Confidence in managing laboratory fume hoods

Eurotherm®

Simplifying compliance to laboratory fume hood regulations through the Digital Fume Hoods VAV kit

A Variable Air Volume kit, with regulatory compliance at its core, designed to optimize energy consumption and help protect your investment. Supervisors, EH&S managers and operators can utilize intuitive and comprehensive Industry 4.0 mobile apps to view, operate, and manage laboratory fume hoods.

eurotherm.com/fume-hoods

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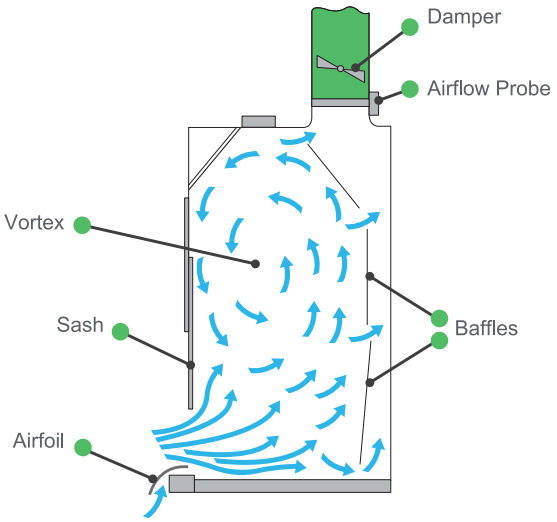
Fume hood design and operations

What is a fume hood?

According to the European standard EN 14175-1:2003, a laboratory fume hood is a *"protective device to be ventilated by an induced flow of air through an adjustable working opening, with an enclosure designed to limit the spread of airborne contaminants to operators and other personnel outside the device, offering a degree of mechanical protection, and providing for the controlled release of airborne contaminants."*



A fume hood must pull an adequate volume of air through the area left open by the sash. The speed of this air, as it passes the sash, is called face velocity. This is just one of the parameters considered by regulations to establish if a fume hood is meeting the safety criteria.

Baffles at the back of a fume hood shape how the air circulates within the hood. The damper at the top of the hood adjusts the volume of air to be exhausted.

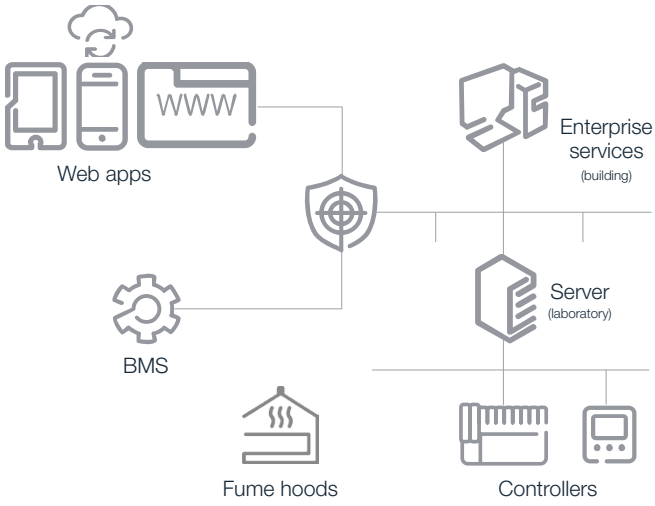
Fume hood operation

It has been mathematically verified that the correct operation of the fume hood is related to the creation of a "stable vortex" in the hood's upper chamber.

A fume hood operation is affected by any environmental disturbance. The control system of a fume hood needs to maintain a stable vortex whatever the position of the sash, operators, and equipment while minimizing makeup air extraction.

A scalable design for a simple architecture

The Eurotherm Digital Fume Hood Variable Air Volume (VAV) kit is a scalable solution, able to suit different application/site sizes and to adapt to evolving needs from the retrofitting of a single fume hood through to a comprehensive Building Management System (BMS) designed to control, monitor, and optimize day-to-day building operations.



- Web app for ease of access, operation, and maintenance
- Enterprise services for centralized archiving and hood management
- Server for web app access and performance enhancement of larger laboratories
- Controllers for advanced and responsive precision control
- Data exchange via wi-fi or wired connection
- BMS-ready, supporting a variety of communication protocols

Worldwide regulations

There are several regulations, standards, and instructions concerning workplace safety, inspections, and tests for laboratory fume hoods. Rules differ from country to country.

Local laws (e.g. Italy Legislative Decree 626/94 and 81/2008, USA OSH Act of 1970) recognize the right to health and safety of the worker and impose on the employer the obligation to ensure the correct application of the related safety provisions in the workplace. In the event of non-compliance to regulations, the employer may incur civil and/or criminal liability cases.

Laboratory fume hood safety standards

Over time, several countries have developed technical guidelines on safety standards to be applied in the design and furnishing of laboratories, specifically for fume hoods, among them SAMA std LF10 and ASHRAE 110-2016 (USA), DIN 12924 (Germany), UNI ISO 45001 and UNI/TS 11710 (Italy), BS 7258 (UK) and AFNOR_ XPX-15-203 (France).

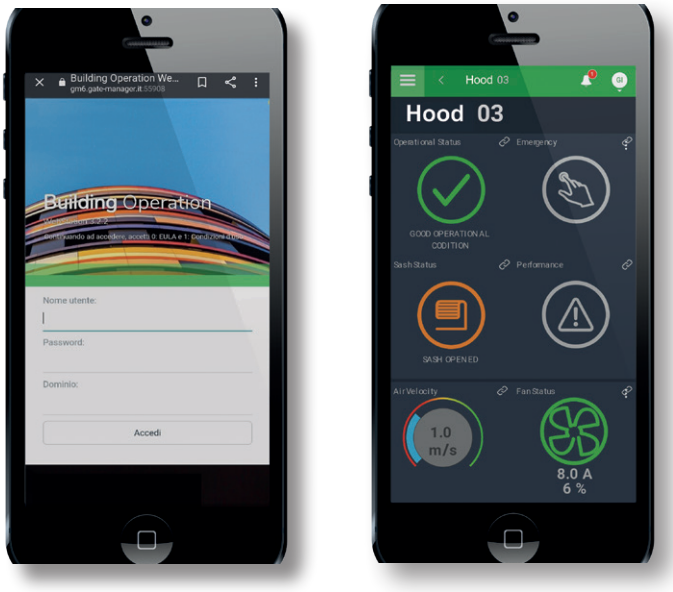
In Europe, the need to standardize the sector's many and various national regulations and to define new performance standards for laboratory fume hoods have led to issuing the EN 14175 regulation, setting safety and performance test requirements for all new extraction hoods sold within the European market.

The Occupational Safety and Health Administration (OSHA) Laboratory Standard (29 CFR 1910.1450) and Laboratory Safety Guidance (3404-11R 2011) state that *"the employer is responsible for ensuring that fume hoods are functioning properly and implementing feasible control (safety) measures to reduce employee exposures (...). If an employer discovers (…) that fume hoods are not effectively reducing employee exposures, it is the employer's responsibility to adjust controls (safety device) or replace hoods as necessary."*

Similarly, CEN/TS 14175-5:2006 (paragraph 5.1) notes that *"In the use of laboratory equipment, risk assessment and appropriate precautions are the responsibility of the organization running the laboratory and the laboratory user."*

Monitoring fume hood performance

As required by EN 14175-2-2003, the Eurotherm Digital Fume Hood VAV kit includes an audible and visual alarm function that notifies the user if the fume hood performance is impaired. The alarm is activated when the exhaust air volume flow or the face velocity is underrun, or when the sash opens beyond the predefined working height.



The Eurotherm Digital Fume Hood VAV kit, with its Industry 4.0 web app, helps make it easier to comply with regulations. It enables operators and laboratory managers to maintain laboratory fume hoods' expected protection levels. The airflow within the hood is continuously measured through sensors, and real-time data is made available for informed decisions and actions based on predictive algorithms. The aim is to meet the face velocity requirement while considering the air vortex stability and necessary air changes.

For a better workplace

Accreditation

The Eurotherm Digital Fume Hood VAV kit is designed to help meet standards and regulations.

"Accreditation ensures that certification, inspection, verification bodies, testing, and calibration laboratories fulfill all the requirements of the standards to undertake conformity assessment activities." [1]

Once installed on new or existing fume hoods, the Eurotherm Digital Fume Hood VAV kit, facilitates achieving accredited test certification while helping maintain an efficient operational performance level [2]

Consistent test results are aided by the superior precision, reliability, and speed of the control algorithms.

Digitization to improve the workplace

Maintenance:

- All sensors retain up-to-date certificates, and the calibration schedule is based on a predictive algorithm and supported by a clear standard operating procedure
- The latest versions of certificates, manuals and reports are available online – search time is optimized
- The criticality level of any intervention can be predicted and adequately planned based on actual use

Operation:

- Access to fume hoods is controlled through a combination of User-ID and Fume Hood ID (QR or bar code), by means of mobile devices, to easily trace operators' exposure to chemicals
- Operator manuals are available on-line
- Personal protective devices can be located using an online map (ask Eurotherm for availability)

1: Credits: https://www.accredia.it/en/accreditation/

2: In many sectors certifications are issued by an accredited third-party body in accordance with the standards ISO/IEC 17065, ISO/IEC 17020, ISO/IEC 17021-1, ISO/IEC 17024, and ISO/IEC 17025 whose independence with respect to the certified object – product, service, organization or person – is verified and attested by an Accreditation Body

Laboratory Fume Hoods Life Cycle

Laboratory fume hoods are collective protection devices that need to efficiently operate during their entire lifecycle

Periodic Tests

During the life cycle of a fume hood, businesses are required to demonstrate that fume hood performance complies to latest ANSI/ASHRAE-110 (USA) and EN 14175 (Europe) guidelines, these include:

- As Manufactured (AM) test, also known as Type test. It shows how the fume hood operates under controlled conditions, at the manufacturer factory
- As Installed (AI) test, also known as Commissioning test It is performed at the end user site, before anything is placed inside the fume hood. It demonstrates how the fume hood performs with the ventilation system in standard conditions
- As Used (AU) test, also known as Periodic test is conducted after installation, and with the fume hood in general use

The estimated average time to complete the AI or the AU testing is around 2 to 4 working hours per hood, dependent upon laboratory/system conditions.

Eurotherm and accredited partners can provide gap analysis services during the life cycle of a laboratory.

Gap Analysis with recommendations

Laboratory safety assessment. An external and independent agency should run the periodic assessment in collaboration with the unit/building manager and the supervision of the company Environmental, Health & Safety (EH&S) representative.

The assessment is performed against a checklist and references the relevant regulations. It reviews equipment, lab and personal/collective protective equipment, emergency kits, ventilation, house-keeping, exit path, chemical management, waste handling, signage, policies, training, and any other aspects related to safety, including the Laboratory Safety Standard Operating Procedures.

Laboratory energy assessment. The energy assessment evaluates the sustainability and the effectiveness of the laboratory against relevant regulations and best practices. Typically, the audit begins with a review of historical and current utility data and a benchmarking of the building's energy use against similar facilities. The final report should contain a rating scorecard against the benchmark.

Advisory. Subject Matter Experts can perform a Cold Eyes review to assess the current status of laboratory fume hoods in use. A non-binding, confidential report would be released after the survey.

Specialised Service Support

- Spare parts management
- Calibrations
- Compliance
- Alarm & event remote management
- Service desk
- Service level agreement
- Exchange web portal
- Cloud hosting

Reduce energy consumption and make your laboratory more sustainable

Within a laboratory, a fume hood is considered to be the device with the most significant impact in terms of energy demand and work processes. Converting a fume hood equipped with CAV (Constant Air Volume) ventilation to VAV is an investment in safety and compliance to standards, with a short payback period. Helping control maintenance and operating costs.

The following table compares air exhaustion data of a fume hood equipped with CAV ventilation and the same fume hood equipped with the Eurotherm Digital Fume Hood VAV kit

		Sash open		Sash work		Sash closed	
	Units	Vav	Cav	Vav	Cav	Vav	Cav
Sash position	cm	50	50	30	30	4	4
	inch	19.69	19.69	11.81	11.81	1.57	1.57
Sash front average air speed	m/s	0.51	0.51	0.51	0.85	1.82	5.08
	FPM	100	100	100	167	359	1,000
Sash air flow volume	m^3 per hour	1,646	1,646	988	1,646	472	1,317
	CFM	969	969	581	969	278	775
Hood internal air changes per hour	ACH	872	872	523	872	250	697
Exhaust daily air flow through the sash	m^3 per day	3,950	3,950	5,530	9,217	7,553	21,068
	CFD	139,485	139,485	195,279	325,464	266,700	743,919

Daily air saving	m^3 per day	17,202
	CFD	607,404
Yearly saving	€	1,885
	$[2]	2,356

Hood internal dimensions: H: 150cm (59”), D: 70cm (28”), W: 180cm (71”). Hood operating 8 hours/day, 320 days/year. Sash fully open 2,4 hours per day. Yearly cost for treated air: € 3/m^3 per hour ($ 6.40/CFM).

Note 1: In order to take into due consideration air dispersion, the air flow for the CAV when the sash is closed has been considered at 80%.

Note 2: Using exchange rate 1€ = 1.2$

Using Eurotherm Digital Fume Hood VAV kit the fume hood exhausts 1,646 m^3 per hour only when the sash is fully open, but will reduce to around 472 m^3 per hour when the sash is closed. This translates into a potential annual operating cost saving around € 1,885 due to the reduced volume of treated air.

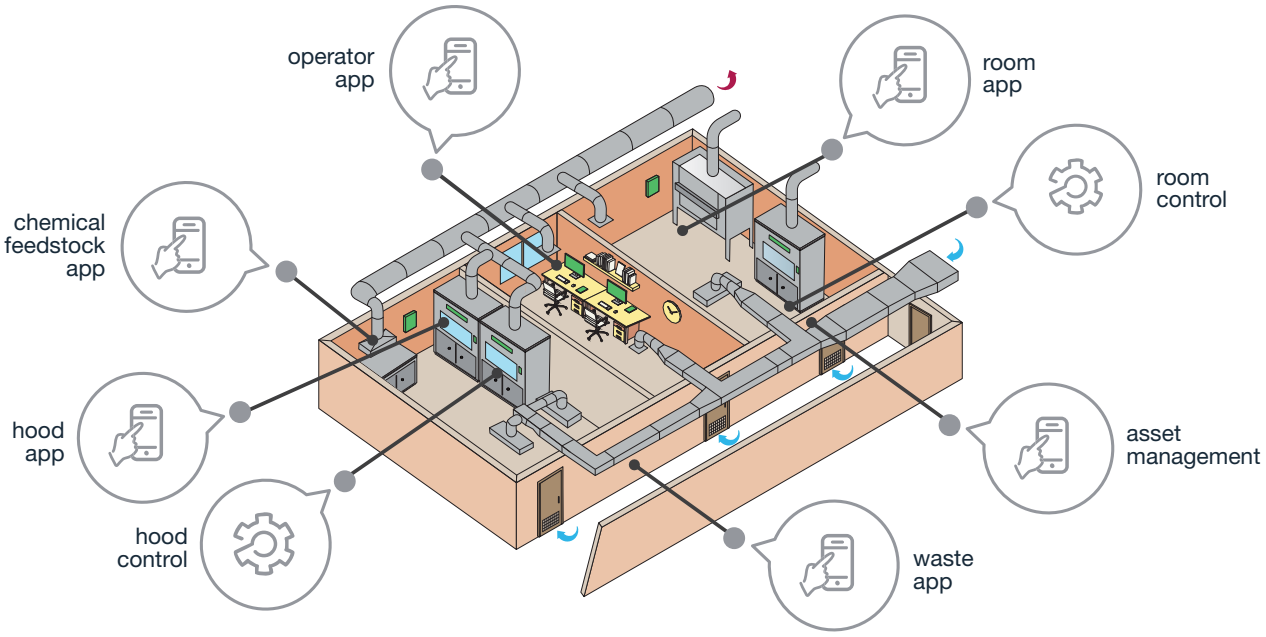
These calculations highlight that retrofitting a CAV fume hood with the Eurotherm Digital Fume Hood VAV kit can provide substantial energy savings, minimize operating and maintenance costs, and considerably lower overall emissions to air.

Other optional features of the Eurotherm Digital Fume Hood VAV kit can include:

- A self-closing function, which automatically lowers the sash after a configurable delay period. In the case of obstacle detection, the automatic closing process is halted, and a visual alarm is activated
- Weekend and Weekday after-hours airflow reduction, possibly in combination with sash self closing
- Fume hood use monitoring to determine optimal residual utilization and allow predictive maintenance
- Fume hood selection is based on past and future use, to balance the overall room energy consumption
- Through the mobile app, operators can scan the fume hood barcode ID to:
  - quickly access relevant functionalities
  - grant permission for use
  - access a list of admissible chemicals for the specified fume hood

Visit eurotherm.com/fume-hoods to calculate your possible savings under different conditions

An Industry 4.0 digital solution, providing contextualized knowledge at your fingertips



Meet key Industry 4.0 requirements

- **Informed decisions.** Key information can be readily accessed by authorized personnel helping manage unexpected situations
- **Interoperability.** Our scalable solution is designed to seamlessly connect devices and equipment. This allows operations, maintenance, and management to optimize CAPEX and OPEX
- **Aggregated data.** The Eurotherm Digital Fume Hood VAV kit provides contextualized data across the entire laboratory, including fume hoods, Building Management System (BMS), feedstock, waste and safety devices
- **Decentralization.** The apps represent the hierarchy of the laboratory building, allowing easier management of the relevant parameters for each element of the hierarchy (hoods/rooms labs/building). This approach helps continuous improvement

Compliance and differentiators

- **Empowerment.** With the Eurotherm Digital Fume Hood VAV kit, efficient compliance represents an opportunity to free up resources to focus on more value-adding activities
- **Sustainability.** Energy efficiency is optimized while reducing emissions to air and maintaining room comfort. The solution provides continuous monitoring to meet the working ranges recommended by the laboratory standard operating procedures
- **Blockchain.** Feedstock, waste, operator activity, and consumables are tracked using a blockchain based technology (future release)
- **Cybersecurity.** The kit supports cybersecurity according to current best practices
- **Cloud.** Data can be archived on-premises, on your company cloud, or via a reliable, cloud-based service solution
- **Analytics.** For informed decisions, the Eurotherm Digital Fume Hood VAV kit provides contextualized data on the entire laboratory, fume hoods, feedstock, waste, assets, and users. You can compare your fume hood work cycle against benchmarks to identify areas for improvements or assess training need

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