Liquid NanoParticle Sizer (LNS): Quick Start Guide

System Overview

The Kanomax 9310 Liquid NanoParticle Sizer system measures the size distribution of particles suspended in water (hydrosol). The measurement of the particle size is done ex situ with the particles dispersed in a gas (aerosol). The hydrosol is nebulized (sprayed into a fine mist) and the mist is then aerosolized (dried to form an aerosol). The aerosol contains particles that were present in the hydrosol and particles formed by previously dissolved Non-volatile Residue (NVR). The influence of the NVR on the true particle size and the overall distribution is mitigated by both limiting the size of the droplets (larger droplets contain more residue and therefore cause a thicker particle coating or larger residue-based aerosol particles) and optionally reducing the amount of NVR present in the nebulized sample. The amount of NVR present is limited by using online dilution which reduces the concentration of dispersants in the sample without concern for coagulation due to the short residence time between dilution and nebulization, and also reduces contamination from lab ware and the atmosphere.

Materials and Site Requirements

The Liquid NanoParticle Sizer System (LNS Model 9310) has three main components: NanoParticle Nebulizer (NPN Model 9110), Annular Flow Ion Mobility Classifier (AFIMC Model 3660) and Fast Condensation Particle Counter (FastCPC Model 3650). The LNS is controlled by Kanolysis Software (Model S330 00).

Check that you have the following tools, equipment, and site requirements before you install your LNS. The relevant user manuals provide instructions for the fluid fittings.

- Unrestricted air flow around the system components.
- An electrical power supply with 5 outlets, 115VAC to 230VAC.
- A ¼ in (outside diameter) Teflon PFA tube, flared and fitted with a Flaretek nut, used to deliver high purity water at 20-70 psig, 50-250 ml/min.
- A ¼ -inch (outside diameter) plastic tube fitted with Swagelok nut, used to drain waste water from the nebulizer.
- A ¼ -inch (outside diameter) plastic tube fitted with Swagelok nut, used to provide compressed, dry air at 3 slpm, 50-60 psi.
- A ¼ -inch (outside diameter) plastic tube fitted with Swagelok nut, used to provide compressed, dry air at 0.3 slpm, 50-60 psi.
- Reagent-grade n-butyl alcohol (Butanol).
- ¼ in ID exhaust tubing to vent n-butyl alcohol vapor to suitable exhaust hood @ 1.5 lpm if desired.
- A clean tube cutter.
- Drain for receiving waste water.
- Stopwatch and 100 ml graduated cylinder.
- Scale with 0.1 mg resolution.

Note: No tubing is supplied to connect the LNS to air or water supplies.

This Quick Start Guide is intended to be used for quick reference only. For more detailed instructions consult the individual manuals.

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Warnings

- The AFIMC and NPN contain components that can expose you to high voltage if the instrument covers are removed. **Do not operate the equipment without the covers in place.**
- The AFIMC contains components that may expose you to radiation. **Do not operate the equipment without the covers in place.**
- The aerosol particles created by the NPN may pose a health risk if inhaled. If not connected to other instrumentation, vent the aerosol output to a fume hood.
- The rollers on the peristaltic pump can pinch fingers. Refer to the pump user manual for detailed information.

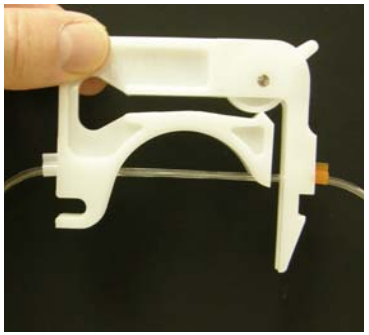
LNS Accessory Pack

The LNS Accessory Pack includes the following:

- BNC cable. (Part # 1330010)
- Transport Flow coupler assembly. (Quick disconnect between AFIMC and FastCPC. Part # LNS Transport Flow Coupler)
- Gas Port coupler assembly. (Connects Ports B&C on AFIMC. Part # AFIMC Gas Port Coupler)
- Charge Conditioner Gas Port coupler assembly. (Connects Port A to B/C. Part # AFIMC Charge Conditioner Coupler)
- Classifier Aerosol coupler assembly. (Connects AFIMC to FastCPC. Part # 1611063)
- Aerosol sample tube. (Part # 3020035)

Installation

1. Unpack the NanoParticle Nebulizer.
2. Connect the **UPW Inlet** on the NPN to the UPW supply.
3. Install the peristaltic pump tubing on the NPN as shown below. Place the open end of the tubing into a waste container.



4. Connect the gas supply to the rear of the NPN.
5. Connect the drain line to the rear of the NPN and place in an appropriate waste container.
6. Place the AFIMC on top of the NPN.
7. Using the provided conductive tubing, connect the aerosol output from the NPN to the inlet of the AFIMC. Use the shortest practical length of tubing to minimize particle losses through diffusion.

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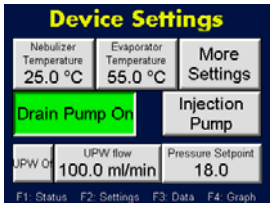
NanoParticle Nebulizer Setup

1. Turn the Sample Selector Valve to **Diluted Sample** and check that the Sample Inlet tubing adapter is in place.
2. Turn on the power for all pieces of equipment.
3. Turn on the gas supply.
4. On the Device Settings screen (F2) touch **Pressure Setpoint** and set the pressure to 18psi.
5. On the Device Settings screen touch **UPW Flow** and set the flow to 100 ml/min.



6. Turn on the UPW supply. Water drains from the open tube end. Adjust the tube tensioner to 2 clicks past the point where water ceases to drain from the tube.

7. To ensure that the peristaltic pump is operating, check that air bubbles are present in the NPN waste line.
8. Inspect the system for leaks.
9. Press the **RESET** button on the peristaltic pump until the dash marks on the display move toward the open tube end (from the Sample Inlet).

10. Press the **RUN/STOP** button. Use ▲▼ to adjust the flow to 100 µl/min.
11. Adjust the flowmeter valve on the NPN to read 100 ml/min at the center of the ball.
12. Turn the **Nebulizer Pressure** regulator on the back panel until the Nebulizer Gas Pressure reads 35 psi on the Device Status screen.

Annular Flow Ion Mobility Classifier and FastCPC Setup

1. Unpack and set up the FastCPC. (See instructions in User Manual.)
2. Unpack the AFIMC and AFIMC Accessory Kit.
3. Loosen the Swagelok nuts on the provided Gas Port Coupler and connect to **Gas Ports B** and **C** on the AFIMC.

4. Remove the elbow joint from the vertical inlet on the Fast CPC. Place the FastCPC on top of the AFIMC. Use the Classifier Aerosol Coupler to connect the AFIMC to the FastCPC inlet. Hand-tighten both nuts. (Do not over-tighten.)

5. Connect the second CDA source to **Gas Port A** on the AFIMC.
6. Connect the provided BNC cable to **Pulse Output** (on the FastCPC) and **Pulse Input** (on the AFIMC).
7. Connect the transport flow coupler from the AFIMC to the **Makeup Air** inlet on the FastCPC.

Note: The sheath flow determines the dynamic range and resolution of the AFIMC. Higher sheath flows means finer resolution (the resolution is proportional to the ratio of the sheath to sample flow rates). However, higher sheath flows also limit the system's upper measurement range. The AFIMC offers two operating modes: High-Resolution (data collected at 64 bins/decade of size from 5.62-312nm); Wide-Range Mode (data collected at 32 bins/decade from up to 10-562 nm). The Fast CPC offers high- and low-inlet-flow modes: for LNS use the FastCPC must be in 600 ccm inlet-flow mode.

Communications

1. Connect each of the component devices and the Serial box with the provided ethernet hub.
2. Connect the Serial cable to the Serial box and the back of the pump. Power on the hub. The FastCPC display should read approx 0 Particles/cm^3.
3. Power on the provided laptop computer. Connect it to the ethernet hub. Note: The instruments are shipped with network addresses assigned for the hub.

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Sample Introduction

The sample is introduced to the NPN using a peristaltic pump. Detailed instructions for operating the pump are included in the pump user manual. Set the diluent flow rate using the Device Settings screen; the operating range is 50 – 250 ml/min. Typical operating conditions are 100 l/min for the sample flow and 100 µl/min for the diluent flow. (See the NPN User Manual for detailed instructions.)

1. Rinse the outside of the peristaltic pump tubing using UPW and the included bottle.

2. Press the **RESET** button to reverse the pump to begin injecting the sample into the Dilution Module.
3. Flick the outside of the tubing to remove residual water droplets.
4. Insert tubing in vial. Wait for at least 10 minutes for the mixed sample concentration to reach the steady state.
5. At the end of the measurement, remove the tubing from the sample, place into a waste container, and reverse the pump feed by selecting the **RESET** button.

Calibration

To perform quantitative analyses, the dilution ratio and inspection volume must be known. These values are calibrated at the factory but should be verified periodically. To perform a flow calibration:

1. Calibrate the rotameter by measuring the dispensed volume from the waste line from the NPN using a graduated cylinder and stopwatch. Use the measured flow rate in calculating concentration and inspection volume
2. Calibrate the peristaltic pump.
   a. Weigh a plastic 60 mL bottle (not provided) and record the weight to 1/100 gram (0.0001 g).
   b. Press **RUN/STOP** to turn on the pump. Start a stopwatch at the same time. Run the pump for approximately 10 mins. Press **RUN/STOP** to stop the pump. Stop the stopwatch at the same time. Record the duration of pump operation.
   c. Weigh the 60 mL bottle and then calculate the flow rate (f):

$$f = \frac{weight(mg)}{time(\min)}$$

   d. To permanently enter a flow rate correction into the peristaltic pump, press the **CAL/MAX** button. The Display flashes. Using the **Settings ▲▼** arrows, adjust the display to match the calculated flow rate. Press the **CAL/MAX** button again to enter the new calibration value.

Calibrate Inspected Volume

1. On the provided laptop computer, open the provided Kanolysis software and follow the on-screen instructions. Perform a volume standard measurement.
2. Perform a scan of the Kanomax FMT 1005 Volume standard.
3. Verify the volume-weighted GSD < 1.22.

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