Frequently Asked Questions

Common questions for the Thermo Scientific™ 5014iQ and Thermo Scientific™ 5030iQ particulate monitors

Regarding the impact of wood smoke conditions, how do your monitors manage the sample collections and measurements in high loading conditions?

There are a number of features that allow the Models 5014iQ and 5030iQ to properly handle high sample loading. In the absence of wood smoke, the system will monitor the collected mass and the sample flow. If the collected mass exceeds a predetermined value, or if the sample flow rate decreases by more than 5%, the system will automatically advance the tape to a clean filter spot before the next scheduled tape advance, which is normally 8-hours. In the case of wood smoke, you may have high loading for wood smoke, but the collected mass may not be high enough to cause the tape to advance prior to the scheduled time. Because the instruments are using beta attenuation to monitor the mass, the measurements are not affected by the wood smoke composition and will accurately report the measured concentration.

One of the concerns that we are aware of with the design of beta monitors related to wood smoke, is that after a tape advance, the tape spot with collected wood smoke may stick to the O-rings in the measurement head of the instrument. The 5014iQ and 5030iQ have an option to increase the distance of the tape advance to ensure that the previously collected spot is moved away from O-rings in the measurement head. This setting is activated in the menu on the instrument. This is a manual setting that can be activated during periods when high wood smoke is present and deactivated after the wood smoke event passes. When activating this setting, the tape will be advanced twice as far as with the regular setting, resulting in a shorter interval requiring the tape replacement in the instrument.

Can I measure white particulates with beta attenuation or SHARP technologies?

Yes, white particulate can be measured. The color of the sample does not affect measurements by the beta detector. However, if the material is metallic with a high reflectivity, there may be a bias in the nephelometer measurement, but because of our design, we always correct the nephelometer readings so that the SHARP will match the beta.

There are certified instruments in the market that measure optically PM10, PM2.5, and PM1. Why does Thermo Fisher Scientific add the cost of beta attenuation to the nephelometer to make an “accurate instrument?” Are the fully optical instruments not accurate? But if that is the case, then how are they certified?

Regulatory agencies have approved many technologies for monitoring ambient particulates. For example, Mass, Gravimetric, Beta, and Light Scattering/Optics are all approved technologies. Environmental conditions and your application needs play strong roles in identifying and selecting a suitable technology.

Under specific conditions such as wood smoke or high particulate loading, optics alone could report artificially high readings or measurement bias resulting in data inaccuracy, and hence such an instrument is not reliable choice. In such situations, Beta attenuation and Gravimetric technologies are better choices for accurate measurements, but these are limited by how fast data

can be collected. Our 5030iQ monitor applies beta-correction to the optical readings to correct for any measurement biases and provides continuous data that is fast, reliable, and accurate.

What are the advantages of the 5014iQ/5030iQ particulate monitors over the competition?

Our 5014iQ monitor offers continuous sampling for faster data collection compared to the stepwise sampling offered on competitive beta monitors. Also, the 5014iQ monitor uses a longer 40m tape that requires tape replacements approximately once every year; competing products use much smaller tape, requiring tape replacements every 60 days.

Compared to light scattering-based technology monitors available in the market, the Thermo Scientific 5030iQ SHARP model stands out because it couples light scattering with beta technology to provide accurate data in real time. The beta attenuation confirms that any biases from light scattering caused by varying environmental conditions is corrected, thus delivering more accurate data for critical decision making. Depending on the environmental conditions and calibration shifts, monitors that rely solely on light scattering alone might provide data that is biased and therefore not accurate.

C14 is a beta emitter. What are the regulations for employing this radioactive source? Is any special permitting needed in the USA? Also, how do you dispose of used 40m tape?

We, as the manufacturer of this product, have US regulatory approval and Nuclear Regulatory Commission (NRC) approval for our facility. Our monitors use a carbon-14 source with <100 microcurie. In the US it is exempt from hazardous material under Code UN2911, and no license is required. With such low C-14 levels, the NRC regards this as disposable in the trash. Similarly, there is no special disposal requirement for the tape after its use and can be simply disposed in the trash. For other countries, please verify the requirements of the local regulatory agencies.

Have you conducted any work on your monitors' carbon-14 decay rate? For example, after a year or two in continuous field measurement?

No, we have not. The half-life on C-14 is over 5000 years. It's such a long time that it does not matter. Also, there is annual calibration of beta source to ensure proper function.

Are there ever any negative readings from the 5014iQ monitor? If yes, what factors do we have to consider when evaluating them, and what is the resolution?

Negative measurement questions must be compared to current ambient conditions and other on-board diagnostics by reviewing instrument data. Also, understanding the reasons behind the negative readings is important for users to correctly interpret the data and understand their ambient environmental conditions.

Particulate matter (PM) can be heterogeneous, consisting of one or more elements including heavy metals; inorganic compounds such as salts; and semi-volatile components like organic carbon or secondary aerosols such as nitrates, sulfates, and water. Particles can exist in solid or liquid form or a mixture of both. PM is often hygroscopic, demonstrating an affinity for water at ambient RH of 75–80% or higher, and stubbornly retaining that bound water until experiencing a RH of less than 30–35%. In general, fine particles (PM-2.5) are more volatile than coarse particles. It is this complex characteristic that can lead to profound difficulty in consistent quantification of PM air pollution. The challenge is to provide a measure of PM under well-defined thermodynamic conditions (temperature, pressure, filter face velocity, and RH%). One must consider filter dynamics when discussing such situations.

What are filter dynamics?

Take the example of a complex mixture of particles collecting on our filter media. When the particulates collect on the filter, their mass may be influenced by interaction with airborne gases (acids, water vapor) or other particles in the sample air stream, or possibly by the filter media itself. The thermodynamic conditions of the sample air stream and the area around the sample filter influence the degree to which these ongoing reactions may occur. All these processes collectively comprise what we define as filter dynamics, and they may result in a positive or negative sampling artifact component of the PM mass concentration. The higher the time resolution of the PM measurement system, the more easily the PM mass concentration change resulting from filter dynamics can be observed.

Regulatory methods employed for the determination of PM generate data that are defined to be an "indicator" of airborne PM. Regulatory standards are then based upon this indicator measurement. Note that the PM indicator measurement is to some degree determined by the definition, and it is not based purely upon scientific considerations. Almost all regulatory methods are "filter based" methods, centered around the measurement of PM collected on a sample filter.

The dynamics explained above describe how airborne particles can change because of their interaction with immediate surroundings, including the filter. Over a long time period, the net result of collecting these particles and measuring them is in a mass gain. This is true even though there may have been shorter periods when particles were losing mass due to negative artifacts. Only the faster-responding continuous methods of PM measurements are capable of seeing the short-term positive and/or negative mass changes that combine to make up the longer-term 24-hour measurement. A couple of examples help to highlight these points.

Example 1

A plume from a source such as a burn barrel, a wood-burning appliance or even a diesel vehicle engulfs a monitoring site. Should this happen, the short-term mass concentration will rise dramatically, followed by a sharp decrease after the plume

ceases. The sharp decrease may be associated with a period (1 to 2 hours or more) of continuing net loss on the sample filter while the collected particulate matter continues to equilibrate to the thermodynamic conditions at the sample filter.

Example 2

Small water droplets from fog or mist are collected on the sample filter but evaporate over time. If the evaporative mass is greater than the collected mass, then net negative mass concentration is observed.

Would you recommend the use of 5014iQ monitors for coastal regions where RH is up to 85-90%?

Yes, model 5014iQ would be a good choice for coastal areas with high humidity. The system will adjust the inlet heater to minimize the impact of changing and high humidity.

Is there a setting on the inlet heater to adjust for very low humidity or cold air in the winter?

Yes, there is a setting to adjust parameters to accommodate seasonal variability.

Does the 5030iQ monitor utilize the same carbon vane pump that the legacy SHARP used? Are the flow path and bypass flow the same as the legacy or the i-series?

The carbon vane pump ended with the legacy FH62C14 and Legacy 5030 SHARP monitors. The i-series and iQ-series now use a piston pump. The sample flow paths are same as the i-Series.

Would either of these instruments be able to measure ultrafine particles, if they were outfitted with a special inlet?

The models 5014iQ and 5030iQ are mass measurement devices and are designed for monitoring TSP, PM10, PM2.5, and PM1. Considering the broader applicable definition of ultrafine particles as PM0.1, we do not have any data to confirm if these monitors can or cannot successfully monitor ultrafine particles, but if particles can be collected on the sample filter, the mass of the collected particles will be measured. If you have an inlet that will cut out particles greater than 0.1 um (the typical definition of ultrafine particles) and these are collected by the sample filter, the mass and concentration can be determined.

Is it possible to do a particle analysis that allows for identification of the chemical composition?

These monitors only do mass-based PM measurements and do not offer particle speciation. For a particle speciation type of analysis, it might be better to co-locate a Partisol sampler and use the sample collected on the filter for further analysis.

Does the filter tape have any time indexing, so users can go back to a time spot to do SEM-EDS, XRF, or optical microscopy?

This would be difficult because the completed tape wraps upon itself. Also, to retrieve this information, you would need to cut the tape, which defeats the purpose of continuous monitoring. For this type of analysis you might be better off to co-locate a Partisol sampler and use that sample filter for further elemental analysis without any compromise.

What is the expected repeatability range for multipoint calibration on the 5014iQ beta detector?

The beta detector is calibrated using zero and mass foils. There are different foils available at different mass levels and you can use the one that most closely aligns with the local concentration conditions.

What is the sampling rate on these instruments?

These monitors function continuously and run at a 1-minute sampling rate. The internal instrument updates data every 10 seconds. The instrument's algorithm performs some averaging and provides a readout once a minute.

I am considering purchasing the 5030iQ monitor for PM2.5. Let's say in future I need to do a PM 10 or a PM1—can I convert my monitor to use for different particulate size?

Yes, these monitors are designed to be able to monitor multiple particulate sizes. Depending on your specific needs, these monitors can be used with sample inlets that have designated particulate cut-offs for TSP, PM10, PM2.5, and PM1.

I recently purchased the 5014iQ monitor to measure PM10, but now I am doing a separate study for which I need a 5030iQ monitor. Do I need to buy a new unit, or there is another option?

Purchasing a new 5030iQ is always an option. However, if you no longer have need for your 5014iQ monitor and are seeking a 5030iQ monitor, you can easily upgrade to a 5030iQ monitor by using our 5014iQ upgrade kit option (Part number 109458-00).

This upgrade kit can be used by our customers onsite. Customers are not required to ship the 5014iQ unit back to the factory for this product upgrade. With this, our customers get the benefit of cost savings and minimal to no downtime.

I currently have a legacy model commissioned that will soon need a replacement. Can I replace it with the iQ series?

Yes, iQ series is designed to facilitate convenient replacement. It is our strong recommendation that our customers take advantage of this option and replace their legacy models with iQ series models when desired. The x-y position on the inlet is compatible with original i-Series monitor facilitating drop-in installation.

Resources

Customer service: orders.aqi@thermofisher.com

Telephone: 1-866-282-0430

5030iQ SHARP Monitor

5014iQ Beta Attenuation Monitor

Air particulate monitoring system product guide