

5030iQ SHARP Monitor

Reliable PM_{2.5} measurements during exceptional events



Thermo Scientific 5030iQ
SHARP Monitor.

Introduction

Exceptional events can produce substantial, short-term changes in ambient fine particulate matter (PM_{2.5}) concentrations. For U.S. regulatory purposes, an exceptional event is an event and resulting emissions that have a clear causal relationship to a monitored exceedance or violation, are not reasonably controllable or preventable, result from a natural event or human activity unlikely to recur at a particular location, and are determined by the U.S. Environmental Protection Agency (EPA) in accordance with 40 CFR 50.14.^[1] Events that may qualify include wildfires, high-wind dust events, prescribed fires, and volcanic activity. An elevated-pollution episode is not automatically an exceptional event.^[2]

These events can also change aerosol composition and physical properties, which can affect the relationship between particle light scattering and particulate mass. The [Thermo Scientific™ 5030iQ SHARP \(Synchronized Hybrid Ambient Real-Time Particulate\) Monitor](#) combines light-scattering nephelometry with beta attenuation measurement. The nephelometer provides rapid response, while beta attenuation provides a mass-based measurement used to calibrate the optical response, supporting high-time-resolution PM_{2.5} measurements.^[3-5]

Why changing aerosols can challenge optical PM_{2.5} measurements

A nephelometer estimates particulate concentration from the amount of light scattered by particles in the sample stream. This provides a rapid, time-resolved response, but scattered light is not determined by particle mass alone. The relationship between scattering and mass depends on aerosol properties such as particle size distribution, refractive index, density, and particle shape.^[3]

Relative humidity and chemical composition can further influence scattering through hygroscopic particle growth. As aerosol composition or water uptake changes, a fixed optical-to-mass relationship can introduce bias. These effects are particularly relevant during smoke, dust, and other episodic conditions in which aerosol properties may differ from typical local ambient conditions.^[4]

SHARP technology: High time resolution with a mass-based reference

The 5030iQ SHARP Monitor integrates two complementary measurement principles in a single instrument. Light-scattering nephelometry provides sensitive, rapid response to changes in particle concentration, while beta attenuation provides a mass-based measurement. The nephelometric measurement is checked against the beta attenuation mass concentration for calibration, reducing dependence on a fixed optical-to-mass relationship while retaining rapid response.^[5]

This distinction is important when aerosol properties change. Rather than treating the optical estimate as an independent mass determination, SHARP technology uses the beta-based measurement as a reference for the nephelometric response. The 5030iQ SHARP Monitor supports mass-concentration averaging periods beginning at 60 seconds, with data output every second.^[5]

Published field studies of the earlier 5030i SHARP Monitor provide supporting evidence for the underlying hybrid measurement approach. A multi-year study in Ontario, Canada, reported high data completeness and good agreement between 24-hour SHARP measurements and filter-based measurements. A separate study in Fort McMurray, Canada, found no statistically significant difference between 24-hour SHARP and Federal Reference Method averages and reported strong agreement during elevated PM_{2.5} periods associated with forest fires.^[6,7]

Note: These published studies evaluated the earlier 5030i SHARP Monitor rather than the current 5030iQ model. They support the SHARP measurement approach but should not be interpreted as direct performance evaluations of the 5030iQ model during a specific exceptional event.

Application during exceptional events

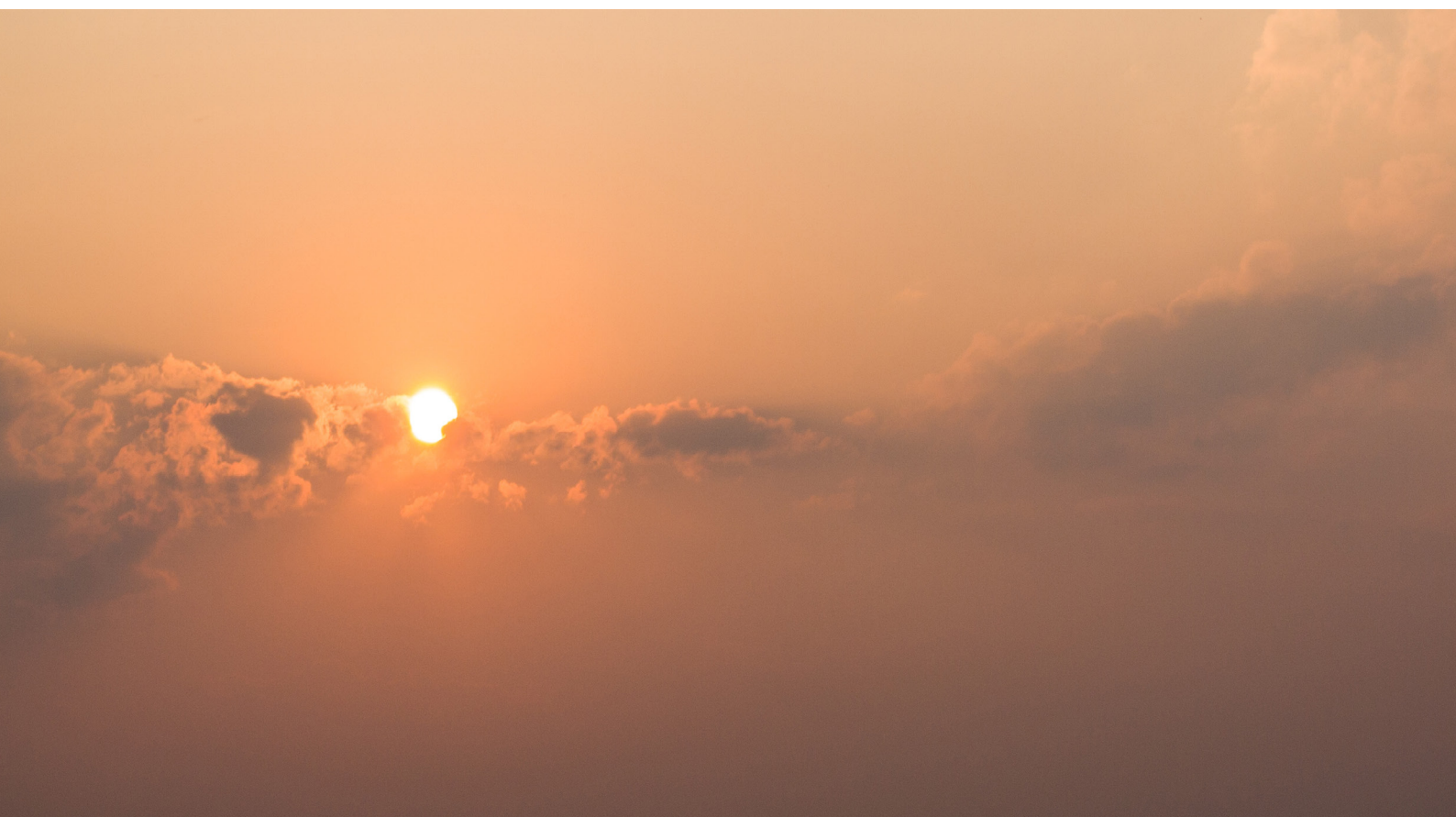
Monitoring exceptional events can require a measurement system to address rapidly changing PM_{2.5} concentrations and changing aerosol characteristics at the same time. The SHARP measurement approach is well suited to these conditions because it combines fast optical response with an independent, mass-based beta attenuation measurement.^[5]

- **Rapid concentration changes:** High-time-resolution measurements help characterize short-duration increases, peaks, and decreases that may occur during smoke, dust, and other episodic events.
- **Changing aerosol properties:** Referencing the nephelometric response to beta attenuation reduces reliance on the assumption that a single optical-to-mass relationship represents all aerosol conditions.
- **Simultaneous changes:** The hybrid approach is particularly useful when concentration and aerosol properties vary together, providing complementary temporal and mass-based information within one measurement system.

U.S. EPA Federal Equivalent Method designation

The 5030iQ SHARP Monitor is included under U.S. EPA Automated Equivalent Method designation EQPM-0609-184 for PM_{2.5} measurement when operated in the configuration and under the conditions specified by the EPA.^[8]

The EPA designation specifies operation for 24-hour average PM_{2.5} measurements and identifies the required inlet, particle separator, flow rate, and operating procedures. High-time-resolution outputs can provide additional temporal detail, but users should follow the applicable FEM designation and instrument operating manual for regulatory monitoring.^[8]





Conclusion

Exceptional events can challenge PM_{2.5} monitoring because particle concentrations and aerosol properties may change rapidly and simultaneously. Optical measurements provide valuable temporal resolution, but their relationship to particle mass can vary as aerosol properties change.^[3,4]

The 5030iQ SHARP Monitor combines light-scattering nephelometry with beta attenuation measurement to calibrate the optical response against a mass-based reference. This hybrid approach provides rapid PM_{2.5} measurements while reducing dependence on a fixed optical-to-mass relationship, making it a strong option for monitoring rapidly changing or compositionally variable PM_{2.5} conditions.^[5]

References

1. 40 CFR 50.1(j), "Exceptional event," and 40 CFR 50.14, "Treatment of air quality monitoring data influenced by exceptional events."
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4. Ren R, Li Z, Yan P, et al. Measurement report: The effect of aerosol chemical composition on light scattering due to the hygroscopic swelling effect. Atmospheric Chemistry and Physics. 2021; 21:9977-9994. doi:10.5194/acp-21-9977-2021. [Source](#)
5. Thermo Fisher Scientific. Thermo Scientific 5030iQ SHARP Monitor: product information and specifications. Product specification PSEPM-5030iQ 07/25. [Source](#) | [Specifications](#)
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7. Hsu Y-M, Wang X, Chow JC, Watson JG, Percy KE. Collocated comparisons of continuous and filter-based PM_{2.5} measurements at Fort McMurray, Alberta, Canada. Journal of the Air & Waste Management Association. 2016; 66(3):329-339. doi:10.1080/10962247.2015.1136362. [Source](#)
8. U.S. Environmental Protection Agency. List of Designated Reference and Equivalent Methods. Issue date July 28, 2026. Thermo Scientific Model 5030i SHARP, Model 5030 SHARP, or Model 5030iQ SHARP Monitor; Automated Equivalent Method EQPM-0609-184. [Source](#)