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PRODUCT

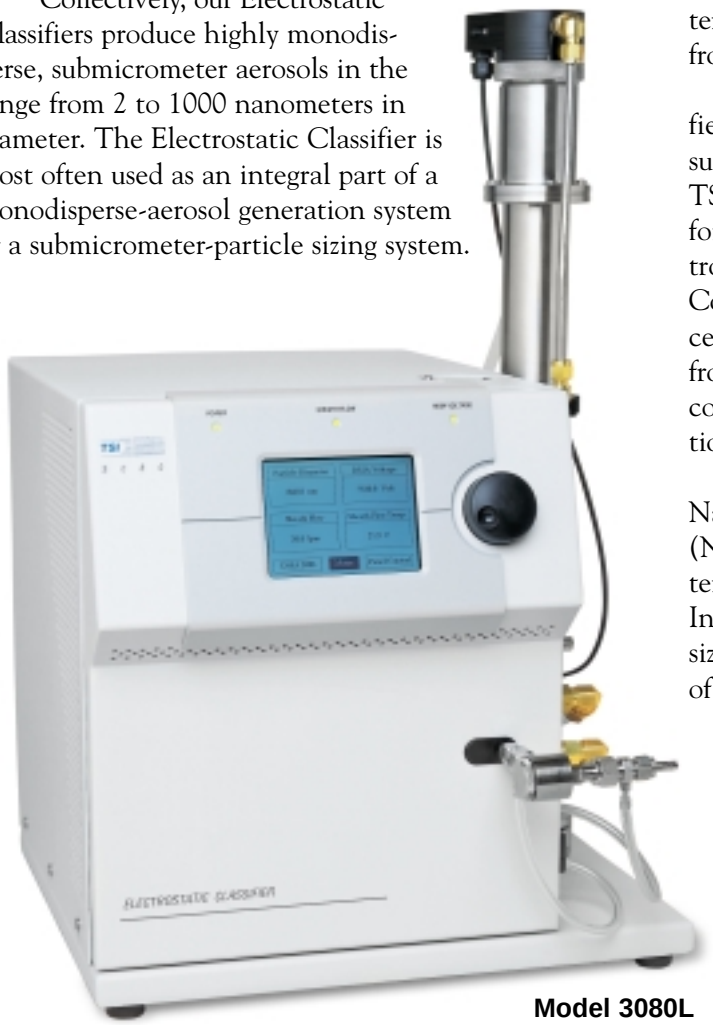
INFORMATION

Model 3080-Series Electrostatic Classifiers

Since 1976, TSI Electrostatic Classifiers have been helping aerosol scientists generate and size submicrometer particles. These instruments have been used in a broad variety of aerosol research and have earned a well-deserved reputation for being highly reliable and extremely versatile.

Our latest Electrostatic Classifiers – the Model 3080-series – continue that tradition, but with an expanded definition of versatility. Designed as a replacement for Models 3071 and 3071A, the current design gives you a choice of differential mobility analyzers (DMAs). The same controller platform works with both DMAs, greatly expanding your research possibilities!

Collectively, our Electrostatic Classifiers produce highly monodisperse, submicrometer aerosols in the range from 2 to 1000 nanometers in diameter. The Electrostatic Classifier is most often used as an integral part of a monodisperse-aerosol generation system or a submicrometer-particle sizing system.



Model 3080L

Choose the right DMA for your application, or switch DMAs as your measurement needs change!

In an aerosol generation system, the Electrostatic Classifier selects airborne particles of uniform size from a polydisperse source, resulting in a highly monodisperse aerosol. With TSI's *Long DMA*, you're able to classify particles in the range from 10 to 1000 nanometers in diameter. The *Nano DMA* offers classification from 2 to 150 nanometers.

In a particle sizing system, the Electrostatic Classifier separates particles by size for high-resolution measurements of particle size distribution. When used in TSI Scanning Mobility Particle Sizer (SMPS) systems, for example, monodisperse aerosol exiting the Electrostatic Classifier passes to a Condensation Particle Counter (CPC), which measures particle number concentration. By scanning quickly through the size range from 3 to 1000 nanometers (size range varies by SMPS configuration), the SMPS measures the size distribution of the aerosol precisely.

The United States Department of Commerce, National Institute of Standards and Technology (NIST) uses a TSI Long DMA for sizing 0.1-micrometer standard reference materials (Kinney *et al.* 1991). In fact, no other technique provides concentration and size-resolution measurements with such a high degree of accuracy.

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REVOLUTIONARY DESIGN

The 3080-series Electrostatic Classifiers offer a modern design consisting of two basic components: a controller platform and a differential mobility analyzer (DMA). The platform (Model 3080) contains a power supply, blowers, Aerosol Neutralizer, LCD display, and all instrument controls. The DMA, however, is the heart of the Electrostatic Classifier. It selects particles of a specific size out of the aerosol sample. You have a choice of two DMAs with the 3080-series:

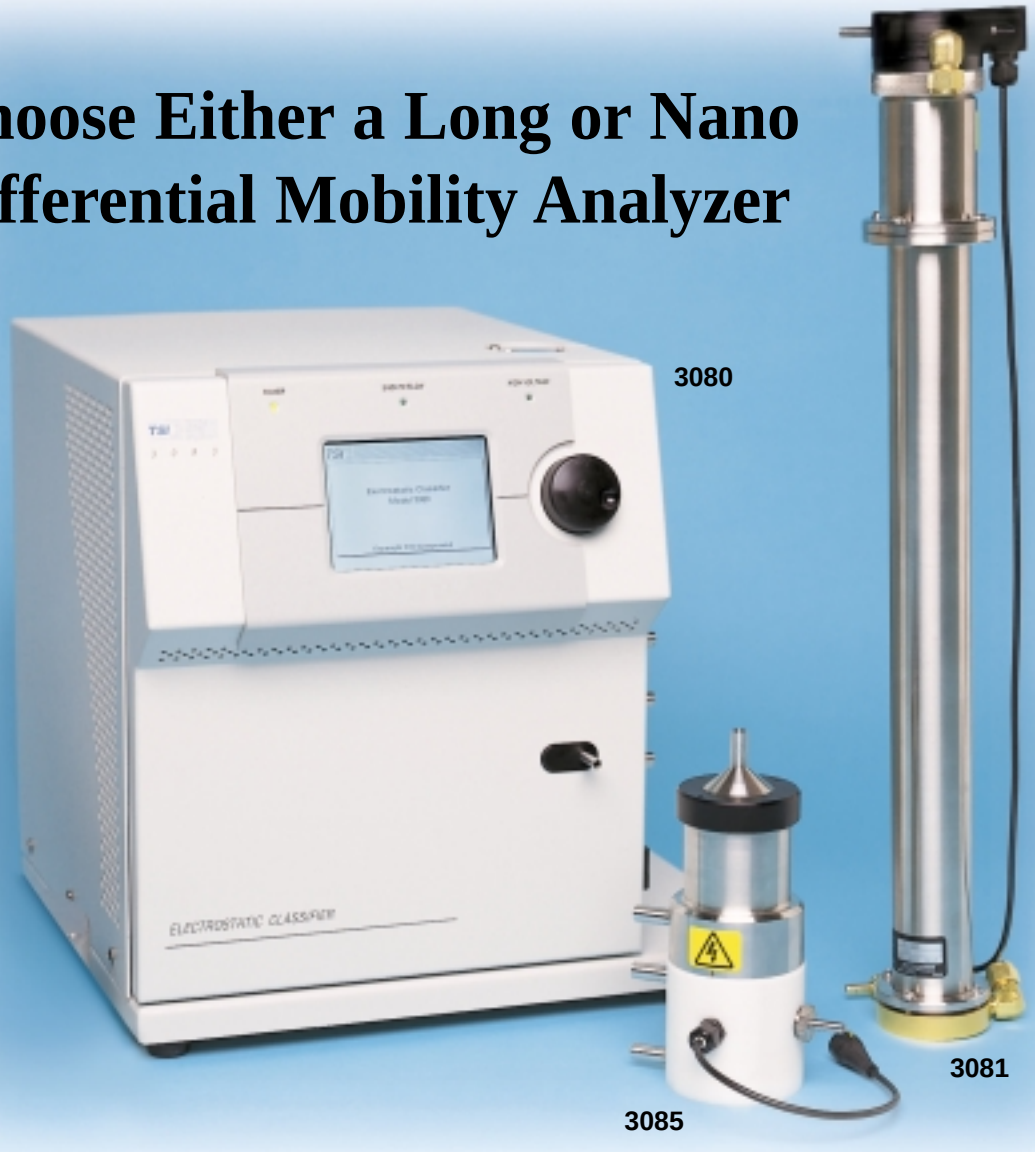
- Long DMA (Model 3081) for the broadest particle size range, from 10 to 1000 nanometers
- Nano DMA (Model 3085) for the best performance at particle sizes below 150 nanometers

The DMAs may be purchased individually, or ordered already installed in a platform, as described in the "To Order" section later in this brochure. Our new Electrostatic Classifiers offer this open-platform design to allow you to easily interchange DMAs. The result is much greater flexibility when selecting an instrument for individual research needs.

In addition to interchangeable differential mobility analyzers, the 3080-series instruments offer these advances over our previous design:

- Recirculating flow for precise match of sheath and excess flows
- Microprocessor-controlled volumetric flow with laminar flow element
- Convenient front-panel design with control knob and built-in display
- Electronic control of flow, voltage, particle-size, gas type, and instrument functions

Choose Either a Long or Nano Differential Mobility Analyzer



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SPECIFICATIONS

3080 Controller Platform

Mode of operation: Bipolar charge neutralization and differential mobility analysis (requires installation of DMA)

Flow rates

Aerosol: 0 to 3 L/min, determined by external pressure or vacuum

Sheath air and excess air: 1 to 20 L/min, manually selectable

Air mover: 0 to 20 L/min, bypass or auxiliary flow

Aerosol temperature range: 10 to 40°C (instrument must be within 3°C of aerosol temperature)

Charger: Bipolar, Kr-85, 2 millicurie, half-life of 10.4 years (Model 3077 Aerosol Neutralizer* supplied with instrument)

Aerosol pressure range: 1 ± 0.2 atm

Front panel display: Backlit, alphanumeric, 320×240-pixel LCD

Calibration: NIST-traceable voltage and flow standards

Dimensions (LWH): 45.7 cm × 41.4 cm × 40.6 cm (18 in. × 16.3 in. × 16 in.)

Weight: 17.6 kg (38.9 lb)

Ports

Polydisperse aerosol: 1/4-in. OD

Sheath air inlet/outlet: 3/8-in. OD

Bypass air inlet/outlet: 3/8-in. OD

Power requirements: 85 to 260 VAC, 50/60 Hz, 200 W maximum

3080L Electrostatic Classifier

DMA included: Long (Model 3081)

Particle type: Solids and nonvolatile liquids

Particle size range (generation mode): Adjustable from 10 to 1000 nm

Maximum input concentration: 10^8 particles/cm^3 at 10 nm

Voltage: 10 to 10,000 VDC

Flow rate

Sheath Air: 2 to 15 L/min

Aerosol: 0.2 to 2 L/min

Bypass: None

Physical measurements

Long DMA

Height: 61 cm (24 in.)

Outside diameter: 7.6 cm (3 in.) excluding ports

Weight: 5.4 kg (11.8 lb)

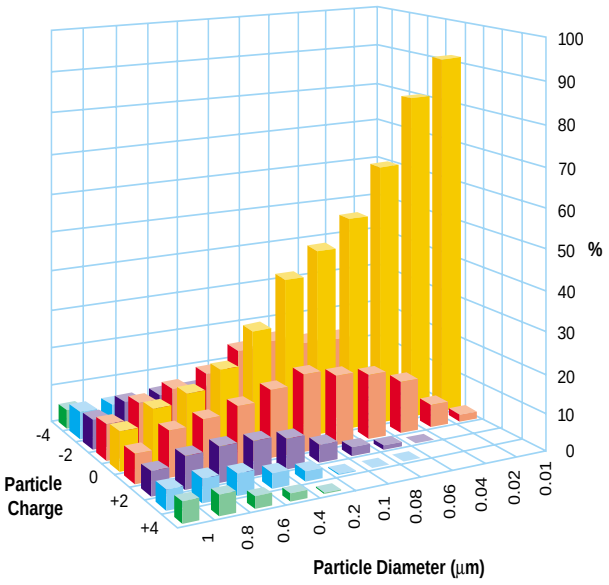
Monodisperse and polydisperse aerosol ports: 1/4-in. OD

Sheath and excess air ports: 3/8-in. OD

Complete instrument

Dimensions (LWH): 45.7 cm × 41.4 cm × 64.3 cm (18 in. × 16.3 in. × 25.3 in.)

Weight: 23.2 kg (51.2 lbs)



Equilibrium-charge distribution graph

3080N Electrostatic Classifier

DMA included: Nano (Model 3085)

Particle type: Solids and nonvolatile liquids

Particle size range (generation mode): Adjustable from 2 to 150 nm

Maximum input concentration: 10^8 particles/cm^3 at 10 nm

Voltage: 10 to 10,000 VDC

Flow rate

Sheath air: 3 to 20 L/min

Aerosol: 0.3 to 3 L/min

Bypass: 0 to 15 L/min

Physical measurements

Nano DMA

Height: 20.3 cm (8 in.)

Outside diameter: 7.9 cm (3.1 in.) excluding ports

Weight: 2.2 kg (4.9 lb)

Polydisperse aerosol inlet: 3/8-in. OD

Monodisperse aerosol outlet: 1/4-in. OD

Sheath, excess, and bypass ports: 3/8-in. OD

Complete instrument

Dimensions (LWH): 45.7 cm × 41.4 cm × 40.6 cm (18 in. × 16.3 in. × 16 in.)

Weight: 20.1 kg (44.3 lb)

*TSI is authorized by the United States Nuclear Regulatory Commission to distribute these Aerosol Neutralizers. If your location is within the United States, no other federal license is required. Check local regulations for your own protection. Neutralizers are shipped separately from other system components. End-user name and address are required.

The design of the Model 3085 Nano DMA is covered under U.S. Patent Number 6,230,572. Specifications are subject to change without notice. TSI and the TSI logo are registered trademarks of TSI Incorporated.

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APPLICATIONS

The 3080-series classifiers are primary-standard aerosol instruments. That means their performance is based on basic physical principals, and their results are highly repeatable. Collectively, these instruments are suitable for a variety of applications.

When used individually:

- Aerosol research, including the study of particle transport, diffusion, coagulation, nucleation, and condensation
- Particle-charge and electrical-mobility studies
- Filter-media tests for filter efficiency
- Enhancing the monodispersity of polystyrene latex (PSL) aerosols used to calibrate optical particle counters (The removal of residue particles and multiplets from the nebulized PSL enhances monodispersity.)

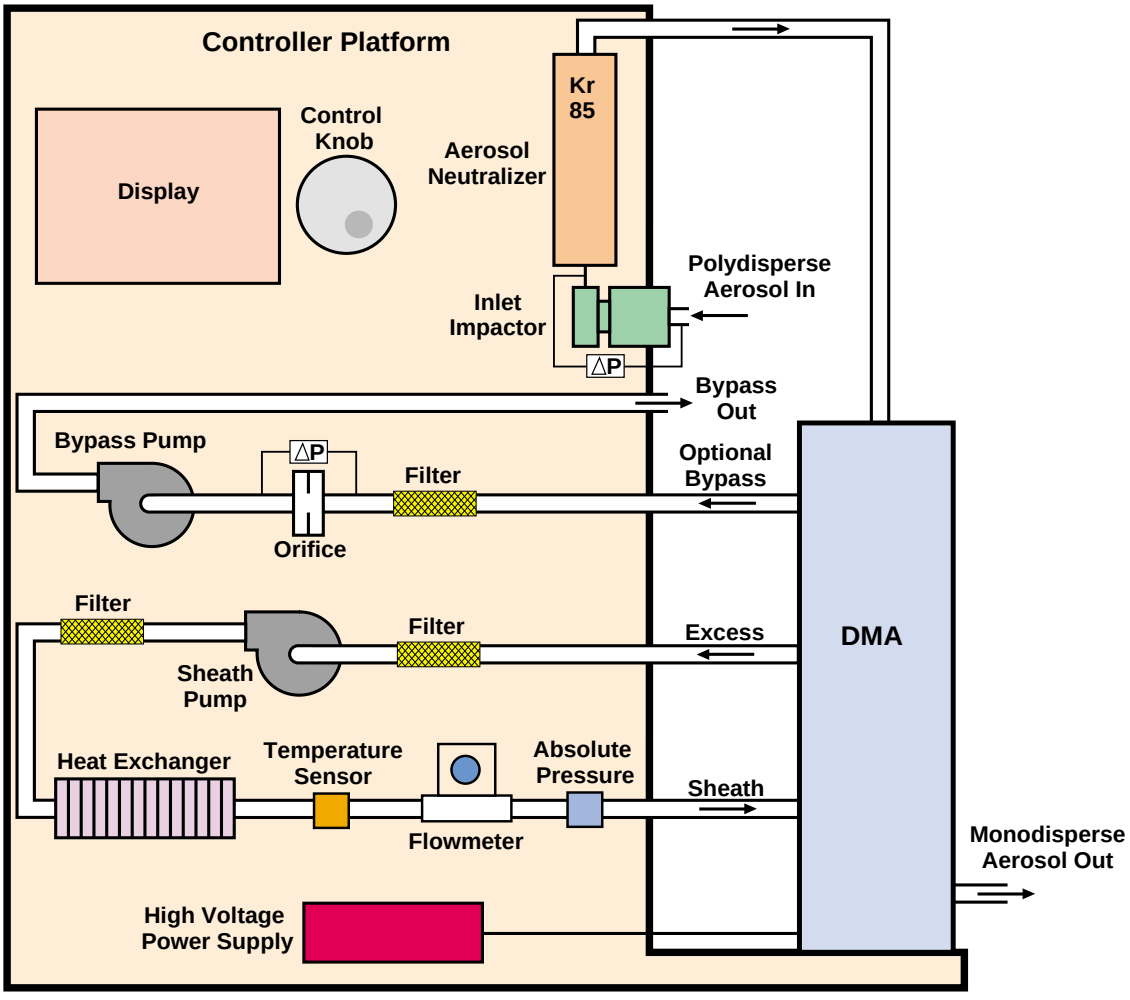
When used in tandem: Measuring small and large changes in particle size due to coagulation, evaporation, condensation, and chemical reactions

When used with a TSI Model 3068A Aerosol Electrometer: Primary size and concentration calibration of Condensation Particle Counters and other aerosol instruments

When used with a TSI Condensation Particle Counter: High-resolution sizing of submicrometer particles

The availability of two DMAs allows even further specialization. The Model 3081 Long DMA is intended for wide usage as a classifier of large particles up to 1000 nanometers in diameter. The Model 3085 Nano DMA is designed for high-resolution sizing of ultrafine particles down to 2 nanometers in diameter. Its short length and bypass inlet flow minimizes diffusional broadening and particle loss, which is a critical re-

MODEL 3080-SERIES ELECTROSTATIC CLASSIFIERS



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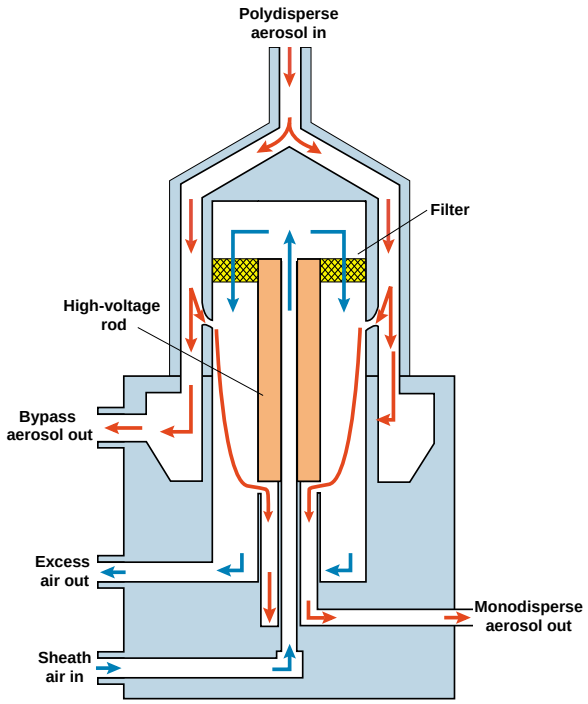
quirement for classifying particles smaller than 20 nanometers. Remember, the DMAs are available individually, or preinstalled in a controller platform. See "To Order" for details.

OPERATION

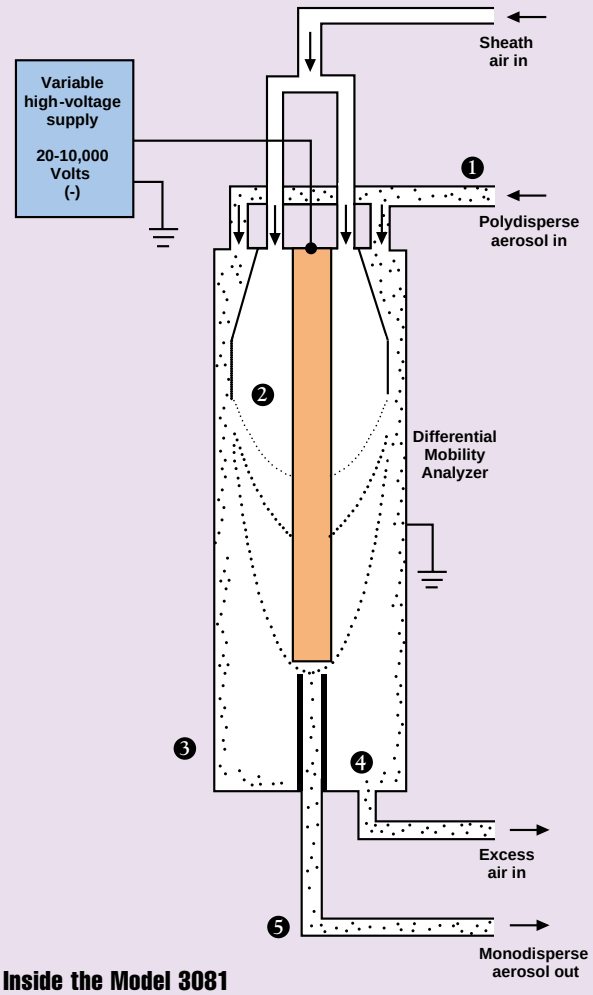
Polydisperse, submicrometer aerosol passes through a radioactive bipolar charger, establishing a bipolar equilibrium charge level on the particles. Nearly all particles from 20 to 300 nanometers in diameter receive either a single positive, single negative, or zero charge. The particles then enter the differential mobility analyzer (DMA) and are separated according to their electrical mobility. This parameter is inversely related to particle size.

An electric field inside the DMA influences the flow trajectory of the charged particles. The DMA contains an inner cylinder that is connected to a negative power supply (0 to 10,000 VDC). This charged element provides a precise negative potential. Particles with negative charge are repelled towards and deposited on the outer wall. Particles with a neutral charge exit with the excess air. Particles with a positive charge move rapidly towards the negatively charged element. Only particles within a narrow range of electrical mobility have the correct trajectory to pass through an open slit near the DMA exit.

Model 3085 Nano DMA



Model 3081 Long DMA



Inside the Model 3081

❶ Charged polydisperse aerosol enters the DMA.
❷ The center rod attracts positive particles.
❸ The center rod repels negative particles to the wall.
❹ Uncharged particles exit with the excess air.
❺ Positively charged particles within a narrow mobility range exit as monodisperse aerosol.

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Kinney PK, DYH Pui, GW Mulholland, and NP Bryner, Use of the Electrostatic Classification Method to Size 0.1-µm SRM Particles—a Feasibility Study, *J. Res. Natl. Inst. Stand. Technol.* **96**(2):147 (1991). *TSI paper A74*

Pourprix M and J Daval, Electrostatic Precipitation of Aerosols on Wafers, a New Mobility Spectrometer, *Proceedings of the 3rd International Aerosol Conference* 2:797-800 (1990).

TO ORDER

Electrostatic Classifiers and Components

Specify	*Description*
3080L	Electrostatic Classifier, includes 3080 Controller Platform (with 3077 Aerosol Neutralizer), 3081 Long DMA, and 1035900 Inlet Impactor
3080N	Electrostatic Classifier, includes 3080 Controller Platform (with 3077 Aerosol Neutralizer), 3085 Nano DMA, and 1035900 Inlet Impactor
3080	Controller Platform with 3077 Aerosol Neutralizer (DMA and 1035900 Inlet Impactor not included)
308003	Controller Platform without 3077 Aerosol Neutralizer (DMA and 1035900 Inlet Impactor not included)
3081	Long DMA (10 to 1000 nm)
3085	Nano DMA (2 to 150 nm)
3077	Aerosol Neutralizer
1035900	Inlet Impactor

Systems

The **Scanning Mobility Particle Sizer** (SMPS) is available in the following configurations. All include an Electrostatic Classifier, Aerosol Neutralizer, Condensation Particle Counter (CPC), and SMPS software. See *Model 3936-Series Scanning Mobility Particle Sizers* product information sheet for additional information.

Specify	*Description*
3936NL25	SMPS system, includes 3080, 3081, 3085, 3025A-S, software, and interconnecting hardware
3936N25	SMPS system, includes 3080N, 3025A-S, software, and interconnecting hardware
3936L25	SMPS system, includes 3080L, 3025A-S, software, and interconnecting hardware
3936L22	SMPS system, includes 3080L, 3022A-S, software, and interconnecting hardware
3936L10	SMPS system, includes 3080L, 3010-S, 3032, software, and interconnecting hardware

The **Submicrometer Monodisperse Aerosol Generation System** includes an Electrostatic Classifier with a Long DMA. See *Model 3940 Submicrometer Monodisperse Aerosol Generation System* product information sheet for additional information.

Specify	*Description*
3940	Submicrometer Monodisperse Aerosol Generation System, includes 3080L, 3012, 3062, 3076, and 3074B

The **Nanometer Monodisperse Aerosol Generation System** includes an Electrostatic Classifier with a Nano DMA. Contact your TSI representative for additional information.

Specify	*Description*
3942	Nanometer Monodisperse Aerosol Generation System, includes 3080N, 3012, 3062, 3480, and 3074B

Optional Accessories

Specify	*Description*
3010 or 3010-S	Compact Condensation Particle Counter
3022A or 3022A-S	General-purpose Condensation Particle Counter
3025A or 3025A-S	Ultrafine Condensation Particle Counter
3012	Aerosol Neutralizer
3032	Vacuum Pump
3062	Diffusion Dryer
3068A	Aerosol Electrometer
3074B	Filtered Air Supply
3076	Constant Output Atomizer
3480	Electrospray Aerosol Generator

These optional accessories are available in several system configurations described above. Other configurations are possible. Ask your TSI representative about recommended Electrostatic Classifier / Condensation Particle Counter combinations.

When ordering an Electrostatic Classifier containing an Aerosol Neutralizer, or systems containing such an Electrostatic Classifier, the name and address of the end user must be provided to comply with nuclear regulatory requirements.

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