KANOMAX FMT
A Kanomax Company

Liquid NanoParticle Sizer System

Model 9310: User Manual

Part Number: 1979310 Version 1.0.6

Liquid NanoParticle Sizer Model 9310: User Manual

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The following is a history of the Liquid NanoParticle Sizer Model 9310 User Manual (part number 1979310):

Version	**Date**	**Change**
Version 1.0	February, 2020	
Version 1.0.1	May, 2020	Updated network configuration procedures
Version 1.0.3	June, 2020	Updated the packing lists
Version 1.0.4	August, 2020	Added Kanolysis software license language
Version 1.0.5	September, 2020	Updated the NanoParticle Nebulizer and peristaltic pump configurations
Version 1.0.6	November, 2020	Added charge conditioner patent; clarified the FCPC flow configurations

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Knowing that inoperative or defective instruments are a detriment to our customers' satisfaction, our service policy is to give prompt attention to any known problems. If you discover any malfunction of the Liquid NanoParticle Sizer, contact Kanomax FMT, Inc. at 651-762-7762 (USA). If you are outside of the USA, please call your authorized distributor.

Table of Contents

About This Manual

Intended Audience

The Liquid NanoParticle Sizer Model 9310 User Manual is intended to be used by qualified personnel (such as technicians and engineers) in a laboratory setting.

Scope of User Manual

This user manual contains detailed instructions for the installation and set up of the Liquid NanoParticle Sizer Model 9310. The manual also contains an explanation of how the nebulizer works.

Definitions

- AC: Alternating Current
- AFIMC: Annular Flow Ion Mobility Classifier
- CDA: Clean Dry Air
- CMP: Chemical Mechanical Planarization
- DNVR: Dissolved Non-volatile Residue
- EU: European Union
- FCPC: Fast Condensation Particle Counter
- IPv4: Internet Protocol Version 4
- kPa: Kilo Pascals
- LNS: Liquid NanoParticle Sizer
- mA: Milliamperes
- NPN: NanoParticle Nebulizer
- NVR: Non-volatile Residue
- PEEK: Polyether Ether Ketone (high purity, chemical resistant plastic)
- PFA: Perfluoralkoxy (high purity, chemical resistant plastic)
- PLC: Programmable Logic Controller
- PNVR: Precipitated Non-volatile Residue
- PSD: Particle Size Distributions
- psi: Pounds per Square Inch
- PTFE: Polytetrafluoroethylene (high purity, chemical resistant plastic)
- TCP: Transmission Control Protocol
- UPW: Ultrapure Water
- USB: Universal Serial Bus
- VAC/VDC: Volts Alternating Current/Volts Direct Current

Safety and Handling Procedures

Read this section to learn safe handling procedures for the Liquid NanoParticle Sizer.

There are limited user-serviceable parts inside the Liquid NanoParticle Sizer: all repair and maintenance must be performed by a qualified service technician.

When working with the Liquid NanoParticle Sizer:

- Do not remove any parts from the instrument unless this manual tells you to do so.
- Do not remove the instrument housing or covers while power is supplied to the instrument.

Safety Signals

The following warning symbols and labels are used in the documentation and on the Liquid NanoParticle Sizer. Follow the procedures described in this manual to use the instrument safely.

Warning

Warnings are used for the following purposes:

- To indicate that unsafe use of the instrument could result in serious injury to you or cause irrevocable damage to the instrument.
- To indicate that if you do not follow the procedures described in this manual, you may damage the instrument.
- To draw attention to important information about the operation and maintenance of the Liquid NanoParticle Sizer.

High Voltage Sticker

A High Voltage warning sticker attached to the Liquid NanoParticle Sizer warns you that un-insulated voltage within the instrument may be sufficient to give you an electric shock. Do not make contact with any part inside the instrument.

Grounding Connection Sticker

A Grounding Connection sticker attached to the Liquid NanoParticle Sizer indicates that the nebulizer is connected to earth ground and cabinet ground.

Warnings

Please familiarize yourself with the following warnings before operating the Liquid NanoParticle Sizer:

- The Liquid NanoParticle Sizer must be used following manufacturer's specifications otherwise safety cannot be guaranteed.
- All service work must be performed by qualified service technicians - only qualified service technicians should remove the cover.
- When the nebulizer is running, there are hot surfaces inside the device. Do not remove the cover at any time unless you are a qualified service technician.
- To prevent electric shocks, ensure that all electrical outlets are grounded.
- The aerosol particles created by the Model 9310 Liquid NanoParticle Sizer may pose a health risk if inhaled. If not connected to other instrumentation, vent the aerosol output to a fume hood.
- Follow the instructions for all inlet and outlet connections. Incorrect connections will cause the nebulizer to malfunction.
- The air or nitrogen supplied to the nebulizer must be clean, dried, oil-free and regulated at 50-60 psi.
- During normal operation, do not tilt the nebulizer at angles >10°.
- You must drain the nebulizer before you move or ship it. Do not ship an undried/undrained nebulizer back to Kanomax FMT, Inc.: doing so might damage the device and invalidate the warranty.
- Do not subject an undrained nebulizer to freezing temperatures: doing so might damage the device and invalidate the warranty.

How the Liquid NanoParticle Sizer Works

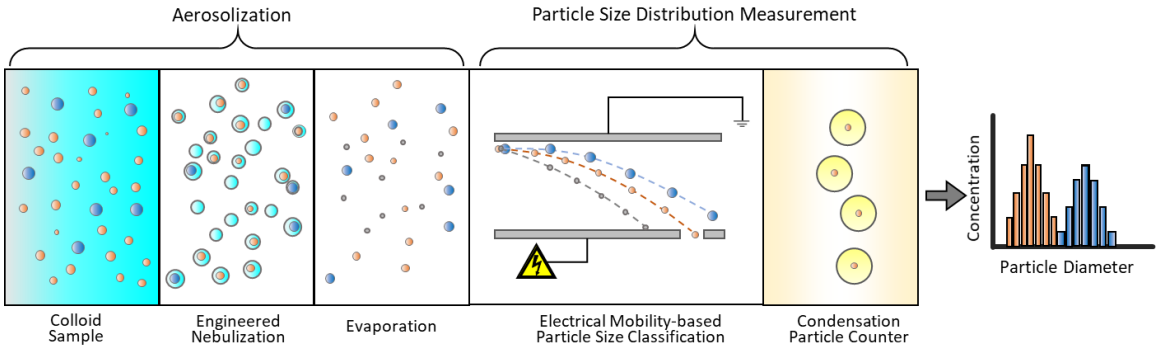
The LNS is a fully integrated three-stage system incorporating a NanoParticle Nebulizer (NPN), an Annular Flow Ion Mobility Classifier (AFIMC) and a Fast Condensation Particle Counter (Fast CPC) to measure particles as small as 5 nm.

A sample of a liquid colloid suspension is introduced to the NPN through an online direct-feed method or using a peristaltic pump or autosampler. The sample can be diluted before introduction to reduce coagulation time and minimize contamination. The sample is nebulized and the largest droplets, which may contain multiple particles, are removed. The nebulized sample is heated to evaporate the water leaving an aerosol of particles suspended in the carrier gas. The aerosol is then combined with clean, dry air. Up to 1.5 L/min of dry aerosol flow can be drawn from the aerosol outlet.

The aerosol particles are electrically charged using a safe and reliable soft x-ray charger. The AFIMC sorts the particles by size in an electric field and is capable of classifying particles from 5-500 nm in size. Using varying electric field strength, the AFIMC systematically selects particles of a narrow size band and passes them on to a Fast CPC.

The Fast CPC immediately counts the concentration of particles in selected size bands and detects individual particles with a dynamic concentration range over three orders of magnitude. Unlike competing particle measurement technologies, the LNS provides actual, not relative, particle concentration.

Figure 1: Aerosolization coupled with Ion Mobility Spectrometry to measure nanoparticle size distribution in liquid.



The Liquid NanoParticle Sizer system offers the following advantages over existing liquid particle size distribution characterization technology:

- Combines proven techniques (used by NIST and AIST, Japan) for counting and sizing aerosol size distributions with a unique nebulizer technology to successfully measure particle size and number concentration in concentrated liquid suspensions.
- Offers greater accuracy, better precision, and improved resolution in CMP slurry size-measurement results (used extensively in the semiconductor industry).
- Straightforward data inversion without complex inversion routines, assumptions or size calibrations. The software can identify each particle-size mode and assigns a cumulative size at 10%, 50% and 90% of the distribution. Changes in the size of a specific mode can be easily monitored with these size statistics.
- Does not make assumptions about the shape of the particle size distributions and measures actual number concentrations not relative particle concentrations. (Instruments that provide relative particle concentrations can lead to significant misinterpretations when comparing different samples because they only provide measurements of relative concentrations within each sample.)
- Cited in three SEMI Guides. In SEMI C92 the LNS is used to determine the quality of ion exchange resin. In SEMI C79 the LNS evaluates the efficiency of sub-15 nanometer filters used in ultrapure water distribution systems. No other particle instrumentation is capable of making the required measurements described by SEMI C79. In SEMI C98 the LNS, as a system consisting of nebulization and particle counting after electrical mobility size classification, is recommended for its accuracy in characterizing particle size distributions (PSD) for chemical mechanical planarization (CMP) slurries.

Applications

- Analyzing Chemical-Mechanical Polishing (CMP) slurries.
- Characterizing the filtration performance of liquid filter media.
- Analyzing drugs and other medical nanoparticles in water.
- Analyzing environmental water samples.

Acknowledgement

The ultrafine nebulization method used in this device is based on technology licensed from CT Associates, Inc. (CTA). We offer our sincere thanks to Don Grant, Gary Van Schooneveld, and Mark Litchy for their invention, their

clever insights to this unique technology, and the gracious feedback they have provided during the development of this product. Patent numbers 8,272,253 and 8,573,034 have been issued to CTA and licensed by Kanomax FMT, Inc. Patent number 7,852,465 has been issued to Kanomax FMT, Inc.

The charge conditioning method used in this device is based on the US Patent US10388502B2 which has been issued to Kanomax FMT, Inc.

How to Install the Liquid NanoParticle Sizer Model 9310

The Liquid NanoParticle Sizer can be operated directly from the Programmable Logic Controller (PLC) screens or the Kanolysis Model S330 software, which is a designated software platform for Kanomax instruments.

Installation Overview

Following is an overview of the steps required to get your Liquid NanoParticle Sizer up and running. Please read the detailed instructions (beginning below) for each step before you set up the instrument.

- Unpacking the NanoParticle Nebulizer Model 9110.
- Unpacking the Annular Flow Ion Mobility Classifier Model 3660.
- Unpacking the Fast Condensation Particle Counter Model 3650.
- Installing the NanoParticle Nebulizer Model 9110.
- Installing the Annular Flow Ion Mobility Classifer Model 3660.
- Installing the Fast Condensation Particle Counter Model 3650.
- Installing the Kanolysis Model S330.
- Installing the local network connections.

Unpacking the NanoParticle Nebulizer

To unpack the NanoParticle Nebulizer, follow these instructions:

1. Carefully remove the nebulizer from its shipping container. Save the original packing materials for use when shipping the nebulizer back to Kanomax FMT, Inc. for service, or for moving the nebulizer to a different location.

Warning. If the NanoParticle Nebulizer is returned to Kanomax FMT, Inc. in anything other than the original shipping container, you will be charged for any damage that occurs during shipping. If you do not have the original shipping container, contact Kanomax FMT Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.)

2. Place the nebulizer on a level surface.
3. Make sure there is an unrestricted air flow around the device. Kanomax FMT, Inc. recommends at least a 2-inch air gap on both sides and the top of the instrument.
4. Allow the nebulizer to reach ambient temperature, if necessary.
5. Refer to the packing list included in the box, and make sure all the packing list items were included in the NanoParticle Nebulizer shipment. If any of the items are missing, or damaged, please call Kanomax FMT, Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.)

Unpacking the Annular Flow Ion Mobility Classifier

To unpack the Annular Flow Ion Mobility Classifier, follow these instructions:

1. Carefully remove the AFIMC from its shipping container. Save the original packing materials for use when shipping the ion mobility classifier back to Kanomax FMT, Inc. for service, or for moving the ion mobility classifier to a different location.

Warning. If the AFIMC is returned to Kanomax FMT, Inc. in anything other than the original shipping container, you will be charged for any damage that occurs during shipping. If you do not have the original shipping container, contact Kanomax FMT Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.)

2. Place the AFIMC on a level surface. Make sure there is an unrestricted air flow around the device. Kanomax FMT, Inc. recommends at least a 2-inch air gap on both sides and the top of the instrument.
3. Refer to packing list included in the box to make sure all packing list items were included in the AFIMC shipment. If any of the items are missing, or damaged, please call Kanomax FMT, Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.

Unpacking the Fast CPC

To unpack the Fast CPC, follow these instructions:

1. Carefully remove the Fast CPC from its shipping container. Save the original packing materials for use when shipping the Fast CPC back to Kanomax FMT, Inc. for service, or for moving the Fast CPC to a different location.

Warning. If the Fast CPC is returned to Kanomax FMT, Inc. in anything other than the original shipping container, you will be charged for any damage that occurs during shipping. If you do not have the original shipping container, contact Kanomax FMT Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.)

2. Place the Fast CPC on a level surface.
3. Make sure there is an unrestricted air flow around the device. Kanomax FMT, Inc. recommends at least a 2-inch air gap on both sides and the top of the instrument.
4. Allow the Fast CPC to reach ambient temperature, if necessary.
5. Refer to the packing list included in the box to make sure all the packing list items were included in the Fast CPC shipment. If any of the items are missing, or damaged, please call Kanomax FMT, Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.

Unpacking the LNS Accessory Kit

To unpack the LNS Accessory Kit, follow these instructions:

1. Carefully remove the LNS Accessory Kit from its shipping container. Save the original packing materials for use when shipping the LNS back to Kanomax FMT, Inc. for service, or for moving the LNS to a different location.

Warning. If the LNS is returned to Kanomax FMT, Inc. in anything other than the original shipping container, you will be charged for any damage that occurs during shipping. If you do not have the original shipping container, contact Kanomax FMT Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.)

2. Make sure all the items listed in the packing list were included in the LNS shipment. If any of the items are missing, or damaged, please call Kanomax FMT, Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.)

Equipment You Need

To install the Liquid NanoParticle Sizer, you will require the following items:

- 9/16 wrench.
- A length of ¼ inch OD tubing sufficient to reach from the instrument to your waste drain (12 ft maximum length).
- A length of ¼ inch OD polyethylene tubing sufficient to reach from the instrument to your air supply.

For online sample introduction:

- A length of ¼ inch OD x 0.156" ID High Purity PFA tubing sufficient to reach from the instrument to your water supply.
- PFA tubing flaring tool, tube gripper, and heat gun.
- Ultrapure Water supply. Note: Water pressure should be 20-70 psi at 100 ml/min.
- Conductive tubing for transporting the generated aerosol (shipped with the LNS aerosol size spectrometer).
- A supply of clean, dry, compressed air at 2 slpm. Note: The air pressure should be 50-60 psi.
- Access to a suitable liquid waste outlet.
- A clean tube cutter.
- 120-240 VAC power at 50/60 Hz.

Note: No PFA tubing is supplied with the Liquid NanoParticle Sizer.

Flaring a Tube

The installation procedure for online analysis requires you to flare a PFA tube. You can either use a heat flaring tool provided by Entegris (customer service numbers: 952-556-4196 or 800-394-4083) or a cold flaring tool provided by Saint Gobain Performance Plastics (customer service numbers: 714-630-5818 or 800-833-5661). The following instructions describe the hot-flare method:

1. Place a flare nut onto the end of a length of PFA tubing.
2. Hold the tubing with a tube gripper.
3. Rotate one end of the tubing evenly over the heat gun.
4. As soon as the end of the tubing becomes clear, push it onto a flaring tool in your required size. Note: If you remove the tubing from the flaring tool too soon, the end shrinks. If you overheat the tube, the tubing will buckle.
5. Hold in place until the tubing is cool (at least two minutes).
6. Pull the tubing from the flare. It is now ready to attach to a fitting.

Installing the NanoParticle Nebulizer

Figures Figure 2 and Figure 3 show the front and back panels of the NanoParticle Nebulizer.

Figure 2: Front Panel of the NanoParticle Nebulizer.

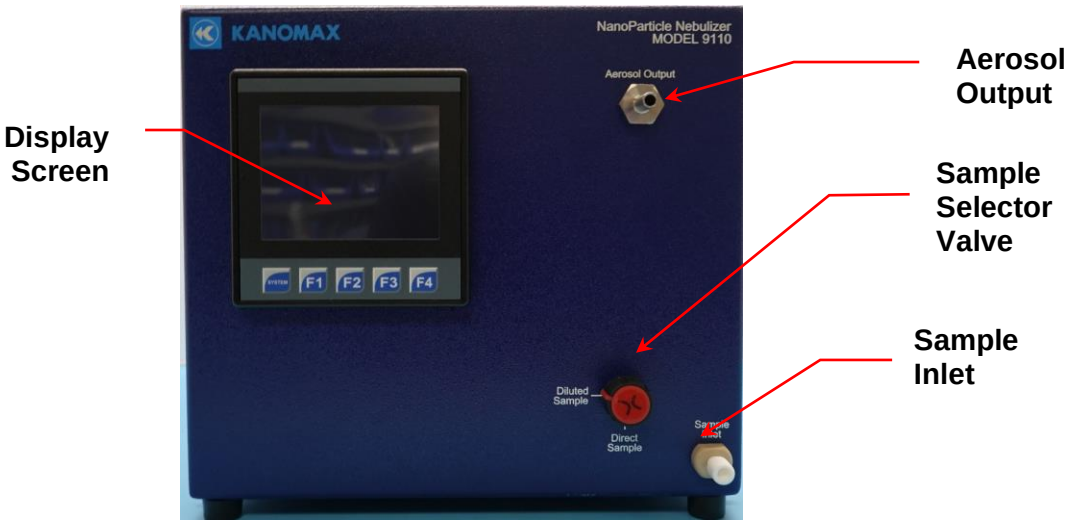
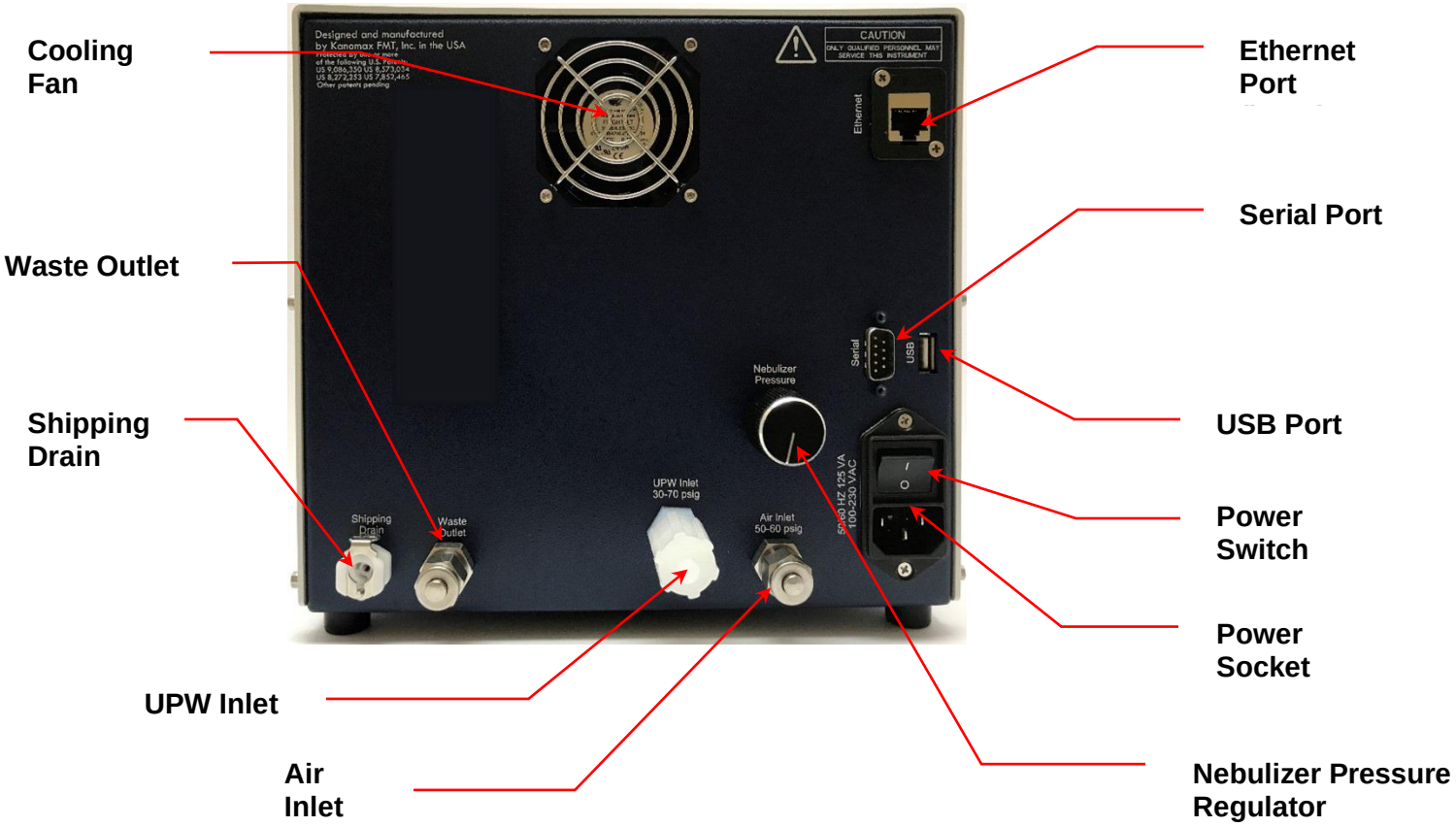


Figure 3: Back Panel of the NanoParticle Nebulizer.

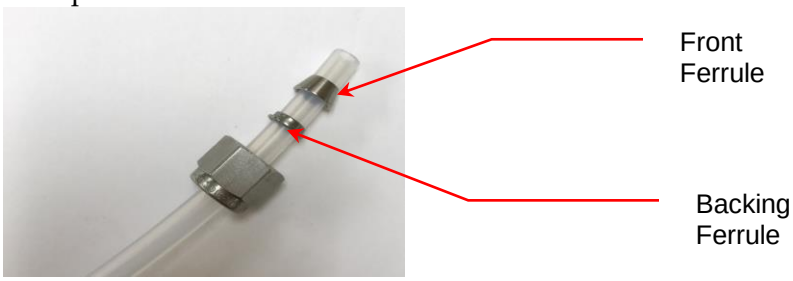


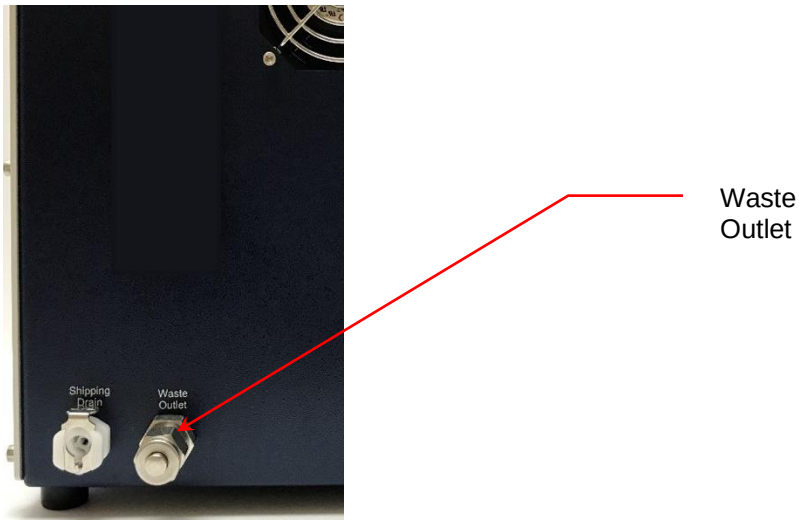
Connecting the Water Drain

Excess sample from the nebulization module is removed from the instrument using a solenoid pump. For online sampling, the excess total flow that is not delivered to the nebulization module is combined inside the device downstream of the pump.

Follow these instructions to connect the water drain:

1. Remove the protective cap from the **Waste Outlet** on the back panel.
2. Using a 6 ft length of ¼ inch OD polyethylene tubing with a Swagelok fitting on one end, insert the tubing into the **Waste Outlet** fitting on the back panel.





3. Using an adjustable wrench, tighten the Swagelok nut one turn past hand-tight to swage the ferrules onto the tubing. Once the ferrules have been swaged the fitting only requires slight tightening upon reassembly. **Warning**: Do not over-tighten the fitting or you will damage the tube and/or fitting.
4. Place the other end of the tube over your drain. Do not connect the waste line to a container in tight coupling manner where the pressure will fluctuate beyond ambient conditions.

Connecting the Compressed Air or Nitrogen Supply

The air or nitrogen supplied to the NanoParticle Nebulizer must be clean, dried, oil-free and regulated at 345-414 kPa (50-60 psi) at 2 slpm. Follow these instructions to connect the compressed air supply:

1. Remove the protective cap from the **Air Inlet** on the back panel.
2. Using a length of ¼ inch OD polyethylene tubing with a Swagelok fitting on one end, insert the tubing into the **Air Inlet** fitting on the back panel.

3. Using an adjustable wrench, tighten the Swagelok nut one turn past hand tight to swage the ferrules onto the tubing. Once the ferrules have been swaged, the fitting only requires slight tightening upon reassembly.
4. Connect the other end of the tube to your air supply.

5. Turn on the air at the source. The incoming pressure must be regulated at 345-414 kPa (50-60 psi).

Connecting the Power

To connect the power supply, follow these instructions:

1. Plug the supplied power cable into the AC power socket on the back panel of the nebulizer.

Plug the cord into an earth-grounded AC power source (100 to 240 VAC, 50 to 60 Hz, 0.6 A).
Warning: Ensure that the ground is secure. Connection to an improperly grounded electrical source is a severe shock hazard.

Connecting the Ultrapure Water Supply

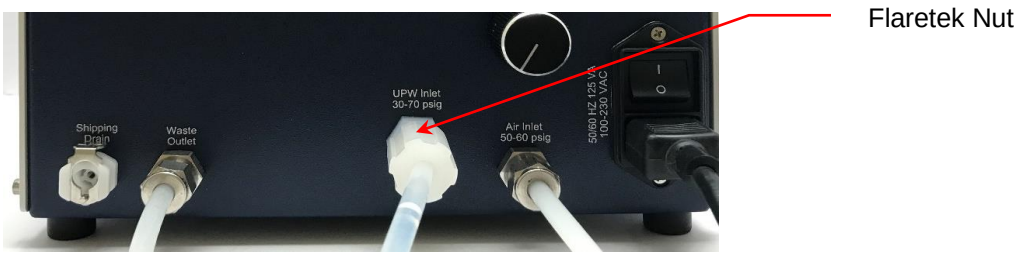
Ultrapure water must be supplied to the nebulizer through a ¼-inch diameter Teflon PFA tube specially adapted to fit the **UPW Inlet** fitting on the front panel of the nebulizer. To prepare the PFA tube for attachment to the **UPW Inlet** fitting, take the following precautions:

- Make sure your hands are clean.
- Do not touch the end of the water supply tube - you may contaminate it.

To connect the ultrapure water supply, follow these instructions:

1. Cut the end of the PFA tubing evenly with a clean tube cutter.
2. Place a Flaretek nut over the end of the PFA tube before attempting to flare the end.
3. Flare the tube (see instructions on page 11).
4. Flush ultrapure water through the tube for several minutes to remove any debris created by the flaring process.
5. Remove the protective nut and plug from the **UPW Inlet** fitting. Keep this Flaretek nut and plug for use when moving or shipping the nebulizer. (See shutdown instructions on page 98).
6. Push the flared end of the tube onto the **UPW Inlet**.

7. Slide the Flaretek nut into place and hand-tighten.

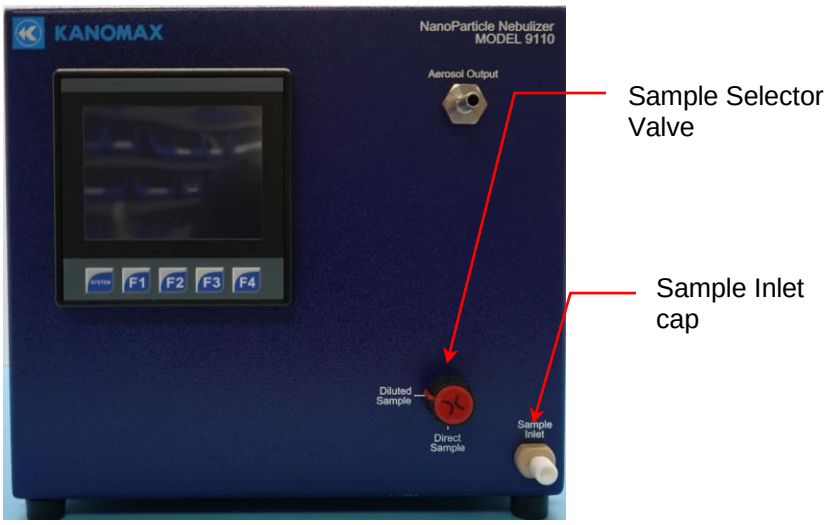


8. Turn on the ultrapure water supply. Water then flows through the instrument and out through the waste line. Ensure that the **UPW Inlet** has no leaks. If you see any leaks, tighten the fitting.

Connecting the Sample Inlet

To connect the Sample Inlet, follow these instructions:

1. On the front panel, turn the Sample Selector Valve to **Direct Sample**.



2. Remove the 1/4-28 plug protective cap from the **Sample Inlet** fitting.
3. Install the supplied 1/4-28 tube adapter to the **Sample Inlet** and hand tighten.
4. Connect the supplied peristaltic pump Tygon tubing to the adapter and verify that the adapter is fully inserted into the pump tubing.
5. Slot the tubing into the pump tube holder (with adjustable pressure lever) shipped with the supplied peristaltic pump. Place the white tube positioner on the far right of the tubing against the tube holder. Stretch the tubing and put the orange positioner into the far-left slot.

6. Hook the tube holder onto the pump and snap down into place.

7. Set the lever at the marked position if it is off.

8. Place the end of the tubing in a suitable drain container.

Controlling the External Injection Pump with the NanoParticle Nebulizer

The external injection (peristaltic) pump can be controlled by the NanoParticle Nebulizer. To connect the pump and the NanoParticle Nebulizer, follow these instructions:

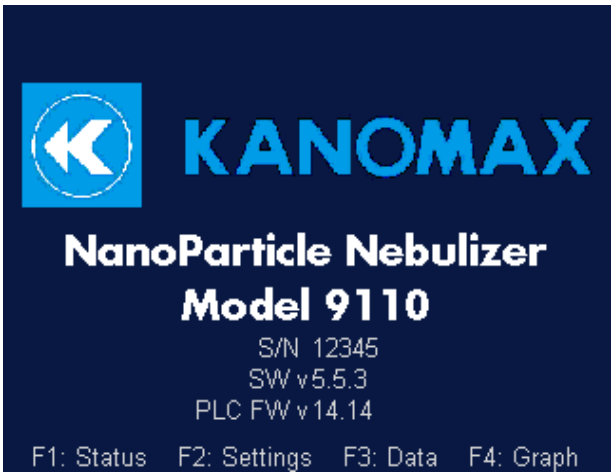
1. Plug the provided RS 232 cable into the **Serial** port on the back panel of the NanoParticle Nebulizer.

2. Plug the other end of the cable into the **RS232 IN** port on the back panel of the peristaltic pump.

Warming Up the Nebulizer

Using the rocker switch on the back panel, turn the power on. You see the instrument splash screen (shown below) and the nebulizer automatically begins its warm-up procedure. The warm-up procedure may take up to 15 minutes. Press **F1** to view the warmup status on the Device Status screen.

Figure 4: NanoParticle Nebulizer Warmup Screen.



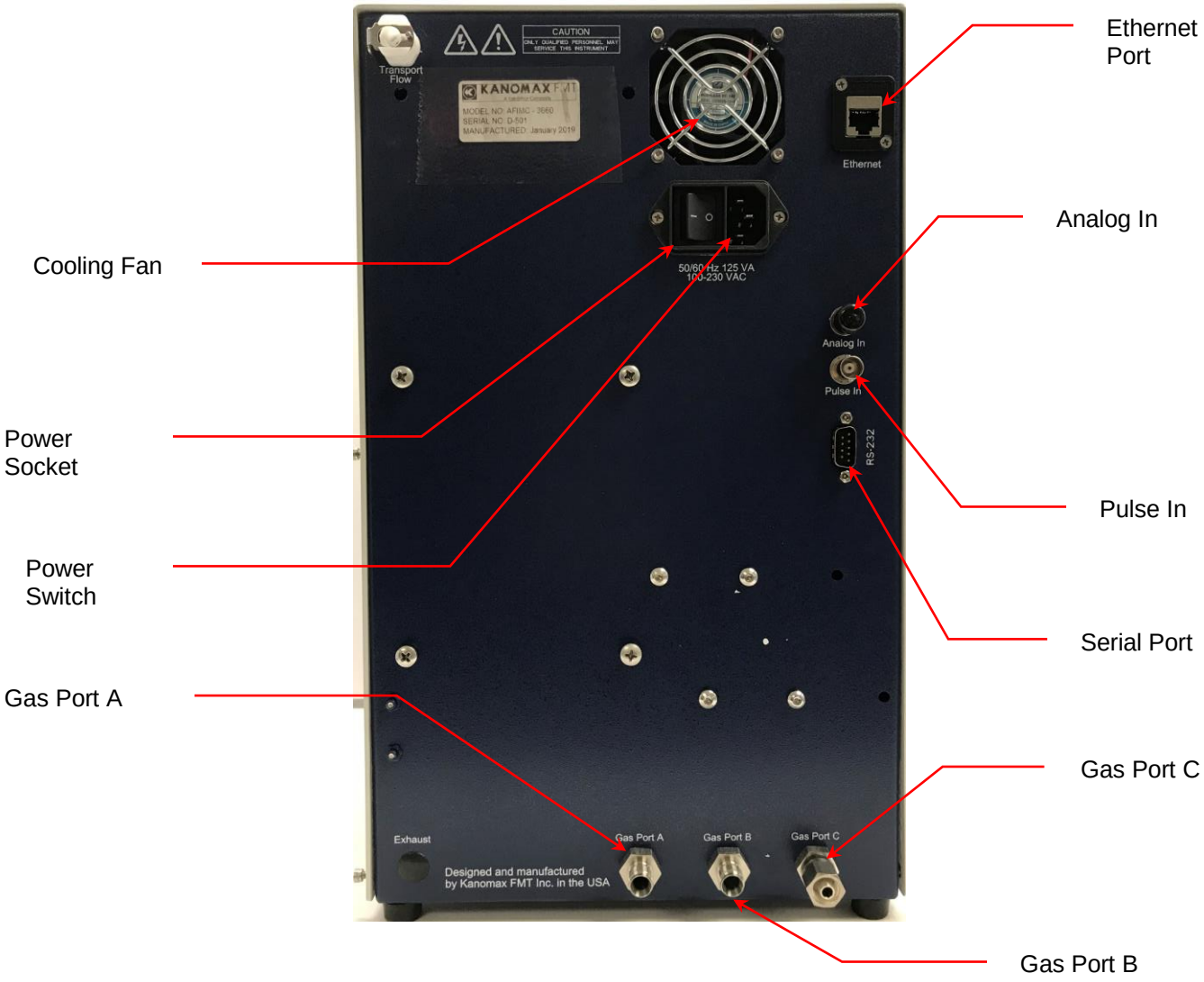
Installing the Annular Flow Ion Mobility Classifier

Figure 5 and Figure 6 show the front and back panels of the Annular Flow Ion Mobility Classifier (AFIMC) Model 3660 .

Figure 5: Front panel of the AFIMC

Components of the back panel are shown in Figure 6 below.

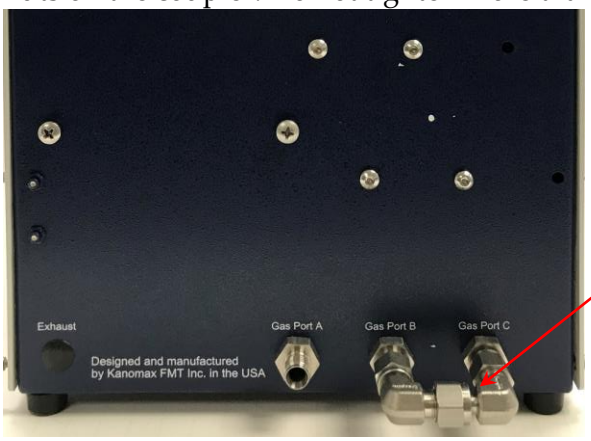
Figure 6: Back panel of the AFIMC.



Connecting Gas Port B to Gas Port C

Follow these instructions to connect Gas Port B to Gas Port C:

1. If you have not already done so, remove the protective shipping caps from Gas Ports B and C.
2. Remove the **Gas Port Coupler** from the LNS Accessory Kit.
3. Connect the **Gas Port Coupler** to Ports B and C. Tighten the Swagelok nuts on the coupler. Do not tighten more than 1/8 turn past finger tight



Gas Port Coupler

Connecting CDA to Gas Port A

Follow these instructions to connect Soft x-ray purge flow gas supply to Gas Port A:

1. If you have not already done so, remove the protective shipping caps from Gas Port A.
2. Provide a gas supply line of Nitrogen or Compressed Dry Air. Note: It is highly recommended to add secondary oil and vapor filters to the gas supply when not using laboratory grade gas. Contact Kanomax FMT for more information.
3. Connect a gas supply line using Swagelok nut and ferrule. When first connecting line, fully swage the nut and ferrule by turning the nut one full turn past finger tight. Use a second wrench to keep the bulkhead fitting from rotating. Subsequent connections require only 1/8 turn past finger tight.

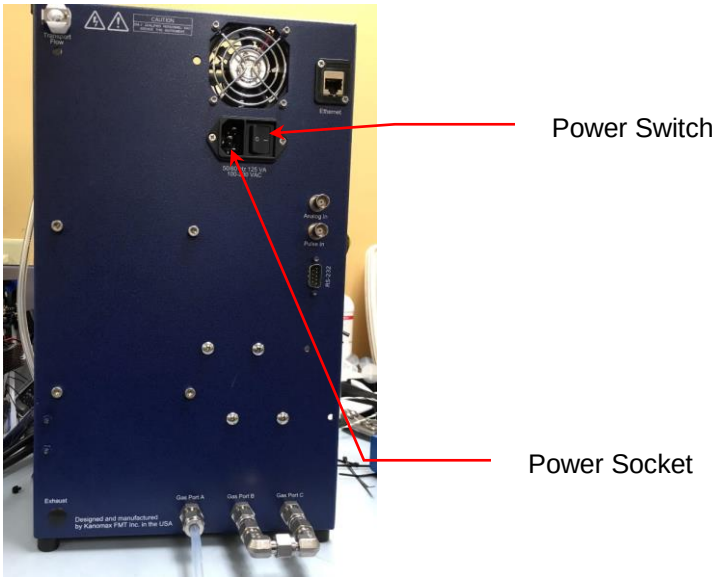
Connecting the Exhaust

The exhaust port is not used for the AFIMC and is intentionally capped.

Connecting the Power

To connect the power supply, follow these instructions:

1. Plug the supplied power cable into the socket on the back of the AFIMC.



2. Plug each cord into an earth-grounded AC power source (100 to 240 VAC, 50 to 60 Hz, 0.6 A).

Warning: Ensure that the ground is secure. Connection to an improperly grounded electrical source is a severe shock hazard.

Using the rocker switch on the back panel, turn the power on. You see the instrument warmup screen, see

Figure 7. Press **F1** to view the warmup status on the Device Status screen.

Figure 7: AFIMC Warmup screen.

Connecting the Aerosol Input

To connect the aerosol line, follow these instructions:

1. Place the AFIMC on top of the NanoParticle Nebulizer.
2. Remove the protective cap from the **Aerosol Output** fitting on the front panel.
3. Using the provided **Aerosol Sample Tube**, connect the aerosol output from the NanoParticle Nebulizer to the inlet of the AFIMC. Use the shortest practical length of tubing to minimize particle losses through diffusion.

Aerosol Sample Tube

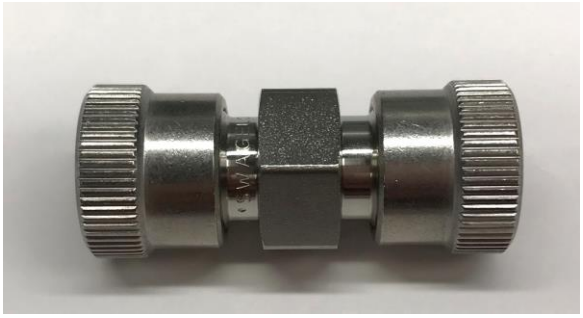
Note: The Aerosol Output outlet is at near-atmospheric pressure with an internal vent. If the AFIMC draws more than 1.5 L/min, ambient aerosol will be drawn into the sample stream. The AFIMC must draw more than 1 L/min to prevent condensation from forming in the aerosol lines.

Warning: The aerosol particles created by the NanoParticle Nebulizer may pose a health risk if inhaled. If not connected to AFIMC, vent the aerosol output to a fume hood.

Connecting the Aerosol Outlet

To prepare the connection of AFIMC aerosol outlet to Fast CPC, follow these instructions:

1. Remove the **Classifier Aerosol Coupler** from the LNS Accessory Kit.



2. Install the **Classifier Aerosol Coupler** onto the aerosol outlet on top of the AFIMC.

Installing the Fast CPC

Figures Figure 8 and Figure 9 show the front and back panels of the Fast CPC.

Figure 8: Front Panel of the Fast CPC.

Figure 9: Back Panel of the Fast CPC.

Cooling fan

Fill bottle bracket

n-Butanol Exhaust port

n-Butanol Supply port

Exhaust outlet

Ethernet port (inactive)

Analog Out

Pulse Out

Power switch

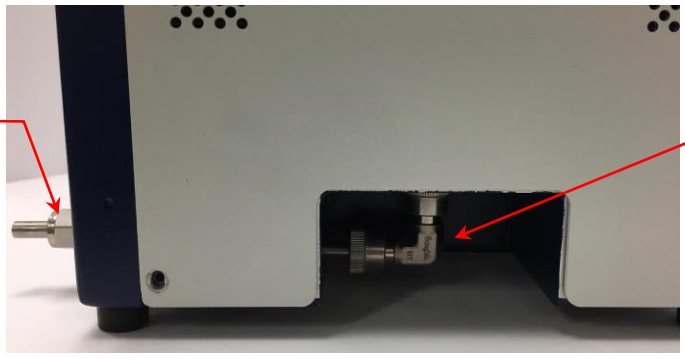
Plug socket

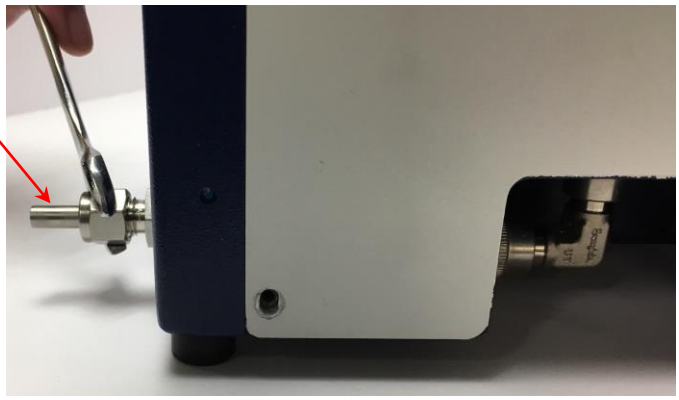
Make-up Air inlet

Connecting the AFIMC

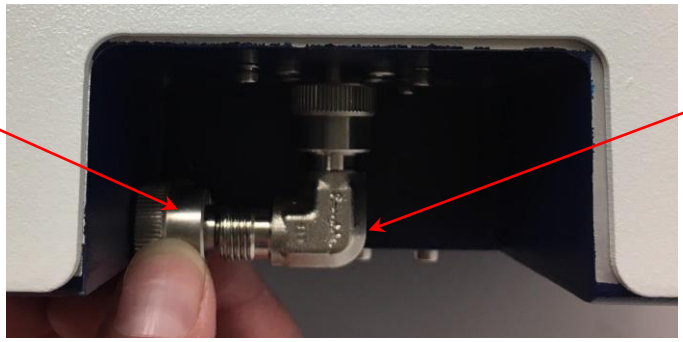
Follow these instructions to connect the Fast CPC to an Annular Flow Ion Mobility Classifier using the high-performance aerosol inlet:

1. Loosen and then remove the stainless steel nut on the **Aerosol In** fitting.



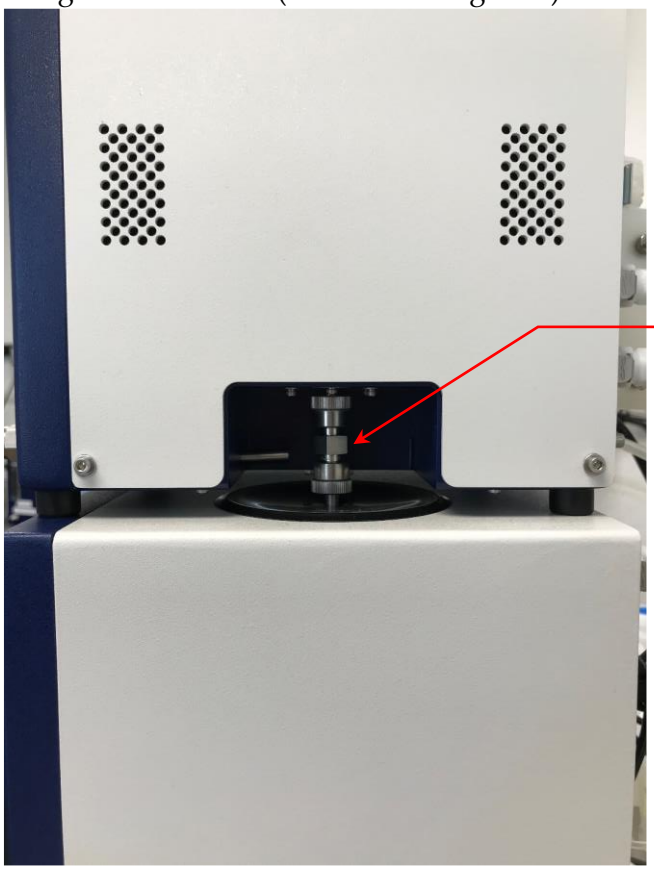


2. Pull the **Aerosol Inlet** tube forward.
3. Loosen the nut on the stainless-steel elbow joint on the **high-performance aerosol** inlet on the base of the Fast CPC.



4. Remove the elbow joint fitting. Save the joint and all its component parts for reuse. (Do not lose the O ring.)

5. Place the Fast CPC on top of the AFIMC with the **Classifier Aerosol Coupler** previously installed on the AFIMC aerosol outlet. Use the **Classifier Aerosol Coupler** to connect the AFIMC to the Fast CPC inlet. Hand-tighten both nuts. (Do not over-tighten.)

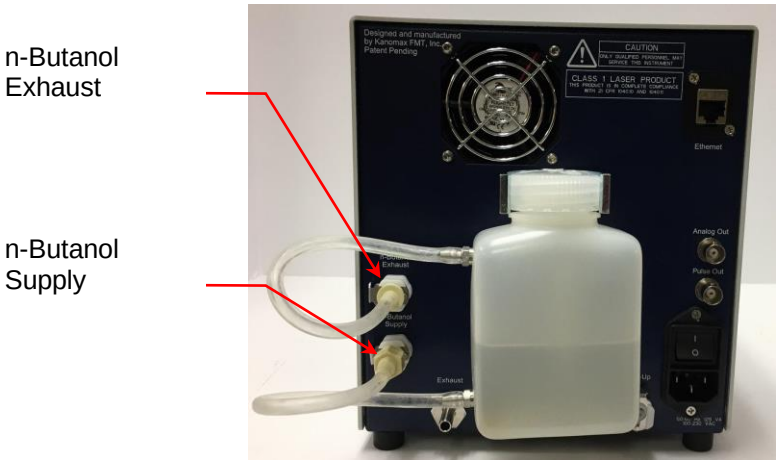


Connecting the n-Butanol Supply

The fill bottle and bottle bracket are supplied with the Fast CPC. To mount the n-Butanol bracket and fill bottle, follow these instructions:

1. Using a Phillips screwdriver, remove the two screws on the back panel of the Fast CPC (beneath the fan).
2. Using the screws, attach the bottle bracket to the back of the Fast CPC in the position shown below.

3. Snap the provided fill bottle into place in the bracket as shown in the photo below.
4. Insert the fitting on the end of the bottle's lower tube into the **n-Butanol Supply** inlet.
5. Insert the fitting on the end of the bottle's upper tube into the **n-Butanol Exhaust** outlet.



Carefully pour n-Butanol into the fill bottle. Do not fill past the n-Butanol exhaust fitting level. The n-Butanol will not flow into the CPC until the connections are made, the instrument is powered on, and the warm-up cycle is complete.
Warning: n-Butanol (n-butyl alcohol) is flammable and toxic; follow appropriate chemical handling procedures.

Connecting the Exhaust

The air flow containing n-Butanol vapor exits the Fast CPC from the Exhaust port. When operating the Fast CPC in a confined space, vent the exhaust

away from the work area using flexible tubing. To vent the exhaust, follow these instructions:

1. Push one end of a length of flexible tubing compatible with n-Butanol onto the **Exhaust** outlet fitting on the back panel.

2. Place the other end of the tubing into a vent hood.

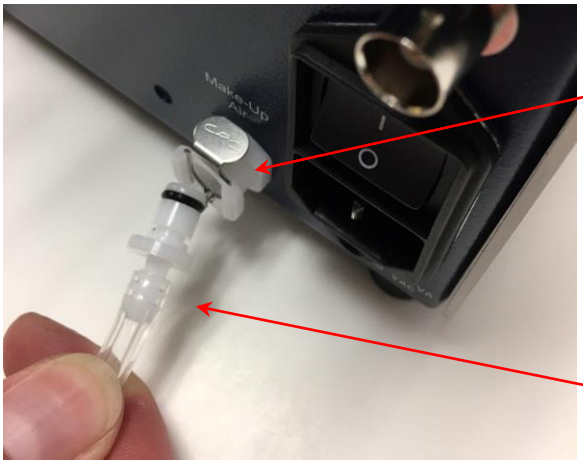
Connecting Make-Up Air

The Fast CPC can be operated in two flow modes. In the high-flow mode the instrument samples at a rate of 1.5 L/min and in the low-flow mode it samples at a rate of 600 ccm. When used as a part of an LNS system, the Fast CPC operates in the low-flow mode. To maintain a consistent flow when operating in low-flow mode, make-up air is drawn in through the **Make-up Air** inlet at 900 ccm.

Warning: Do not connect the fitting to this port while operating in the high flow mode.

To connect the make-up air supply, follow these instructions:

1. Insert one end of the supplied **LNS Transport Flow Coupler** with Quick Disconnect 1/8 in barbed tube into the **Make-Up Air** port on Fast CPC, and the other into the **Transport Flow** port on AFIMC.


Make-Up Air port
LNS Transport Flow Coupler


KANOMAX FMT
Ethernet
Analog Out
Pulse Out
n-Butanol Exhaust
n-Butanol Supply
Exhaust
CAUTION
LNS Transport Flow Coupler

Connecting the Power

To connect the power supply, follow these instructions:

1. Plug the supplied power cable into the AC plug socket on the back panel of the Fast CPC.

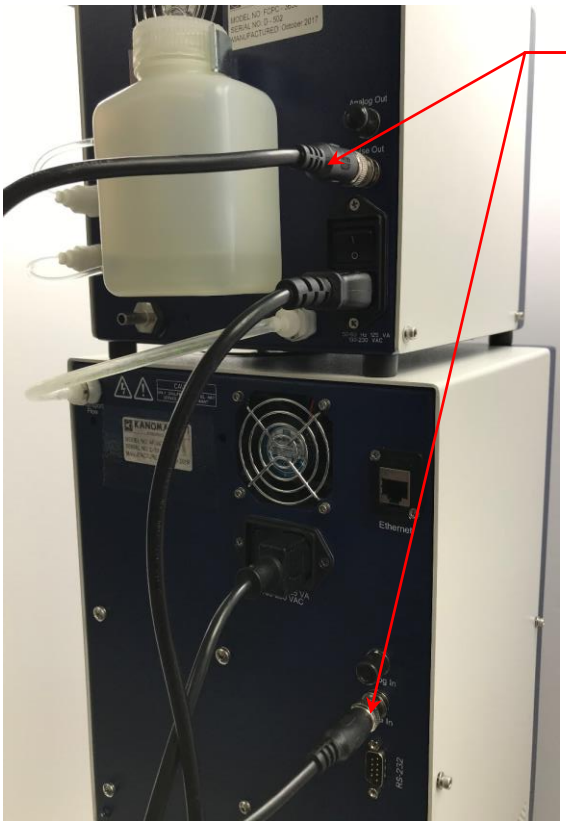
2. Plug the cord into an earth-grounded AC power source (100 to 240 VAC, 50 to 60 Hz, 0.6 A).

Warning: Ensure that the ground is secure. Connection to an improperly grounded electrical source is a severe shock hazard.

Connecting the BNC Cable

To connect the BNC Cable, follow these instructions:

1. Remove the BNC Cable from the LNS Accessory Kit.
2. Connect the BNC Cable to **Pulse Output** (on the Fast CPC) and **Pulse Input** (on the AFIMC).

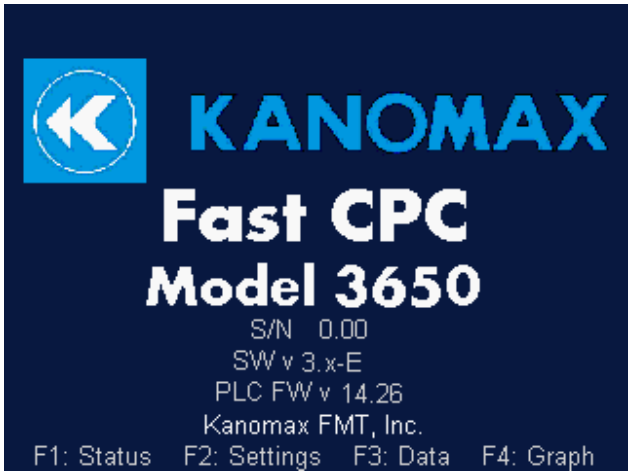

BNC Cable
Connection

Warming Up the Fast CPC

Using the power switch on the back panel, turn the power on. You see the instrument splash screen (shown below) and the Fast CPC automatically begins its warm-up procedure. Note: The warm-up procedure may take up to 15 minutes. When the warm-up cycle is complete, n-Butanol begins to fill the internal reservoir.

Press **F1** to view the warm-up status on the Device Status screen.

Figure 10: Fast CPC Warmup Screen.



If you experience any problems installing your Model 9310 Liquid NanoParticle Sizer system, please contact Kanomax FMT, Inc. at 651-762-7762 (Customers in Asia please call +81 6-6877-0183.) You may also open a help ticket by sending an email to Support@KanomaxFMT.com.

Installing the Kanolysis Model S330 Software

Kanolysis (Model S330) is software specifically designed to operate Kanomax FMT products such as the Liquid NanoParticle Sizer system. A copy of the software installer is supplied on the USB flash drive shipped with the LNS Accessory Kit. It can also be downloaded from the URL below using the unique passcode supplied on page **Error! Bookmark not defined.** of this user manual.

https://kanolysis.com/download

If you experience any problems installing or using Kanolysis, please contact Kanomax FMT, Inc. at 651-762-7762 for support. (Customers in Asia please call +81 6-6877-0183.)

System Requirements

A computer running the *Microsoft Windows 10* ® operating system is required in order to use Kanolysis. Recommended minimum system capabilities are as follows:

- Intel Core i5-8300 2.3GHz CPU
- 8GB RAM
- 128GB SSD with at least 1GB of available storage space
- Wired network interface adapter (Gigabit Ethernet)

If support for other platforms (such as Mac OS and Linux) is desired, please contact Kanomax FMT, Inc. to discuss possible accommodations.

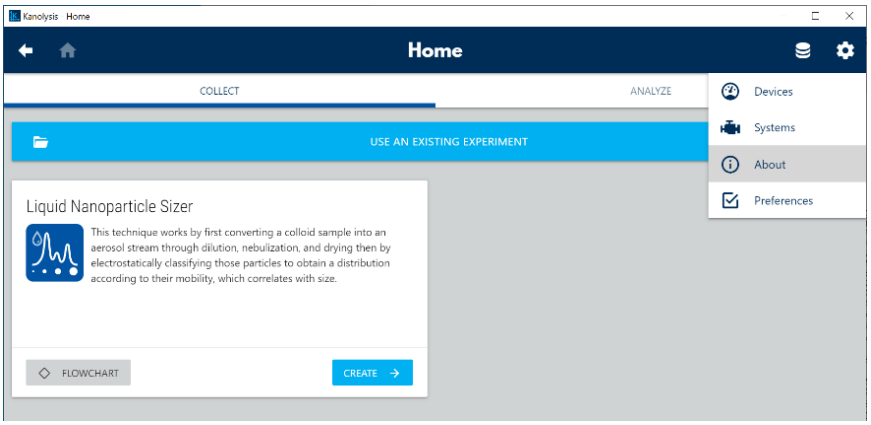
Installing Kanolysis

To install Kanolysis on a computer for the first time, run the corresponding installer (e.g. "kanolysis-1.0.0 Setup 64-bit.exe"). When the installation has finished successfully, a desktop shortcut will be added, and the program will start automatically.

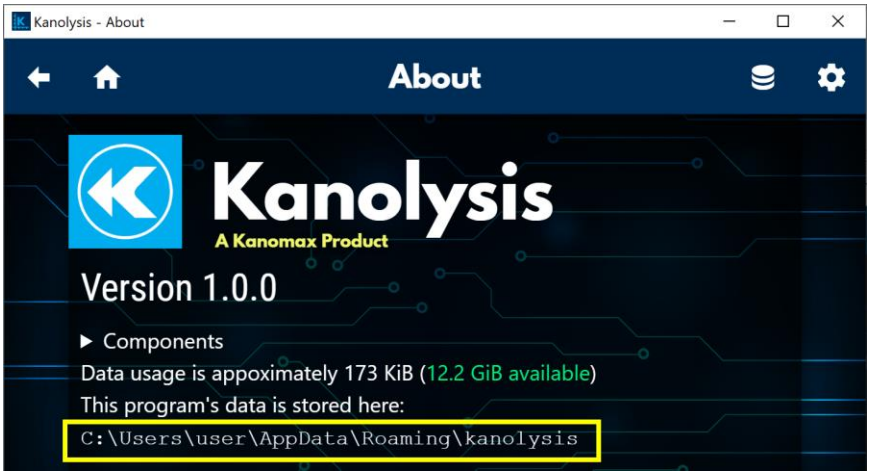
Creating a Backup Archive of Kanolysis Data

The following instructions can be used to create a backup copy of all data stored by Kanolysis:

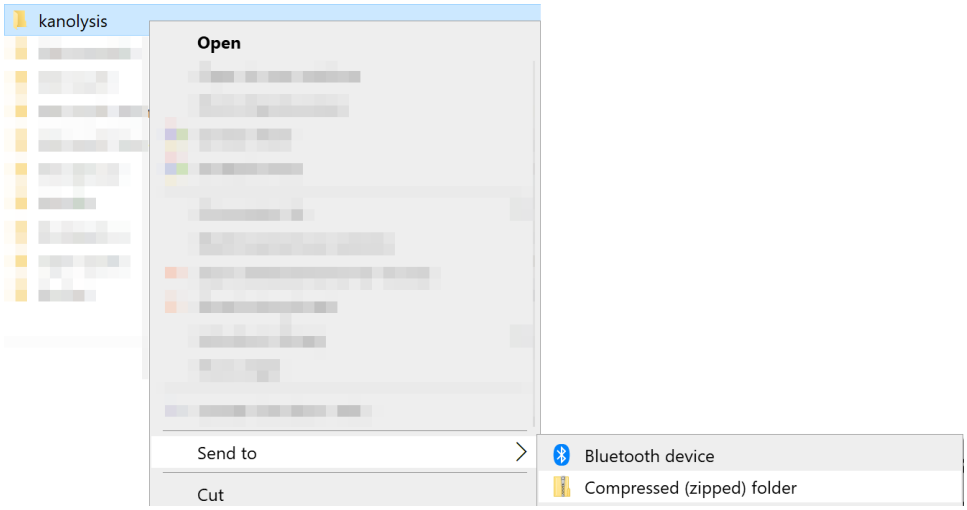
1. Run Kanolysis
2. Navigate to the "About" screen by clicking the settings menu button () button then selecting "About".



3. Note the data storage location (as illustrated in the example below)



4. Run Windows Explorer.
5. In Windows Explorer, navigate to the folder containing the one observed in step 3.
   Note: It may be convenient to begin by entering `%APPDATA%` in the location bar, since this is typically equivalent to entering the path "`C:\Users\<name>\AppData\Roaming\`"
6. Right-click on the data folder and select "Send to" > "Compressed (zipped) folder."



7. Rename the generated archive file so that it includes the version of the software and current date for reference. For example, “kanolysis_customerX_v1.0.0_20200218.zip”

Upgrading Kanolysis

If upgrading from a previous version, it is strongly recommended that you first make a backup of your data as described in the previous section. This is particularly noteworthy for versions prior to v1.0.0 because data from those versions will not be automatically preserved. If you would like to migrate existing data please contact Kanomax FMT, Inc. for support. Otherwise, follow the instructions in the “Installing Kanolysis” section on page 37.

Uninstalling Kanolysis

To uninstall the software, use the standard tool provided by the operating system (e.g. in Windows 10, search for "Add or Remove Programs" or run the "Settings" application and click on "Apps"). Note that custom program data, such as collected measurements, are not automatically removed by this process. To delete all data, remove the program data folder (as shown on the “About” screen and described in the “Creating a Backup Archive of Kanolysis Data” section on page 37) manually after uninstalling the software.

If you experience any problems upgrading your Model S330 Kanolysis Software, please contact Kanomax FMT, Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.)

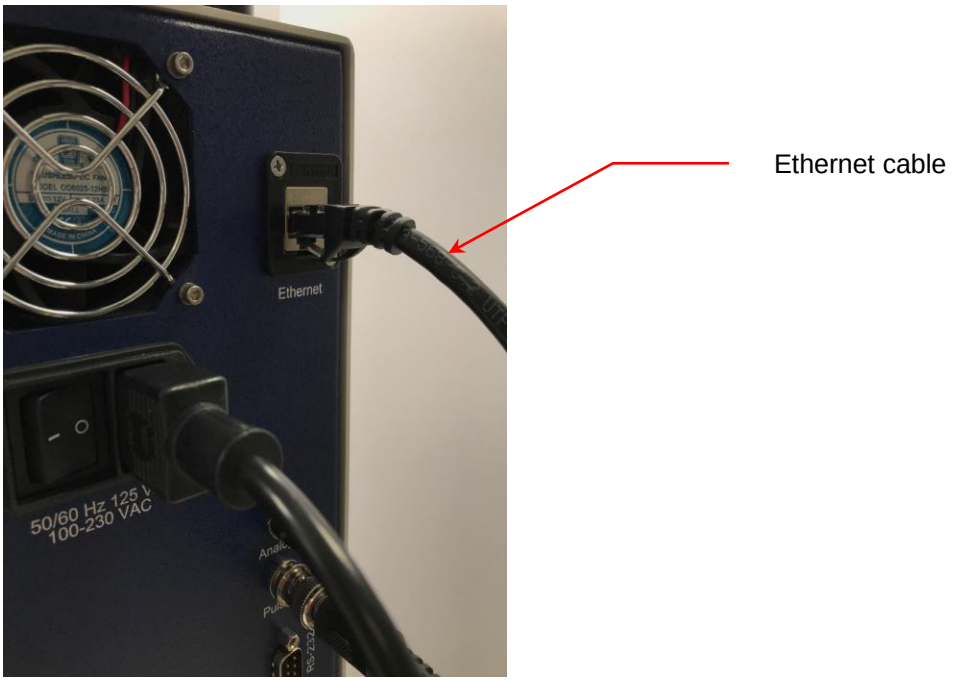
Installing the Local Network

Kanolysis communicates with the LNS instruments using the ModbusTCP protocol and thus requires that the computer running the software, as well as each instrument, have a its corresponding network interface properly configured. The instruments each use a wired Ethernet connection with a static IPv4 configuration. Many configurations are possible, but a thorough discussion of network administration is beyond the scope of this document. Instead, Kanomax FMT recommends and supports the setup described in the subsequent sections. If you would like to connect these instruments to an existing network, please contact your network administrator for the appropriate settings to enter. Be sure to use those same IP address values when following the instructions in the "Configuring Kanolysis Software for LNS Measurements" section.

To install the local network for Kanolysis communication, follow these instructions:

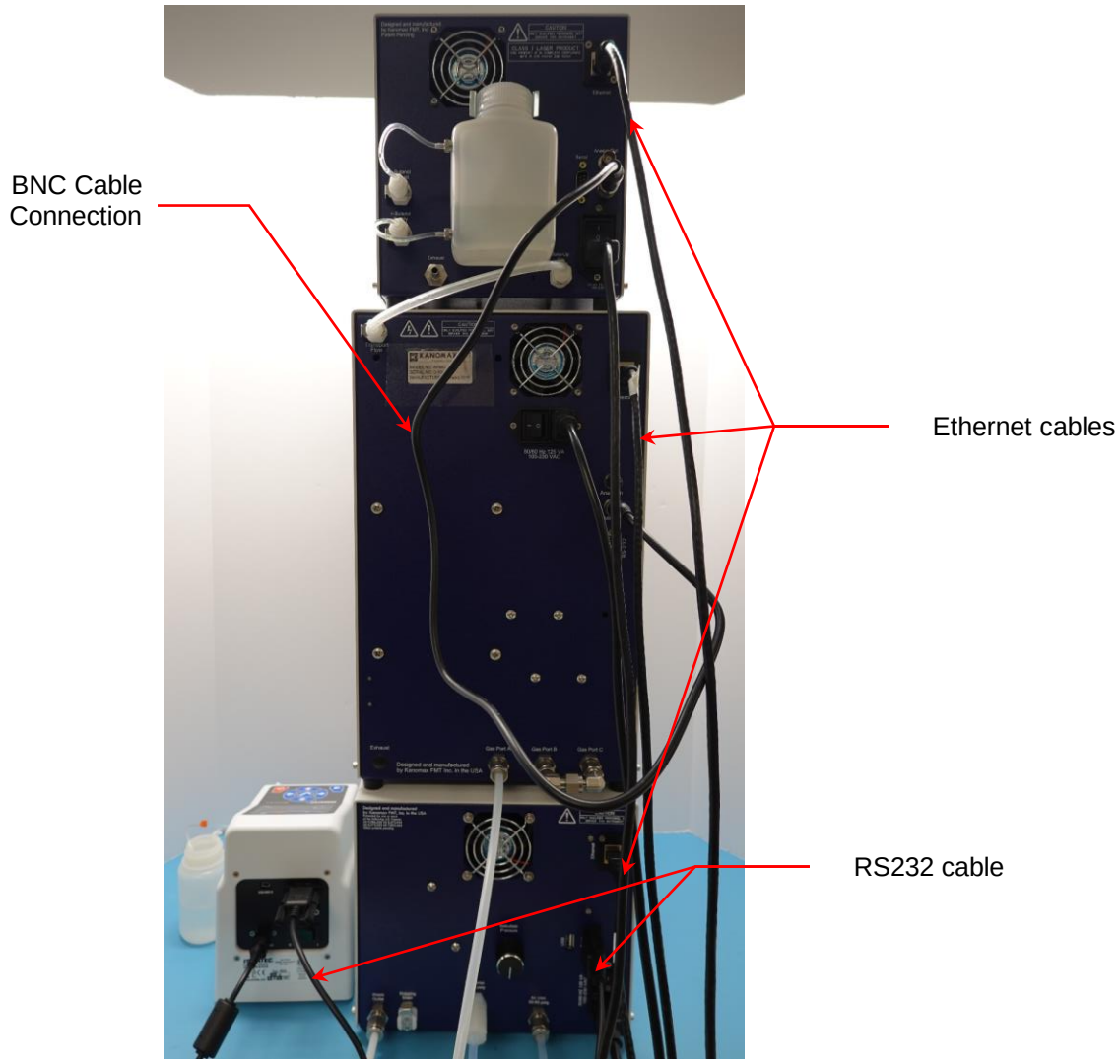
1. Plug one supplied Ethernet cable into the **Ethernet** port on the back panel of the NanoParticle Nebulizer.

2. Plug one supplied Ethernet cable into the **Ethernet** port on the back panel of the Annular Flow Ion Mobility Classifier.



3. Plug one supplied Ethernet cable into the **Ethernet** port on the back panel of the Fast CPC.

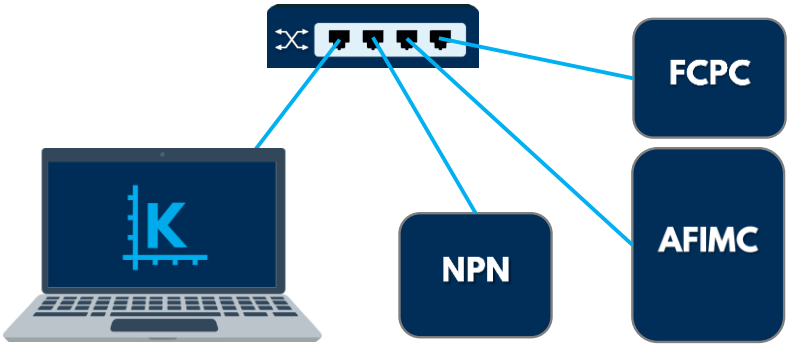
4. The LNS back panel configuration is now complete.



5. Plug the other end of each Ethernet cable into one Ethernet port on the supplied Ethernet switch.

6. Use one supplied Ethernet cable to connect the Ethernet switch to a nearby network access point, or to the computer with Kanolysis Model

S330 installed. Although it is possible to use the computer's built-in Ethernet port if equipped, Kanomax FMT recommends using a dedicated USB-Ethernet adapter, supplied in the LNS Accessory Kit, to avoid interfering with connectivity to other networks.



7. For IPv4 configurations, apply the network settings shown in Table 1. To access the network settings screen of each instrument, press **F2** on the display screen and touch **More Settings / Configuration** and **Network** buttons.

Table 1: IPv4 Configuration Settings

Device name	IP address	Network mask	Default gateway	DNS servers
Computer	10.41.4.1	255.255.255.0	(blank)	(blank)
NPN	10.41.4.2	255.255.255.0	0.0.0.0	N/A
AFIMC	10.41.4.3	255.255.255.0	0.0.0.0	N/A
FCPC	10.41.4.4	255.255.255.0	0.0.0.0	N/A

Note that if the computer is attached to other networks, the user must also ensure there is no overlap with this subnet.

To configure the computer's network interface, follow these instructions:

8. Right-click the Start button and select "Run" from the context menu (or press ⊞ + R).
9. Enter "ncpa.cpl" then click "OK" to open the "Network Connections" window.
10. Right-click on the Ethernet adapter that is connected to the instrument network then select "Properties" from the context menu to open the network adapter properties window.
11. Select "Internet Protocol Version 4 (TCP/IPv4)" then click "Properties".
12. Enter the corresponding network settings then click "OK" to close the "Internet Protocol Version 4 (TCP/IPv4) Properties" dialog window.

13. Click “OK” to apply the changes to the network adapter settings.

Operation Instructions

Once all installation procedures have been completed, you are ready to begin standard operation of the Liquid NanoParticle Sizer system.

The touchscreen displays on NanoParticle Nebulizer, AFIMC, and Fast CPC can be navigated by the F1, F2, F3, F4, and F5 (for AFIMC only) buttons. The F buttons perform the following functions:

- F1: Press F1 to view instrument status.
- F2: Press F2 to view/change instrument settings.
- F3: Press F3 to view/change data collection options.
- F4: Press F4 to view onscreen graphs.
- F5: Press F5 to view home screen.
- System: The System button is for factory use only and is non-functional for the customer.

Checking the Status

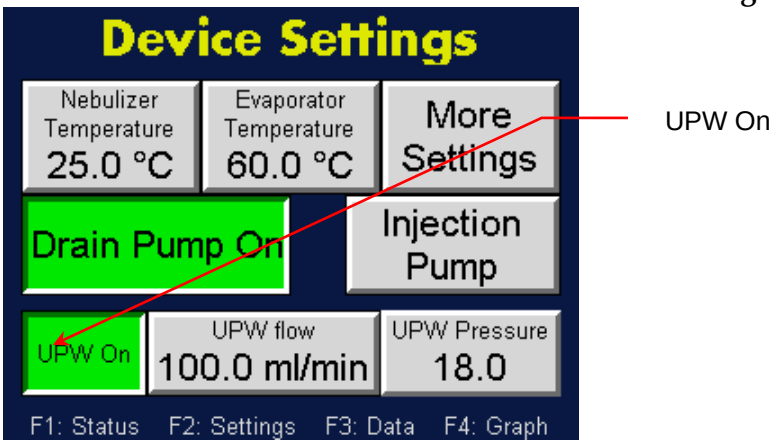
On the touchscreen displays of NanoParticle Nebulizer, AFIMC, and Fast CPC, press **F1** to see the **Device Status** screen of each instrument. The current time and date (hh:mm:ss, dd-mm-yyyy) is displayed below the screen heading. Any status readings displayed in red indicate that the status is outside the acceptable range or the set point has not been reached.

Details about the status readings of each instrument can be found in their respective user manual supplied.

Changing the NanoParticle Nebulizer Settings

To change the NanoParticle Nebulizer settings, follow these instructions:

1. Press F2 to see the NanoParticle Nebulizer **Device Settings** screen.



The **Device Settings** screen displays the following:

- **Nebulizer Temperature** allows you to set the nebulizer temperature.
- **Evaporator Temperature** allows you to set the evaporator temperature.
- **Drain Pump On/Off** allows you to turn the pump on and off to lengthen its life.
- **Injection Pump** allows you to access the settings for injection pump remote control.
- **More Settings** allows you to see options for Calibration, setting the injection pump direction and loading new firmware.
- **UPW On/Off** allows you to turn UPW supply on and off to avoid flooding before the instrument is warmed up.
- **UPW flow** allows you to set the online dilution flow rate.
- **Pressure Setpoint** allows you to set the sample pressure.

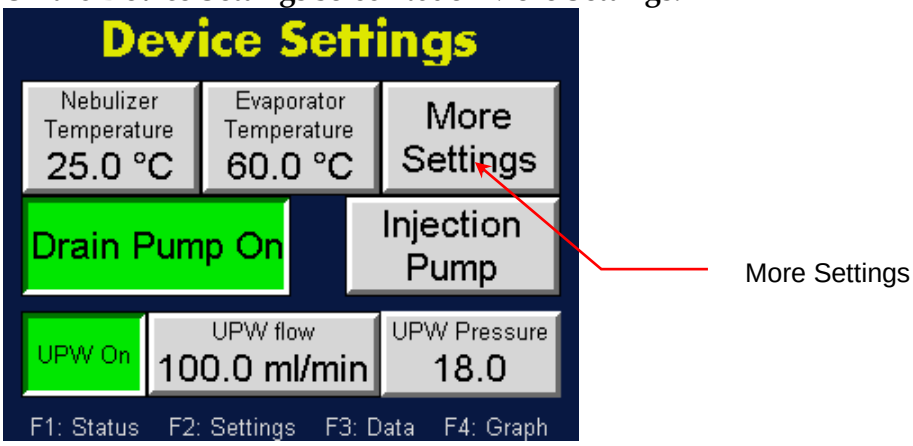
More details about the default setpoint values of the above parameters can be found in the NanoParticle Nebulizer User Manual included in the NanoParticle Nebulizer Accessory Kit.

2. Touch the **UPW On** toggle button to turn the UPW flow on.

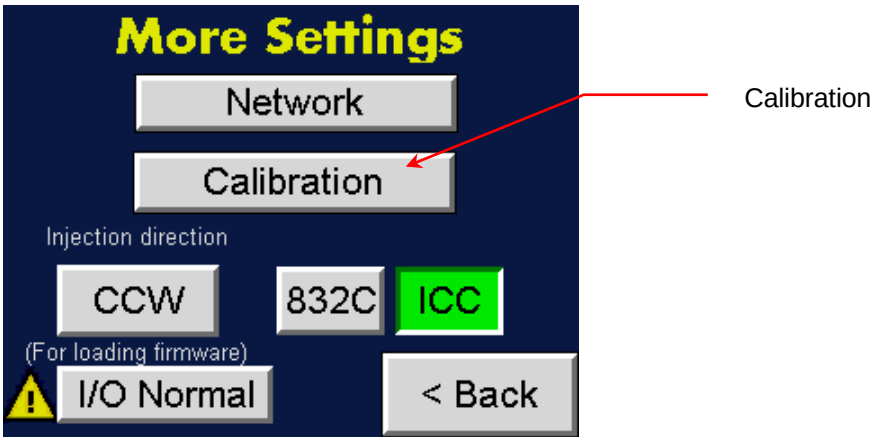
Changing the Date and/or Time

To change the date and time, follow these instructions:

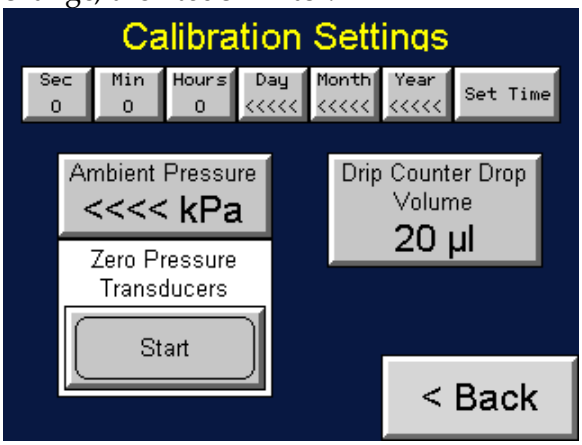
1. Press **F2**.
2. On the **Device Settings** screen touch **More Settings.**

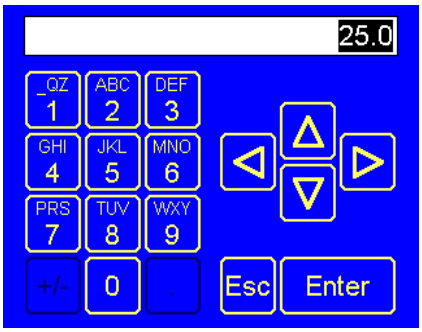


3. On the **More Settings** screen touch **Calibration**.



4. On the **Calibration Settings** screen touch **Sec** to change the seconds, **Min** to change the minutes, **Hours** to change the hours, **Day** to change the day, **Month** to change the month, and **Year** to change the year. Use the on-screen keypad to enter a value for any of the parameters you wish to change, then touch **Enter**.





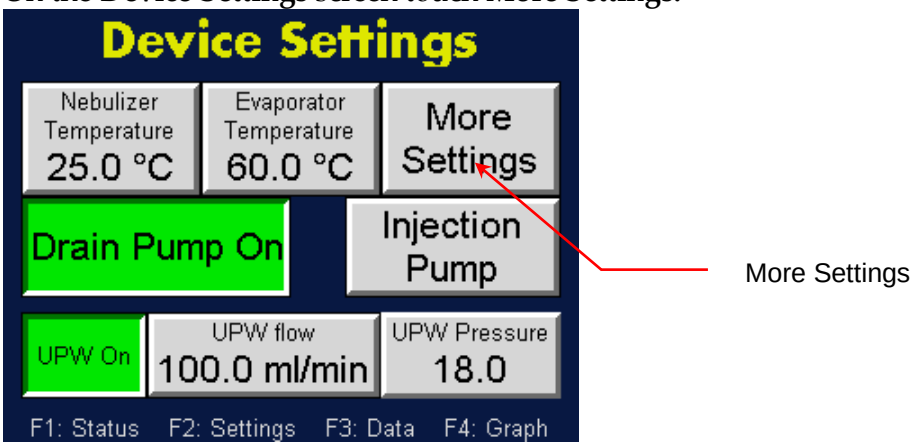
Note: △ ▽ buttons index the number. ◁ ▷ buttons set the cursor. ± sets the sign on the number.

5. Press **Set Time**. The date and time appear below the heading on the Device Status screen.

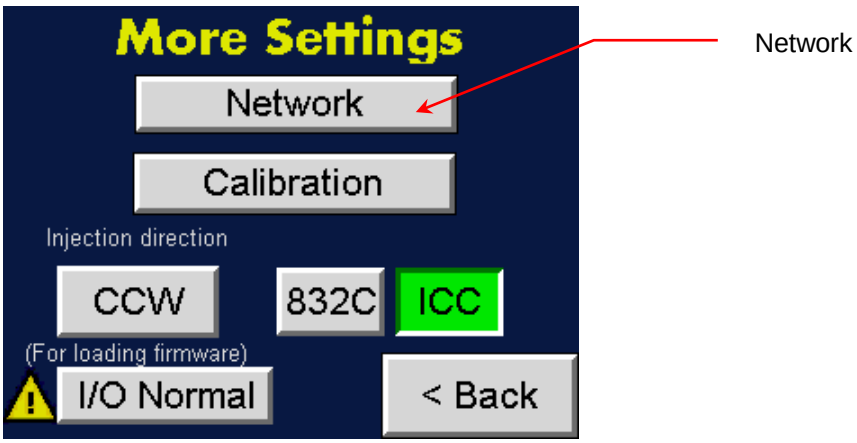
Changing the NanoParticle Nebulizer Network Settings

To change the network settings of the NanoParticle Nebulizer, follow these instructions:

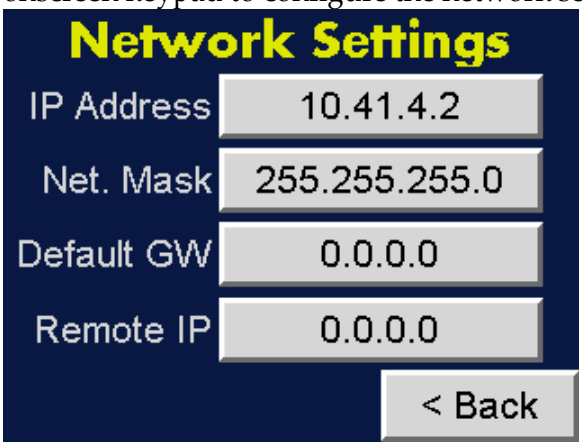
1. Press **F2**.
2. On the **Device Settings** screen touch **More Settings.**

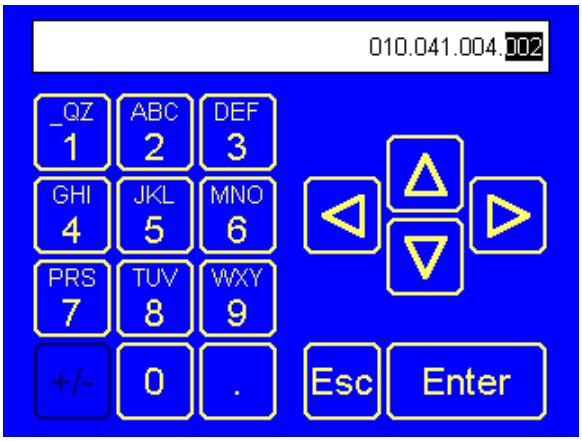


3. On the **More Settings** screen touch **Network**.



4. On the **Network Settings** screen, touch the textboxes and use the onscreen keypad to configure the network settings as below.



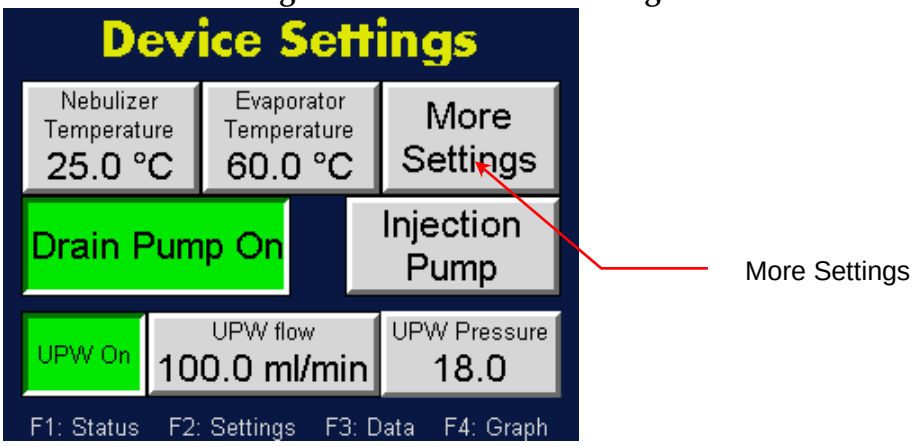


Setting Control for the Injection Pump

The external peristaltic pump can be controlled manually using the buttons on the pump or it can be controlled automatically by the NanoParticle Nebulizer.

To set the injection pump model, follow these instructions:

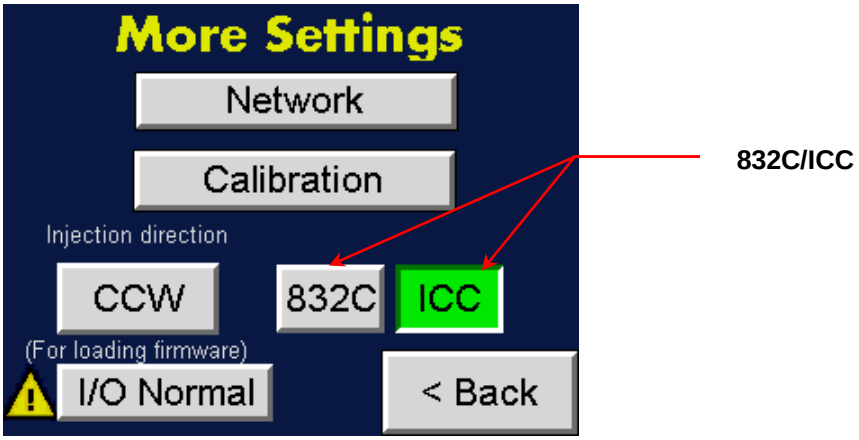
1. Press **F2**.
2. On the **Device Settings** screen touch **More Settings.**



3. There have been two peristaltic pump models provided with the LNS system, the ICC two-channel on the left, and the 832C single channel on the right.

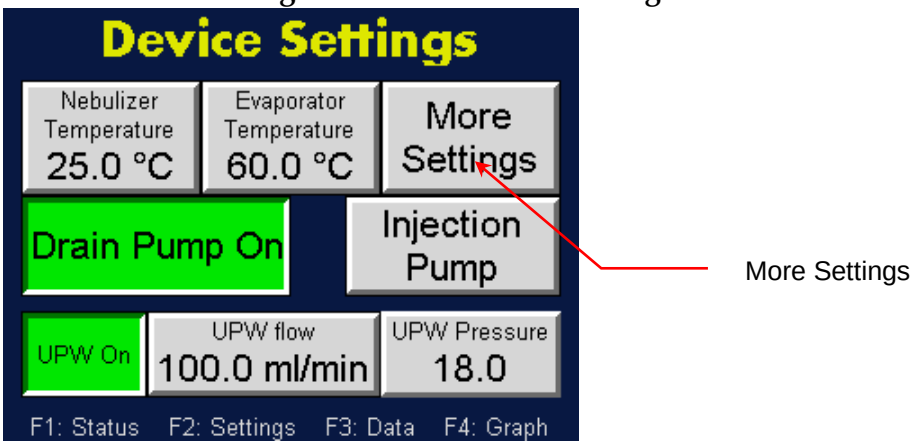
ICC  **832C** 

4. On the **More Settings** screen touch the 832C button for 832C single channel peristaltic pump, or ICC for the ICC two-channel peristaltic pump according to the model shipped with the LNS system.

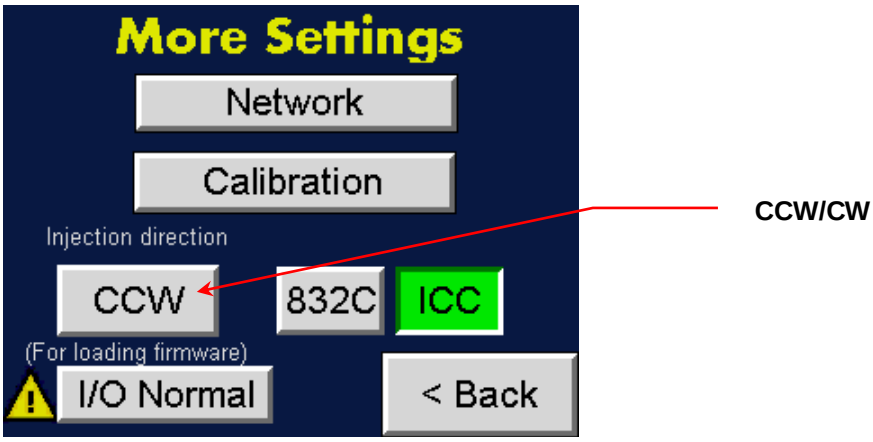


To set the injection pump direction, follow these instructions:

1. Press **F2**.
2. On the **Device Settings** screen touch **More Settings.**

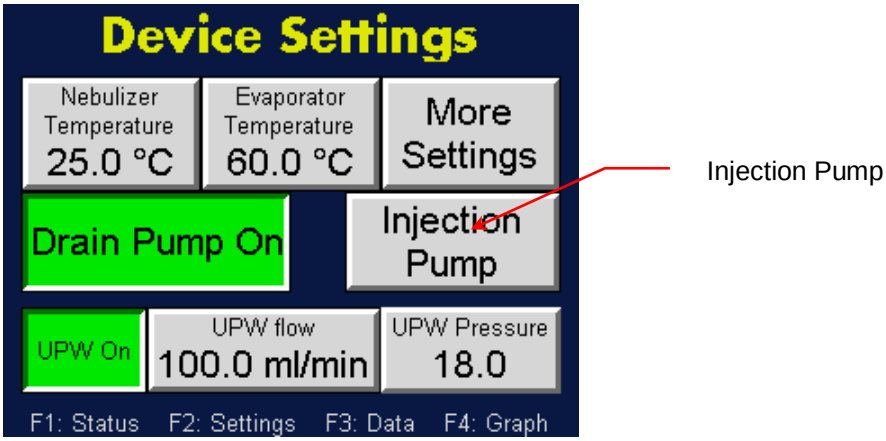


3. On the **More Settings** screen touch the CCW/CW toggle button to change the direction of injection into the nebulizer. CCW indicates a counter-clockwise direction; CW indicates a Clockwise direction.

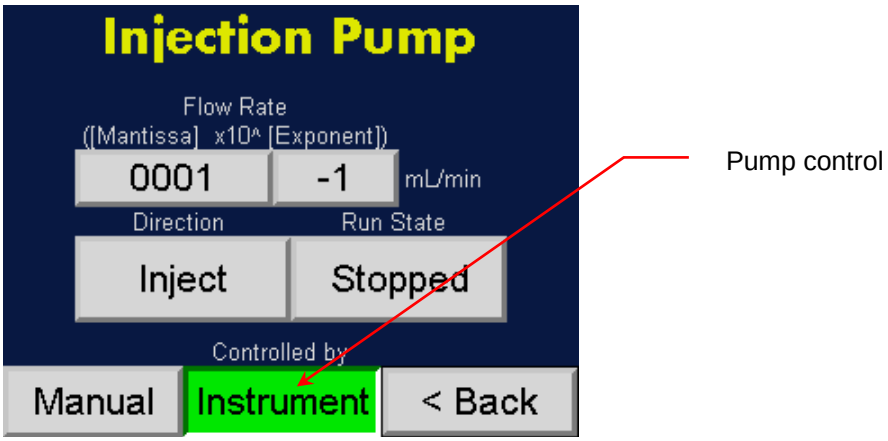


To set the injection pump control, follow these instructions:

1. Press **F2.**
2. On the **Device Settings** screen touch **Injection Pump**.



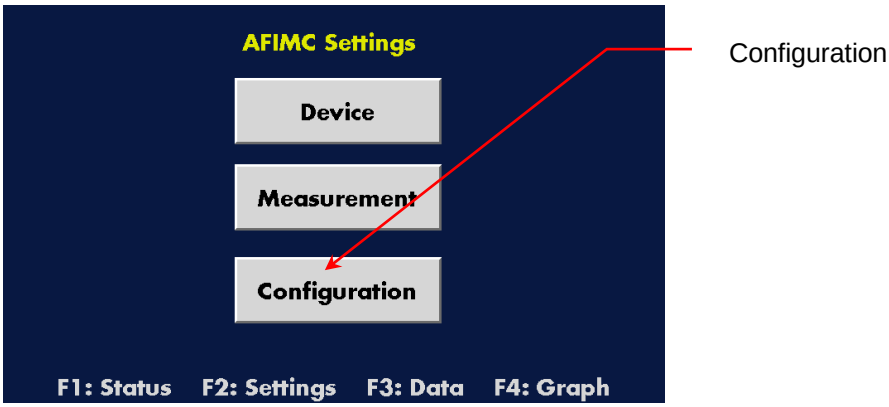
3. The **Controlled by** button toggles between **Instrument** and **Pump**. Confirm the green **Instrument** button is active so that the injection pump is controlled by the NanoParticle Nebulizer.



Changing the AFIMC Settings

To change the AFIMC settings, follow these instructions:

1. Press F2 to see the **AFIMC Settings** screen.



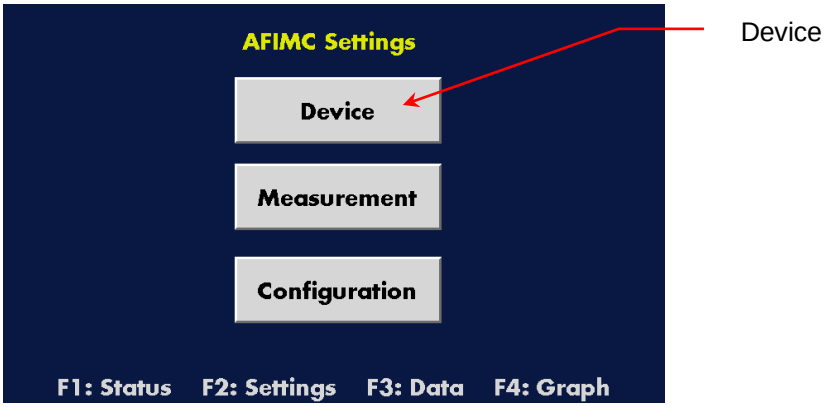
The **AFIMC Settings** screen displays the following:

- **Device** directs you to the AFIMC Device Settings screen.
- **Measurement** directs you to the AFIMC Measurement Settings screen.
- **Configuration** directs you to the Additional Settings screen.

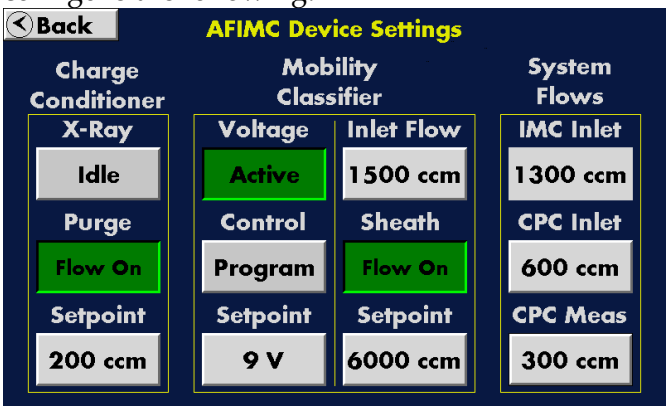
Changing the Device Settings

To change the device configuration settings of AFIMC, follow these instructions:

1. Press **F2**.



2. Touch the **Device** button.
3. On the **AFIMC Device Settings** screen, touch buttons or textboxes to configure the following:



- **Charge Conditioner** allows you to change settings of the charge conditioner.
  - **X-Ray** shows current working status of the X-Ray charge conditioner.
  - **Purge** is the **Flow On/Off** status of charge conditioner purge flow.
  - **Setpoint** is the setpoint flow rate of the charge conditioner purge flow in ccm.
- **Mobility Classifier** allows you to change settings of the ion mobility classifier.
  - **Voltage** shows the current working status of the ion mobility classifier high voltage power supply.
  - **Control** is the source of control for the high voltage power supply, confirm it is set to **Program** for LNS operations.
  - **Setpoint** is the setpoint voltage for the high voltage power supply when its control is set at **Direct**.
  - **Inlet Flow** is the total aerosol flow rate at the inlet of the AFIMC, confirm it is set at 1500 ccm for LNS operations.

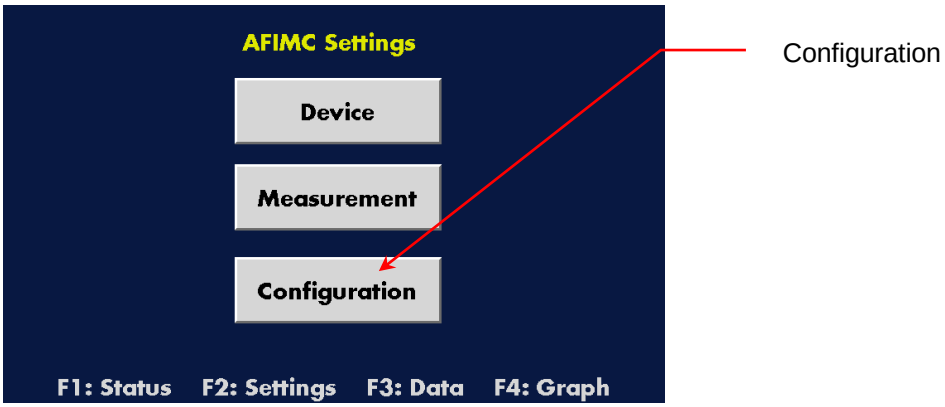
- **Sheath** is the **Flow On/Off** status of the sheath flow applied to the ion mobility classifier.
- **Setpoint** is the setpoint flowrate for the sheath flow applied to the ion mobility classifier, it is automatically set according to the selected scan mode from Kanolysis software.

- **System Flows** allows you to configure flow settings of the Annular Flow Ion Mobility Sizer (AFIMC + Fast CPC) system.
  - **IMC Inlet** is an automatically calculated value based on the **Inlet Flow** and **Charge Conditioner Purge Flow** settings.
  - **CPC Inlet** is the aerosol flow rate at the **Aerosol Inlet** of the Fast CPC.
  - **CPC Meas** is the inspected aerosol flow rate of the Fast CPC, confirm it is set at the default value of 300 ccm for LNS operations.

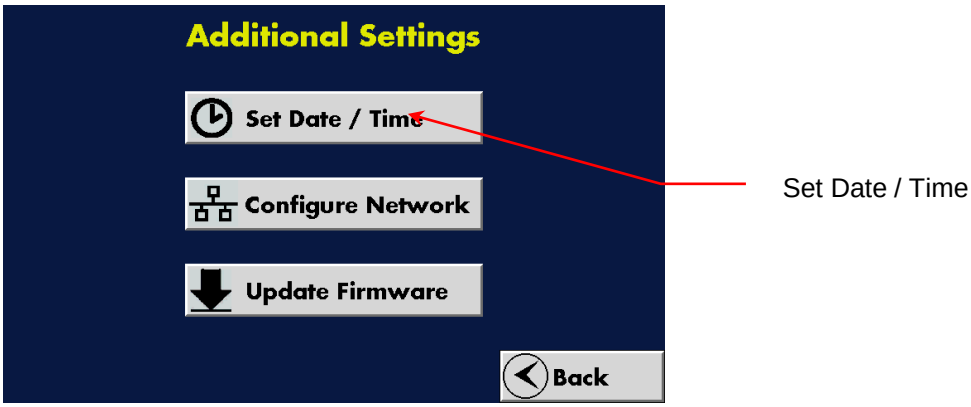
Changing the Date and/or Time

To change the date and time of AFIMC, follow these instructions:

1. Press **F2**.



2. Touch the **Configuration** button.
3. On the **Additional Settings** screen, touch the **Set Date / Time** button.



4. Touch the **Configuration** button.
5. On the **Date & Time** screen touch **Sec** to change the seconds, **Min** to change the minutes, **Hours** to change the hours, **Day** to change the day, **Month** to change the month, and **Year** to change the year. Use the on-screen keypad to enter a value for any of the parameters you wish to change, then touch **Enter**.

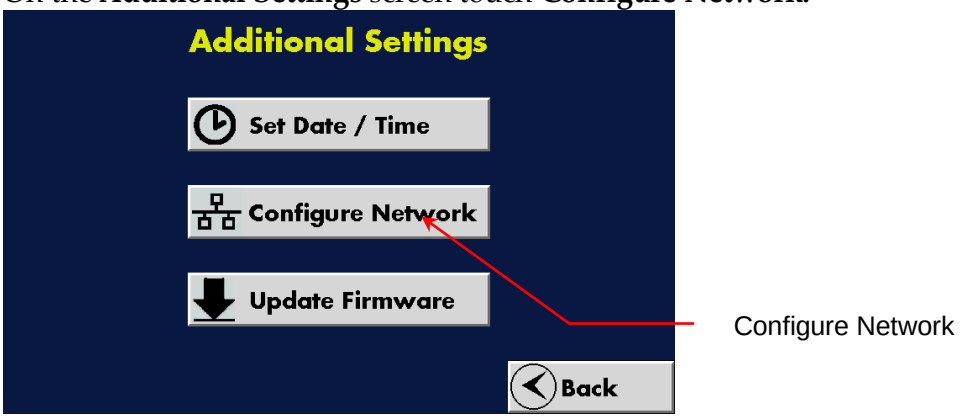
Note: △ ▽ buttons index the number. ◁ ▷ buttons set the cursor. ± sets the sign on the number.

Changing the AFIMC Network Settings

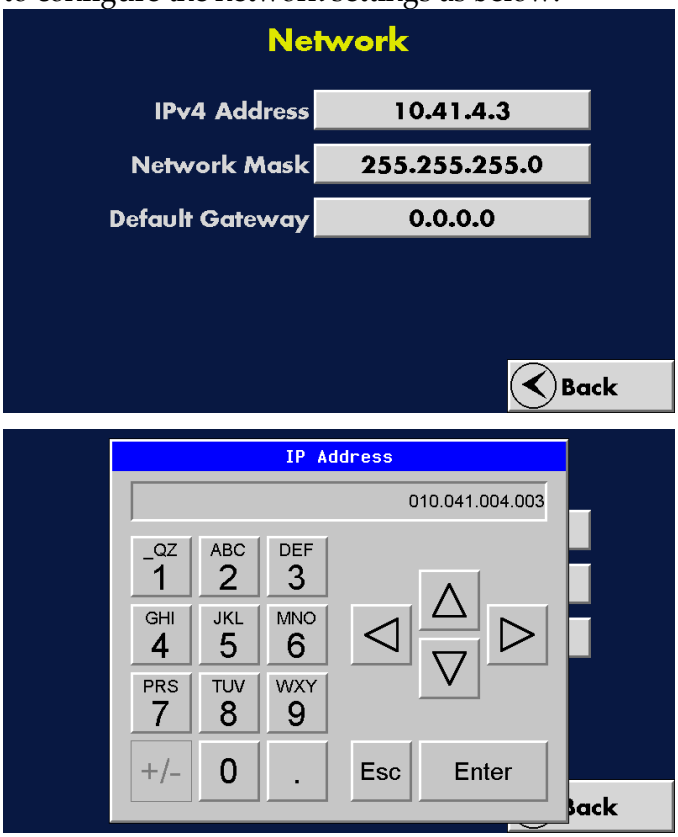
To change the network settings of the AFIMC, follow these instructions:

1. Press **F2**.

2. On the **Additional Settings** screen touch **Configure Network.**



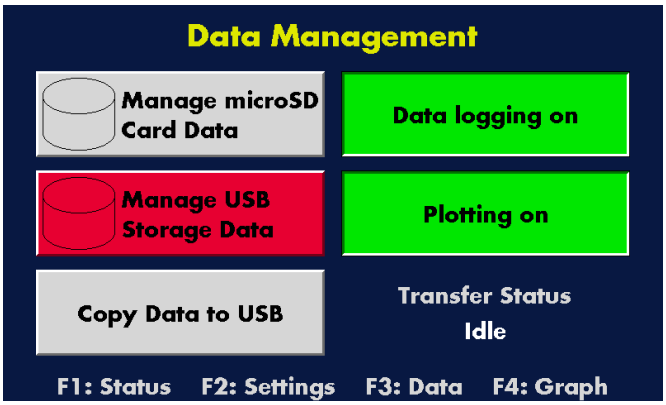
3. On the **Network** screen, touch the textboxes and use the onscreen keypad to configure the network settings as below.



Turning AFIMC Data Logging On

To turn AFIMC data logging on, follow these instructions:

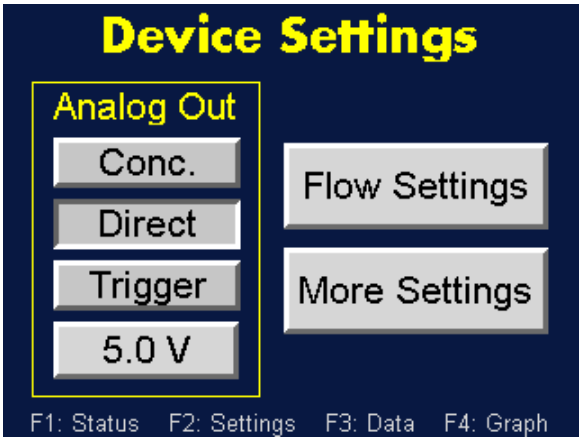
1. Press **F3.**
2. On the **Data Management** screen, if the data logging is not already on, touch the **Data Logging On/Off** toggle button to turn data logging on.



Changing the Fast CPC Settings

To change the Fast CPC settings, follow these instructions:

1. Press **F2** to see the Fast CPC **Device Settings** screen.



The **Device Settings** screen displays the following:

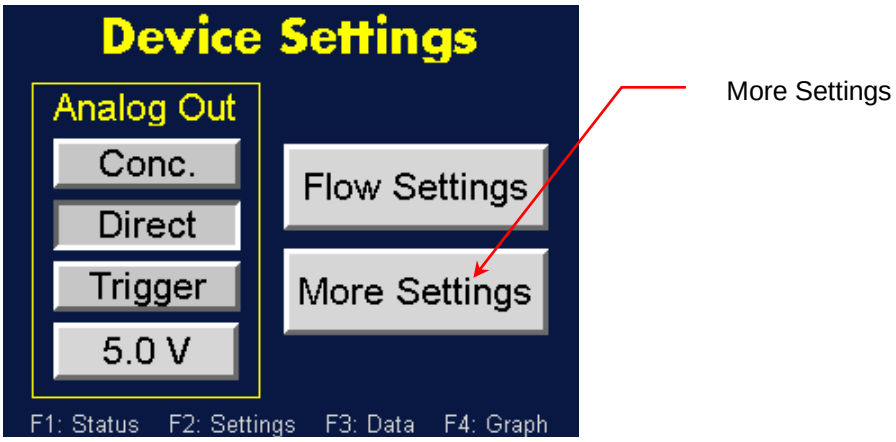
- **Analog Out** allows you to change the Analog Output signal settings.
- **Flow Settings** directs you to the Fast CPC Flow Settings screen.
- **More Settings** directs you to the Fast CPC More Settings screen.

More details about the Analog Out function can be found in the Fast CPC User Manual included in the Fast CPC Accessory Kit.

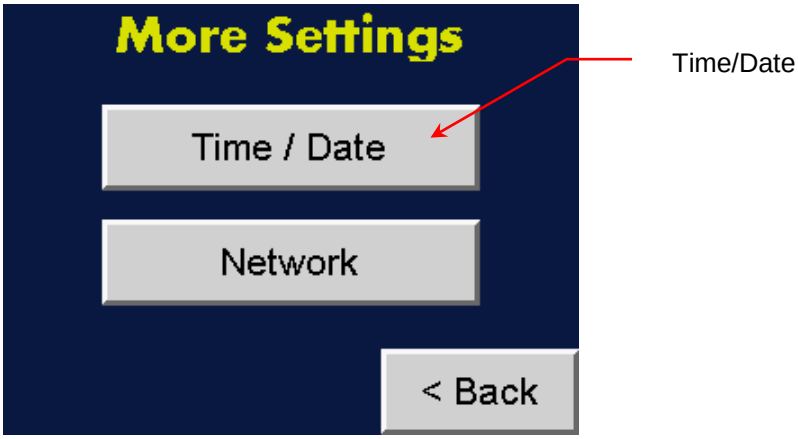
Changing the Date and/or Time

To change the date and time of Fast CPC, follow these instructions:

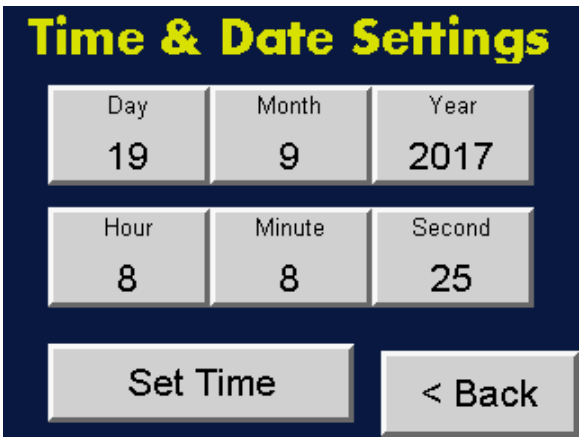
1. Press **F2**.
2. On the **Device Settings** screen, touch the **More Settings** button.

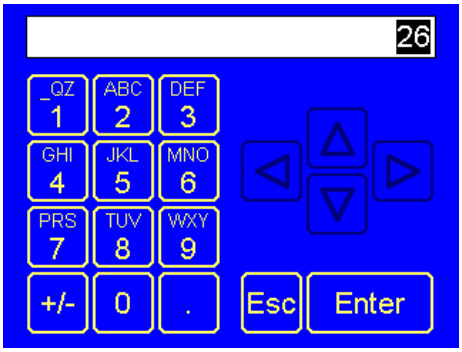


3. On the **More Settings** screen touch **Time/Date**.



4. On the **Time & Date Settings** screen, touch **Day** to change the day, **Month** to change the month, **Year** to change the year, **Hour** to change the hour, **Min** to change the minutes **and Sec** to change the seconds. Use the on-screen keypad to enter a value for any of the parameters you wish to change, then touch **Enter**.



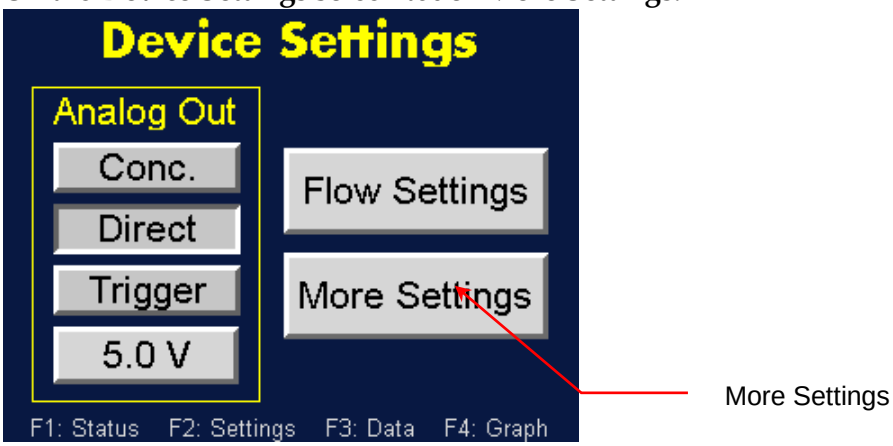


Note: △ ▽ buttons index the number. ◁ ▷ buttons set the cursor. ± sets the sign on the number.
Press **Set Time**. The date and time appear below the heading on the **Device Status** screen.

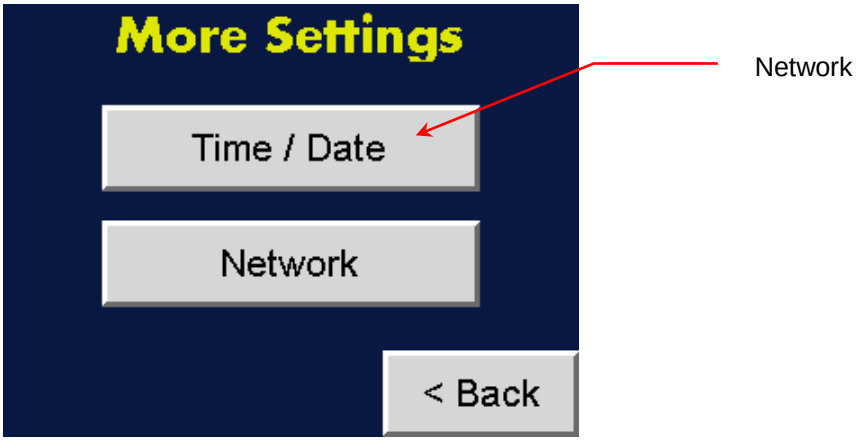
Changing the Fast CPC Network Settings

To change the network settings of the Fast CPC, follow these instructions:

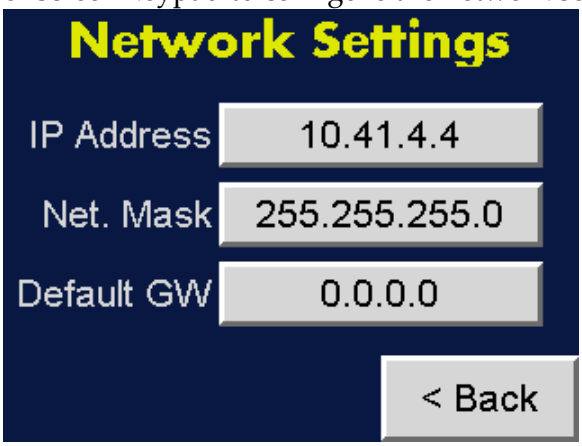
1. Press **F2**.
2. On the **Device Settings** screen touch **More Settings.**



3. On the **More Settings** screen touch **Network**.



4. On the **Network Settings** screen, touch the textboxes and use the onscreen keypad to configure the network settings as below.

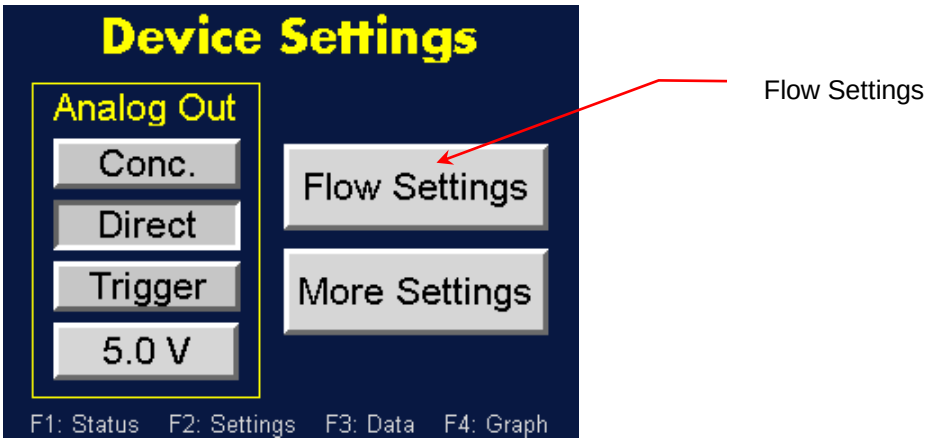


Changing the Fast CPC Flow Settings

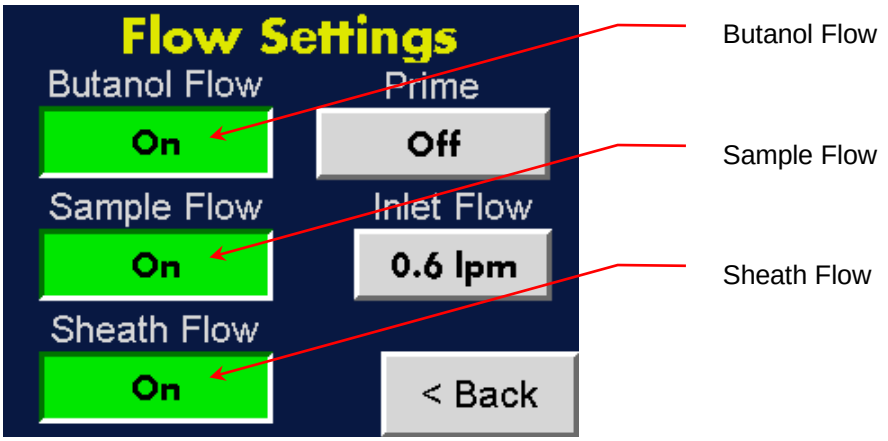
The flow setting buttons allow you to turn the Butanol, Sample, and Sheath flows On/Off, and to choose the Inlet Flow rate.

To change the flow settings, follow these instructions:

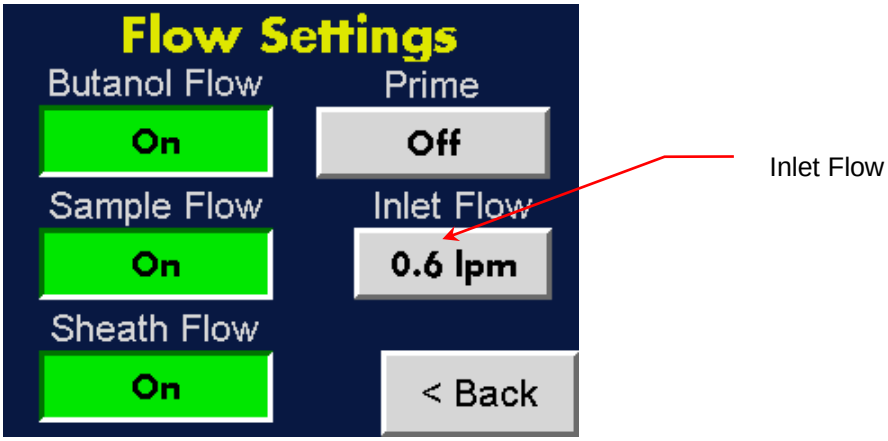
1. Press **F2**.
2. On the Device Settings screen, touch **Flow Settings**.



3. On the **Flow Settings** screen, touch the **Butanol Flow**, **Sample Flow**, and **Sheath Flow** toggle buttons to turn each flow **On** if they are not already on.



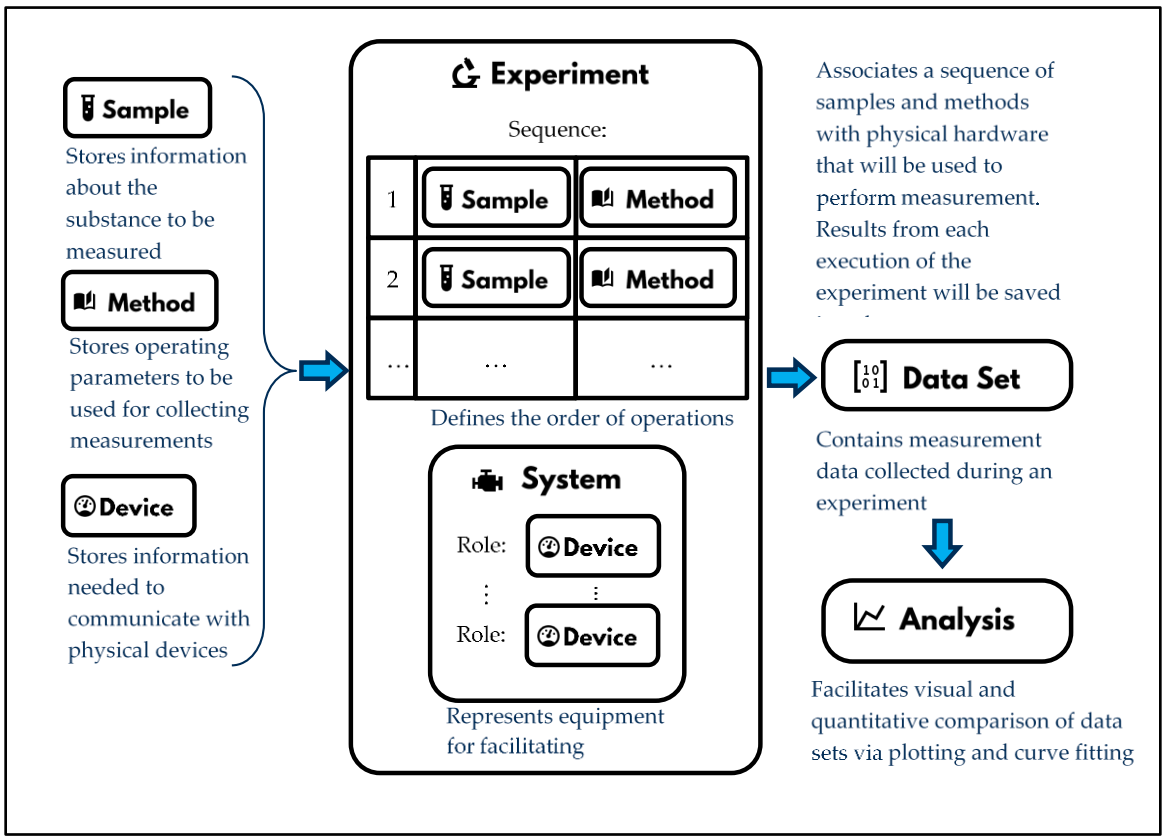
4. The **Inlet Flow** can be switched between high- (1.5 lpm) and low- Inlet Flow mode (0.6 lpm), touch the **Inlet Flow** toggle button. In high-flow mode the button is blue; in low-flow mode the button is gray. Set the **Inlet Flow** at 0.6 lpm if it is not already set so.



Configuring Kanolysis Software for LNS Measurements

The Kanolysis software uses the following structure for data organization.

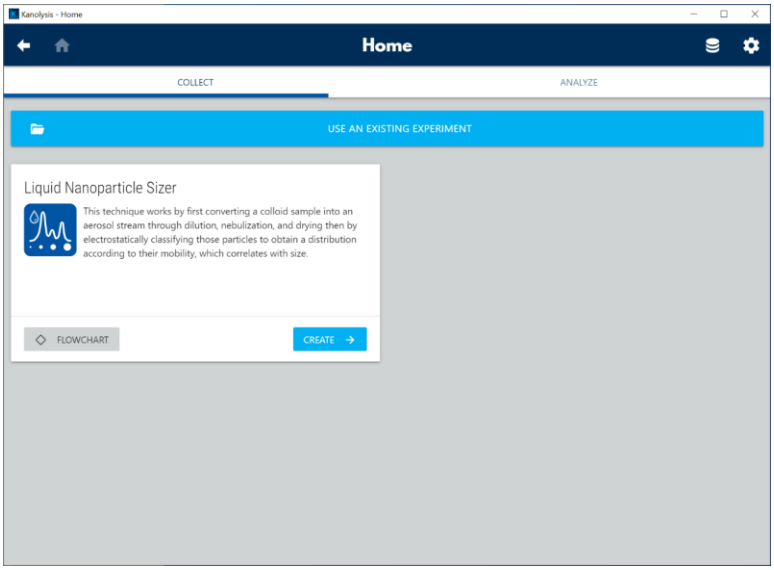
Figure 11: Kanolysis Software Data Organization Structure



To configure the Kanolysis software for making LNS measurements, follow these instructions:

1. On the computer with Kanolysis installed, double click the Kanolysis icon to launch the Kanolysis software.

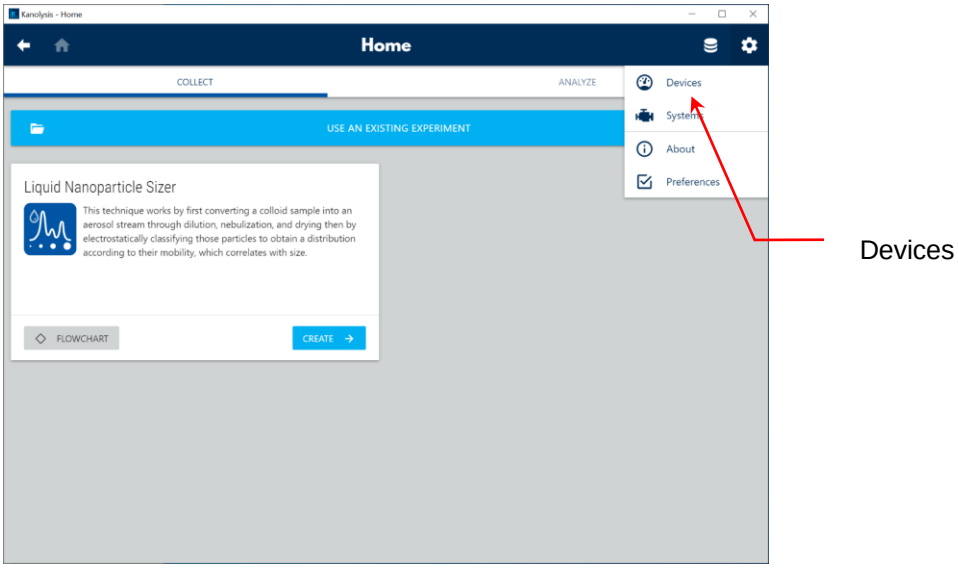
2. Confirm the Liquid NanoParticle Sizer module is shown on the main panel.



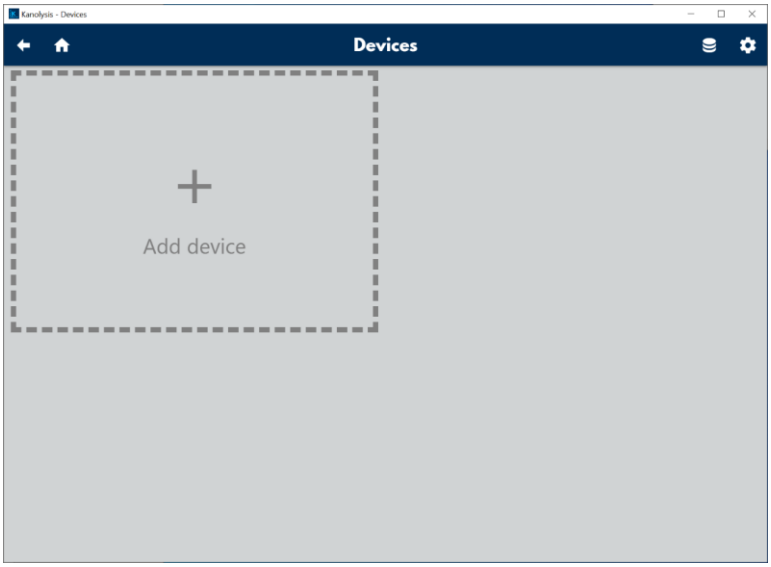
Adding Liquid NanoParticle Sizer Devices

To add device settings for the Liquid NanoParticle Sizer system, follow these instructions:

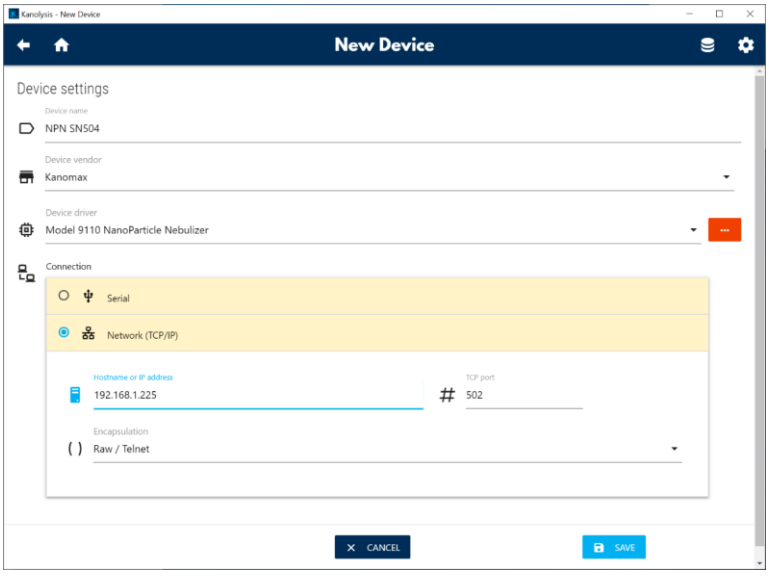
1. Click the  button to the upper right corner of the Kanolysis **Home** screen, in the drop-down list click **Devices.**



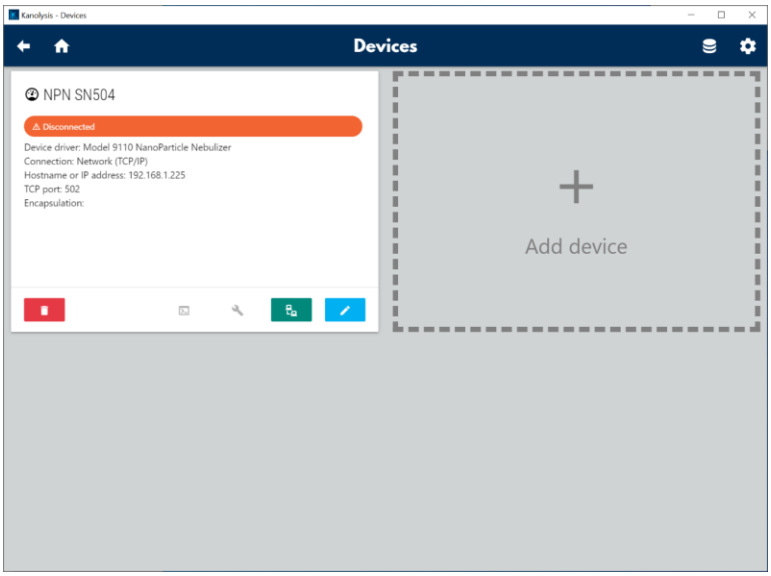
2. On **Devices** screen, click **Add device.**



3. On **New Device** screen, fill in the **Device Settings** fields with following information for the NanoParticle Nebulizer:
   - **Device name** is the name of the connected NanoParticle Nebulizer unit.
   - **Device vendor** is the vendor of the connected NanoParticle Nebulizer unit.
   - **Device driver** is the model number of the connected NanoParticle Nebulizer unit.
   - **Connection** is the network (TCP/IP) configurations of the connected NanoParticle Nebulizer unit.

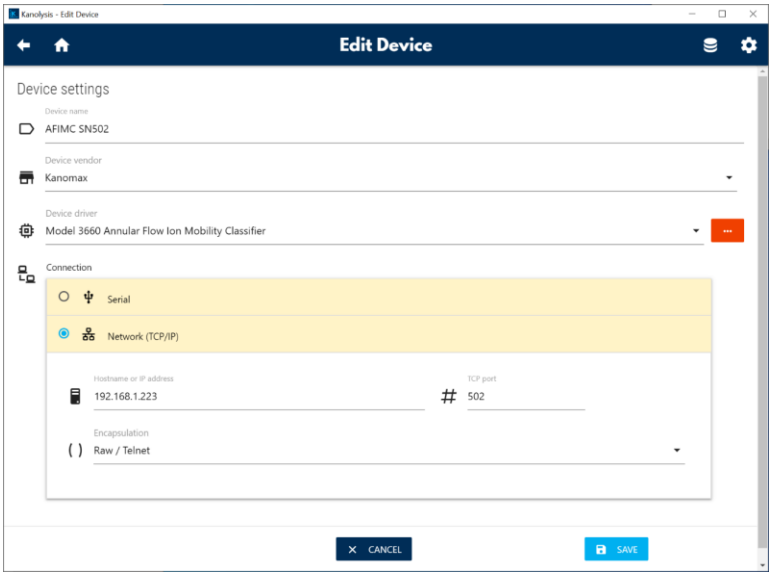


4. Click **SAVE** button and exit.
5. Back on **Devices** screen, click **Add device.**

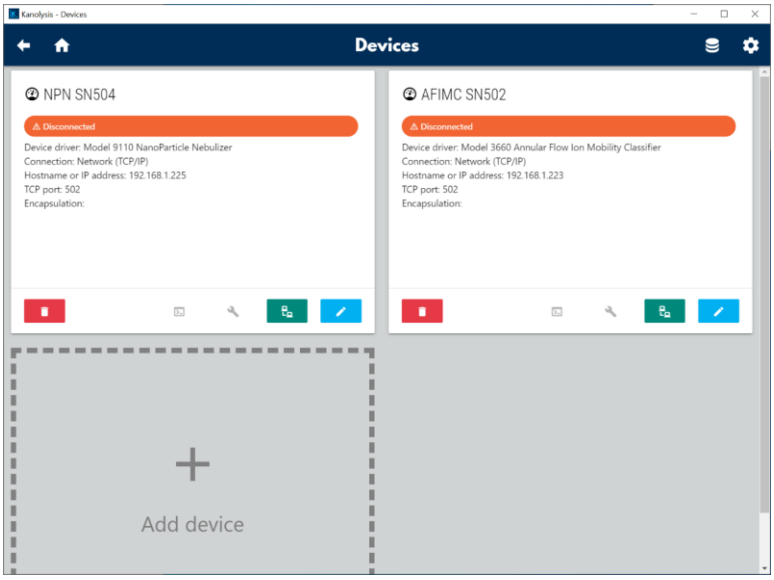


6. On **New Device** screen, fill the **Device Settings** fields with following information for the Annular Flow Ion Mobility Classifier:

   - **Device name** is the name of the connected AFIMC unit.
   - **Device vendor** is the vendor of the connected AFIMC unit.
   - **Device driver** is the model number of the connected AFIMC unit.
   - **Connection** is the network (TCP/IP) configurations of the connected AFIMC unit.

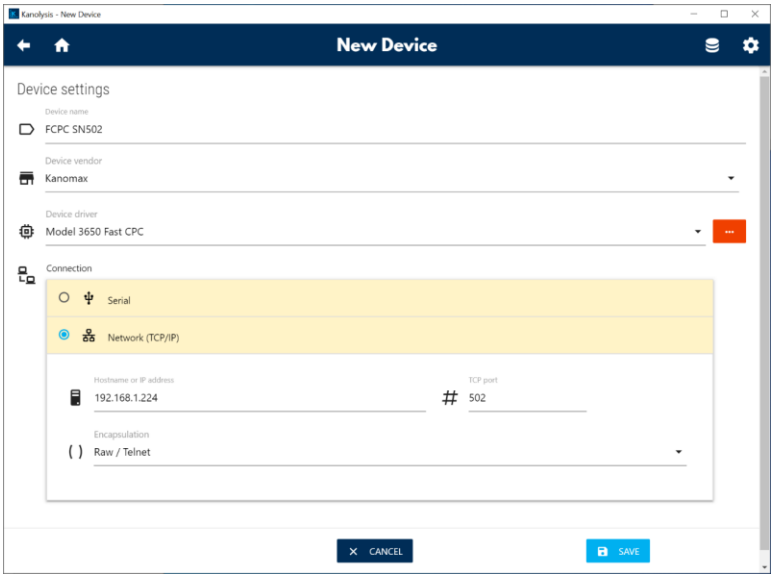


7. Click **SAVE** button and exit.
8. Back on **Devices** screen, click **Add device.**



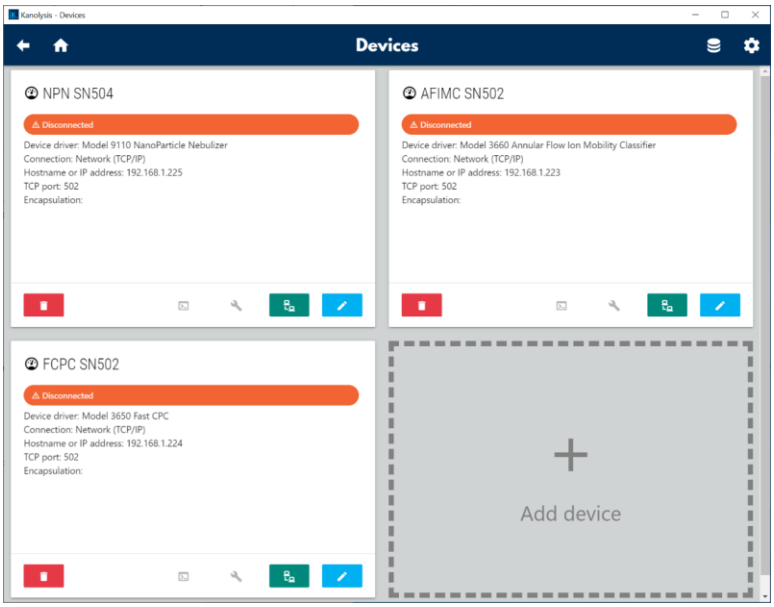
9. On **New Device** screen, fill in the **Device Settings** fields with following information for the Fast CPC:

   - **Device name** is the name of the connected Fast CPC unit.
   - **Device vendor** is the vendor of the connected Fast CPC unit.
   - **Device driver** is the model number of the connected Fast CPC unit.
   - **Connection** is the Network (TCP/IP) configurations of the connected Fast CPC unit.

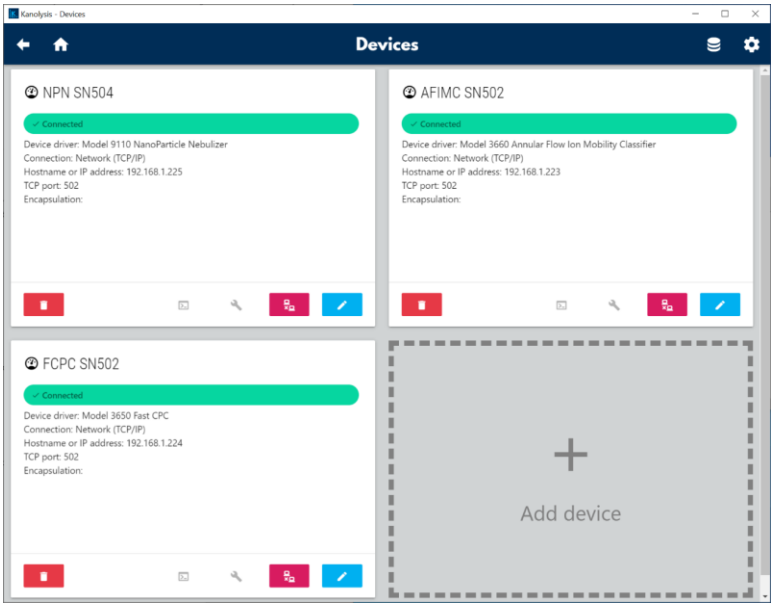


10. Click **SAVE** button and exit.

11. On **Devices** screen, click the  button on each device panel.



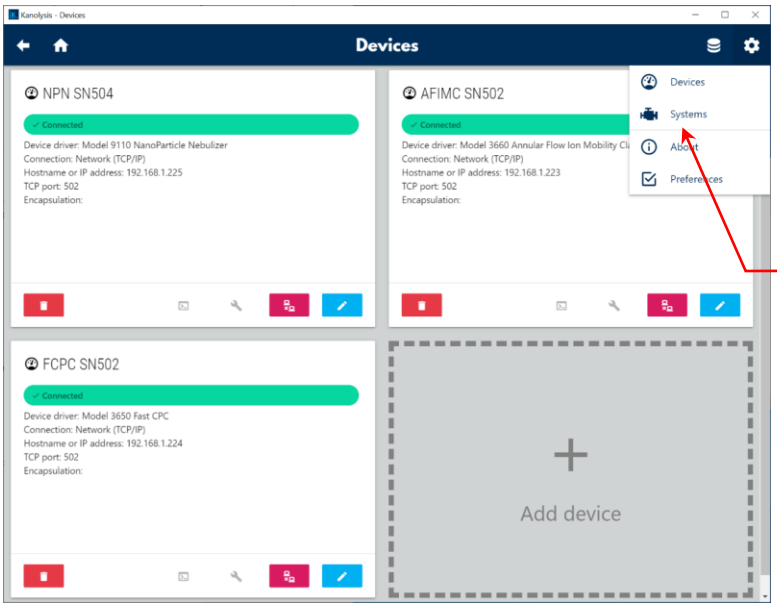
12. Confirm all devices are connected with green "Connected" banners displayed.



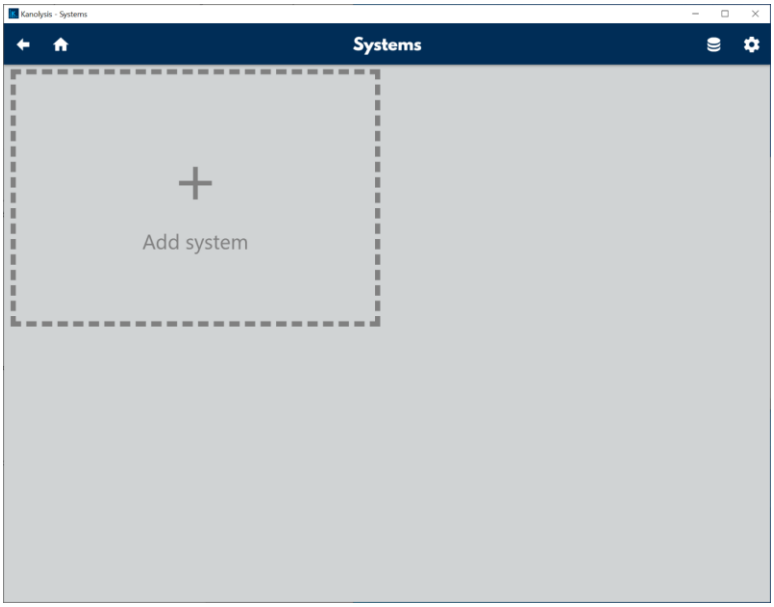
Adding an LNS System for Measurements

To define a Liquid NanoParticle Sizer system with connected devices, follow these instructions:

1. Click the  button to the upper right corner of the software window, in the drop-down list click **Systems.**



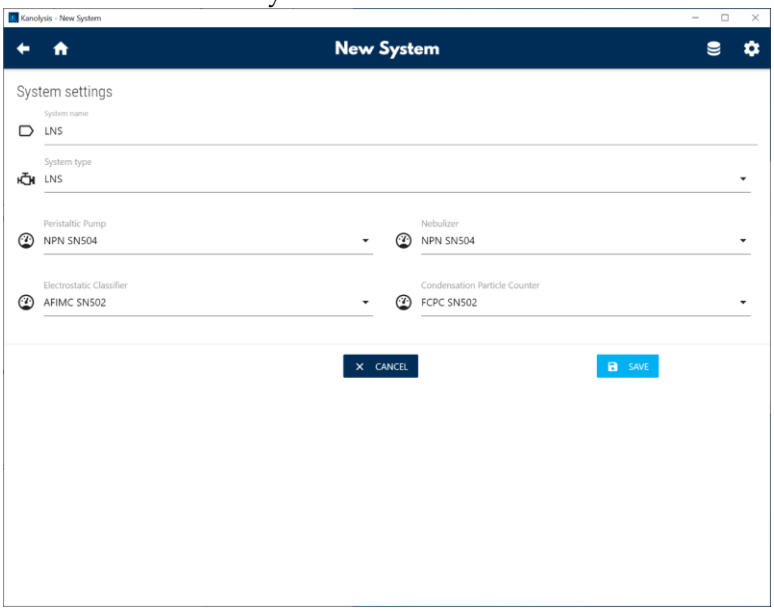
2. On **Systems** screen, click **Add system**.



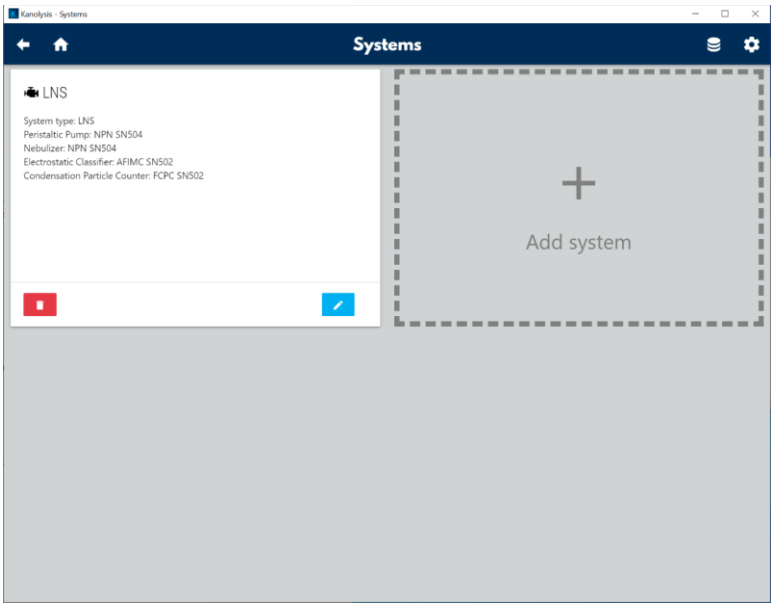
3. On **New System** screen, fill in the **System Settings** fields with following information for the Liquid NanoParticle Sizer system:

   - **System name** is the name of the connected LNS system.
   - **System type** is the configuration type of the connected LNS system.
   - **Peristaltic Pump** is the peristaltic pump unit to be used for the connected LNS system, which is recognized as the NanoParticle Nebulizer unit that pump is connected to via an RS-232 serial cable.
   - **Nebulizer** is the NanoParticle Nebulizer unit to be used for the connected LNS system.

- **Electrostatic Classifier** is the AFIMC unit to be used for the connected LNS system.
- **Condensation Particle Counter** is the Fast CPC unit to be used for the connected LNS system.



4. Click **SAVE** button and exit.

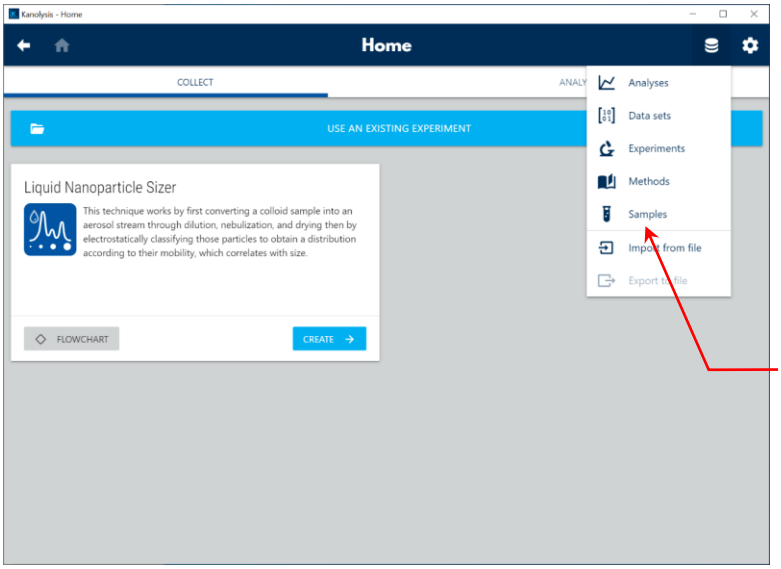


5. Click  button to go back to Kanolysis home screen.

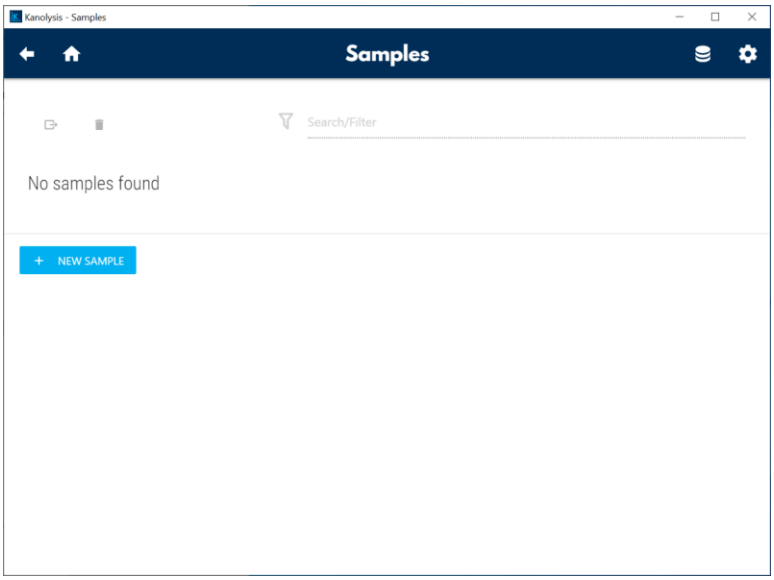
Adding Samples for LNS Analyses

To add samples that are pending for LNS measurements, follow these instructions:

1. Click  button to the upper right corner of the Kanolysis **Home** screen. In the drop-down list, click **Samples**.



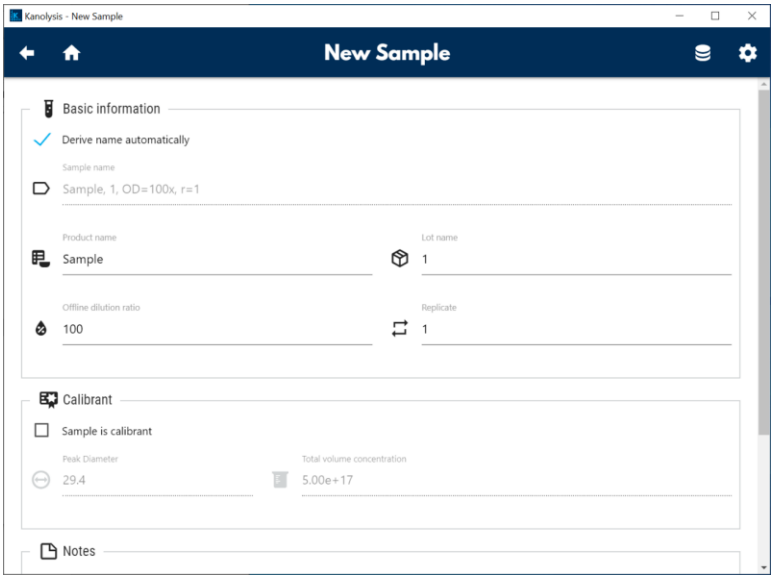
2. On **Samples** screen, click **+ NEW SAMPLE** button.



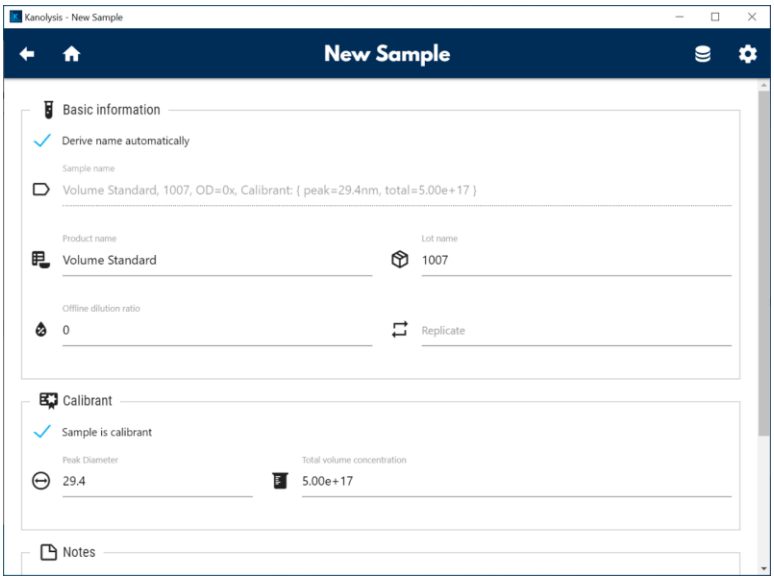
3. On **New Sample** screen, fill in the **Basic information** fields with following information of the new sample:

   - **Device name automatically** is a checkbox allows you to select if a device automatically generated sample name is desired.

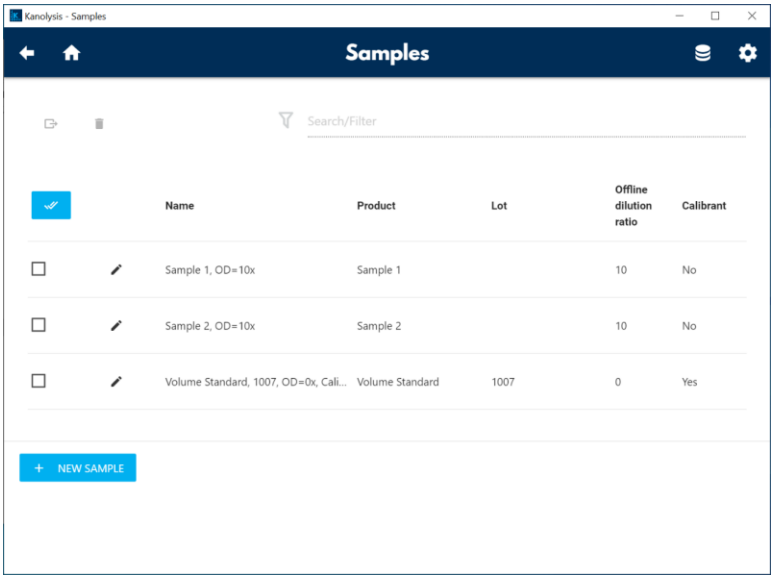
- **Sample name** displays the device automatically generated sample name or allows you to type in the sample name if **Device name automatically** is unchecked.
- **Product name** allows you to type in the name of the sample.
- **Lot name** allows you to type in the lot number of the sample.
- **Offline dilution ratio** allows you to type in the dilution ratio that has been applied to the sample prior to analysis.
- **Replicate** allows you to type in the replicate number of the sample.



4. Check the **Sample is calibrant** box if this pending sample is a volume standard to be used as a calibrant for the LNS system. Type in its peak diameter and total volume concentration in the corresponding fields using values from the calibrant certificate.



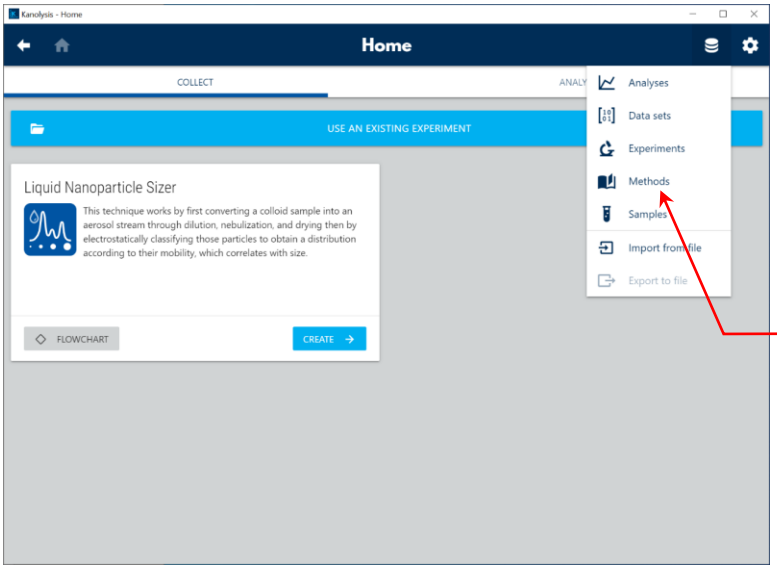
5. Click **SAVE** and exit to the **Samples** screen.
6. Repeat steps 2-5 to add more samples.



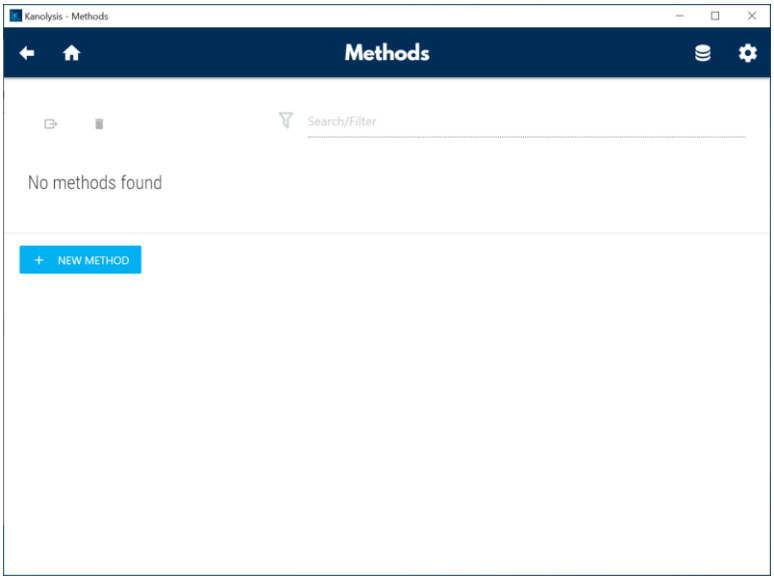
Defining Methods for LNS Analyses

To define test methods for an LNS measurement, follow these instructions:

1. Click  button to the upper right corner of the Kanolysis **Home** screen. In the drop-down list, click **Methods**.



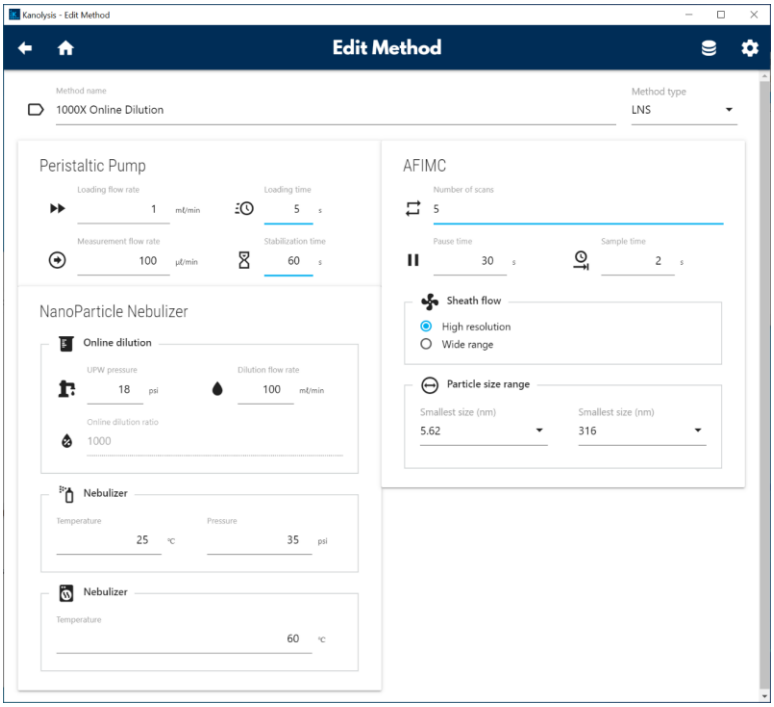
2. On **Methods** screen, click **+ NEW METHOD** button.



3. On **Edit Method** screen, fill in all fields with following information of the new method:
    - **Method name** allows you to define a name for the new method.
    - **Peristaltic Pump** allows you to configure the peristaltic pump settings for the new method.
        - **Loading flow rate** is the fast-forwarding flow rate to be applied when a sample is newly switched.
        - **Loading time** is the time to fast forward the new sample at the loading flow rate defined above.

- **Measurement flow rate** is the regular sample injection flow rate to be applied during a measurement.
- **Stabilization time** is the time to wait for the sample injection concentration to stabilize before a measurement starts.

- **NanoParticle Nebulizer** allows you to configure the NanoParticle Nebulizer settings for the new method.
  - **UPW pressure** is the setpoint value of the UPW supply pressure.
  - **Dilution flow rate** is the setpoint value of the UPW flow rate to be metered at for online dilution.
  - **Online dilution ratio** is the dilution ratio automatically calculated by (Dilution flow rate / Measurement flow rate), not editable.
  - **Nebulizer Temperature** is the setpoint value of the operation temperature of the nebulizer module.
  - **Nebulizer Pressure** is the setpoint value of the operation gas pressure of the nebulizer.
  - **Evaporator Temperature** is the setpoint value of the operation temperature of the heated evaporator.
- **AFIMC** allows you to configure the AFIMC settings for the new method.
  - **Number of scans** is the number of replicated measurement scans to be performed.
  - **Pause time** is the time that measurement to be paused for between scans.
  - **Sample time** is the dwelling time period on each size bin that particle concentration to be averaged for.
  - **Sheath flow** defines the sizing resolution of the method, the **High resolution** mode has a resolution of 64 bins per decade on LOG(10) scale, while the **Wide range** mode is 32 bins per decade on LOG(10) scale.
  - **Particle size range** defines the lower and upper size limit to be scanned through for this method, both in the unit of nm.

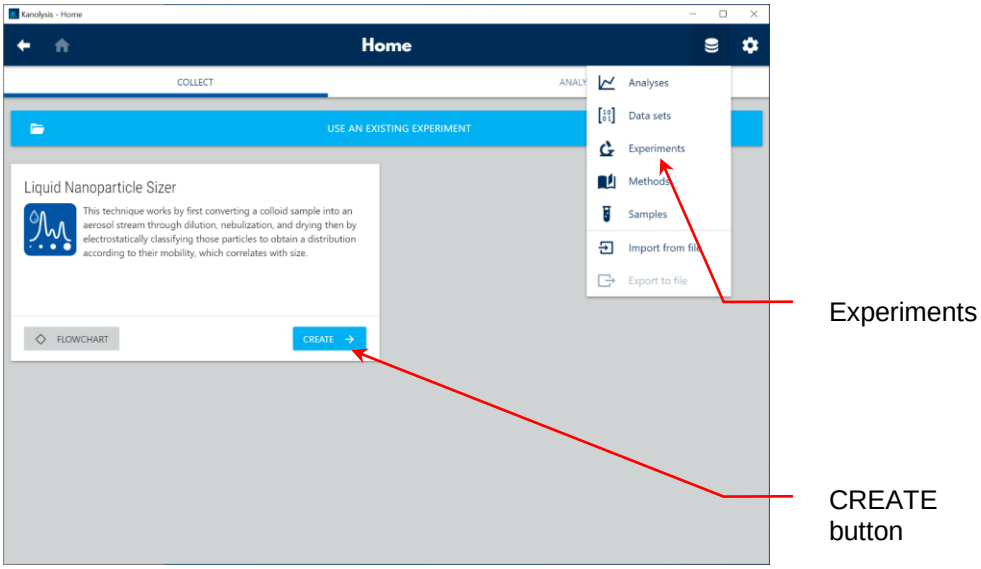


4. Click  button to the upper left corner of **Edit Method** screen to go back to **Methods** screen.
5. Repeat steps 2-4 to add more methods.

Creating a New Experiment for LNS Analyses

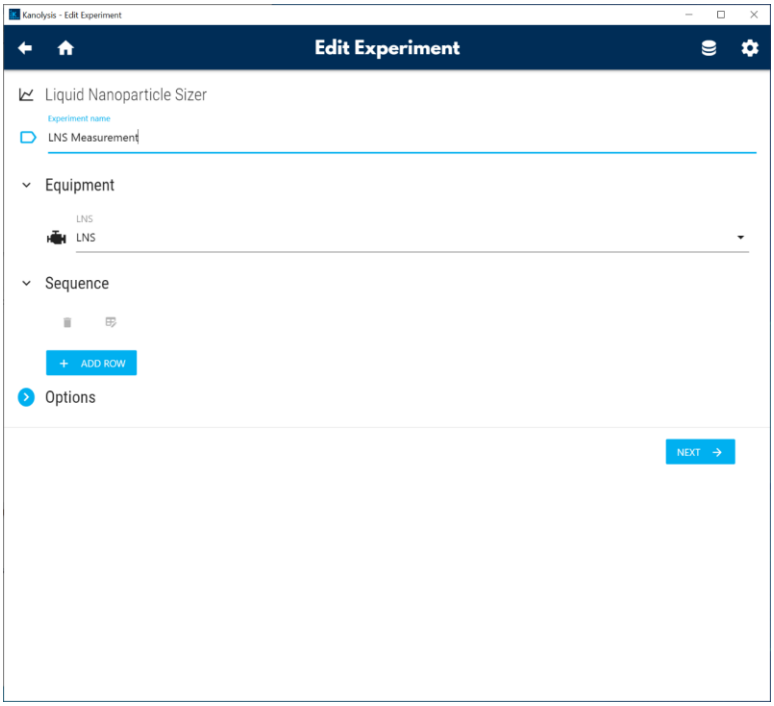
To create an LNS experiment using the samples and methods defined above, follow these instructions:

1. Click  button to the upper right corner of the Kanolysis **Home** screen. In the drop-down list, click **Experiments**. Alternatively, you can also click the **CREATE** button on the Liquid NanoParticle Sizer panel.

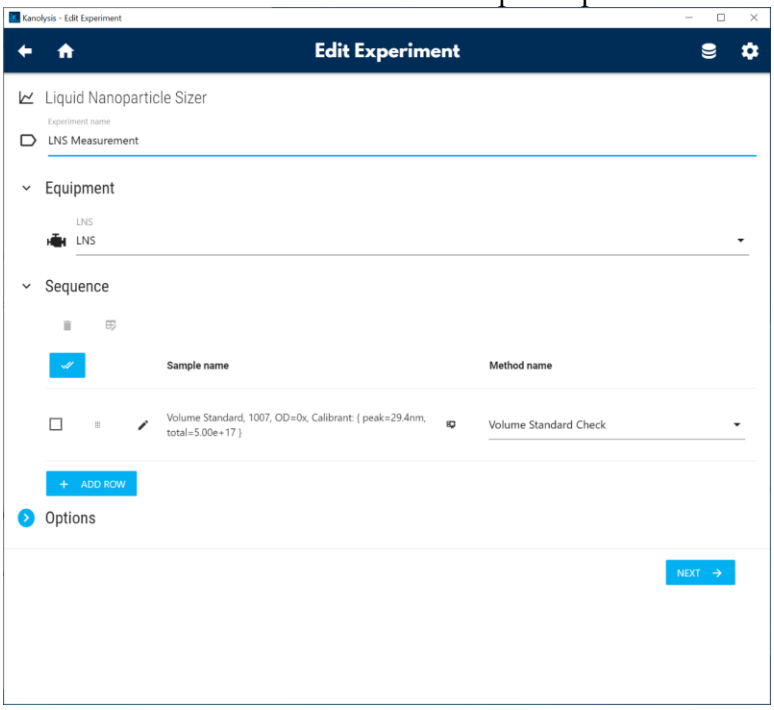


2. On **Edit Experiment** screen, fill in fields with following information of the new method:

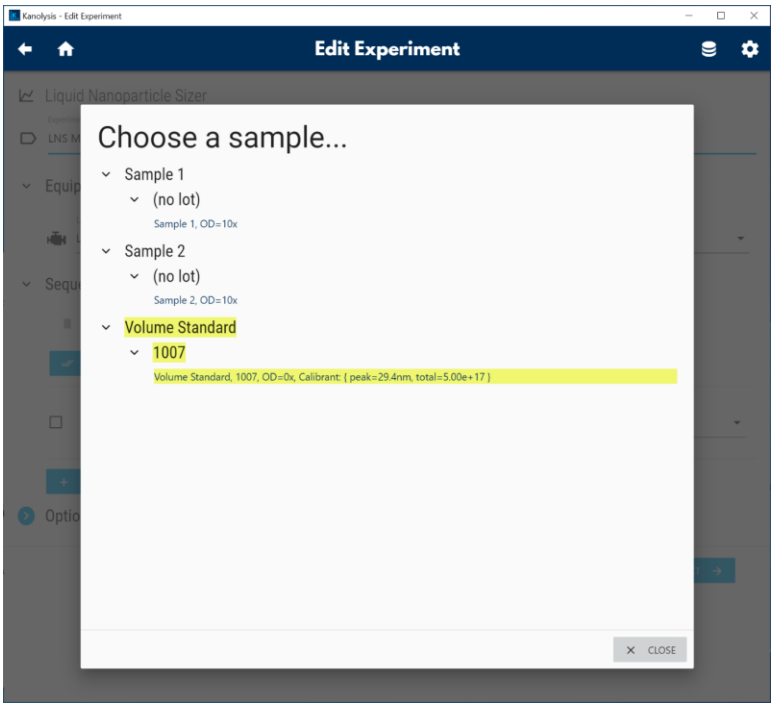
   - **Experiment name** allows you to define a name for the new experiment.
   - **Equipment** allows you to select an LNS system to be used for the new experiment.
   - **Sequence** allows you to define a test sequence for the new experiment.



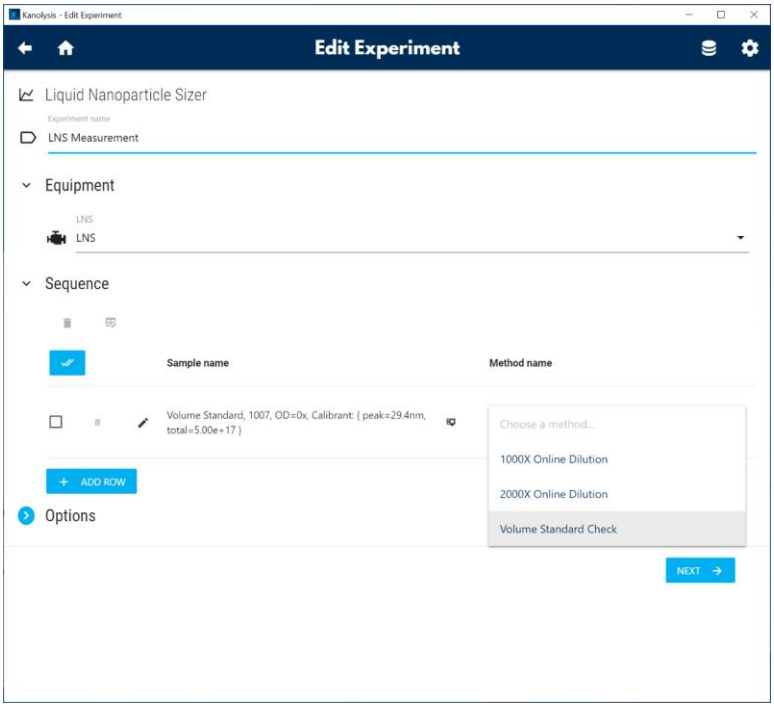
3. Click **+ ADD ROW** button to add sample sequence.



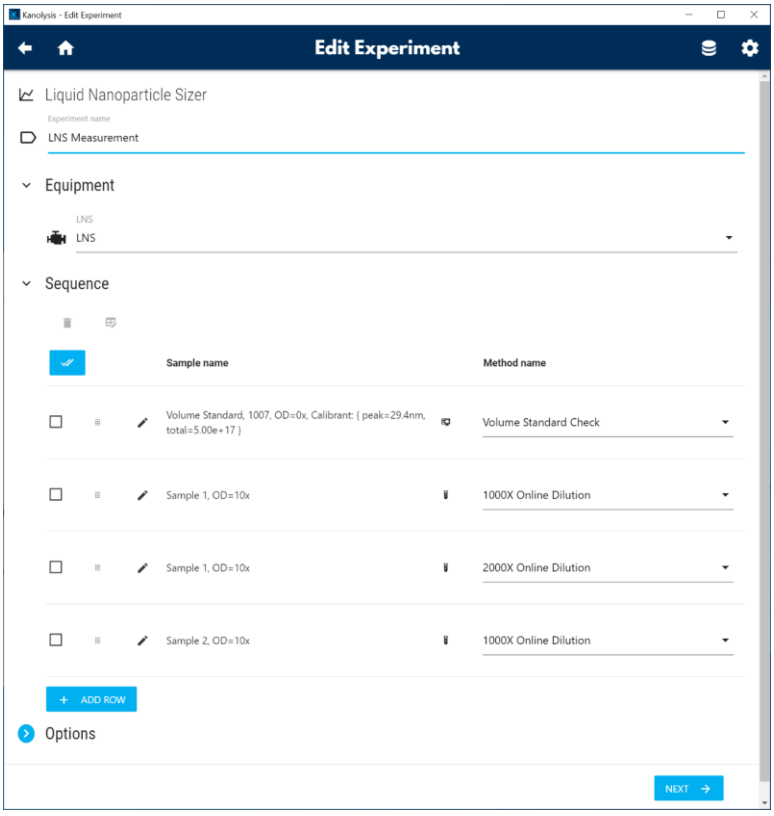
4. Click  before **Sample name** column to select a sample from the pop-up list, selected sample is highlighted in yellow. Click X CLOSE to exit.



5. From the drop-down list of the **Method name**, select a method for the corresponding sample. Selected method is highlighted in gray.

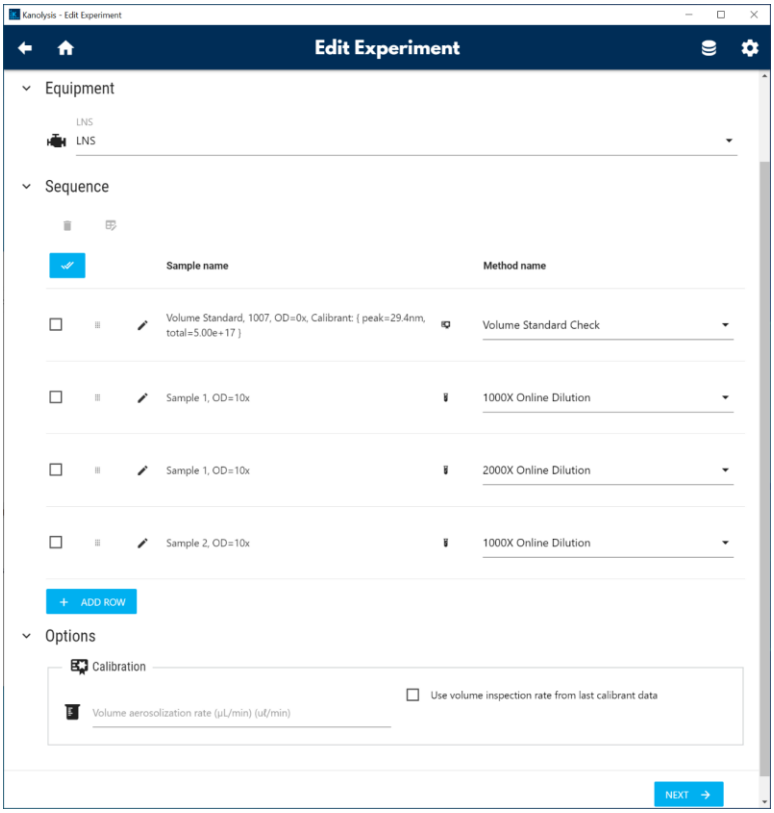


6. Repeat steps 3-5 to complete the sample sequence.

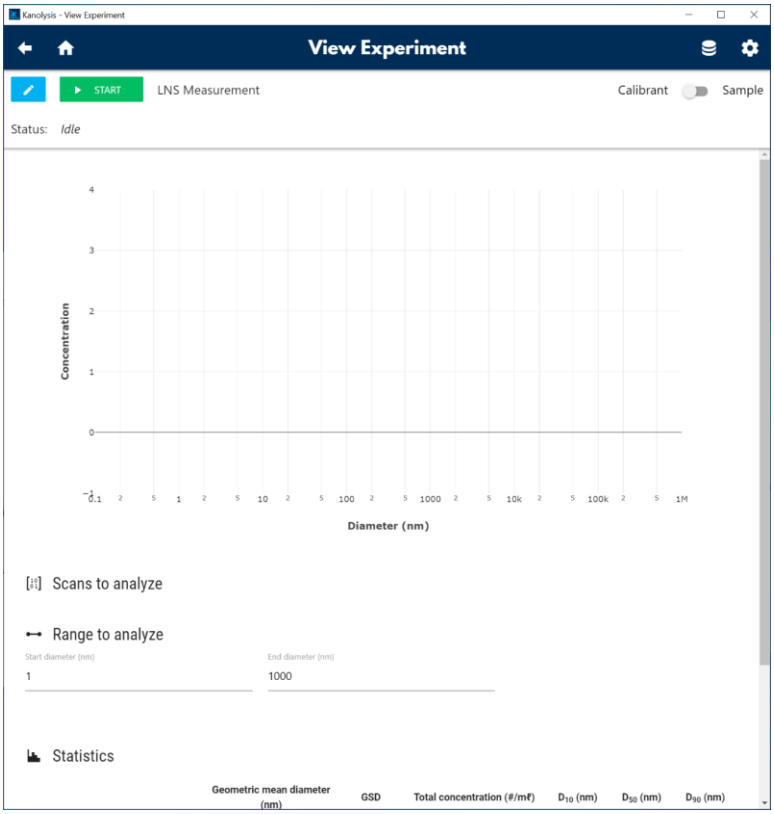


7. Click **Options** arrow, check **Use volume inspection rate from last calibrant data** if no volume standard sample is included in the sample sequence of this experiment. Note: this option must be disabled if there is

no stored calibrant data on the copy of Kanolysis used for this experiment.



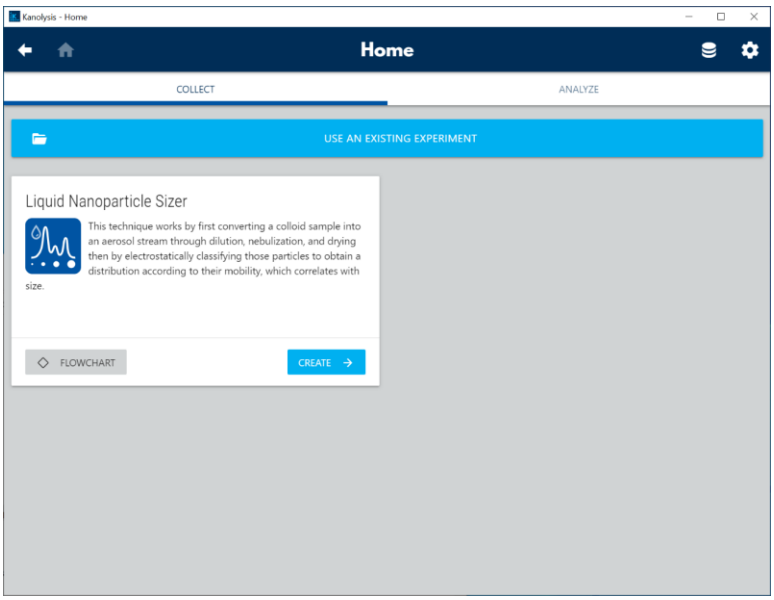
8. Click **NEXT** → button when all experiment configurations are complete.
9. Click **START** to start the selected experiment.



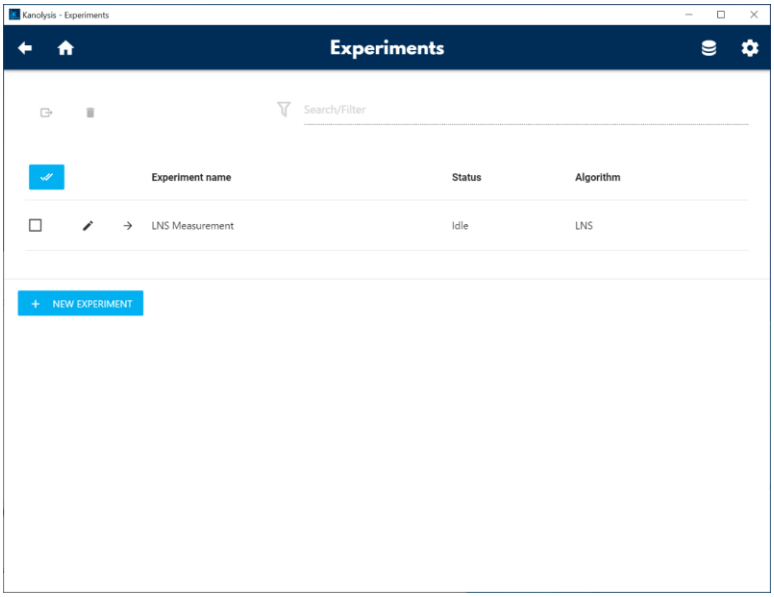
Editing an Existing Experiment for LNS Analyses

To edit an existing LNS experiment, follow these instructions:

1. On Kanolysis **Home** screen. Click the **USE AN EXISTING EXPERIMENT** banner.



2. On **Experiments** screen, click before an experiment name to edit the experiment.

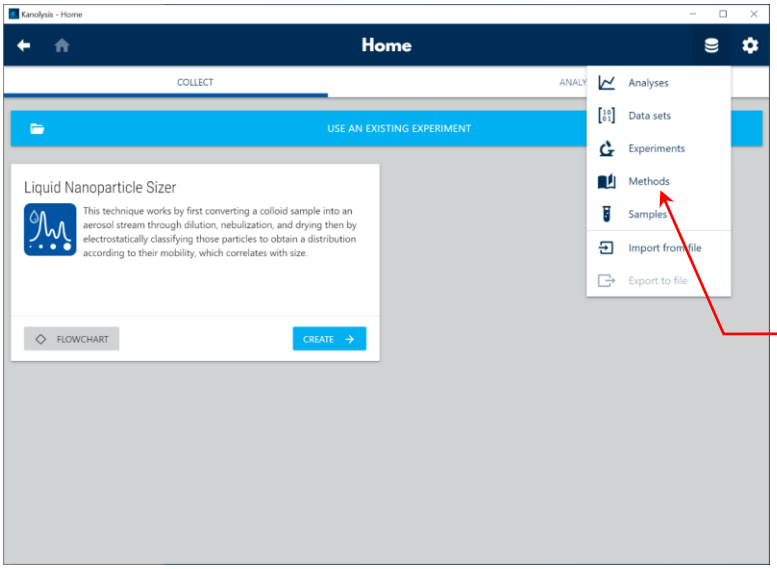


3. When done editing, click **NEXT** → button on **Edit Experiment** screen to jump to **View Experiment** screen, where you can start the experiment by clicking the **START** button. Alternatively, the **View Experiment** screen can be directly accessed by clicking the → before an experiment name on **Experiments** screen.

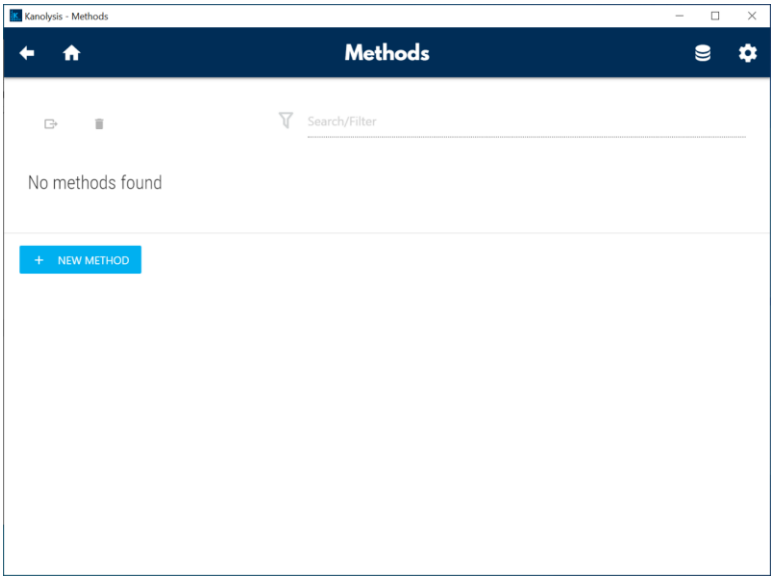
Performing a Volume Standard Calibration for LNS Analyses

It is suggested to perform a volume standard calibration of the LNS system on each day when an LNS measurement is scheduled. To run a calibration with the LNS Volume Standard for the system, follow the following instructions. Note: The volume standard calibration can be included as one sample among other to-be-analyzed samples in the sample sequence of an experiment.

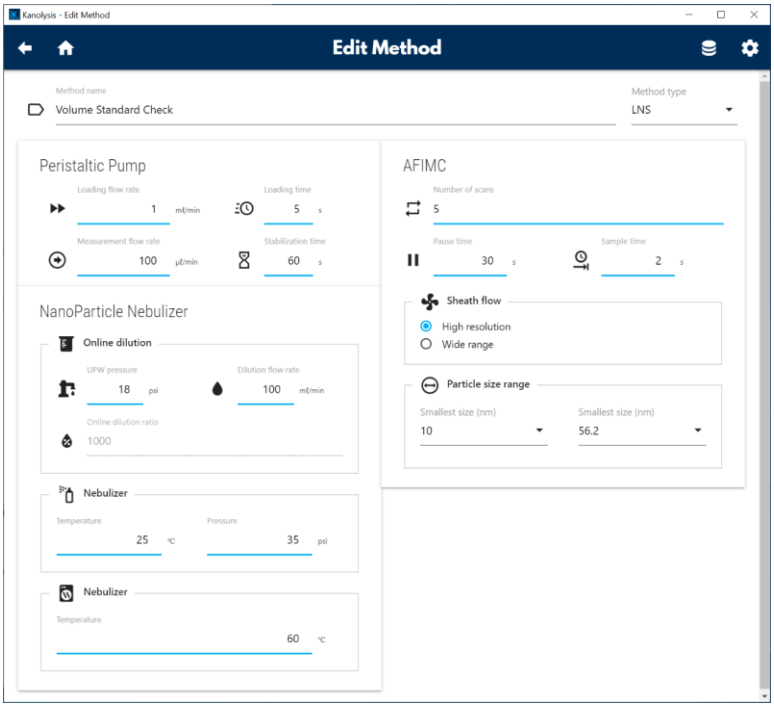
1. Click button to the upper right corner of the Kanolysis **Home** screen. In the drop-down list, click **Methods**.



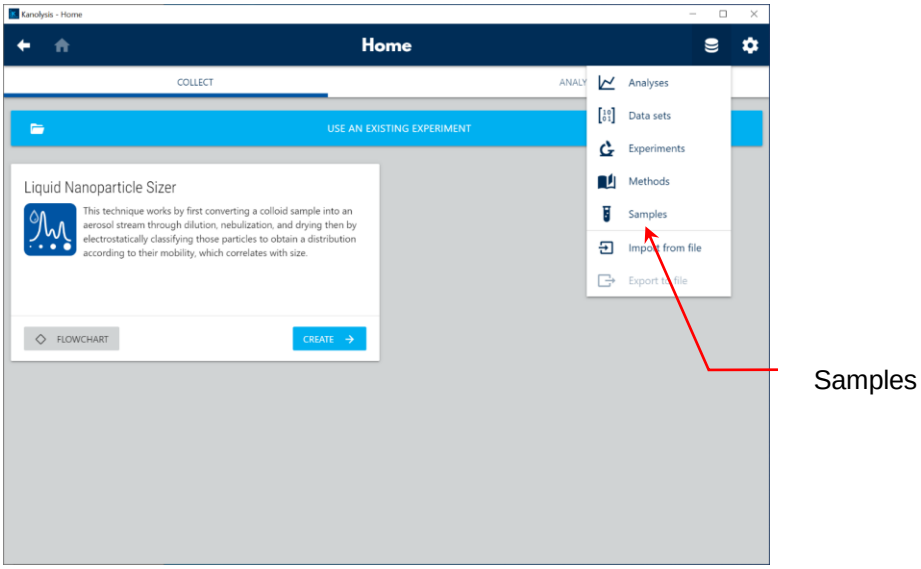
2. On **Methods** screen, click **+ NEW METHOD** button.



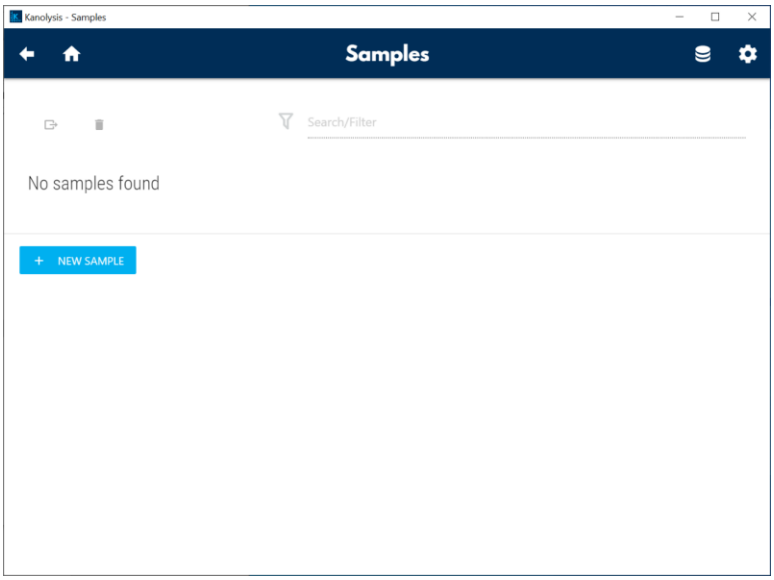
3. On **Edit Method** screen, create a **Volume Standard Check** method with information shown in the figure below.



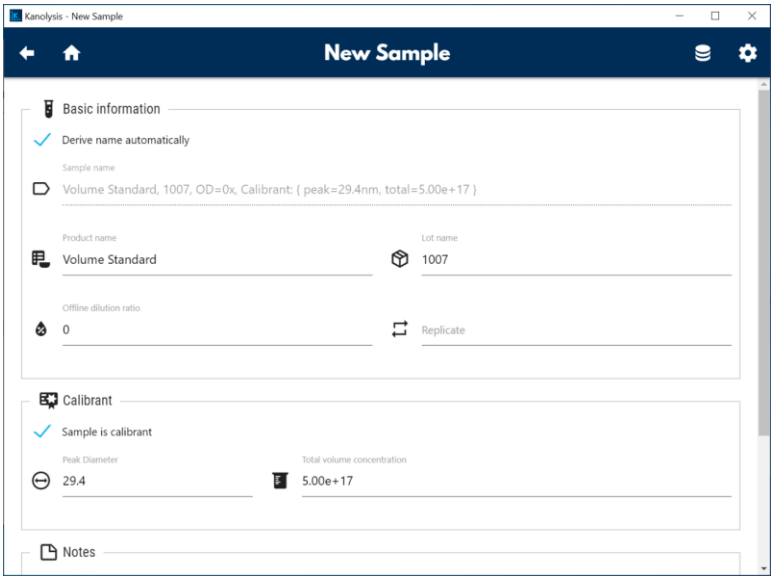
7. Click  button to the upper right corner of the Kanolysis **Home** screen. In the drop-down list, click **Samples**.



8. On **Samples** screen, click **+ NEW SAMPLE** button.

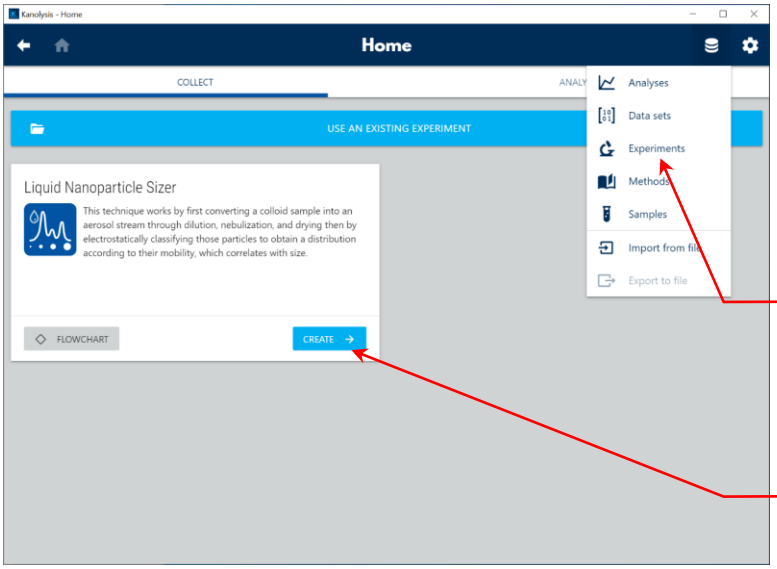


9. On **New Sample** screen, name the LNS volume standard with its corresponding **Product name** and **Lot name**, check the **Sample is calibrant** box.

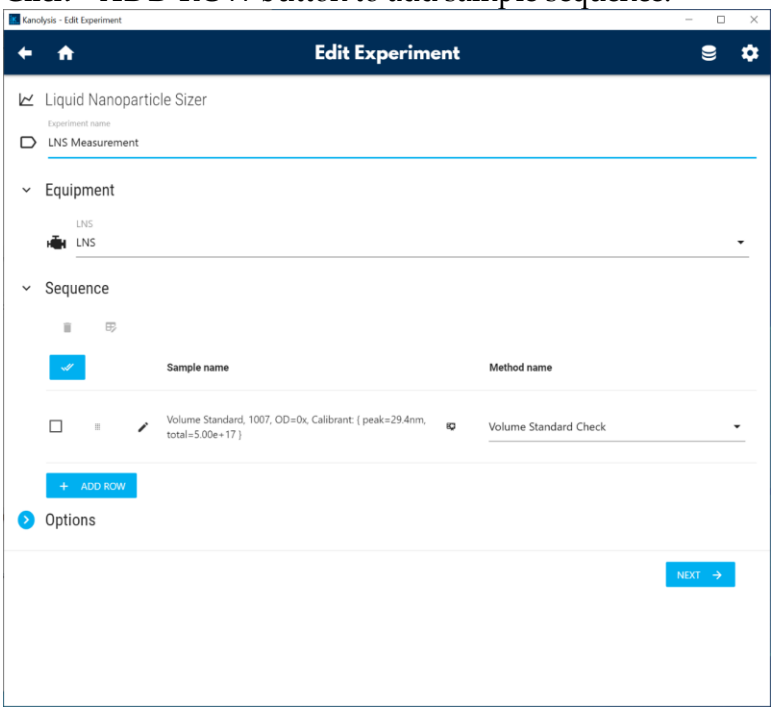


10. Click **SAVE** and exit to the **Samples** screen.

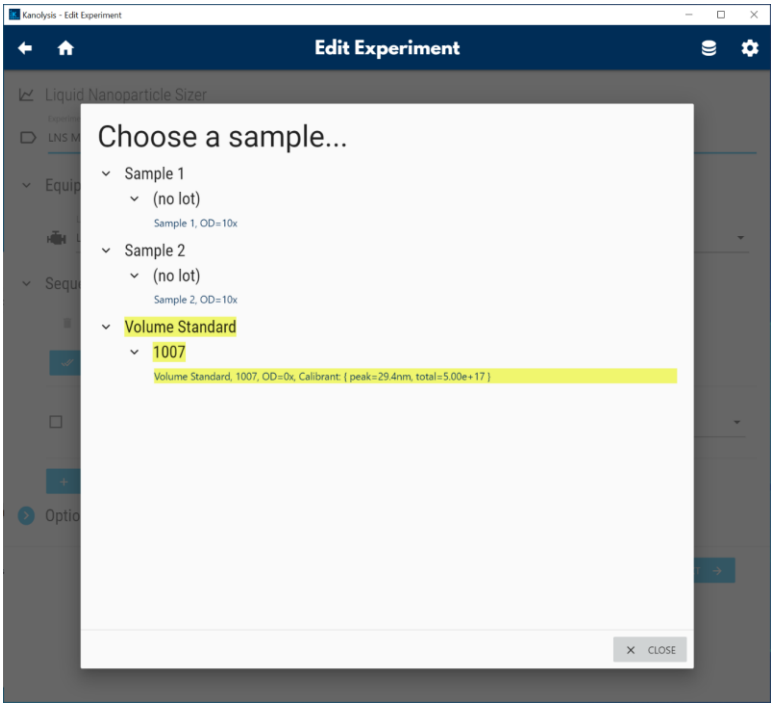
11. Click  button to the upper right corner of the Kanolysis **Home** screen. In the drop-down list, click **Experiments**. Alternatively, you can also click the **CREATE** button on the Liquid NanoParticle Sizer panel.



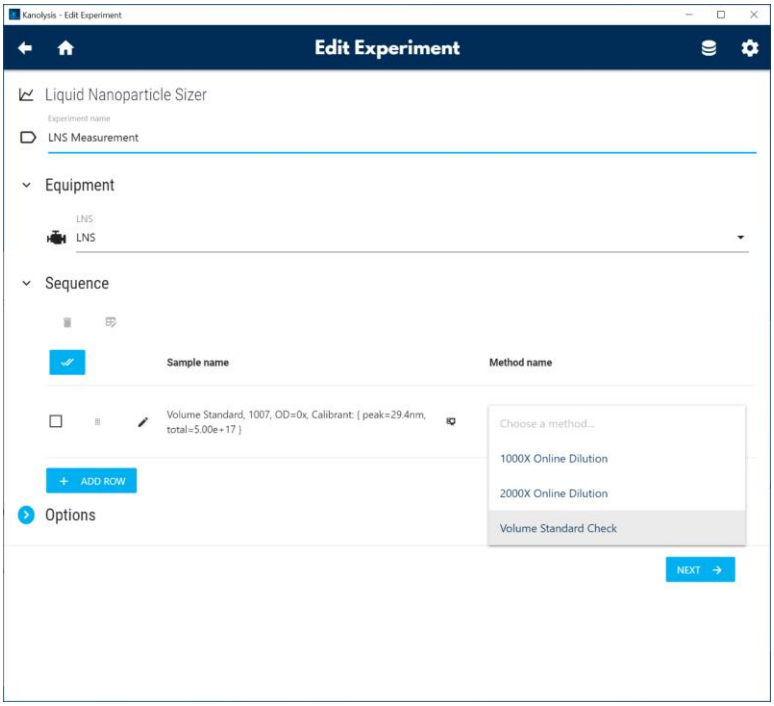
12. Click **+ ADD ROW** button to add sample sequence.



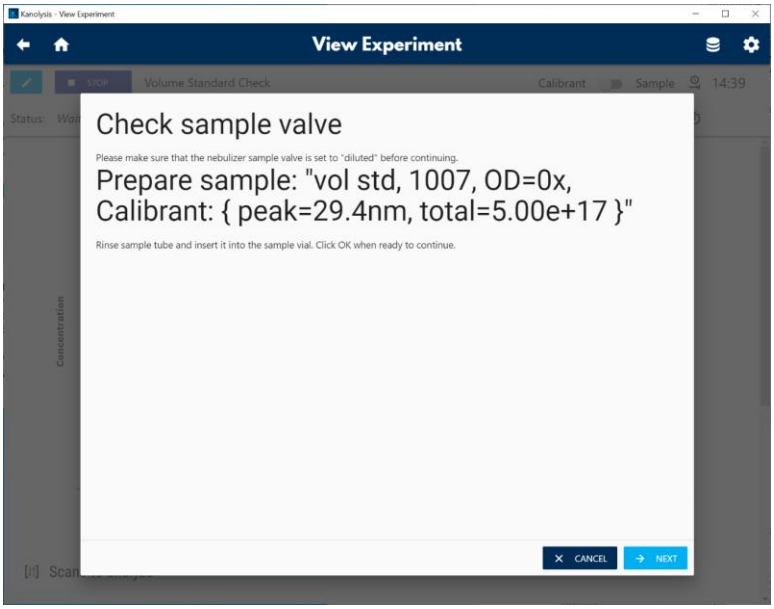
13. Click  before **Sample name** column to select a sample from the pop-up list, selected sample is highlighted in yellow. Click X CLOSE to exit.



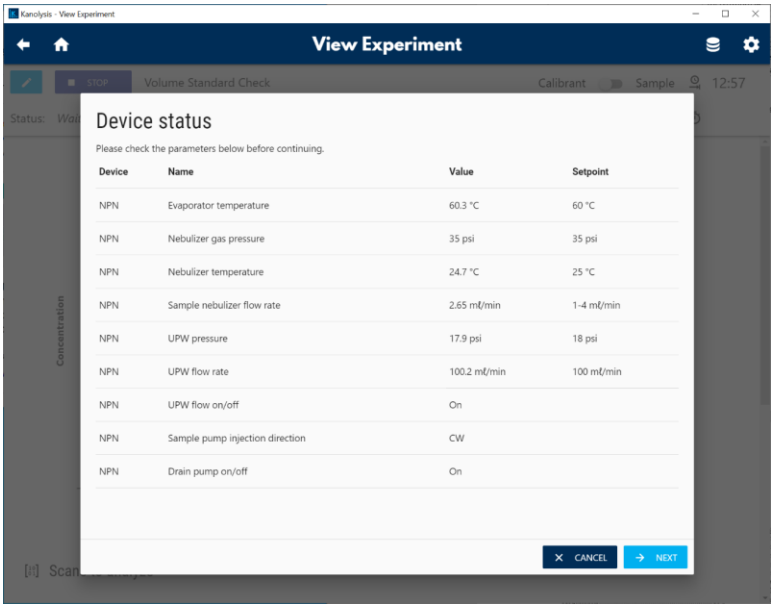
14. From the drop-down list of the **Method name**, select a method for the corresponding sample. Selected method is highlighted in gray.



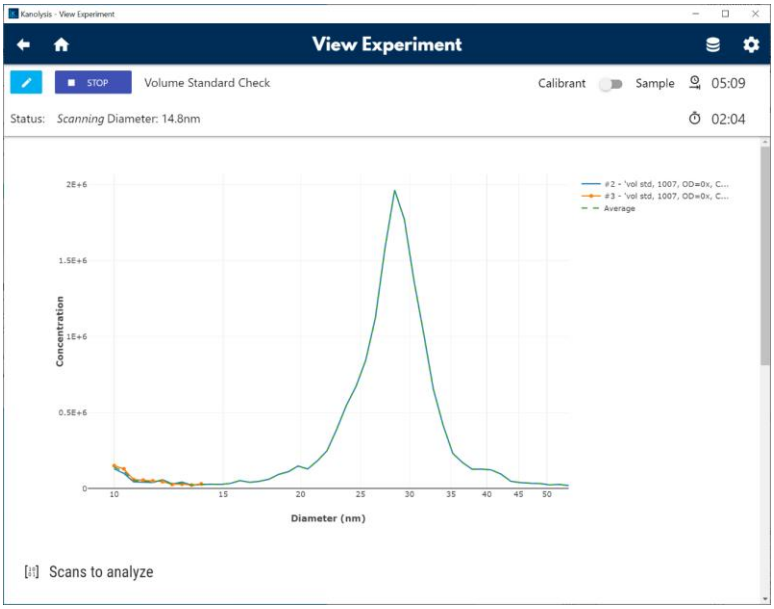
15. Click **NEXT →** button, on the **View Experiment** screen, click **START** to start the volume standard calibration experiment.
16. Prepare the volume standard for injection and click **Next** to the bottom of the pop-up window.



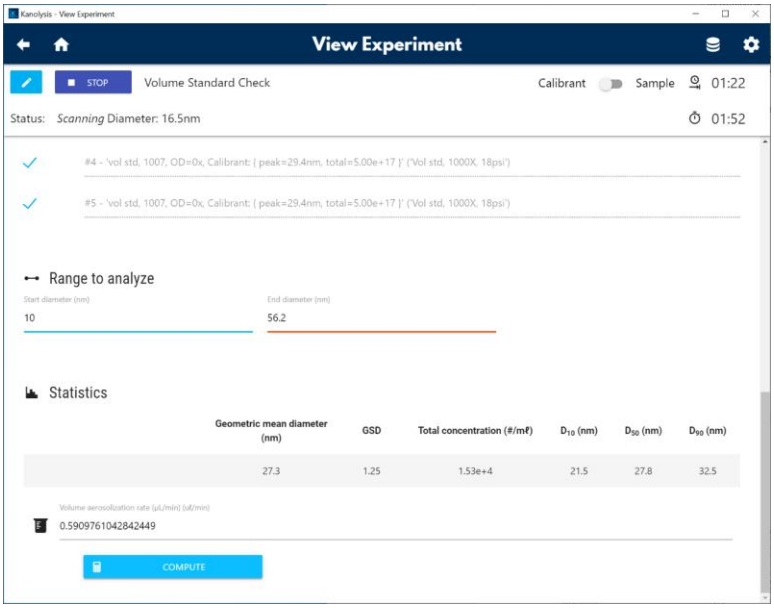
17. Check all **Device Status** parameters are at their respective setpoints. Out-of-range values will be displayed in red.



18. The particle size distribution of the volume standard are shown in line plots on **View Experiment** screen.



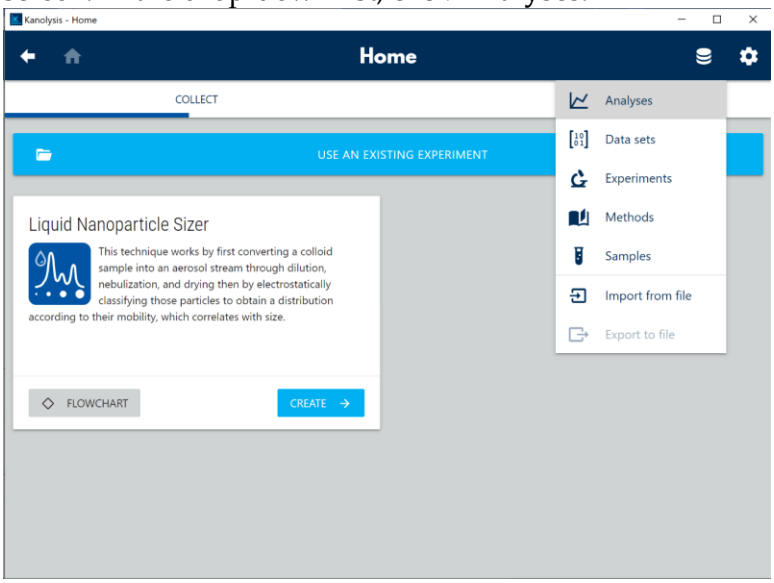
19. Scroll down to view the **Statistics**, click **COMPUTE** button to calculate the Volumetric Inspection Rate in µL/min. Note: The nominal range of the Volumetric Inspection Rate is 0.2 – 1.0 µL/min. If you experience any problems obtaining a Volumetric Inspection Rate value within the nominal range, please contact Kanomax FMT, Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.)



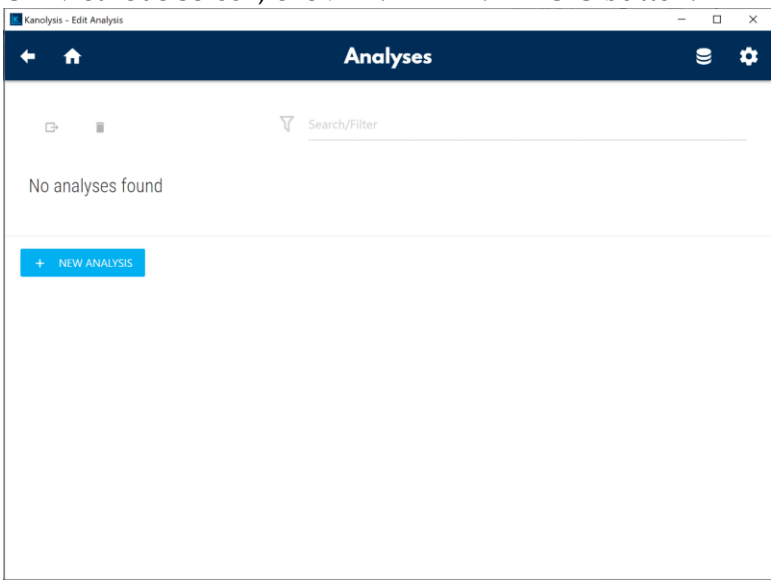
Analyze Measurement Results using Kanolysis

The **Analyses** function in Kanolysis allows users to review and analyze the measured size distributions within the software.

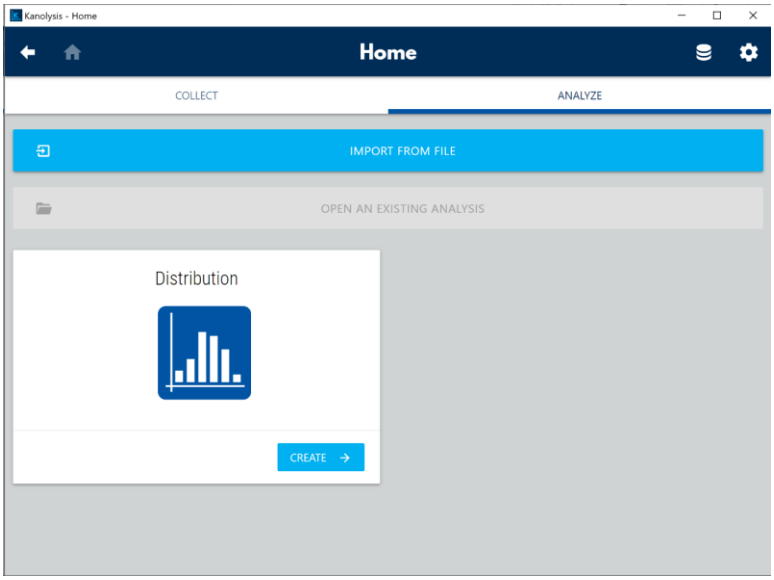
1. Click  button to the upper right corner of the Kanolysis **Home** screen. In the drop-down list, click **Analyses**.



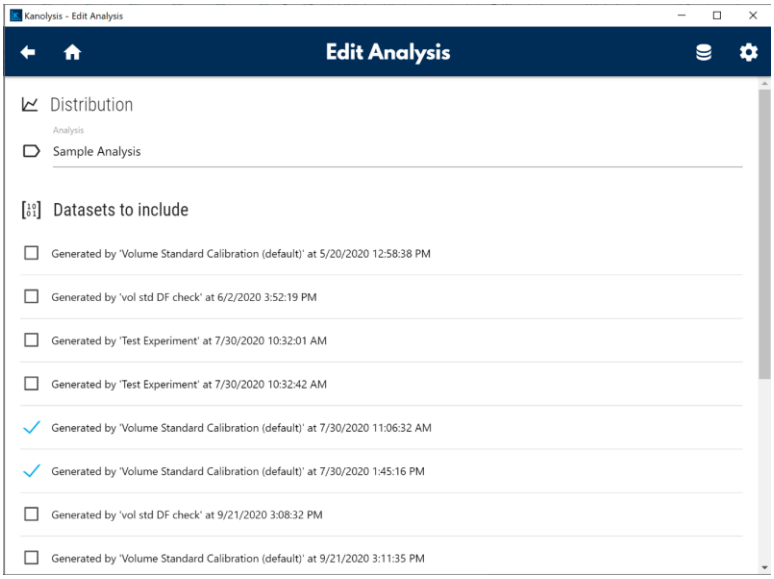
2. On **Methods** screen, click **+ NEW ANALYSIS** button.



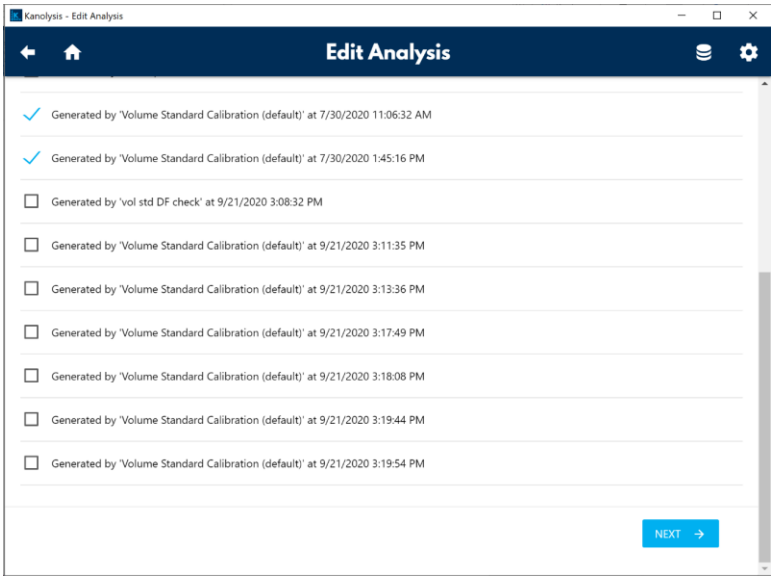
3. On the pop-up **Home** screen, click **CREATE →** button to create a Distribution Analysis



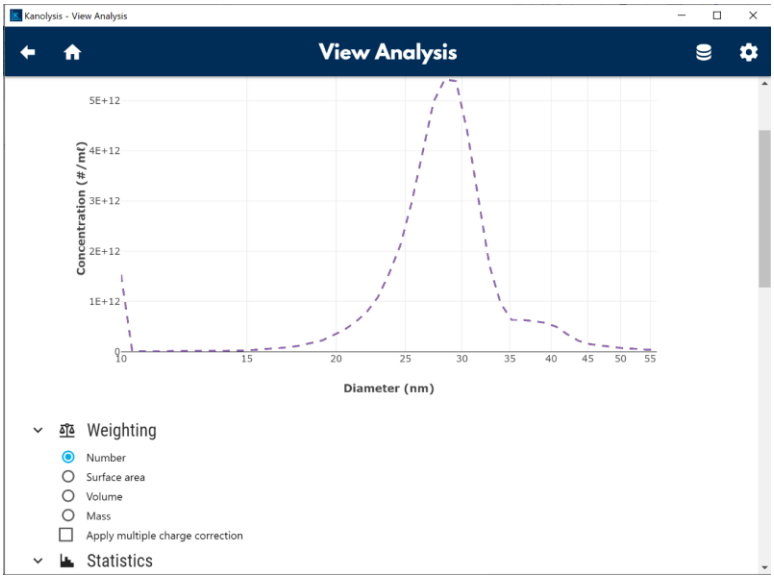
4. On the **New Analysis** screen, name the Analysis and select data sets to include by checking their box(es).



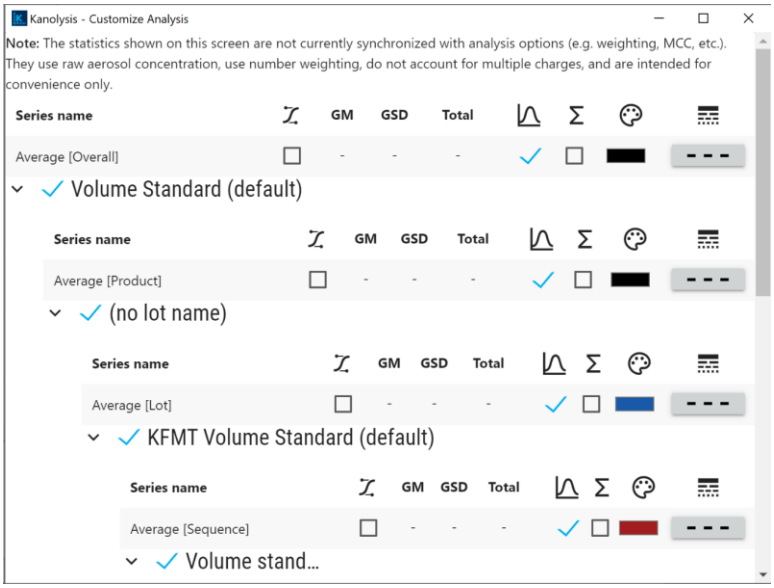
5. Click **NEXT →** button.



6. Select the plot weighting and if multiple charge correction needs to be applied.



7. Click the  button to call out a window where options to customize the analysis are provided.

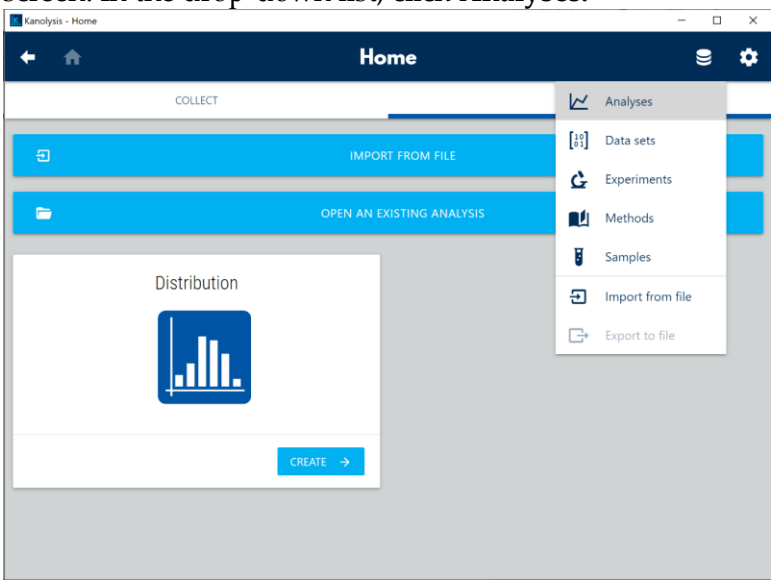


Export Data from Kanolysis

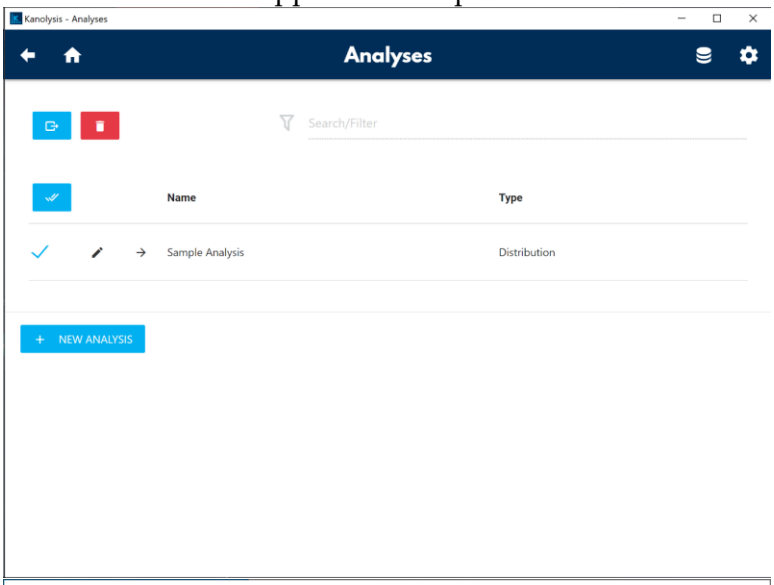
There are two data formats available for export in Kanolysis, one is the **Analyses** data which has the customized weighting and correction applied, and is the primary data format for analysis use; the other is the **Data sets** backup file that is mainly used for data backup or transfer between two Kanolysis platforms (e.g. two computers).

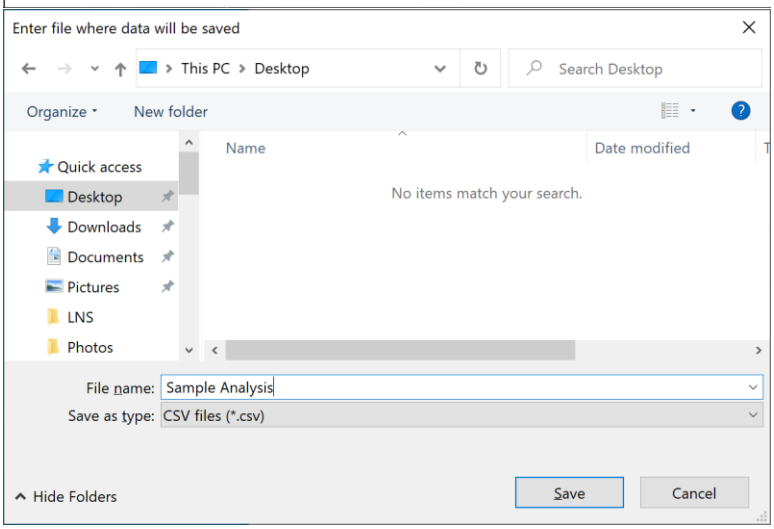
To export the **Analyses** data, follow these instructions:

1. Click  button to the upper right corner of the Kanolysis **Home** screen. In the drop-down list, click **Analyses.**

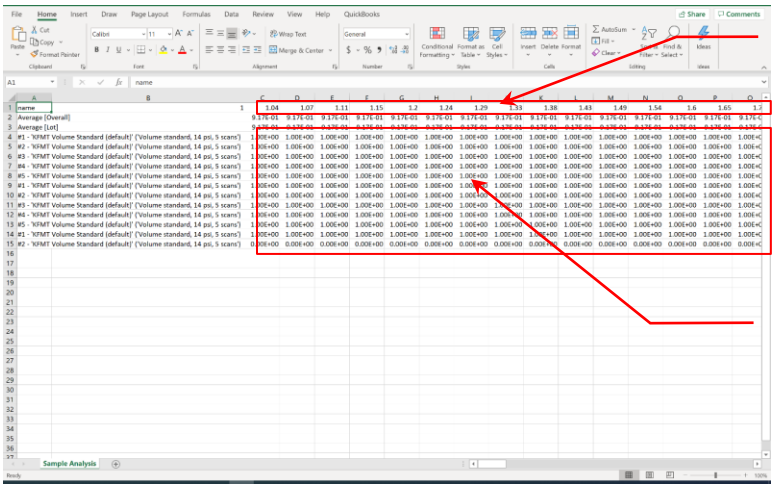


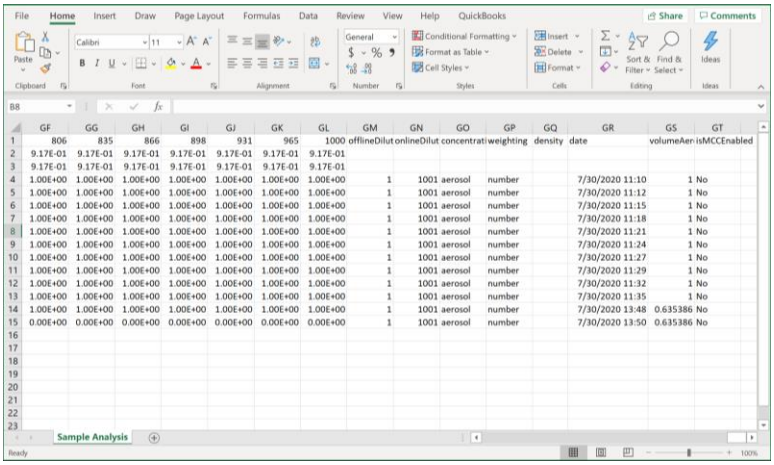
2. Select an Analysis to export data of by checking its box, then click the  button to the upper left to export the selected data as a .csv file.





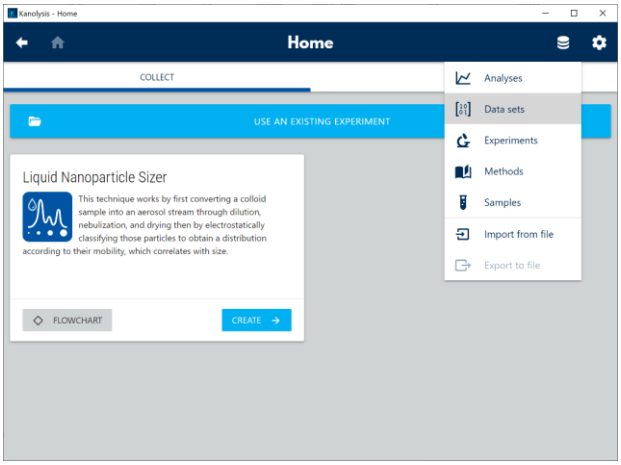
3. In the exported .csv file, Column A is sample name, Column C to GL are the particle concentrations measured at each corresponding size bin, with the particle size (in nm) labeled in the top row of each column. Column GM to GT record the parameters of Offline Dilution Ratio, Online Dilution Ratio, Concentration Type, Weighting, Density, date (of measurement), Volumetric Aerosolization Rate, and the MCC (multiple charge correction) Enabling Status, respectively.



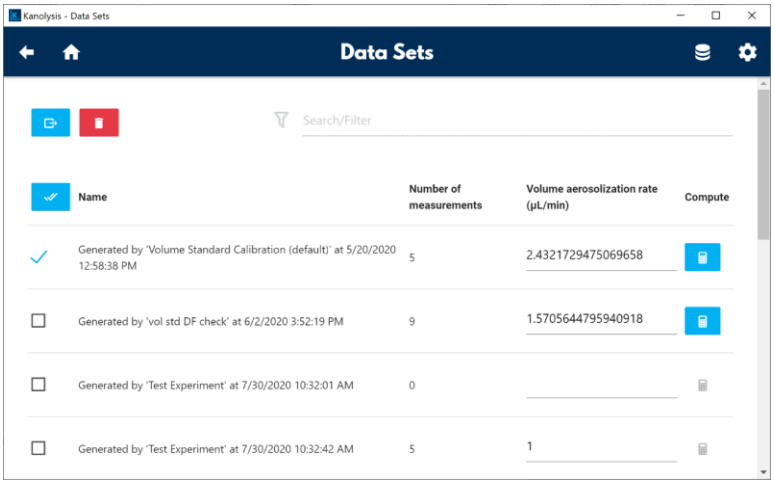


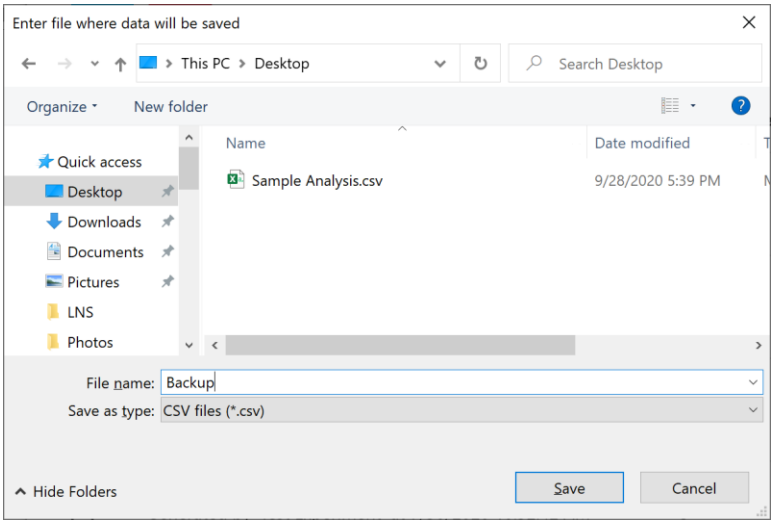
To export the **Data sets** backup file, follow these instructions:

1. Click  button to the upper right corner of the Kanolysis **Home** screen. In the drop-down list, click **Data sets.**



2. On the **Data Sets** screen, check the data record to be exported and click the  button to the upper left to save the backup datasets as a .csv file.

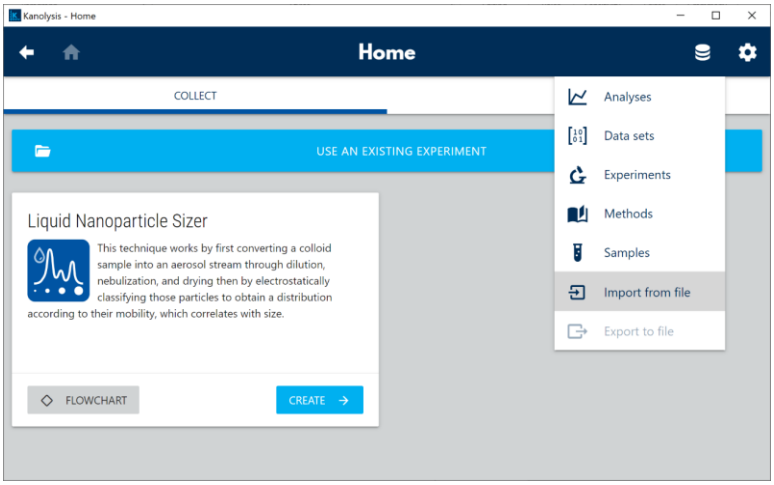




Import Data to Kanolysis

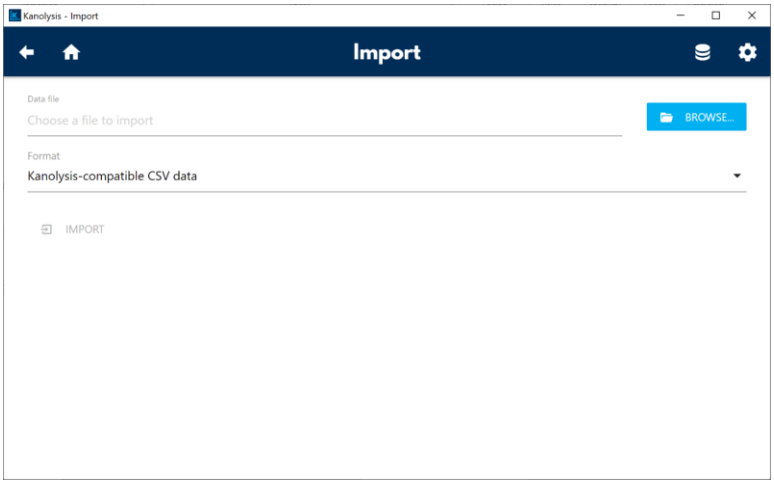
The backup datasets file can be used to transfer data between Kanolysis platforms. To import such a data file, follow these instructions:

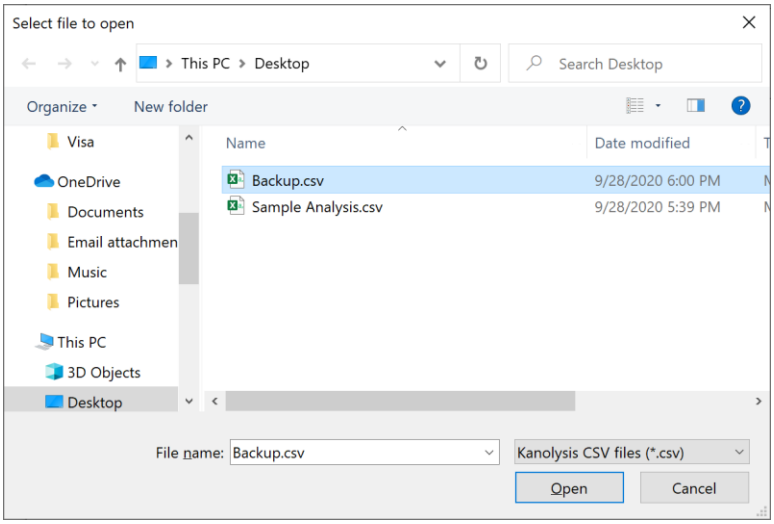
1. Click  button to the upper right corner of the Kanolysis **Home** screen. In the drop-down list, click **Import from file.**



2. On the **Import** screen, click 

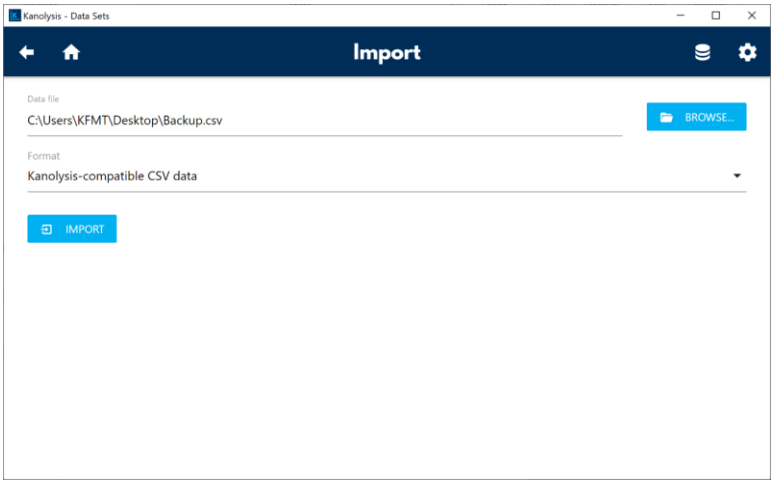
button, locate the backup datasets file to be imported in the pop-up window, and click **Open**.





3. When back on the **Import** screen, confirm the data file is correctly selected and click 

button to import the selected data file.



Note: Only the data files exported as backup datasets format can be imported using this Data Import feature in Kanolysis described above.

How to Shut Down the Liquid NanoParticle Sizer System for Moving or Shipping

If you need to move the Liquid NanoParticle Sizer system to another lab or facility or ship it for service, read this section to familiarize yourself with the precautions you should take and the procedures you should follow.

Performing any of the following improper handling techniques may damage the instrument and will invalidate the warranty:

- Shipping/transporting an undried/undrained instrument.
- Tipping > 10° during normal operation.
- Subjecting an undried/undrained instrument to freezing temperatures.

Preparing the NanoParticle Nebulizer for Shipping

To prepare the NanoParticle Nebulizer for shipping, follow these instructions:

1. Turn off the water supply to the NanoParticle Nebulizer and wait a few seconds for the water pressure to drop to zero (confirm that the pressure is zero by looking at the Device Status screen).
2. Keep the power turned on and the compressed air flowing into the **Air Inlet** on the back panel.
3. Connect the CDA/N_2 adapter fitting (provided with the instrument) to the UPW inlet port and apply clean dry air or nitrogen at 30 psi to the port. Run for 2 hours.
4. Remove the tubing and cap the **UPW Inlet** on the front panel.
5. Remove the **Shipping Drain** cap. Water will drain from the fitting. Tilt the device towards the back to allow the nebulizer module reservoir to empty completely. Note: If necessary, you can install tubing to take the waste flow to a suitable drain.
6. Disconnect the air or nitrogen supply line and the water waste line and turn off the power.
7. Place all the caps that you received with the instrument on the inlets and outlets to prevent material from entering the instrument. The NanoParticle Nebulizer is now prepared for shipping or moving.
   Note: If you did not save the original protective caps, find suitable alternatives.
8. Place the instrument in its original packing materials for shipping.

Preparing the AFIMC for Shipping

To prepare the AFIMC for shipping, follow these instructions:

1. Disconnect the aerosol sample tubes.
2. Disconnect the communication cables.
3. Turn off the power.
4. Place all the caps that you received with the instrument on the inlets and outlets to prevent material from entering the instrument. The AFIMC is now prepared for shipping or moving.
   Note: If you did not save the original protective caps, find suitable alternatives.
5. Place the instrument in its original packing materials for shipping.

Preparing the Fast CPC for Shipping

To prepare the Fast CPC for shipping, follow these instructions:

1. Disconnect and remove the n-Butanol fill bottle then empty it into an appropriate container. (Note: To preserve the n-butanol, swap the supply and exhaust connections so that the supply is drawing from the top of the bottle and the exhaust is feeding the bottom.)
2. Set the butanol flow in Prime mode.
3. Place the empty bottle back in the bracket and reconnect.
4. Operate the Fast CPC until the counts on the **Device Status** screen read 0.
5. Disconnect the aerosol supply from either the **Aerosol In** fitting on the front panel or from the high-performance aerosol inlet (beneath the instrument).
6. Disconnect the exhaust and make-up air tubing.
7. Replace the aerosol inlet adapter elbow if not already in place.
8. Turn off the power and unplug the power cable.
9. Place all the caps that you received with the instrument on the inlets and outlets to prevent contaminants from entering the instrument. **Note:** If you did not save the original protective caps, find suitable alternatives.
10. The Fast CPC is now prepared for shipping or moving.
11. Place the instrument in its original packing materials for shipping.

If you have any questions about shipping or moving the Liquid NanoParticle Sizer system, contact Kanomax FMT, Inc. at 651-762-7762. (Customers in Asia please call +81 6-6877-0183.)

Appendix A: Liquid NanoParticle Sizer Model 9310 Specifications

Table 2: LNS System Model 9310 Specifications.

Particle size range	6-316 nm (high resolution), 10-562 nm (wide range)
Particle size resolution	64 channels per decade of size (high resolution), 32 channels per decade of size (wide range)
Measurement time	<5 minutes
Inspection volume rate	0.2-1.0 µL/min
Total liquid sample flow rate (online)	50-200 mL/min
Dilution factor range	50-20,000
Sample conc. range (post offline and/or online dilution)	3E7-3E11 number/mL
Sample percent solids (post offline and/or online dilution)	10 ppm maximum
Response time to concentration change	<90 seconds
Inlet water pressure (online)	200-300 kPa (30-45 psig)
Compressed air flow rate/pressure	2.5 std L/min CDA or Nitrogen 2.8 bar (50 - 60 psi)
Wetted surfaces (before nebulization)	PFA, PTFE, sapphire, 316L stainless steel, PEEK
CPC working fluid	n-butyl alcohol (butanol)
I/O Communications	Ethernet, internal memory
Power requirements	100/115/220/240 VAC; 50-60 Hz
Operating temperature	10-35°C
Operating humidity	0-90% RH non-condensing
Storage temperature	5-35°C
Dimensions	10 × 9 × 36 inches (D/W/H) (not including peristaltic pump)
Software – computer operating system	Windows 10

Refer to individual product sheets for component details.
Computer not included.
Specifications subject to change without notice.
The LNS System was developed in collaboration with CT Associates, Inc.
The LNS System uses a soft X-ray charge conditioner.

Table 3: NanoParticle Nebulizer Model 9110 Specifications.

Peak droplet diameter	< 1.0 micrometer (nominally 0.2 micrometer)
Droplet dN/dLogDp > 10µm	< Peak dN/dLogDp x 10^{-5}
Volumetric Inspection Rate	0.2-1.0 µL/min
Total Liquid Flow Rate (online)	50-280 mL/min
Nebulizer Flow Rate (direct)	0.5-3.0 mL/min
Aerosol Flow Rate	1.0 – 1.5 L/min
Response time to concentration change	< 90 seconds
Inlet Water Pressure (online)	200-500 kPa (29 – 72 psig)
Compressed air flow rate/pressure	3 std L/min CDA or Nitrogen, (345-414 kPa, 50-60 psi)
Wetted Surface Materials	PFA Teflon, PTFE, sapphire, 316L, stainless steel, PEEK
Ambient Temperature Range	15-35°C, 59-95°F
Ambient Relative Humidity Range	0-85%
Maximum Water Temperature	80°C, 176°F
Dimensions (WxDxH)	23 (9) x 23 (9) x 35.5 (14) (46 (18) with fittings)
Weight	6 kg (13..2 lb)
Power	Universal 100 - 230 VAC 50/60 Hz, 90 W max
Output	RJ-45 for Modbus, USB FlashDrive
Internal storage	Micro SD
Ultrapure Water Inlet	¼ inch PFA Flaretek®
Waste Outlet	¼ inch SS Swagelok®
Compressed Air inlet	¼ inch SS Swagelok®
Detector vacuum	¼ inch SS Swagelok® port
Display	3.5 inch TFT Color, touch panel

Specifications subject to change without notice.

Appendix A: Specifications

Table 4: AFIMC Model 3660 Specifications.

Concentration Range	1 to 1E6 #/cc
Particle size range	5.62 – 316 nm (High Resolution Mode) 10 – 562nm (Wide Range Mode)
Measurement Time	2-3 seconds/bin (High Resolution Mode) 2.5-3.5 seconds/bin (Wide Range Mode)
Resolution	64 bins/decade (High Resolution Mode) 32 bins/decade (Wide Range Mode)
Sheath Flow	6 liters/minute (High Resolution Mode) 6 liters/minute (Wide Range Mode)
Sample Flow	1.5 lpm less Charge Conditioner Purge Flow
Charge conditioner flow	100 to 300 ccm, user seletable
Gas Requirements	100-300 ccm clean dry air (dewpoint < -40C) Minimum 10 psi
Aerosol Temperature	10- 40 C
Inlet pressure	+/- 20 mbar relative to ambient
Maximum sample dewpoint	14 degree C
I/O	Pulse input (5 V) Analog Input (0-10 V) USB port (for data download and firmware updates) DB9 (not currently used)
Software	Kanolysis
Dimensions and Weight	23 in (9 cm) x 46 in (18 cm) x 35.5 in (14 cm) 6.8 kg (15 lb)
Power requirements	50/60 Hz, 100-220 VAC, 75 Watts

Specifications subject to change without notice.

Table 5: Fast CPC Model 3650 Specifications.

Particle Size detection	1.9 nm to > 3 μm
Concentration range	1 – 100,000 particles/cm^3
Response time	50% response time ~ 80 ms, 10-90% response time ~ 35 ms, time constant (τ) ~ 20 ms
Working condensing fluid	n-butyl alcohol
Flow control	Critical orifices with internal pumps
Aerosol sample flow	300 cm^3/min
Inlet flow	600 or 1500 cm^3/min (user selectable)
Sheath flow	300 cm^3/min
Aerosol inlet	Front panel or vertical from the bottom (user selectable, fitting access on right side of instrument)
Dimensions (WxDxH)	8.5" × 7.5" × 8.5" (21.6 cm × 19 cm × 21.6 cm)
Weight	6.8 kg (15 lb)
Power requirements	50/60 Hz, 100-220 VAC, 75 Watts
I/O	RJ-45 with Ethernet (future), pulse output and user selectable analog output

Specifications subject to change without notice.

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