2025

Dust Measurement in Construction Projects

English Reference Version by eGate Smart Building Innovation, 17.12.2025

1 Foreword

Dust control is a central part of occupational safety and quality. The purpose of this guideline is to facilitate the correct and effective implementation of dust control so that the working environment remains safe and employees' health is protected.

Legislation sets clear limits on the maximum allowable levels of quartz dust at construction sites, but in practice the lack of effective measurement and documentation methods has made dust control challenging. Successful dust control requires not only measurement but also clear documentation that demonstrates the adequacy of the measures taken and their results. Real-time measurement is particularly important, as it enables early detection of problems and the implementation of corrective actions before conditions deteriorate. In addition, fact-based documentation of dust control is needed for later review, for example during regulatory inspections or site evaluations.

In 2021, an interdisciplinary working group was established to determine how construction sites can verify whether conditions are safe for workers and whether statutory requirements are met. The group commissioned a correlation measurement study (Raiski, 2022), which showed that the tested measurement equipment achieved sufficient accuracy compared to occupational hygiene measurements. Once correlation was established, the working group concluded that the next step was to prepare guidelines for the reliable execution of measurements under construction site conditions.

Although quartz dust is particularly hazardous due to its association with lung cancer risk, it is recommended to monitor all respirable dust in work environments, as other fine particles may also cause significant health effects (Finnish Institute of Occupational Health, 2016 & 2024). Measurement and monitoring can improve occupational safety and make visible dust exposures that may not previously have been identified. For this reason, the guideline emphasizes real-time monitoring and control of total particle mass as one of the cornerstones of dust control.

This guideline has been prepared to support the practical and professional implementation of dust control at construction sites. It provides tools for both measurement and related documentation, enabling demonstration of successful dust control. The aim is to help construction sites meet legislative requirements, improve working conditions, and ensure safety for all parties.

The guideline provides general principles and considerations for conducting measurements. However, it must be noted that each construction site is unique and therefore requires an individual measurement plan. Successful dust control is a holistic process in which the success of earlier stages determines the success of subsequent ones. The process requires continuous evaluation of different stages and a return to the preparation phase if actual

conditions do not correspond to the intended objectives. This guideline is not intended to serve as a site-specific dust control or measurement plan.

2 Terminology

2.1 Construction dust

Dust generated as a result of demolition or construction activities at a construction site, which may include quartz dust, hardwood dust, cement dust, and other substances harmful to health. Dust is generated particularly during mechanical processing such as chiseling, drilling, and grinding.

2.2 Quartz (crystalline silica)

A widely occurring natural mineral found in bedrock, sand, and stone materials. In construction materials, quartz is present for example in concrete, bricks, mortar, and other aggregates.

2.3 Quartz dust

Fine particulate dust containing crystalline silica (quartz). It is released especially during construction activities involving materials that contain quartz, such as concrete, stone, or bricks. In Finland, the occupational exposure limit for respirable crystalline silica is 0.05 mg/m^3, with a binding limit value of 0.1 mg/m^3 (8-hour time-weighted average). Quartz dust is hazardous when inhaled and may cause diseases such as silicosis and lung cancer.

2.4 Hardwood dust

Generated during the processing of hardwoods such as oak, beech, or elm. Under EU and Finnish legislation, hardwood dust is classified as a carcinogenic substance. According to Government Decree 1267/2019, the binding limit value is 2 mg/m^3 of inhaled air.

2.5 Respirable fraction

Airborne particles with an aerodynamic diameter of less than 4 micrometers (µm). Particles of this size can penetrate into the alveoli of the lungs, where they may cause serious health effects.

2.6 OEL value (Occupational Exposure Limit)

A limit value set for contaminants in workplace air, indicating the maximum permissible concentration to which an employee may be exposed without health risk. Values are defined as 8-hour time-weighted averages, and for some substances separate short-term exposure limits apply.

2.7 Occupational hygiene measurements

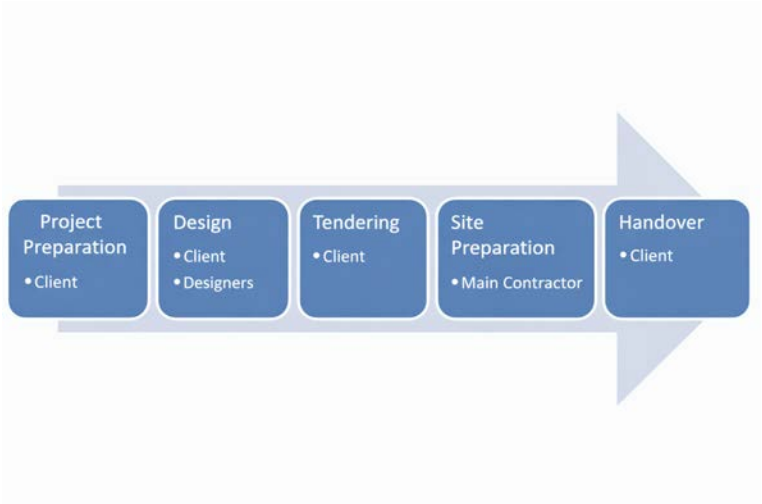
Measurements used to assess workers' exposure to harmful agents such as dust, chemicals, or noise. Dust measurements may include total dust, inhalable dust, or respirable dust, measured either at the workstation or in the worker's breathing zone using personal samplers.

2.8 Dust measurement using a continuous recording system

Measurement technology that enables continuous monitoring of airborne dust concentrations without separate laboratory analysis of samples. Real-time measurement systems (for example, solutions based on optical sensors) produce data on dust concentrations and particle size fractions at second- or minute-level resolution, enabling rapid response to exceedances.

3 Project Progression

A construction project proceeds from identification of a need to its fulfillment. The diagram below illustrates a typical construction project progression and the responsible party at each phase. This guideline describes matters related to dust measurement that must be considered at different phases.



3.1 Project Preparation Phase

During the preparation phase, the client's intent is defined. The client may require continuous dust measurement to better manage construction site dust control and to verify compliance with legal requirements. The responsible party is the client or a representative appointed by the client.

3.1.1 Required baseline information

- Project scope, contract type, schedule
- Special characteristics of the site (exceptional demolition work, materials)
- Hazardous materials survey, condition assessment report (for renovation projects)
- Risk assessment / hazard identification, evaluation of project complexity from a dust control perspective
- Area of impact of the construction site in terms of dust control, including adjacent occupied spaces and ventilation contamination risk
- In some cases, pre-measurements before work starts to determine baseline conditions

3.1.2 Documents to be prepared and clarifications

- Clarifications to commercial documents
    - The client requires designers to define dust measurement needs, system requirements, and reporting, to be reviewed in site meetings and approved as part of official occupational safety reporting
    - If necessary, a separate document for design tender materials assessing the dust control complexity of the project
- Entries in the safety document
    - Definition of responsible parties and measurement requirements

3.1.3 Quality requirements and quality assurance

The appointed safety coordinator reviews preparation phase documentation. The occupational safety coordinator ensures that dust-related risks have been considered during preparation.

Examples include daycare centers or schools where activities continue during demolition work, requiring early appointment of a cleanliness management coordinator. In projects involving demolition of microbe-damaged materials adjacent to occupied spaces, dust measurement should be arranged in the occupied areas.

3.2 Design Phase

During the design phase, dust control requirements related to the project are specified in more detail. The objective is to ensure that the client's dust control goals are incorporated into the designs and that all designers assess and account for dust control needs. The client is responsible for appointing a person responsible for dust control design.

3.2.1 Required baseline information

- Site-specific characteristics (e.g. demolition scope and exceptional work phases)
- Hazardous materials assessment report (renovation projects)
- Risk assessment
- Safety document

3.2.2 Documents to be prepared and clarifications

- Clarifications to commercial documents
- Clarifications to work descriptions (structural, architectural, HVAC), including demolition specifications
- Updates to the safety document
- Cleanliness management document
- Dust control requirements (measurement-related) recorded in design documents
- Identification of work phases generating dust and areas where dust must not spread
- Definition of measurement duration and need for post-handover measurement
- Possible requirement for a dust control mock-up as part of quality assurance
- Definition of reporting requirements and frequency
- Number and placement of measurement devices
- Assessment of minimum number of devices relative to area, spaces, or floors
- Measurements focused on areas where people work without respiratory protection
- Assessment of measurement needs in adjacent occupied spaces
- Assessment of pressure differential measurement needs

3.2.3 Quality requirements and quality assurance

The safety coordinator reviews the designs from an occupational safety perspective, taking dust control requirements into account.

3.3 Construction Phase

The objective is to implement dust control during construction in a planned and proactive manner based on information. Dust measurement is used as a tool to improve occupational safety. The main contractor is responsible for site safety and dust-related measurements.

3.3.1 Responsible party

A person responsible for dust control is appointed. This person documents alarms and actions, reports in contractor and site meetings, and monitors dust control systems.

3.3.2 Required baseline information

- Design documents
- Safety document
- Hazardous materials assessment (renovation projects)

3.3.3 Documents to be prepared

- Occupational safety plan
    - Dust measurement status may be included in TR measurements
    - The plan includes assessment of the site's impact area to ensure nearby occupants are not exposed
- Cleanliness / conditions management plan
    - Prepared by the main contractor in cooperation with supervisors and coordinators
    - Includes measurement areas, containment zones, number of devices, competence of the measurer, quality requirements for negative pressure units and air cleaners, and sufficiency of air purification
    - Considers dust exposure risks outside the site and measurement in occupied impact areas if needed
    - Personnel training on dust control requirements and alarm handling

Cleanroom or controlled environment plan must indicate designed particle meter locations, containment boundaries, and negative pressure equipment usage.

3.3.4 Quality requirements and quality assurance

Reporting and review of results are conducted in site meetings. The safety coordinator ensures dust control and measurement are implemented as planned.

Dust levels cannot be seen with the naked eye, so without measurement there is no woy of knowing whether the dust levels at the worksite are within tolerances.

3.4 Handover Phase

At handover, the contractor transfers the project to the client, who accepts it partially or fully. Responsibilities transfer to the client. From a dust measurement perspective, the handover documentation is essential. The main contractor verifies that dust control requirements have been met. In some cases, measurement may continue after handover to verify conditions.

3.5 Measurement

If earlier phases determine that dust measurement is required, the measurement method and equipment must be defined before measurement begins. At this stage, all construction dust is measured, as hazardous particles such as quartz dust or hardwood dust cannot be reliably measured continuously on their own.

3.5.1 Baseline information

- Cleanliness / conditions management plan

3.5.2 Documents to be prepared

- Measurement plan as an appendix to the dust or conditions management plan

3.5.3 Quality requirements and quality assurance

The safety coordinator or client's representative reviews the measurement plan. The client reviews and approves the proposed system and equipment.

3.5.4 Measurer

The measurer must be familiar with project-specific safety and dust control plans, measurement equipment operation, and reporting systems. The main contractor is responsible for training, although equipment suppliers may provide training on system use.

3.6 Requirements for the Dust Measurement System

The measurement system must be a verified, reliable, continuous IoT-based solution, either:

- certified by an authority or standardization body, or
- validated and documented by an independent expert organization (research institute, university, accredited laboratory)

Third-party validation must be completed before system deployment.

3.6.1 Documentation requirements

- Calibration certificates
- Technical specifications
- Operating, installation, maintenance, and calibration instructions
- Documentation of independent testing
- Declared error margin and measurement uncertainty

3.6.2 Operational reliability in site conditions

The system must be tested and proven functional in demanding site conditions, including temperature and humidity variation, dust load, vibration, mechanical stress, and maintainability.

3.6.3 Measurement method and functionality

The system must be continuous and real-time, including:

- automatic data logging and transfer
- alarm thresholds and alert system
- reporting functionality
- ability to record notes and actions alongside measurement data

3.6.4 Measurement interval and frequency

The measurement interval must not exceed 5 minutes.

3.6.5 Data storage and retention

Data must be stored securely, accessible for at least five (5) years after project completion, and comply with data security requirements.

3.6.6 Compatibility and usability

The system must function on common devices and operating systems without separate installations, and support Finnish, Swedish, and English user interfaces.

3.6.7 Measured parameters

The system must measure respirable fractions, particularly PM4, and if required PM2.5 and PM1, and produce 8-hour time-weighted averages.

3.6.8 Training

The system supplier must provide training upon request.

3.7 Guidelines for Placement and Installation of Measurement Devices

3.7.1 Measurement purpose

Devices are used to:

- monitor air quality in dust-generating areas
- monitor dust levels outside containment zones
- track worker exposure
- verify dust control effectiveness

3.7.2 Placement

- Height: 1–2 m from floor, approx. 1.5 m recommended
- Location: representative of exposure, avoid vents, doors, damage-prone areas
- Orientation: per manufacturer instructions

3.7.3 Marking and protection

Devices must be clearly marked and protected, with locations documented.

3.7.4 Number and coverage

Device quantity must ensure comprehensive coverage based on dust sources, work phases, space usage, and containment structures.

3.7.5 Determination responsibilities

Final quantities and locations are defined in the cleanliness management plan. Indicative guidelines:

- 1 device / 150 m
- 1 device per exposure-prone space

3.7.6 Pre-measurement readiness check

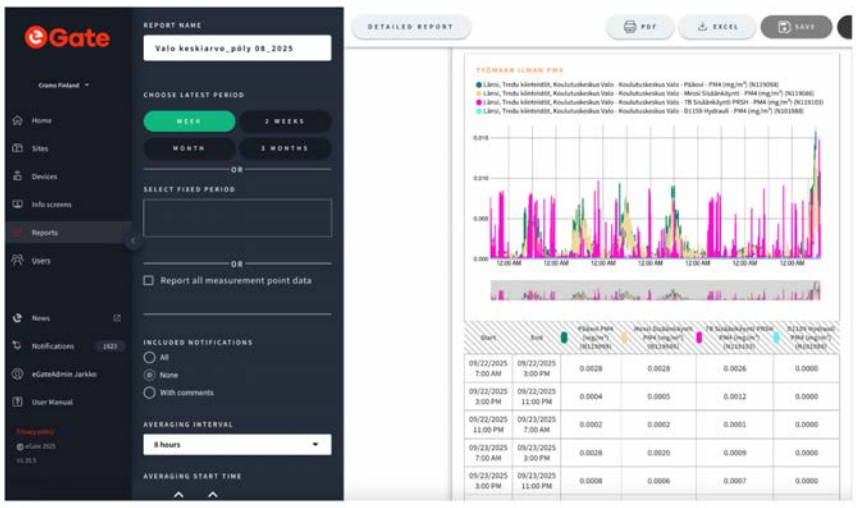
Ensure calibration, connectivity, system visibility, and approved placement.

3.7.7 Maintenance during measurement

Regular or as-needed maintenance to ensure data reliability.

3.7.8 Data processing and reporting

All data is documented transparently and available throughout the project and for five years thereafter. Interpretation considers context, work phase, containment, and ventilation.



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