



CONSTRUCTION DUST MONITORING: WHY FIT-FOR-PURPOSE PM₁₀ MEASUREMENT MATTERS

TSI Incorporated explores why fit-for-purpose PM₁₀ measurements are important at construction and demolition sites

Construction and demolition sites generate short, intense bursts of coarse dust. These events are not outliers; they are a predictable part of demolition, earthworks, construction and trackout activity, and are explicitly recognised in the Institute of Air Quality Management (IAQM) Construction Dust Guidance. Managing these emissions is essential for protecting local receptors, preventing complaints, and meeting planning or permit requirements.

In recent years, low-cost optical particle counter (OPC) sensors have become widely available and are sometimes positioned as a solution for construction monitoring. While they have clear value in certain ambient applications, their typical technical design means they are not well suited to the high-dust, coarse-particle environments found on active construction sites.

The risk is simple. If the instrument cannot reliably capture the dust events that matter, it cannot provide defensible evidence within a Dust Management Plan (DMP) or to a local authority.

This article explains why many low-cost OPC-based sensors struggle, why PM₁₀ construction monitoring is fundamentally different from typical ambient monitoring, how standards like MCERTS and CEN/TS 17660 fit into this landscape, and what a fit-for-purpose monitor needs to deliver on real sites.

Why construction sites are different: high-dust events are expected

IAQM guidance makes clear that construction dust risk should be assessed using Dust Emission Magnitude (DEM) combined with receptor sensitivity. DEM categories are based on:

- Volume of material to be demolished
- Site area and soil type for earthworks
- Volume and construction method for new structures
- Vehicle movements and trackout distances.

Large DEM phases routinely generate PM₁₀ concentrations far beyond typical ambient levels, often reaching into the hundreds or thousands of micrograms per cubic metre.

These bursts are not anomalies; they are an inherent feature of construction activity. Monitoring systems must therefore be able to remain stable and usable during rapid changes, coarse particulate loads, and strong winds. Those conditions can be well outside the design envelope of many low-cost ambient sensors.

Why low-cost OPC sensors struggle in construction environments

Many low-cost OPC-based sensors do not directly measure PM₁₀ mass across the full coarse size range. They count smaller particles, often focused on fine fractions up to a few micrometres in diameter, and then estimate PM₁₀ mass using assumed particle densities and size distributions.

This can work reasonably well in clean ambient environments dominated by fine combustion aerosols. It breaks down when coarse mechanical dust dominates, such as:

- Demolition debris
- Concrete crushing
- Soil disturbance
- Trackout from haul routes.

In addition, many low-cost OPC systems move very little air through a compact optics chamber. From an active sampling perspective, the flow is low and the air is only just being drawn past the optics. This can slow the response to rapid concentration changes, smoothing out or missing short-duration peaks that are important for IAQM-based dust management.

Three fundamental problems arise.

1. PM₁₀ is inferred, not robustly measured

Once the aerosol becomes coarse and the true size distribution differs from the assumptions in the OPC algorithm, uncertainty increases. PM₁₀ can be under-reported because the instrument is less sensitive to the larger particles that drive mass. The same issue affects PM₁ estimates, which contribute to the total PM₁₀ mass. The result can be misleading behaviour in both PM₁ and PM₁₀ estimates, varying significantly with dust type.

2. Concentration range is limited

Many low-cost OPC sensors specify an upper measurement range in the region of 150-200 µg/m³. In practice, some units saturate or clamp readings in this range, either to avoid false positives in fog or high humidity, or because the optics and fan cannot handle high loading. This can create flatlines during peak events; exactly when monitoring is most important for IAQM-based risk management.

3. Environmental stability can be poor

Low-cost OPCs typically rely on very small fans and relatively exposed optical paths. Wind gusts, humidity spikes and optical contamination can all introduce noise and drift. Even if the system is aligned or calibrated on day one, performance can degrade more quickly on exposed construction sites than in the ambient environments for which many of these sensors were designed.

When these issues combine, there is a real risk of missing or underestimating the events that matter to local authorities, communities, and project compliance teams.

As local authorities gain expanded powers and as developers adopt more robust DMPs, the distinction between ambient-grade sensors and construction-grade monitors becomes increasingly important

Where standards fit: MCERTS, CEN/TS 17660 and high-dust applications

MCERTS has historically provided a performance framework for indicative ambient PM monitors in the UK. The DustTrak™ Environmental Monitor achieved certification under the previous scheme, demonstrating agreement with reference samplers and meeting uncertainty requirements for the tested conditions. MCERTS remains widely referenced by local authorities, particularly in London boroughs where real-time PM₁₀ monitoring is often attached to planning conditions.

The newer European Technical Specification, CEN/TS 17660-2:2024, is an important step toward more consistent evaluation of sensor systems. At present it is focused on ambient applications rather than high-dust construction environments, and it will take time for test capacity and market use to develop.



TSI DustTrak™ Environmental Aerosol Monitor

Other programmes, including work on air sensor evaluation in North America, have begun to recognise that different monitoring purposes may justify different performance expectations. For construction dust, this highlights a simple point: using an ambient-grade, low-cost sensor for high-dust work is a different question from asking whether a monitor is fit for purpose on a busy site with coarse particles and rapid peaks.

For now, the most practical approach in the UK is to be explicit in specifications about the environment and concentration range the monitor needs to handle, rather than assuming that any ambient sensor or indicative monitor will automatically be suitable for construction dust management.

Photometric measurement: why it suits construction dust

For construction dust monitoring, it is advantageous to use a monitor that measures a signal proportional to mass, rather than inferring PM_{10} solely from fine-particle counts and assumed distributions.

The DustTrak™ monitor uses a real-time photometric measurement method where the intensity of scattered light in the sensing chamber is proportional to the mass concentration of particulate matter, subject to a calibration factor. This offers several advantages for construction environments:

Direct mass-proportional measurement

The photometric signal responds to the total mass of particles within the instrument's size sensitivity range, so coarse particles contribute directly to the signal. The response is still influenced by aerosol properties such as refractive index, density and size distribution, but it does not depend on counting only the finest fractions and extrapolating to PM_{10} .

High concentration capability

Because the optical system is designed for high loading, DustTrak™ monitors can remain usable through large spikes. Laboratory evaluation of the DustTrak™ Environmental optical system, including its extended beam dump design, has shown:

Case evidence from real sites

Grand Paris Express

A major infrastructure project required continuous PM_{10} and $PM_{2.5}$ perimeter monitoring at multiple active sites. DustTrak™ Environmental Monitor was chosen for its stability under variable dust loads, ability to provide real-time alerts, and clear reporting to stakeholders. The system operated without saturation during high-dust events, supporting rapid mitigation and maintaining community confidence.

UK demolition site (Clugston)

During a demolition project in Surrey, DustTrak™ monitor recorded PM_{10} peaks up to 1.9 mg/m^3 ($1,900 \text{ } \mu\text{g/m}^3$) associated with heavy vehicle activity. These peaks were clearly tracked and used to manage suppression. A typical low-cost OPC sensor with an upper range around $150\text{--}200 \text{ } \mu\text{g/m}^3$ could have saturated or significantly under-reported these events, masking the true scale of emissions.

These examples illustrate the magnitude of real construction dust events and the need for instruments designed to capture them.

- Stable operation under $100\text{--}200 \text{ mg/m}^3$ continuous loading
- Burst tolerance exceeding 400 mg/m^3

These conditions are far above the levels at which many low-cost ambient OPC sensors are specified to operate.

Optics protection and flow design

A combination of optics protection, including sheath air and purge flows around sensitive components, reduces contamination and drift. The beam dump design helps prevent optical saturation and reduces background scatter, maintaining stability during high-dust bursts. A higher-flow sampling system supports robust sampling even in gusty, complex wind conditions typical of open sites.

Baseline control and humidity management

Features such as auto-zero routines and heated inlets support baseline stability and help to reduce humidity-related artefacts. This is important where hygroscopic growth and fog events could otherwise interfere with measurements.

Taken together, these features are designed to support stable, defensible data on the days when dust levels matter most.

Selecting a fit-for-purpose PM_{10} monitor

A suitable PM_{10} monitor for construction must offer more than generic indicative measurement. Minimum requirements include:

- Real-time mass-proportional measurement, rather than purely algorithmic estimation of PM_{10} from fine-particle counts
- Stable operation well above $150 \text{ } \mu\text{g/m}^3$, ideally into the thousands
- Protection of optical components (for example sheath air and beam dump) to limit contamination-related drift
- Sampling design and flow suitable for robust operation in windy, open environments
- Ability to operate continuously outdoors with manageable drift and realistic maintenance intervals
- Clear, actionable alerts that can be tied to DMP response actions
- Reliable data export for DMPs, planning compliance and stakeholder reporting.

When monitoring is tied to planning conditions or potential enforcement, missing a high-dust event has real consequences. A monitor must be able to remain reliable during the phases where risk is highest.

Conclusion

Construction sites need PM_{10} monitors that can withstand coarse dust, rapid bursts, humidity, wind and long operating hours, and still produce reliable data. Many low-cost OPC sensors, designed primarily for ambient fine-particle monitoring, struggle to meet these demands. They can saturate early, underestimate coarse fractions, and leave gaps in data exactly when dust levels matter most.

Photometric instruments such as DustTrak™ monitors provide a real-time mass-proportional measurement method supported by an optical and sampling architecture tailored to high-dust environments. They have demonstrated stable performance in both laboratory loading tests and real-world deployments on projects where data integrity is essential.

As local authorities gain expanded powers and as developers adopt more robust DMPs, the distinction between ambient-grade sensors and construction-grade monitors becomes increasingly important. A clear high-dust performance tier within MCERTS would help the market align around this reality, but contractors and consultants do not need to wait for the certification framework to evolve. The technical requirements are already clear, and performance evidence is already available.

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