Particles	1.4	1.39 ± 0.12	1.24 ± 0.11	355	95.00/5g
Alumina Particles	3.0	4.94 ± 0.25	4.68 ± 0.25	386	95.00/5g
Titanium Dioxide Particles	7.0	7.05 ± 0.7		204	95.00/5g
Alumina Particles	14	14.0 ± 0.6		387	95.00/5g
Silica Particles	24	24.3 ± 1.1		209	95.00/2g
Alumina Particles	81	82.5 ± 6.2		388	95.00/5g
Carbon Black Particles	110	110 ± 7		344	95.00/2g
Alumina Particles	265	265 ± 11		398	95.00/5g
Silica-alumina Particles	467	467 ± 21		389	95.00/5g

ORDERING INFORMATION: Order directly from Duke Scientific Corporation. Prices are f.o.b. Palo Alto. We routinely ship via 2nd Day UPS, freight prepaid and added to invoice. We can also ship via Federal Express with all charges collect; please provide your account number. We reserve the right to revise specifications or prices without notice.

LIMITED WARRANTY: These products are intended for research use by trained scientific personnel. Their suitability for use as diagnostic reagents, particle-size standards, or other specific uses must be determined and validated by the customer. Our warranty is limited to replacement of defective merchandise if returned with our [illegible] within 60 days of purchase date.

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June 11, 1997

Jeremy Grata
Biocontrol Technology
300 Indian Springs Road
Indiana, PA 15701

Dear Mr. Grata:

Thank you for your interest in our particle size standards and reference materials. We offer a large assortment of sizes and materials for calibration, research and quality control applications.

Our product offering includes:

* ***Certified Particle Size Standards*** Includes Nanosphere™ Size Standards, calibrated in billionths of a meter (nanometers) from 20 to 900nm, and a complete selection of glass and polymer microspheres from 1 to 2000µm in diameter. All are certified for mean diameter with calibration methods traceable to the National Institute of Standards and Technology (formerly NBS).

* ***Fluorescent Microspheres*** Distinctive colors provide extra sensitivity and detectability for use in flow tracing, microcirculation studies, membrane filter testing, fluorescence microscopy and flow cytometry research.

* ***Research Microspheres and Particles*** Includes uniform latex particles and a selection of other spherical particles for research and testing applications. Useful for light scattering studies, filter checking, fluid mechanics, aerosol generation and latex agglutination research.

* ***Exotic Particles and Powders*** Includes pollens, spores, metals, minerals and powders with measured surface areas.

Our standards and particles are used by more than 3000 industrial and scientific laboratories throughout the world. Established in 1971, Duke Scientific has the experience to assist you with your applications and problems.

Please call us and let us know how we may be of service.

Sincerely,

E. Chae

Elizabeth Chae
Technical Services

The chemically clean surfaces of the microspheres permit strong adsorption of proteins, including antibodies, by hydrophobic interaction. The bright fluorescent dyes permit a variety of detection and assay methods including flow cytometry, fluorometry, and epifluorescence microscopy. Applications for protein coated microspheres include cell surface receptor marking, phagocytic cell studies, non-radioactive in vivo tracing, drug targeting, and immunodiagnostic research.

Antibody labeled Bioclean spheres have more fluorescence intensity and are easier to detect and observe than antibody conjugated dyes, especially by epifluorescence microscopy.

Bioclean microspheres can be suspended in aqueous buffers without affecting the dye; however, excessive pH levels or ionic concentrations can promote clumping of the particles. The monodisperse spheres are made of polystyrene and can be used for any application requiring polystyrene latex particles. Polystyrene has a density of 1.05g/ml; the index of refraction is 1.59 @ 590nm and 25°C. Unlike conventional latex, neither the bead surfaces nor the suspension media require cleanup procedures for most applications.

The color guide below will help you select the right fluorescence parameters for your experiments. Dye compositions and production methods are proprietary information.

Bioclean Fluorescent Microspheres reflect Duke Scientific's experience in particle technology applied to biological research problems. Our product lines include particle size standards, non-fluorescent latex particles and a wide variety of research particles.

SPECTRAL PROPERTIES OF BIOCLEAN™ MICROSPHERES IN DEIONIZED WATER

Specified Color	Excitation Maxima (nm)	Emission Maxima (nm)	Stokes Shift (nm)
Green	469 (blue)	509 (green)	40
Red	541 (green)	611 (red)	70
Blue	365 (UV) 388 (UV-violet) 412 (violet)	446 (blue) 446 (blue) 473 (blue)	81 58 61

Authorized Distributor:

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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.