

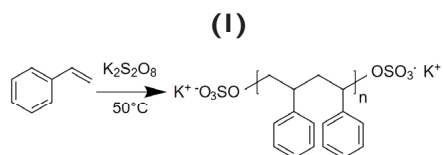
## Product Information

### SPHERO™ Polystyrene Particles

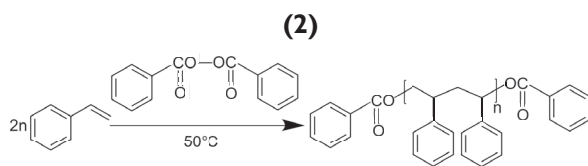
- Uniform Shape and Size
- Multi-liter Capabilities
- Available from 0.05 to 500µm.

The SPHERO™ polystyrene particles are prepared by conventional emulsion polymerization with styrene as the monomer and potassium persulfate or benzoyl peroxide as polymerization initiator. In general, microparticles less than 0.5µm are prepared in one step. Larger particles are prepared by step wise growing of smaller particles with the addition of styrene monomer and initiator without any additional detergent. The microparticles are cleaned by repeated centrifugation. Cleaned microparticles are resuspended in deionized water. Sodium azide (0.02%) is added as a bacteriostatic. As a result, the SPHERO™ microparticles can be coated with proteins without further cleaning.

Microparticles made using potassium persulfate as the initiator have sulfate groups on their surface. As a result, these particles are negatively charged and are hydrophilic, as shown in equation (1).

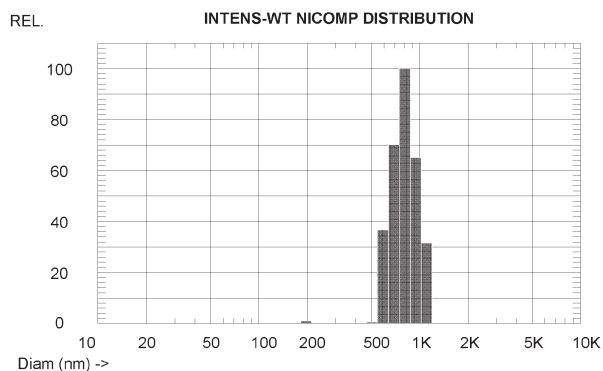


The SPHERO™ polystyrene particles greater than 3µm are usually prepared using benzoyl peroxide as the initiator. These particles are relatively more hydrophobic, as shown in equation (2).



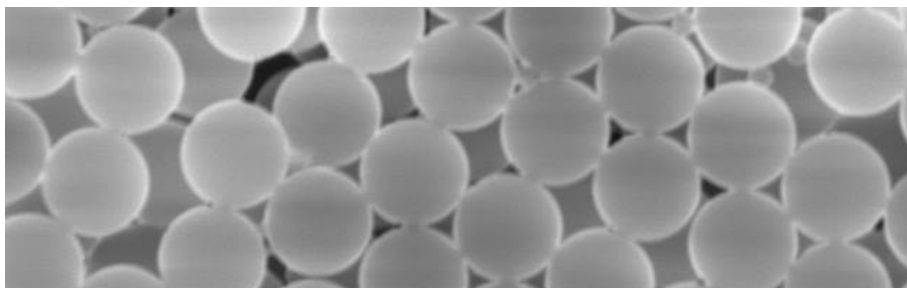
SPHERO™ polystyrene particles are composed of linear polystyrene without any cross-linking agent. These particles cannot tolerate organic solvents such as toluene, xylene, chloroform, methylene chloride, acetonitrile, dimethyl formamide or acetone. However, SPHERO™ polystyrene particles are stable in the presence of some water miscible solvents such as dimethyl sulfoxide and alcohols. Uniform size cross-linked polystyrene particles that are stable in the presence of organic solvents are also available.

Uniform SPHERO™ polystyrene particles are ideal for use in immunoassays such as latex agglutination, particle based enzyme immunoassays and fluorescence immunoassays. A tight size range of SPHERO™ polystyrene particles is maintained by monitoring size using a NICOMP Laser Particle Sizer (for particles less than 3µm) and a Scanning Electron Microscope and/or Beckman Coulter Multisizer™ 3 for larger particles. Although the size measurements are accurate, these particles are not certified for use as a calibration standard for size measurements or pore size analysis.



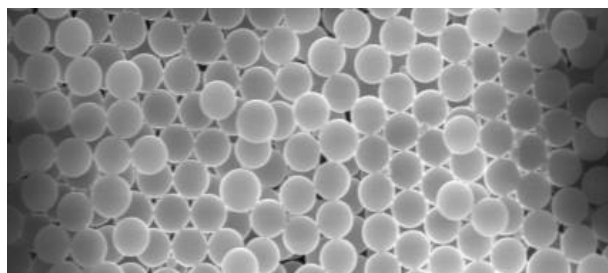
*Histogram of SPHERO™ 0.8 µm Polystyrene Particles from the NICOMP Laser Particle Sizer.*

These polystyrene beads are used during the production of our other product lines including fluorescent, functionalized, crosslinked, magnetic, and protein coated particles. In addition, Spherotech polystyrene beads are used to manufacture a wide range of flow cytometry beads for applications, such as calibration, alignment, sensitivity measurements, compensation, and various kits for assay development.



**SPHERO™ Polystyrene Particles**

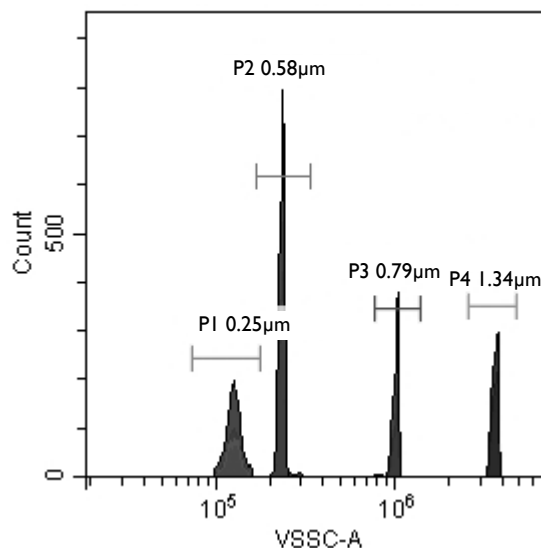
Particle Type and Surface	Size, $\mu\text{m}$	% w/v	Catalog No.	Unit
Polystyrene	0.05-0.1	5.0	PP-008-10	10 mL
Polystyrene	0.05-0.1	5.0	PP-008-100	100 mL
Polystyrene	0.05-0.1	10.0	PP10-008-10	10 mL
Polystyrene	0.1-0.2	5.0	PP-015-10	10 mL
Polystyrene	0.1-0.2	10.0	PP10-015-10	10 mL
Polystyrene	0.2-0.3	5.0	PP-025-10	10 mL
Polystyrene	0.2-0.3	5.0	PP-025-100	100 mL
Polystyrene	0.2-0.3	10.0	PP10-025-10	10 mL
Polystyrene	0.4-0.6	5.0	PP-05-10	10 mL
Polystyrene	0.4-0.6	5.0	PP-05-100	100 mL
Polystyrene	0.4-0.6	10.0	PP10-05-10	10 mL
Polystyrene	0.7-0.9	5.0	PP-08-10	10 mL
Polystyrene	0.7-0.9	5.0	PP-08-100	100 mL
Polystyrene	0.7-0.9	10.0	PP10-08-10	10 mL
Polystyrene	1.0-1.4	5.0	PP-10-10	10 mL
Polystyrene	1.0-1.4	5.0	PP-10-100	100 mL
Polystyrene	1.0-1.4	10.0	PP10-10-10	10 mL
Polystyrene	1.5-1.9	5.0	PP-15-10	10 mL
Polystyrene	1.5-1.9	5.0	PP-15-100	100 mL
Polystyrene	1.5-1.9	10.0	PP10-15-10	10 mL
Polystyrene	2.0-2.4	5.0	PP-20-10	10 mL
Polystyrene	2.0-2.4	5.0	PP-20-100	100 mL
Polystyrene	2.0-2.4	10.0	PP10-20-10	10 mL
Polystyrene	2.5-2.9	5.0	PP-25-10	10 mL
Polystyrene	2.5-2.9	5.0	PP-25-100	100 mL
Polystyrene	3.0-3.4	5.0	PP-30-10	10 mL
Polystyrene	3.0-3.4	5.0	PP-30-100	100 mL
Polystyrene	3.5-3.9	5.0	PP-35-10	10 mL
Polystyrene	3.5-3.9	5.0	PP-35-100	100 mL
Polystyrene	4.0-4.4	5.0	PP-40-10	10 mL
Polystyrene	4.0-4.4	5.0	PP-40-100	100 mL
Polystyrene	4.5-4.9	5.0	PP-45-10	10 mL
Polystyrene	4.5-4.9	5.0	PP-45-100	100 mL
Polystyrene	5.0-5.9	5.0	PP-50-10	10 mL
Polystyrene	5.0-5.9	5.0	PP-50-100	100 mL
Polystyrene	5.0-5.9	10.0	PP10-50-10	10 mL
Polystyrene	6.0-8.0	5.0	PP-60-10	10 mL
Polystyrene	6.0-8.0	5.0	PP-60-100	100 mL
Polystyrene	8.0-12.9	2.5	PP-100-10	10 mL



**SPHERO™ Nano Polystyrene Particle Size Standard Kit**

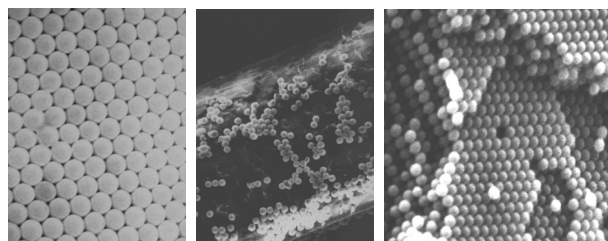
- Consists of ready to use blank beads with 4 different diameters from  $\sim 200\text{nm}$  to  $\sim 1.5\mu\text{m}$
- Designed to estimate the size of microparticles, aquatic bacteria, and platelets with analytical sizing instrumentation
- Provides a cost effective submicron size standardization substitute when NIST beads are not necessary.

Particle Type and Surface	Catalog No.	Unit
Nano Polystyrene Size Standard Kit, Analytical Grade, $10^7/\text{mL}$ , 0.1-0.3 $\mu\text{m}$ , 0.4-0.6 $\mu\text{m}$ , 0.7-0.9 $\mu\text{m}$ , & 1.0-1.9 $\mu\text{m}$ .	NPPS-4K	4x5 mL



NPPS-4K on a CytoFLEX LX

(A) (B) (C)



Scanning Electron Microscope (SEM) photos of polystyrene particles are shown below to illustrate the uniformity of their size. (a) Single sheet of  $0.8\mu\text{m}$  polystyrene particles. (b)  $3.4\mu\text{m}$  polystyrene particles on the surface of a human hair. (c) Face-centered-cubic packing of  $0.86\mu\text{m}$  particles. Theoretically, particles fill  $\sim 74\%$  of the space regardless of their size.

## SPHERO™ Crosslinked Polystyrene Particle

### Non-Uniform Crosslinked Particles

- Cost effective alternative if uniform shape is not required
- Uniform size distributions
- Stable in organic solvent.

Spherotech offers a wide range of crosslinked polystyrene particles. Both non-uniform and uniform shaped crosslinked polystyrene particles are manufactured at Spherotech. The low cost non-uniform particles are useful when particle shape does not matter. These non-uniform crosslinked polystyrene particles are stable in the presence of organic solvents. The figure below shows the differences between the polymeric particles consisting of polystyrene and particles made from copolymers, styrene/divinylbenzene.

### SPHERO™ Non-Uniform Crosslinked Polystyrene Particles

Particle Type and Surface	Size, $\mu\text{m}$	% w/v	Catalog No.	Unit
Polystyrene, Crosslinked, non-uniform shape	0.4-0.6	5.0	PPX-05-10	10 mL
Polystyrene, Crosslinked, non-uniform shape	0.7-0.9	5.0	PPX-08-10	10 mL
Polystyrene, Crosslinked, non-uniform shape	1.0-1.9	5.0	PPX-10-10	10 mL
Polystyrene, Crosslinked, non-uniform shape	2.0-2.4	5.0	PPX-20-10	10 mL
Polystyrene, Crosslinked, non-uniform shape	2.5-2.9	5.0	PPX-25-10	10 mL

### Uniform Crosslinked Particles

- Highly uniform and monodispersed
- Available from 3 to 30 micron

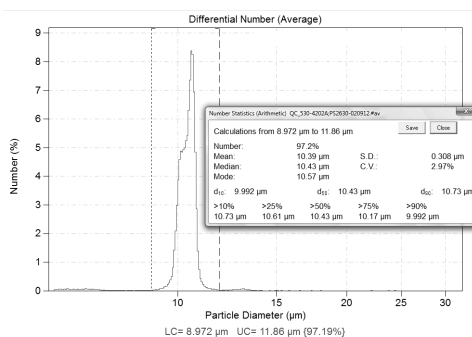
If highly spherical monosized polymer particles are needed, Spherotech also has crosslinked polystyrene particles that are uniform in size and shape. Beckman Coulter Multisizer™ 3 histograms for Cat. No. PPX-150-10 (Polystyrene Particles, Crosslinked, 2.5% w/v, 15.2 $\mu\text{m}$ , 10mL) and Cat. No. CPX-30-10 (Carboxyl Polystyrene Particles, Crosslinked, 5% w/v, 3.3 $\mu\text{m}$ , 10mL) can be seen on page 8.

### SPHERO™ Uniform Crosslinked Polystyrene Particles

Particle Type and Surface	Size, $\mu\text{m}$	% w/v	Catalog No.	Unit
Polystyrene, Crosslinked	5.0-5.9	5.0	PPX-50-10	10 mL
Polystyrene, Crosslinked	8.0-12.9	2.5	PPX-100-10	10 mL
Polystyrene, Crosslinked	13.0-17.9	2.5	PPX-150-10	10 mL
Polystyrene, Cross-linked	18.0-24.9	2.5	PPX-200-10	10 mL
Polystyrene, Cross-linked	25.0-37.0	2.5	PPX-250-10	10 mL

### SPHERO™ Crosslinked Polystyrene Particles, Dry Powder

Particle Type and Surface	Size, $\mu\text{m}$	Catalog No.	Unit
Polystyrene, Crosslinked, Powder	2.5-2.9	PPXR-25-1	1 g
Polystyrene, Crosslinked, Powder	6.0-8.0	PPXR-60-1	1 g
Porous Polystyrene, Crosslinked, Powder	8.0-12.9	PPXR-100-1	1 g
Polystyrene, Crosslinked, Powder	90.0-105.0	PPXR-1000-1	1 g



Histogram of PPX-100-10 from a Beckman Coulter Multisizer™ 3 Coulter Counter.

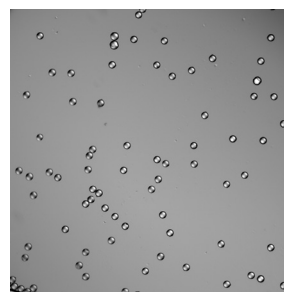
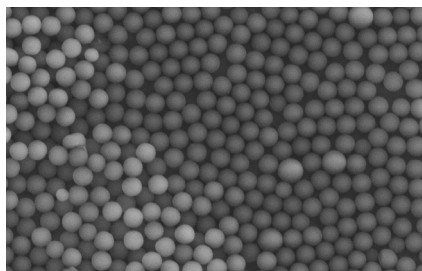
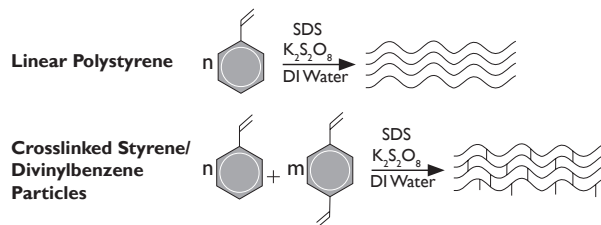


Image of PPX-250-10.



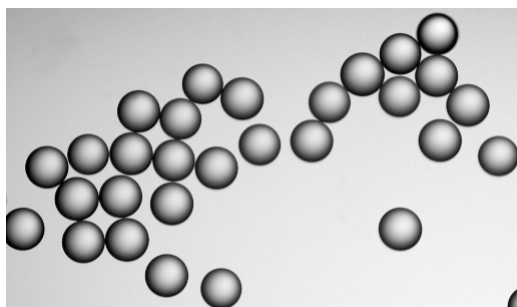
SEM photos of PPX-20-10.



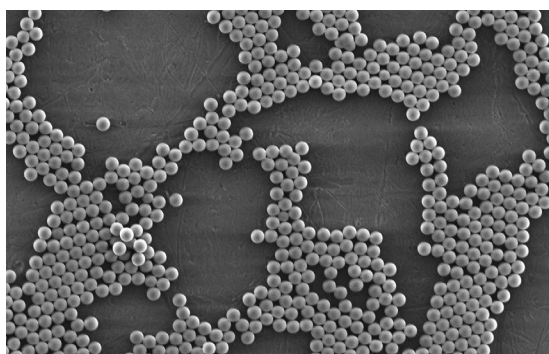
Comparison of linear polystyrene particles and crosslinked copolymers particles made of styrene/divinylbenzene.

**SPHERO™ Large Research Grade Crosslinked Polystyrene Particles**

Particle Type and Surface	Size, $\mu\text{m}$	% w/v	Catalog No.	Unit
Polystyrene, Crosslinked,	38.0-52.0	5.0	PPX-400-10	10 mL
Polystyrene, Crosslinked,	53.0-69.0	5.0	PPX-600-10	10 mL
Polystyrene, Crosslinked	70.0-89.0	5.0	PPX-800-10	10 mL
Polystyrene, Crosslinked	90.0-105.0	5.0	PPX-1000-10	10 mL
Polystyrene, Crosslinked	106.0-124.0	5.0	PPX-1200-10	10 mL
Polystyrene, Crosslinked	125.0-149.0	5.0	PPX-1400-10	10 mL
Polystyrene, Crosslinked	150.0-175.0	5.0	PPX-1600-10	10 mL
Polystyrene, Crosslinked	196.0-211.0	5.0	PPX-2000-10	10 mL
Polystyrene, Crosslinked	212.0-249.0	5.0	PPX-2200-10	10 mL
Polystyrene, Crosslinked	400.0-600.0	5.0	PPX-5000-10	10 mL



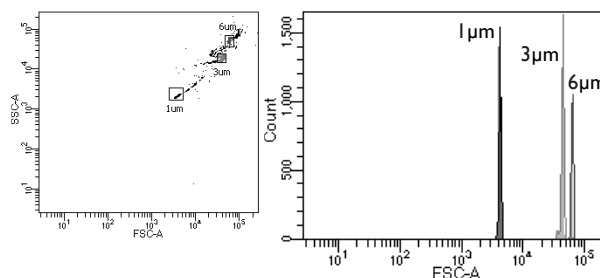
Differential interference contrast image of PPX-1000-10



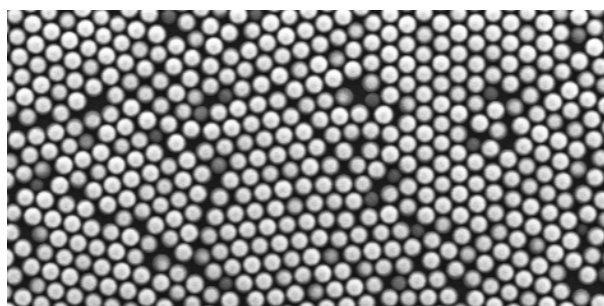
SEM photos of PPX-400-10.

**SPHERO™ Functionalized Crosslinked Polystyrene Particles**

Particle Type and Surface	Size, $\mu\text{m}$	% w/v	Catalog No.	Unit
Carboxyl polystyrene, Crosslinked	1.0-1.9	5.0	CPX-10-10	10 mL
Carboxyl polystyrene, Crosslinked	3.0-3.4	5.0	CPX-30-10	10 mL
Carboxyl polystyrene, Cross linked	5.0-5.9	2.5	CPX-50-10	10 mL
Carboxyl polystyrene, Cross-linked	6.0-6.9	2.5	CPX-60-10	10 mL
Carboxyl polystyrene, Crosslinked	8.0-12.9	2.5	CPX-100-10	10 mL
Carboxyl polystyrene, Crosslinked	8.0-12.9	2.5	CPX-100-100	100 mL
Carboxyl polystyrene, Crosslinked	13.0-17.9	2.5	CPX-150-10	10 mL
Carboxyl polystyrene, Crosslinked	18.0-24.9	2.5	CPX-200-10	10 mL
Carboxyl polystyrene, Crosslinked	40.0-45.0	1.0	CPX1-450-10	10 mL
Carboxyl polystyrene, Crosslinked	40.0-45.0	1.0	CPX1-450-100	100 mL
Carboxyl polystyrene, Crosslinked	125-149	1.0	CPX-1400-10	10 mL
Amino polystyrene, Crosslinked	2.0-2.9	1.0	APX-20-10	10 mL
Amino polystyrene, Crosslinked	3.0-3.4	2.5	APX-30-10	10 mL
Amino polystyrene, Crosslinked	6.0-6.9	2.5	APX-60-10	10 mL
Amino polystyrene, Crosslinked	8.0-12.9	2.5	APX-100-10	10 mL



Histogram of Cat. No. CPX-10-10, CPX-30-10 & CPX-60-10



SEM photos of APX-100-10.