REAL-TIME DUST MONITOR
TEOM 1405-F

The TEOM 1405 Real-time Dust Monitor measures airborne dust, volatile and semi-volatile compounds in real time. It the immediate replacement of the FDMS module equipped TEOM 1400 analyser, a device chosen by many countries for the quality of its measures.
The weighing of the dust collected on a filter after filtration of a known volume of air is the standard method for measuring the mass concentration of dust in the environment.
Two models are available: the 1405-F and the 1405-DF. Depending on the model, several concentrations are programmable (see technical data).

BENEFITS

- Real-time measurement of the mass of the dust deposited on the collection filter
- TÜV tested and certified
- Takes into account the volatile and semi-volatile fraction of the particles by technical FDMS
- Analog Outputs, RS232/485, USB, Ethernet
- Colour touch screen with internal library for maintenance and use
- Rapid response time
- Easy installation and transportation

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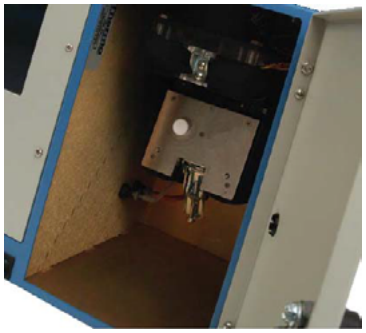
MEASUREMENT PRINCIPLE



The heart of the TEOM 1405-F is an inertial microbalance that uses a tapered element oscillating at its natural frequency (TEOM - Tapered Element Oscillating Microbalance).
A hollow and conical element is attached to its base. The collection is set on the top of the tapered portion.
The set oscillates at its natural frequency (about 200 Hz) determined by the physical characteristics of the conical element and the mass of the filter. The atmospheric air is suctioned by a pump connected to the base of the microbalance.

The airborne particles are trapped by the filter, thus increasing the mass of the oscillating system, producing a decrease in the natural vibration frequency. This frequency change is measured and converted into a real time mass change. The TEOM microbalance can detect variations of mass as low as 10 nanograms.
This technique offers many advantages over alternative methods:
• Absence of influence of the nature of the on the measurements
Unlike beta gauges or light scattering meters, the TEOM microbalances operate regardless of the atomic structure or optical characteristics of the particles.
• Speed of response
The impact on human health of pollution peaks was clearly highlighted in numerous epidemiological studies. Updating every six minutes the concentration values allows the TEOM 1405-F to quantify pollution episodes with high accuracy.
• Ease of installation and transportation
The TEOM 1405-F directly measures the mass of dust deposited on the collection filter and does not require recalibration based on specific site conditions. The absence of radioactive sources simplifies the procedures regarding staff training, maintenance and transport. The microbalance operating at its natural frequency is not influenced by interfering vibrations. The TEOM 1405-F can be set in sites subject to vibrations (e.g. vibrations generated by traffic).

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FDMS OPERATING PRINCIPLE

The FDMS is a device that measures in real time the mass loss during the TEOM collection filter sampling due to volatilisation of volatile dust such as ammonium nitrate.

This operation involves several steps:
- Drying the dusts upstream of the microbalance, in order to remove the water around the particles before they are trapped by the filter. This drying is performed using a desiccant such a Nafion membrane.
- Measurement of mass loss due to the volatilisation of volatile dust.

To measure the mass loss, the analyser cyclically stops collecting particles. During that interval, the change in the filter mass represents the volatilisation of volatile and semi-volatile dust on the TEOM filter.

SAMPLING SYSTEM

Air is introduced into the microbalance by means of a sampling head. Thermo offers several types of sampling heads meeting EU and U.S. regulations: PM-10, PM-2.5, PM-1.0, Total Dust.
The air flow rate is kept constant by a flow rate regulator taking into account the atmospheric pressure and the ambient temperature.
Before filtration, the air dried and heated to 30 °C to avoid the condensation of water on the collection filter.

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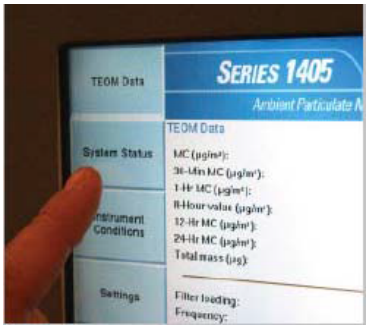
RESULTS

The oscillation frequency is measured every two seconds and is used to calculate hourly averages updated every 6 minutes.



The TEOM 1405-F displays in real time the three following concentrations:

- Total dust concentration (volatile and non-volatile)
- Non-volatile dust concentration in the sampling conditions
- Volatile dust concentration in the sampling conditions

The TEOM 1405-F also measures in real time a number of operating parameters.
These parameters and concentration values can be transmitted either by configurable Analog outputs or by RS232/485, USB or Ethernet port.
The TEOM 1405-F has several communication protocols usually used in large European networks.
In case of flaws, TEOM 1405-F also provides contact shutdowns for remote retransmission.

ANALYSER ARCHITECTURE

The entire analyser is packaged in a single housing, comprising electronics, a volume flow controller, a FDMS membrane, a microbalance, a colour screen. Only the pump and the sampling system are outside the analyser's case. The TEOM 1405-F's design offers a wide range of advanced solutions to facilitate the use, maintenance and interfacing:

- Colour touchscreen to display on-screen instructions for use and audit
- Communication via Ethernet, serial RS232/485 and USB
- Multiple Analog I / O, alarm contacts
- Internal database for remote diagnosis
- Internal memory

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CONSUMABLES

The TEOM 1405-F is an economical device. The average lifespan of the collection filter is of about 4 to 5 weeks. The TEOM 1405-F is sold with a year of consumables.

CALIBRATION

Since the microbalance operates at its own frequency, the response is not likely to change over time. An optional calibration kit containing a standard filter allows the user to ensure perfect operation of the TEOM 1405-F all year round.
The calibration of the mass flow controllers must be completed twice a year.
The idea behind the TEOM 1405-F is to unambiguously link measurements to international standards of mass and volume.
In contrast to other techniques that measure the mass concentration of particles (beta gauge, nephelometer), the TEOM 1405-F is a real mass analyser, not using any empirical calibration factor.

A WIDE RANGE OF ANALYSERS

Several TEOM 1405-F-derived analysers are available:
- TEOM 1405 single microbalance without FDMS
- TEOM 1405-D with double microbalance and virtual impactor for the simultaneous measurement of PM-10 and PM-2.5 fractions
- TEOM 1405-DF with double microbalance and double FDMS module for the simultaneous measurement of PM-10 and PM-2.5 fractions. Also takes into account the volatile and semi-volatile dust

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SPECIFICATIONS

DISPLAYED CONCENTRATIONS	1405-F: available in PM-2,5, PM-10, PM-1, and total dust versions 1405-DF: measures simultaneously 3 granulometric fractions: PM-2,5, PM-10 et PM Coarse
SAMPLE CONDITIONING	Nafion membrane dehydration, 4°C filtration purge
MEASUREMENT UPDATES	Every 6 minutes
REAL-TIME VALUE AVERAGE	60 minutes
LONG TERM AVERAGING	1, 8 and 24 hours
RANGE	0 to 1 000 000 µg/m³ (0-1 g/m³)
RESOLUTION	0,1 µg/m³
PRECISION	+/- 2 µg/m3 (one hour average) +/- 1 µg/m3 (24 hour average)
STANDARD CONFIGURATION	TEOM microbalance with colour touch screen, FDMS stage, input selector (PM-10, PM-2.5, PM-1, TSP), flow separator, vacuum pump, temperature probe, annual consumables
OUTPUTS	- Ethernet, USB, RS232, RS485 - 8 Analog outputs (0-1 or 0-5 VDC) - 2 programmable alarm relays - 4 Analog outputs (0-5 VDC)
FLOW RATES	- Main Circuit: 3 lpm - Bypass Circuit: 13,67 lpm
INTERNAL DATA ACQUISITION	Up to 500 000 recordings
DIMENSIONS	- Height: 127 cm - Width: 43.2 cm - Depth: 48.3 cm - Weight: 34 kg
TERMS OF USE	- Suctioned Air Temperature: -40°C to 60°C - Shelter Temperature: 8 to25°C - Power Consumption : 240 VAC, 4 A max
APPROVALS AND CERTIFICATIONS	EN 12341: 1998 (PM-10), EN 14907: 2005 (PM-2,5)

ECOMESURE

Réf.F98 V1

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