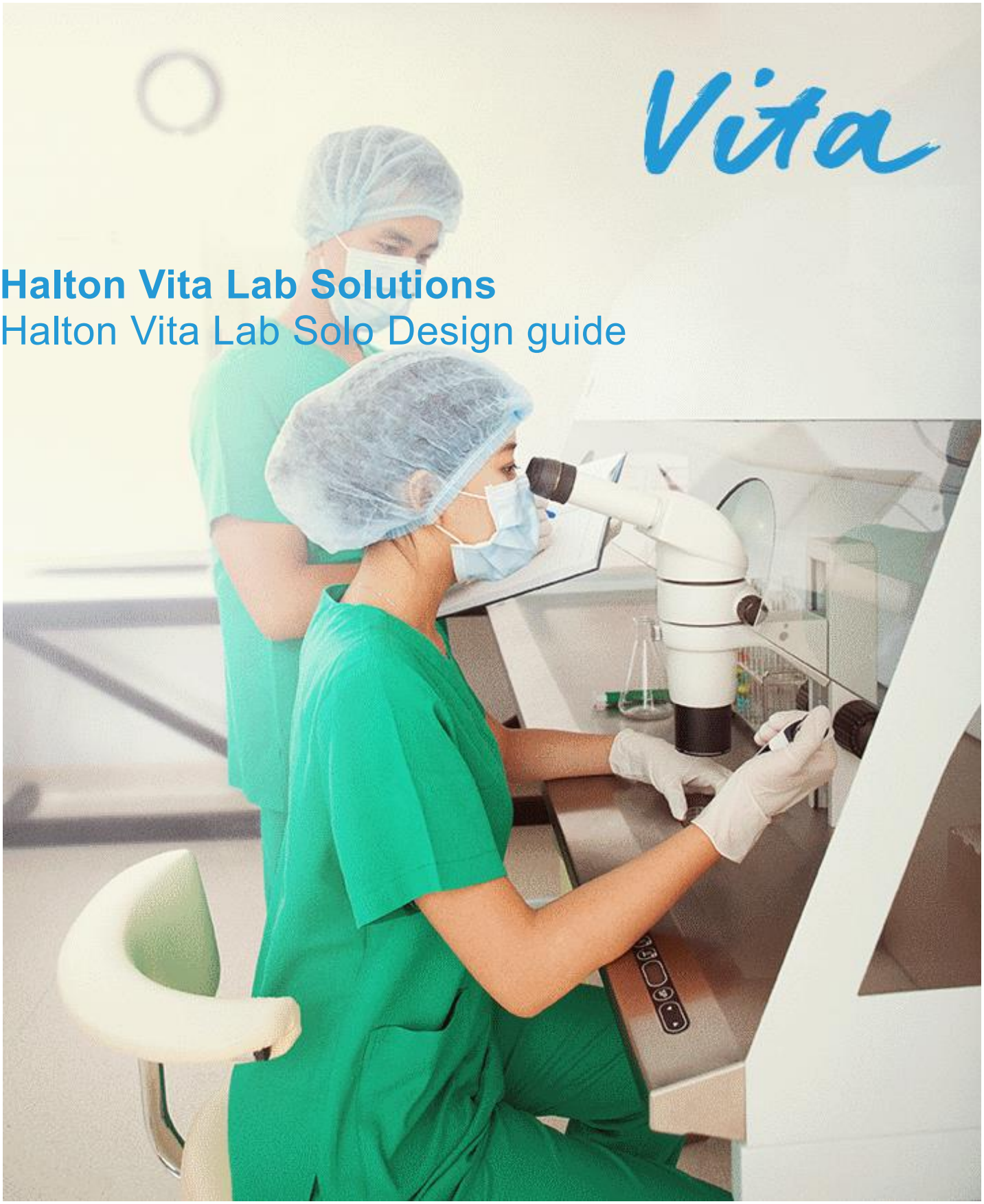
Halton Vita Lab Solutions

Halton Vita Lab Solo Design guide



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1 Introduction

This document is a guide to designing the ventilation for laboratory fume cupboards with Halton's Vita Lab Solo solution. The guide gives you an overview of the Halton Vita Lab Solo solution, its features and functionality.

The document helps you select the right configuration for your needs and gives information about design requirements. However, as all designs vary, this document only provides a general guideline. Therefore, close cooperation with Halton is recommended in order to ensure the best results.

1.1 Halton Vita solutions

Halton Vita Lab Solo is part of the Halton Vita Lab solution family for demanding laboratory spaces:

- Halton Vita Lab Solo (VLS) is a fast and accurate airflow management system for all types of fume cupboards
- Halton Vita Lab Room (VLR) is an intelligent and efficient management system for laboratory pressure and thermal comfort
- Halton Vita Lab Zone (VLZ) provides enhanced system stability with integrated zonal pressure management for a space or a group of spaces

The Halton Vita Lab Solo solution can be seamlessly integrated with the Halton Vita Lab Room and the Halton Vita Lab Zone solutions for total room control and enhanced duct pressure control.

1.2 Fume cupboard ventilation requirements

Demanding laboratory environments set strict requirements on the ventilation system. The most important ones are safety, energy efficiency, usability and flexibility. See section 2.2 for further details on how Halton Vita Lab Solo fulfils these requirements.

Safety

The most important requirement for the ventilation of demanding laboratory spaces is uncompromised safety. Safety is always a combination of proper safety procedures, the quality of the fume cupboard and the performance of the ventilation system.

The highest level of safety can be achieved by a quick response time to the fume cupboard sash movement and high system stability. Research*) shows "an increased outward leakage of tracer gas from the fume hood if the air flow rate is not re-established within 1–2 s after the sash is opened. If the delay exceeds 3 s the safety function is temporarily defeated". In other words, once the response time exceeds 3 seconds, the exposure risk increases significantly. Maximum concentrations of harmful substances may be reached already after 5 seconds from opening the sash.

Halton Vita Lab Solo is a high-quality ventilation system that guarantees safety through accurate measuring mechanisms, advanced sensor solutions and a reliable alarm system. These together provide quick response times and high system stability. Halton's advanced Vita Lab Solo solutions combine the best response time on the market with high system stability.

*) Lars E. Ekberg, Jan Melin, Department of Building Services Engineering, Chalmers University of Technology, S-412 96 Göteborg, Sweden: Required Response time for variable air volume fume hood controllers.*The Annals of Occupational Hygiene* (Volume 44, Issue 2, 1 March 2000, Pages 143–150 / http://www.sciencedirect.com/science/article/pii/S0003487899000824)

Energy efficiency

Energy efficiency is considered increasingly important in the design of laboratory ventilation systems. Fume cupboards use a lot of energy when in use; energy consumption is at its maximum when the sash window is open, and at minimum when closed. Therefore it is essential that the system adjusts the airflow based on actual usage.

The Halton Vita Lab Solo energy-saving features based on demand-based airflow and occupancy control can bring significant savings to the day-to-day operation of the laboratory by minimising energy usage when the fume cupboard is not in active use.

Simplicity and usability

An easy-to-use user interface minimises the risk of human errors, while smooth commissioning and easy maintenance add value to the customer experience.

The Halton Vita Lab Solo systems offer superior customer experience with a user-friendly all-in-one control system, the Halton HTP touch panel. Fast installation, commissioning and optimal performance are guaranteed through high-quality services.

Flexible design

The type of fume cupboard, exhaust design and the need for changes after installation set special requirements on the ventilation design.

Halton Vita Lab Solo provides flexible alternatives for all types of fume cupboards and ventilation designs. When integrated with the Halton Vita Lab Zone for enhanced duct pressure control, Halton Vita Lab Solo provides a flexible solution allowing easy layout modifications. This simplifies the installation, minimises disturbance on site and considerably reduces refurbishment costs.

2 Halton Vita Lab Solo

Halton Vita Lab Solo provides fast and accurate airflow management for all types of fume cupboards. The solution is

- designed for the ventilation control of fume cupboards in laboratories where safety, air quality and comfort need to be maintained at the required level regardless of external conditions
- suitable for fume cupboards in research, production and educational laboratories
- energy efficient
- equipped with a user-friendly Halton HTP touch panel multitool, which allows the control of the system on all levels: end-user, commissioning and maintenance functions
- adaptable, tested and validated, and fulfils the requirements for the European fume cupboard standard, EN 14175-6
- complemented with pre-commissioning and maintenance services for the whole lifecycle of the solution

2.1 Halton Vita Lab Solo applications

Halton Vita Lab Solo is available in five configurations using different control concepts, depending on the application needs.

Advanced solutions that meet the requirements for the most demanding laboratory spaces:

- Double Sensor Control - maintains the face velocity at a predefined level and controls the sash movement in order to provide an exceptionally quick increase of the exhaust airflow
- Sash movement control - controls the sash movement to provide a quick increase of the exhaust airflow, while also controlling the sash position in order to maintain a constant face velocity

Basic applications for normal laboratory conditions:

- Face Velocity Control - maintains a constant face velocity regardless of the sash position
- Dual position airflow control - maintains a minimum face velocity by detecting if the sash is open or closed
- Sash Position Control - maintains a constant face velocity depending on the sash position

The choice of control concept and configuration depends on the type of fume cupboard, ventilation design and the requirements on the level of safety and energy efficiency.

2.2 Halton Vita Lab Solo features

Halton Vita Lab Solo offers a range of features on the system level, admin level and for end-users.The solution guarantees a high level of safety, advanced energy-saving options, usability and flexible design alternatives.

2.2.1 Feature summary

The following table summarises the features of the Halton Vita Lab Solo configurations. The table is followed by a description of each of the features.

	Halton Vita Lab Solo system configurations				
	Double Sensor Control	Sash Movement Control	Sash Position Control	Face Velocity Control	Dual Position Control
Safety features					
Exceptionally fast response time	•	•			
High stability & blockage recognition with velocity sensor	•			•	
High stability with sash sensor	•	•	•		
Duct blockage recognition	•	•	•	•	•
Minimum face velocity with on/off control					•
MAX mode *	•	•	•	•	
Audio-visual alarm *	•	•	•	•	o
Energy-saving features					
Variable airflow control	•	•	•	•	
Manual ECO mode *	•	•	•	•	
Automatic ECO-mode	o	o	o	o	
Automatic sash closing	o	o	o	o	
Simplicity and usability					
Easy-to-use touch panel control system*	•	•	•	•	o
Light control *	o	o	o	o	o
Easy maintenance with HTP*	•	•	•	•	o
Prewired components	•	•	•	•	•
Halton Services	o	o	o	o	o
Flexible alternatives					
For centralised & single exhaust fan ventilation	•	•	•	•	•
For vertically sliding sash types	•	•	•	•	•
For horizontally sliding sash types				•	
For vertical & horizontal sash types	•			•	

• = Standard
o = Optional. Requires an additional component
* Halton HTP touch panel feature

2.2.2 Safety features

Exceptionally fast response time

The advanced Halton Vita Lab Solo solutions that meet the requirement for the most demanding laboratory spaces (response time < 3s) are:

- Double Sensor Control - offers the fastest response time with high system stability by using velocity and sash sensors to control the airflow. See section 3 for a system description.
- Sash Movement Control - provides a quick response time and high stability by combining the measurement of the sash movement and sash position. See section 4 for more details.

High stability and blockage recognition with velocity sensor

The Double Sensor Control and Face Velocity Control solutions provide high stability with constant face velocity. The velocity sensor provides variable airflow and seamless control of the exhaust airflow volume. The face velocity is constantly controlled and kept at a predefined speed (e.g. 0.3 m/s) regardless of the sash position.

The velocity sensor enhances safety further by recognising blockages in front of the fume cupboard by measuring the air volume inside the fume cupboard. When a blockage (a person, for example) causes a change in the air volume, the system adapts the airflow accordingly and gives an audio-visual alarm if the desired level is not reached.

High stability with sash sensor

The Halton Vita Lab solutions with sash sensor (Double Sensor, Sash Movement and Sash Position Control) provide stable conditions by monitoring the opening percentage of the sash and adjusting the airflow so that a constant face velocity is maintained.

Duct blockage recognition

Recognition of blockages in the ductwork guarantees a safe operation of the fume cupboard. In Halton Vita Lab Solo, this is made possible by the accurate measuring mechanism of the differential pressure sensor included in the exhaust unit. In case of blockage, the system adapts the airflow and gives an audio-visual alarm if the desired level is not reached.

Minimum face velocity control

If the laboratory conditions do not require a constant face velocity, then the Dual Position Control configuration is sufficient to guarantee the safety of the laboratory personnel. It ensures minimum velocity with an on/off switch.

MAX mode

MAX mode is a safety feature available to the end user from the Halton HTP touch panel. It provides a quick increase of airflow by setting the ventilation directly to the maximum position. It is used as a safety mechanism in situations where toxins are about to escape from the fume cupboard. It is enabled and adjusted from the configuration menu.

Audio-visual alarm

The Halton HTP touch panel displays an audio-visual alarm which is activated when the airflow is below the set alarm range.

The end-user can cancel the sound alarm from the panel, but the visual alarm (red blinking light) is not turned off until the reason for alarm is cancelled.

2.2.3 Energy efficiency

Variable airflow control

Variable airflow control provides demand-based operations by adjusting the airflow according to the actual use of the sash window.

ECO mode

The ECO mode saves energy by setting the ventilation directly to the minimum position.

The manual ECO mode allows the user to activate it from the Halton HTP touch panel. The feature is enabled and adjusted from the configuration menu.

The automatic ECO mode is an optional feature and requires an occupancy sensor. It provides further savings in energy usage by automatically activating the ECO mode when there is no presence in front the fume cupboard. The set value is pre-configured from the HTP configuration menu.

Automatic sash closing

Automatic sash closing provides further energy savings by automatically closing the window when there is no presence in front of the fume cupboard. This reduces the energy consumption to a minimum. Automatic sash closing is an optional feature and requires an occupancy sensor. It is equipped with collision control and fixed positioning of the sash window.

2.2.4 Simplicity and usability

Easy-to-use touch panel control system

The Halton HTP touch panel is a user-friendly user interface that makes the system easy to commission, use and maintain. The HTP is a standard feature in all configurations except in Dual Position Control, where it is available as an optional feature . See section 2.3.2 for more details.

Light control

Light control is an optional feature that allows the end user to switch the light on directly from the Halton HTP touch panel. Requires a light relay (pre-installed in the control box on the damper).

Easy installation with pre-wired components

The controller and exhaust unit with integrated control box, containing the relevant components, are prewired at the factory. Only the sensors and the touch panel need to be wired on site. This simplifies the installation and minimises disturbance on site.

Easy commissioning and maintenance

Commissioning on site is made easy through preloaded parameters and validation from the Halton HTP touch panel on site. Service and maintenance is also quick and easy with the HTP.

Halton Services

Halton Services are available for the different stages of the building project

- Halton Design Studio to support the design project with mockups and CFD simulations
- Halton Tune for commissioning, performance testing and end-user training
- Halton Life Cycle for maintenance services

2.2.5 Flexible alternatives

Centralised and single fan exhaust designs

The EN 14175-6 fume cupboard standard requires that the exhaust fumes must be directed outside the building. The ventilation can be designed using centralised or single exhaust fans.

- In centralised ventilation systems, the fume cupboard exhausts are connected to one common fan. The general room exhaust can be either separated from the fume cupboard exhaust or connected to it
- In single exhaust fan ventilation design, each fume cupboard is connected to its own exhaust fan

All the Halton Vita Lab Solo system configurations can be used in both centralised exhaust and single exhaust fan ventilation systems. In single exhaust fan design, the exhaust fan and frequency inverter are not delivered as part the system. In centralised designs, the simultaneity factor can be considered, while in single exhaust fan designs the simultaneity factor cannot be taken into account.

Sash types

All the configurations are suitable for vertically sliding sashes, while some restrictions apply to fume cupboards with horizontally sliding sashes (see Feature Summary table in 2.2.1 for more details):

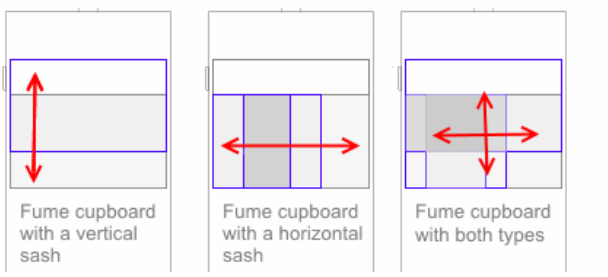


Figure: Sash types

2.3 Halton Vita Lab Solo component overview

Halton Vita Lab Solo system configurations consist of the Halton HTP touch panel user interface (not in Dual Position Control), a controller, an exhaust unit and sensors. An occupancy sensor, a light relay and a transformer are also provided as options.

2.3.1 Component summary

The configuration varies according to the ventilation control mechanism. The following table summarises the components for each configuration.

	Halton Vita Lab Solo configurations				
	Double Sensor Control	Sash Movement Control	Sash Position Control	Face Velocity Control	Dual Position Control
Halton Vita Lab Solo components					
Halton HTP touch panel	•	•	•	•	o
Exhaust unit *	•	•	•	•	•
Velocity sensor	•			•	
Sash sensor	•	•	•		
On/off switch					•
Occupancy sensor	o	o	o	o	
Transformer (included in exhaust unit control box)	o	o	o	o	o
Relay for light switch (included in control box)	o	o	o	o	o

• = standard
o = optional
* Includes control box with Halton VLC controller and differential pressure sensor. Integrated actuator included in centralised ventilation designs. Single exhaust fan designs require a frequency inverter, not provided by Halton

See the sections below for brief component descriptions. For technical details on the individual components, component datasheets are available from Halton Sales (see 8.3).

2.3.2 Component descriptions

Halton HTP touch panel

Each Halton Vita Lab Solo fume cupboard is equipped with a user-friendly Halton HTP touch panel user interface, which allows the control of end-user functions, configuration parameters and maintenance functions.

The Halton HTP touch panel is a multitool that controls the system on all levels, providing the following features:

- Easy-to-use touch screen end-user functions
- Servicing tool
- Configuration tool
- Maintenance tool
- Audio-visual alarm
- Temperature sensor

The HTP has a 3.5" touch screen that can display different settings and controls for the user. The menu structure provides access to end-user functions and admin functions.

The admin level functions available from the Halton HTP touch panel through a password-protected menu are:

- setting configuration parameters for commissioning and servicing the system
- enabling/disabling end-user functions

All the end-user functions can be activated or deactivated from the configuration menu. The end-user functions include:

- System on/off
- Audio-visual alarm
- MAX mode
- Manual ECO mode
- Light control (optional)

A 10-meter cable for the HTP is provided for easy installation.

Exhaust units

Halton provides a wide range of high-quality exhaust units for the Halton Vita Lab solutions in order to match various design requirements.

The Halton Vita Lab exhaust units are available in PVC/PPS, galvanised steel and stainless steel. All exhaust units come with an integrated control box equipped with a differential pressure sensor for airflow measurement and the Halton VLC controller.

As an option, a transformer for power supply and a light relay for controlling the fume cupboard light can be included in the control box, both prewired at the factory. The control box can also be delivered separately from the exhaust unit.

In spaces with centralised exhaust design, the exhaust unit consists of a damper and an actuator (models VFP, VFI, VFH). In spaces with a single exhaust fan design, a measuring unit is used instead (models VVP, VVI, VVH). Measuring units require a frequency inverter (not provided by Halton). For a description of centralised and single exhaust fan ventilation designs, see section 2.2.5.

See the Appendix for a quick exhaust unit selection guide (section 8.2).

Sensors

Depending on the ventilation control mechanism, velocity and/or sash sensors are used. For an enhanced energy efficiency of the system, an occupancy sensor can be integrated as an option, providing the automatic ECO mode and automatic sash closing features.

Cables for the sensors are provided for easy installation.

Controller

The Halton Vita Lab Controller (VLC) is a multi-purpose component for different Halton Vita Lab solutions. In Halton Vita Lab Solo solutions, the VLC functions as a fume cupboard controller and is premounted on the exhaust unit in the control box.

The Halton VLC has a built-in communication interface that allows communication between the Halton VLC fume cupboard controller, the Halton VLC room controller and the sensors. If several fume cupboards are installed and internal communication is needed, the communication between the VLC is established via a cable connection as a serial connection.

Communication to the Building Management System is also possible with the MODbus RTU and Bacnet IP protocols.

Light relay

A light relay for controlling the light in the fume cupboard is available as an option. The light relay is installed in the control box and prewired upon delivery.

Transformer

A local power supply can be installed in the control box for decentralised power supply (24Vdc). The transformer is prewired upon delivery.

On/off switch

In Dual Position Control, the airflow is controlled by an on/off. The switch detects whether the sash is open or closed.

2.4 Operating principle

Depending on the control concept, the velocity and/or sash sensors measure the relevant values and send them to the Halton VLC fume cupboard controller (VLC). The VLC retrieves the measured values (face velocity and/or sash position) and compares them with the assigned setpoint. The differential pressure sensor included in the exhaust unit measures the pressure in the exhaust unit and calculates the airflow rate. Based on the calculations, the VLC then adapts the damper position or frequency using a PID control in order to maintain a constant face velocity. If the airflow does not reach the predefined setpoint, an audio-visual alarm is triggered.

When the fume cupboard is connected to a centralised ventilation system, the exhaust unit consists of a damper with differential pressure sensor. The measurement is provided by a measurement probe or by a venturi principle, depending on the damper model. An integrated actuator ensures a fast control of the damper position.

When the fume cupboard is connected to a single fan, the exhaust unit consists of a measuring unit with differential pressure sensor. The measurement is provided by a measurement probe. An exhaust fan and a frequency inverter (not provided by Halton) control the exhaust airflow rate.

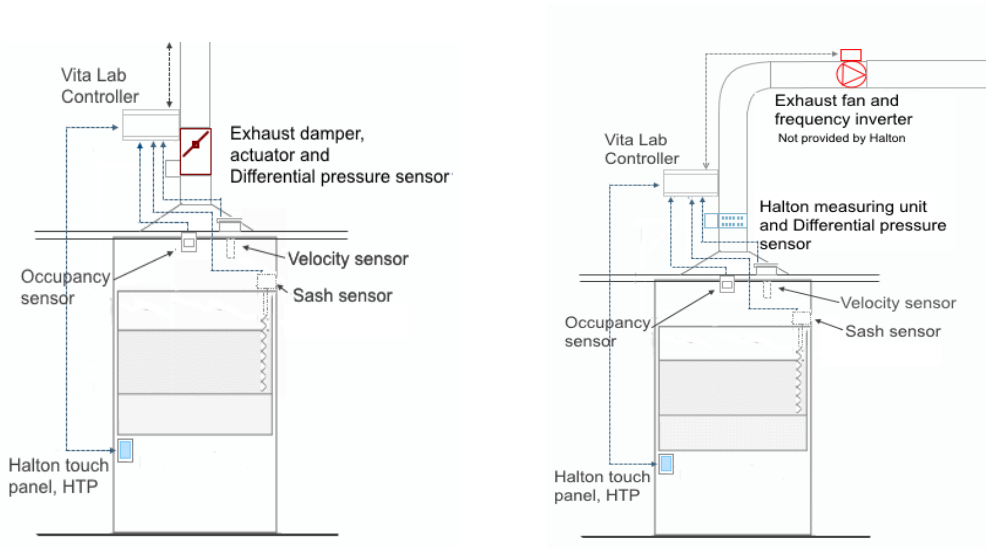


Figure: Double Sensor Control with centralised and single exhaust fan ventilation

The occupancy sensor (optional) detects presence in front of the fume cupboard. If there is no presence, the automatic ECO mode is activated and the sash window automatically closed (if the feature is enabled).

The communication between the fume cupboard controller and the room controller uses local protocol. Communication to BMS is available in Modbus RTU or Bacnet IP.

The admin view of the Halton HTP touch panel provides access to the following configuration parameters:

- Application type
- Alarm parameters
- Communication parameters
- PID parameters
- Sensor parameters (range, calibration)
- Software version
- Application setpoints
- Enabling end-user functions (ECO, MAX, ON/OFF)
- Controller setup (AUTO/Manual)

The Halton HTP touch panel also displays the functions that are available to the user in the day-to-day operation of the system (such as the light switch, MAX mode, manual ECO mode). The screen displays only the icons for those functions that are enabled for the configuration in question. The functions are enabled from the configuration menu.

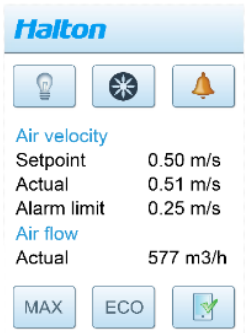


Figure: HTP end-user view

See the system descriptions of the different configurations in the following sections (3-7) for any configuration-specific functionality.

2.5 Installation and commissioning process

Halton Vita Lab Solo is delivered as a turnkey solution, including smooth commissioning by Halton. Normally, the responsibilities in the process are as follows:

- Design by customer
  - Defining the operational parameters and airflow signals
  - Sending the design information to Halton
- Precommissioning by Halton
  - Downloading the software to the Halton HTP touch panel and the Halton VLC fume cupboard controllers
  - Setting and verifying the predefined parameters and airflow signals
- Delivery by Halton
  - Prewired components
    - Exhaust unit with control box (inc. differential pressure sensor) and Halton VLC fume cupboard controller, mounted on the exhaust unit
    - Transformer and light switch relay (optional components), included in the control box

    - Non-prewired components with cables (typically the Halton HTP touch panel and sensors)
- Installation by customer
    - Installing the delivered components: prewired exhaust unit package, Halton HTP touch panel and sensors
    - Wiring the Halton HTP touch panel and sensors
- Commissioning by Halton (Halton Tune)
    - Commissioning (including setting final parameters), measuring and verifiying system performance, commissioning report
    - Maintenance instructions and user training

In addition, Halton Design Studio and Halton Lifecycle services are available as an option for support in the design phase and during the use of the system.

A detailed list of materials provided by Halton is specified in the project-specific commissioning checklist provided by Halton.

Component datasheets provide technical details such as dimensions, installation and wiring details (see 8.3).

Project-specific wiring diagrams are provided by Halton for all system configurations. Following is an example of a wiring diagram:

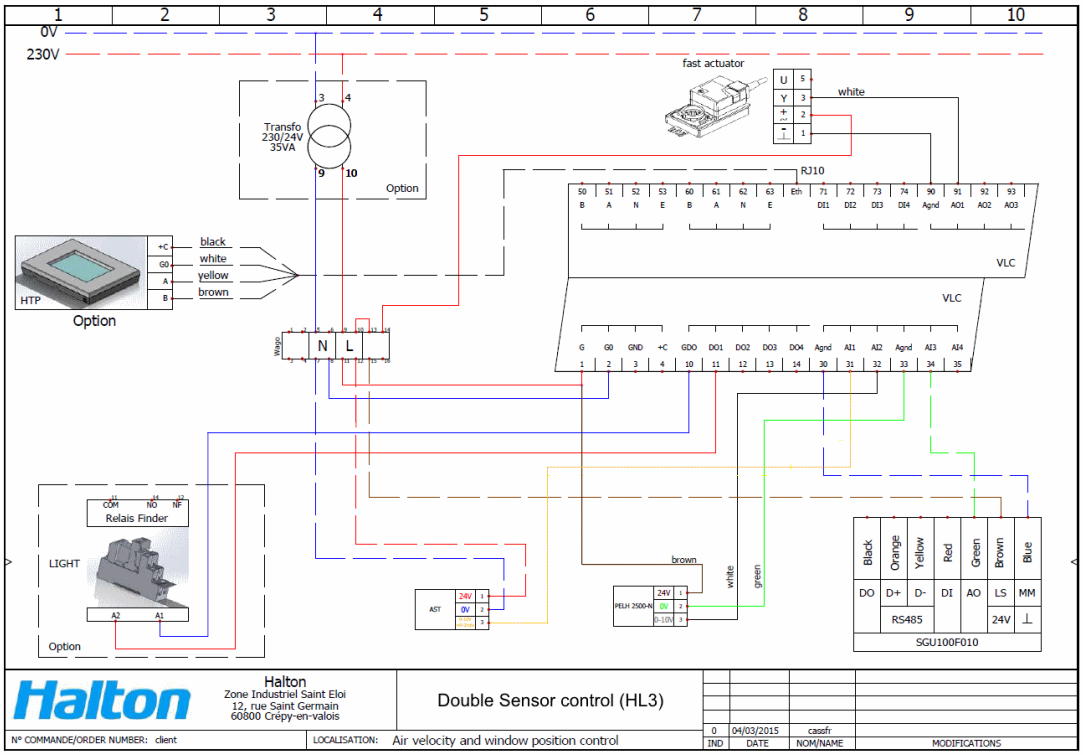


Figure: Wiring diagram for Double Sensor Control, centralised exhaust ventilation design

3 Double Sensor Control

3.1 System overview

The Halton Vita Lab Solo Double Sensor Control offers the fastest response time and a high system stability for the most demanding laboratory environments. The solution uses two sensor controls to provide the best solution:

- Control of the sash movement in order to provide a quick increase of the exhaust airflow
- Control of the face velocity in order to maintain the face velocity at its setpoint

The Double Sensor Control system is suitable for fume cupboards with high safety requirements as the use of two sensors ensures an extremely fast response time and high stability: the reaction time and stabilisation delay is less than 3 seconds. The ability to recognize blockage in front of an open sash allows the system to adjust the face velocity and airflow, which increases safety even further. The system can also recognise blockages in the duct system.

The system is compatible with fume cupboards with both vertical and horizontal sashes. For more details on the standard and optional features related to the safety, energy efficiency and usability of the system, see section 2.2.

The standard delivery includes an exhaust unit with prewired components in the control box, Halton VLC fume cupboard controller mounted on the damper, velocity and sash sensors as well as the Halton HTP touch panel. Optional components include the occupancy sensor, transformer and a light relay. For a description of the components, see section 2.3.

The solution can be seamlessly integrated with the Halton Vita Lab Room and the Halton Vita Lab Zone solutions for total room control and enhanced duct pressure control .

Response time and system stability

The Halton Vita Lab Solo Double Sensor Control system has been tested by Halton according to EN 14175-6 with the following results:

- Fast stabilization - even after maximum change, less than 3 seconds from min to max position
- Immediate reaction to change was less than 1 second
- Fast and steady response to sash movement for both from minimum to maximum and maximum to minimum

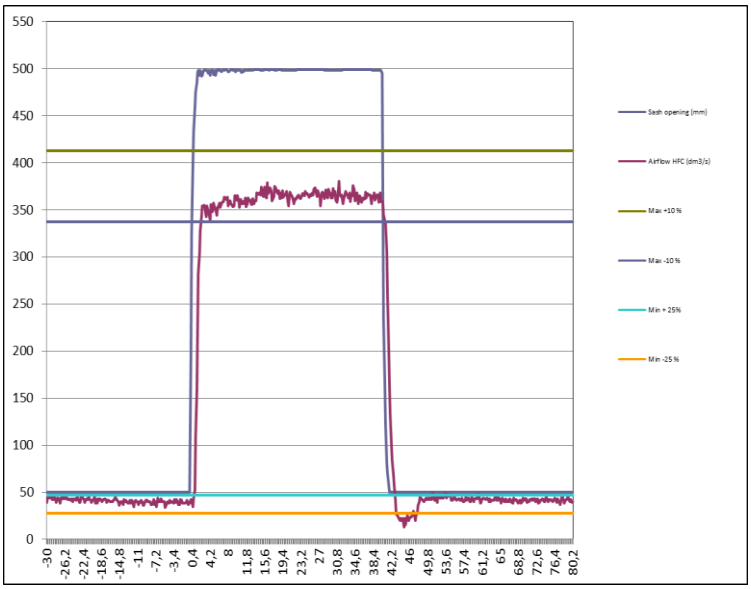


Figure: Double Sensor Control, system stability and reaction time

Operating principle

The system requires that both the velocity and the sash sensors are installed and used. The use of the two sensors allows the control system to have a fast reaction time and reduced delays without compromising the stability of the system. The basic principle is that

- In the steady state, velocity is controlled using a velocity sensor
- When the sash moves, the control is switched to the sash sensor
- The damper actuator is driven directly by the sash sensor with a predefined curve
- When the sash movement stops, the control switches back to the face velocity sensor

The velocity sensor measures the face velocity and the sash sensor measures the position of the sash. For more information on the general operating principle, see section 2.4.

3.2 Installation requirements

Project-specific wiring diagrams are provided by Halton for all system configurations. For the responsibilities between the customer and Halton as well as an example of a wiring diagram, see section 2.5. For details about installation and wiring, see the relevant component datasheets in section 8.3.

Placement of components

Consider the following in order to ensure accurate measurements:

- Exhaust unit must be installed at a safe distance from any duct obstacle
- Velocity sensor
    - Must be placed on top of the cupboard and at a safe distance from the walls
    - The pressure difference between the false ceiling and the room space can induce deviation in the velocity measurement. Therefore, it is recommended that the space with the sensor be connected to the room using a duct.
- Sash sensor can be installed vertically or horizontally either to the sash or to the counterweight system
- Occupancy sensor (optional) is placed in the upper corner of the fume cupboard

Wiring Double Sensor Control

The exhaust unit with control box are prewired at the factory and the Halton VLC controller is premounted on the damper. Only the following components need to be wired on site during installation (see component datasheets for details):

- Velocity sensor (3-meter cable included)
- Sash sensor (2.5-meter cable included)
- Halton HTP touch panel (10-meter cable included)
- Local communication from the Halton VLC fume cupboard controller to the room controller (Shielded twisted pair cable, i.e. BELDEN: 3105A)
- Light relay, optional (prewired, 2-meter wire included for attachment to the light installation)
- Occupancy sensor, optional (cable included)

All the wiring must have the same ground in order to avoid any deviation of the signals.

3.3 Double Sensor Control specification/example

The system provides maximum security with a reaction time and stabilisation delay of less than 3 seconds, achieved by the use of two sensors for the control. A PID control system is used for obtaining and maintaining the face velocity specified in the design. The system recognises blockages by the fume cupboard opening and foreign elements in the duct system

The system consists of the following components.

- Damper with an integrated control box. The control box comes with a differential pressure sensor for airflow measurement and a fume cupboard controller for controlling the system. Optional components include a transformer for power supply and a light relay for controlling the fume cupboard light. All the components are prewired at the factory.
- Face velocity sensor. The sensor, installed on the fume cupboard, monitors the velocity in order to keep a constant face velocity.
- Sash sensor. The sensor, installed on the fume cupboard, monitors the sash position in order to keep a constant face velocity.
- 3.5-inch digital color touch panel. The touch panel displays the essential system functions such as the audio-visual alarm, actual airflow and velocity. The touch panel also acts as a user interface for end-user functions as well as for admin functions through a password protected menu. The admin functions provide all the configuration parameters that are necessary in the commissioning and servicing of the system, such as enabling/disabling end-user functions as well as setting alarm, airflow and sensor parameters.
- Occupancy sensor (optional). The sensor detects presence allowing the energy saving mode and automatic sash closing functionalities.

Installation and wiring on site is limited to the sensors and the touch panel. Wiring for the prewired optional components in the control box: 230Vac for the transformer and the connection from the light relay to the light installation.

4 Sash Movement Control

4.1 System overview

Sash Movement Control has a dual control function:

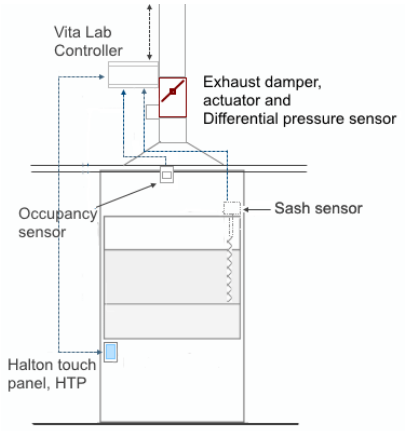
- Control of the sash movement in order to obtain a quick increase of the exhaust airflow
- Control of the sash position in order to maintain a constant face velocity

The system is suitable for fume cupboards with high safety requirements as this dual control of the sash ensures an exceptionally fast response time and high stability: the reaction time and stabilisation delay is less than 3 seconds. The system also recognises blockages in the duct system.

The system is compatible with fume cupboards with vertical sashes. For more details on the standard and optional features related to the safety, energy efficiency and usability of the system, see Halton Vita Lab Solo features in section 2.2

The standard delivery includes an exhaust unit with prewired components in the control box, Halton VLC fume cupboard controller mounted on the damper, sash sensor and the Halton HTP touch panel. Optional components include the occupancy sensor, transformer and a light relay. For a description of the components, see section 2.3

The solution can be seamlessly integrated with the Halton Vita Lab Room and the Halton Vita Lab



Zone solutions for total room control and enhanced duct pressure control .

Figure: Sash Movement Control, centralised exhaust ventilation

Operating principle

The sash sensor sends a signal about the sash movement to the Halton VLC fume cupboard controller, which then adjusts the damper positon or frequency to a predefined setpoint. It adapts the damper position or the frequency by using a PID control in order to reach the set face velocity and then maintains a constant face velocity based on the sash position.

The use of the two controls allows the control system to have a fast response time and reduced delays without compromising the stability of the system. For more information on the general operating principle, see section 2.4

4.2 Installation requirements

Project-specific wiring diagrams are provided by Halton for all system configurations. For the responsibilities between the customer and Halton, as well as an example of a wiring diagram, see section 2.5. For details about installation and wiring, see the relevant component datasheets (8.3).

Placement of components

Consider the following in order to ensure accurate measurements:

- Exhaust unit must be installed at a safe distance from any duct obstacle
- Sash sensor can be installed vertically or horizontally either to the sash or to the counterweight system
- Occupancy sensor (optional) is placed in the upper corner of the fume cupboard

Wiring Sash Movement Control

The exhaust unit with control box are prewired at the factory and the Halton VLC fume cupboard controller is premounted on the damper. Only the following components need to be wired on site during installation (see component datasheets for details):

- Sash sensor (2.5-meter cable included)
- Halton HTP touch panel (10-meter cable included)
- Local communication from the Halton VLC fume cupboard controller to the room controller (Shielded twisted pair cable, i.e. BELDEN: 3105A)
- Light relay, optional (prewired, 2-meter wire included for attachment to the light installation)
- Occupancy sensor, optional (cable included)

All the wiring must have the same ground in order to avoid any deviation of the signals.

4.3 Sash Movement Control specification/example

The system provides a fast reaction time and stabilisation delay of less than 3 seconds. A PID control system is used for obtaining and maintaining the face velocity specified in the design.

The system consists of the following components:

- Damper with an integrated control box.The control box comes with a differential pressure sensor for airflow measurement and a fume cupboard controller for controlling the system. Optional components include a transformer for power supply and a light relay for controlling the fume cupboard light. All the components are prewired at the factory.
- Sash sensor. The sensor, installed on the fume cupboard, monitors the sash position in order to keep a constant face velocity and the sash movement in order to obtain a quick increase of the exhaust airflow
- 3.5-inch digital colour touch panel. The touch panel displays the essential system functions such as the audio-visual alarm, actual airflow and velocity. The touch panel also acts as a user interface for end-user functions as well as for admin functions through a password protected menu. The admin functions provide all the configuration parameters that are necessary in the commissioning and servicing of the system, such as enabling/disabling end-user functions as well as setting alarm, airflow and sensor parameters.
- Occupancy sensor (optional). The sensor detects presence allowing the energy saving mode and automatic sash closing functionalities.

Installation and wiring on site is limited to the sensors and the touch panel. Wiring for the optional components: 230Vac for the transformer and the connection from the light relay to the light installation.

5 Sash Position Control

5.1 System overview

The Sash Position Control system maintains a constant face velocity in the fume cupboard depending on the sash position. It also recognises blockages in the duct system.

The system is suitable for normal laboratory conditions and for fume cupboards with vertically sliding sashes. For more details on the standard and optional features related to the safety, energy efficiency and usability of the system, see Halton Vita Lab Solo features in section 2.2

The standard delivery includes the exhaust unit with prewired components in the control box, Halton VLC fume cupboard controller mounted on the damper, sash sensor and the Halton HTP touch panel. Optional components include the occupancy sensor, transformer and a light relay. For a description of the components, see section 2.3

Operating principle

In Sash Position Control, the system receives the opening percentage data of the sash from the sash sensor and then adjusts the exhaust airflow to maintain a constant face velocity, depending on the sash position. The fan can be turned off or on manually

For more information on the general operating principle, see section 2.4

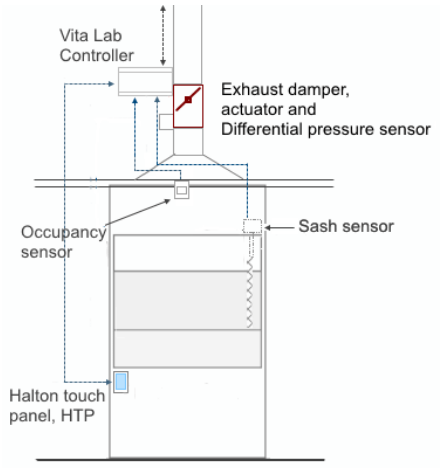


Figure: Sash Position Control, centralised exhaust ventilation

5.2 Installation requirements

Project-specific wiring diagrams are provided by Halton for all system configurations. For the responsibilities between the customer and Halton, as well as an example of a wiring diagram, see section 2.5. For details about installation and wiring, see the relevant component datasheets (8.3).

Placement of components

Consider the following in order to ensure accurate measurements:

- Exhaust unit must be installed at a safe distance from any duct obstacle
- Sash sensor can be installed vertically or horizontally either to the sash or to the counterweight system
- Occupancy sensor (optional) is placed in the upper corner of the fume cupboard

Wiring Sash Position Control

The exhaust unit with control box are prewired at the factory and the Halton VLC fume cupboard controller is premounted on the damper. Only the following components need to be wired on site during installation (see component datasheets for details):

- Sash sensor (2.5-meter cable included)
- Halton HTP touch panel (10-meter cable included)
- Local communication from the Halton VLC fume cupboard controller to the room controller (Shielded twisted pair cable, i.e. BELDEN: 3105A)
- Light relay, optional (prewired, 2-meter wire included for attachment to the light installation)
- Occupancy sensor, optional (cable included)

All the wiring must have the same ground in order to avoid any deviation of the signals.

5.3 Sash Position Control specification/example

The system maintains a constant face velocity in the fume cupboard based on the sash position.

The system consists of the following system components:

- Damper with an integrated control box. The control box comes with a differential pressure sensor for airflow measurement and a fume cupboard controller for controlling the system. Optional components include a transformer for power supply and a light relay for controlling the fume cupboard light. All the components are prewired at the factory.
- Sash sensor. The sensor, installed on the fume cupboard, monitors the sash height in order to keep a constant face velocity.
- 3.5-inch digital colour touch panel. The touch panel displays the essential system functions such as the audio-visual alarm, actual airflow and velocity. The touch panel also acts as a user interface for end-user functions as well as for admin functions through a password protected menu. The admin functions provide all the configuration parameters that are necessary in the commissioning and servicing of the system, such as enabling/disabling end-user functions as well as setting alarm, airflow and sensor parameters.
- Occupancy sensor (optional). The sensor detects presence allowing the energy saving mode and automatic sash closing functionalities.

Installation and wiring on site is limited to the sensors and the touch panel. Wiring for the optional components in the control box: 230Vac for the transformer and the connection from the light relay to the light installation.

6 Face Velocity Control

6.1 System overview

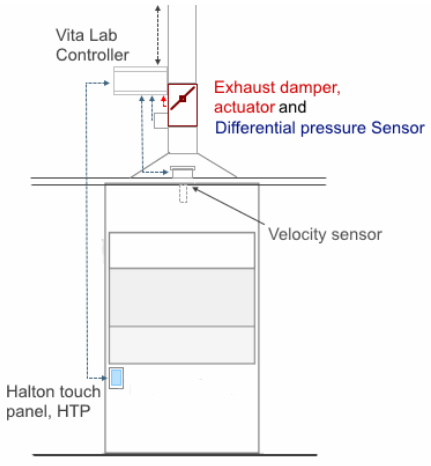
The Face Velocity Control system maintains a constant face velocity in the fume cupboard regardless of the sash position. It also recognises blockages by the fume cupboard opening and in the duct system.

The system is suitable for normal laboratory conditions and for fume cupboards with all types of sashes (vertical and horizontal). For more details on the standard and optional features related to the safety, energy efficiency and usability of the system, see Halton Vita Lab Solo features in section 2.2

The standard delivery includes the exhaust unit with prewired components in the control box, Halton VLC fume cupboard controller mounted on the damper, velocity sensor and the Halton HTP touch panel. Optional components include the occupancy sensor, transformer and a light relay. For a description of the components, see section 2.3

Operating principle

In Face Velocity Control, the system receives the face velocity data from the velocity sensor and adjusts the exhaust airflow in order to maintain a constant face velocity. For more information on the general operating principle, see section 2.4



6.2 Installation requirements

Project-specific wiring diagrams are provided by Halton for all system configurations. For the responsibilities between the customer and Halton, as well as an example of a wiring diagram, see section 2.5. For details about installation and wiring, see the relevant component datasheets (8.3).

Placement of components

Consider the following in order to ensure accurate measurements:

- Exhaust unit must be installed at a safe distance from any duct obstacle
- Velocity sensor
    - Must be placed on top of the cupboard and at a safe distance from the walls
    - The pressure difference between the false ceiling and the room space can induce deviation in the velocity measurement. Therefore, it is recommended that the space with the sensor be connected to the room using a duct.

- Occupancy sensor (optional) is placed in the upper corner of the fume cupboard

Wiring Face Velocity Control

The exhaust unit with control box are prewired at the factory and the Halton VLC fume cupboard controller is premounted on the damper. Only the following components need to be wired on site during installation (see component datasheets for details):

- Velocity sensor (3-meter cable included)
- Halton HTP touch panel (10-meter cable included)
- Local communication to the controller with a shielded, twisted pair cable (i.e. BELDEN:3105A)
- Light relay, optional (prewired, 2-meter wire included for attachment to the light installation)
- Occupancy sensor, optional (cable included)

All the wiring done on site must have the same ground, in order to avoid any deviation of the signal received by the Halton VLC controller.

6.3 Face Velocity Control specification/example

The system maintains a constant face velocity in the fume cupboard regardless of the sash position.

The system consists of the following system components.

- Damper with an integrated control box. The control box comes with a differential pressure sensor for airflow measurement and a fume cupboard controller for controlling the system. Optional components include a transformer for power supply and a light relay for controlling the fume cupboard light. All the components are prewired at the factory.
- Face velocity sensor. The sensor, installed on the fume cupboard, monitors the velocity in order to keep a constant face velocity.
- 3.5-inch digital colour touch panel. The touch panel displays the essential system functions such as the audio-visual alarm, actual airflow and velocity. The touch panel also acts as a user interface for end-user functions as well as for admin functions through a password protected menu. The admin functions provide all the configuration parameters that are necessary in the commissioning and servicing of the system, such as enabling/disabling end-user functions and setting alarm, airflow and sensor parameters.
- Occupancy sensor (optional). The sensor detects presence allowing the energy saving mode and automatic sash closing functionalities.

Wiring and installation on site is limited to the sensors and the touch panel. Wiring for the optional components in the control box: 230Vac for the transformer and the connection from the light relay to the light installation.

7 Dual Position Control

7.1 System overview

The Dual Position Control system adapts the airflow rate in order to maintain a minimum face velocity by detecting if the sash is open or closed. The system is an on/off solution suitable for fume cupboards with vertically sliding sashes.

The standard delivery includes the exhaust unit with prewired components in the control box, Halton VLC fume cupboard controller mounted on the damper and an on/off switch. Optional components include the HTP touch panel, a transformer and a light relay. For more details, see section 2.3.

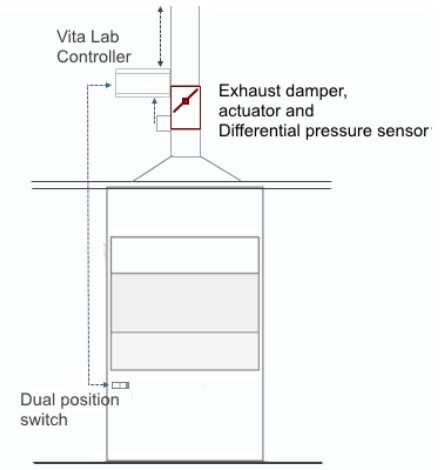


Figure: Dual Position Control, centralised exhaust ventilation

Operating principle

In Dual Position Control, the airflow is controlled by an on/off switch. The value of the exhaust airflow setpoint is controlled by the signal emitted by a contact switch located in the lower part of the fume cupboard. The switch allows the system to detect when the sash is closed:

- Sash closed / Switch closed = Min airflow rate setpoint
- Sash open / Switch open = Max airflow rate setpoint

The system then adapts the damper position or frequency to maintain the airflow set-point and sends the exhaust flow rate and controller state to the room controller.

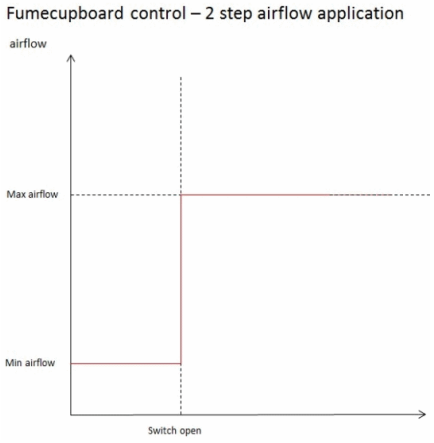


Figure: Dual position airflow control

7.2 Installation requirements

Project-specific wiring diagrams are provided by Halton. For the responsibilities between the customer and Halton, see section 2.5. For details about installation and wiring, see the relevant component datasheets (8.3).

Placement of components

Consider the following in order to ensure accurate measurements:

- Exhaust unit must be installed at a safe distance from any duct obstacle
- The on/off switch (24 $V_{DC,)}$ must be placed either at the bottom of the fume cupboard or at the top of the sash counterweight system (corresponding to the closed position of the sash)

Wiring Dual Position Control

The exhaust unit with control box are prewired at the factory and the Halton VLC fume cupboard controller is premounted on the damper. Only the following components need to be wired on site during installation (see component datasheets for details):

- On/off switch (2-meter wire, Ø 0.75 mm² included)
- Local communication to the controller with a shielded, twisted pair cable (i.e. BELDEN:3105A)
- Light relay, optional (prewired, 2-meter wire included for attachment to the light installation)

All the wiring done on site must have the same ground in order to avoid deviation of the signal received by the VLC fume cupboard controller.

7.3 Dual Position Control specification/example

The system consists of the following system components:

- Damper with an integrated control box. The control box comes with a differential pressure sensor for airflow measurement and a fume cupboard controller for controlling the system. Optional components include a transformer for power supply and a light relay for controlling the fume cupboard light. All the components are prewired at the factory.
- On/off switch. The switch, installed on the fume cupboard, maintains a minimum face velocity by detecting whether the sash is open or closed.
- 3.5-inch digital colour touch panel (optional). The touch panel provides an audio-visual alarm and access to admin functions through a password protected menu.

Installation and wiring on site is limited to the switch (and touch panel, optional). Wiring for the optional components in the control box entails: 230Vac for the transformer and the connection from the light relay to the light installation.

8 Appendices

8.1 Communication

The communication between the fume cupboard controller and the room controller uses local protocol. Communication to BMS is available in Modbus or Bacnet IP.

Local communication

A local communication protocol is used internally to transmit the fume cupboard controller information to the room controller. The protocol works as master/slave communication, with the room controller as the master, wired to a series of fume cupboard slave controllers. Certain fume cupboard controller data (such as airflow rate, alarm, controller state) may be sent further to the Building Management System (BMS) via the room controller.

Design requirements for local communication:

- A maximum of 10 fume cupboard controllers (slave) can be connected to a single room controller (master)
- For the connections between the slave controllers and the room master controller, a serial connection (RS485) and a shielded twisted pair cable must be used
- The slave controller connections must be daisy chained

Communication to Building Management System (BMS)

In the standard solution, the BMS is wired onto the Halton VLC room controller. The Halton VLC controller supports the Modbus Remote Terminal Unit (RTU) and BACnet IP communication protocols for communication to the BMS.

The user has access via the BMS to all the room controller parameters and to certain fume cupboard control parameters (such as airflow rate, velocity, alarm, controller state etc).

Design requirements for Modbus:

- A maximum of 47 registers can be sent in one message
- For the connection between the BMS and the room master controller
    - Serial connection (RS485) must be used
    - Shielded cable (1 pair (A,B) + 1 shield (N)
    - Additional insulation may be used (i.e. BELDEN 3105A)
- Bit rate speed: 1200 – 38400 bps
- 8 data bits, 1 stop bit, parity none

Design requirements for BACnet IP:

- For the connection to the room master controller a shielded RJ45-cable must be used
- The slave controller connections need to be daisy chained

8.2 Exhaust unit quick selection guide

Halton provides a wide range of high-quality exhaust units for Halton Vita Lab solutions in order to match various design requirements.

This section gives you a quick overview of the selection criteria. For more comprehensive documentation about the dimensions and other properties, see the Halton HIT Design Tool or the Dampers and Measuring units document available from Halton Sales.

8.2.1 Type of exhaust unit

The exhaust design of the laboratory determines whether a damper or a measuring unit is required:.

- In spaces with centralised exhaust design, the system is built using a damper and an actuator (models VFP, VFI, VFH) .
- In spaces with a single exhaust fan design, a measuring unit is used instead (models VVP, VVI, VVH). Note that measuring units require a frequency inverter, not provided by Halton.

For a description of centralised and single exhaust fan ventilation designs, see section 2.2.5

8.2.2 Material and shape

All dampers and measuring units are available in PVC/PPS, galvanised steel and stainless steel to match the requirements for different kinds of ductwork in accordance with the tested chemicals.

The Halton Vita Lab Solo exhaust units are circular in shape and available with or without flanges.

The Halton VFP damper is available in two models depending on the measuring principle:

- VFP-Y with a measurement probe
- VFP-V with the venturi principle

The following table summarises the product characteristics:

	VFP	VFI	VFH	VVP	VVI	VVH
Material	PVC, PPS	Stainless steel	Galvanised steel	PVC, PPS	Stainless steel	Galvanised steel
Shape	Circular	Circular	Circular	Circular	Circular	Circular
Flanges	Optional	Yes	Optional	Optional	none	none
Casing classification	none	EN1751	EN1751	none	EN1751	EN1751
Corrosion proofing	no	yes	yes	no	yes	yes

Figure: Exhaust unit product characteristics

8.2.3 Airflow requirements for fume cupboards

The requirements for airflow vary greatly for different kinds of cupboards and you must consult the fume cupboard manufacturer for their specific requirements.

Face velocity also varies depending on country-specific regulations and the safety-level requirements based on the laboratory usage. In Northern Europe, for example, a face velocity of 0.5 m/s is standard, while in many Central European countries, a velocity of 0.3 m/s is sufficient.

The following tables give an example of maximum airflow for different widths of fume cupboards with a face velocity of 0.3 and 0.5 m/s respectively. Note that the amounts vary depending on the design of the fume cupboard.

Maximum airflow in the tables below is given in cubic metres per hour (m³/h):

Width of fume cupboard mm	Sash window opening in cm		
	10	30	50
900	162	486	810
1200	216	648	1080
1500	270	810	1350
1800	324	972	1620
2400	432	1296	2160

Max airflow (m³/h) when face velocity is 0.5 m/s

Width of fume cupboard mm	Sash window opening in cm		
	10	30	50
900	97	292	486
1200	130	389	648
1500	162	486	810
1800	194	583	972
2400	259	778	1296

Max airflow (m³/h) when face velocity is 0.3 m/s

The maximum airflow in the tables below is given in litres per second (l/s):

Width of fume cupboard mm	Sash window opening in cm		
	10	30	50
900	45	135	225
1200	60	180	300
1500	75	225	375
1800	90	270	450
2400	120	360	600

Max airflow (l/s) when face velocity is 0.5 m/s

Width of fume cupboard mm	Sash window opening in cm		
	10	30	50
900	27	81	135
1200	36	108	180
1500	45	135	225
1800	54	162	270
2400	72	216	360

Max airflow (l/s) when face velocity is 0.3 m/s

8.2.4 Size of exhaust unit

When selecting the size of the exhaust unit, consider the required face velocity and airflow requirements for the fume cupboard in question (see section 8.2.3. for an example). The airflow should not exceed the maximum value of of the exhaust unit.

See the following table for the available sizes and the minimum and maximum airflow ranges for the different models (max is based on damper velocity of 8 m/s).

Airflow ranges for the dampers White= l/s Grey= m³/h

	VVP, VFP-Y		VVI, VVH, VFI &VFH		VFP-V	
Size mm	Q_{min}	Q for 8m/s	Qmin	Q for 8 m/s	Qmin	Q for 8m/s
100			8	64		
			29	230		
125	12	98	13	104		
	44	353	47	374		
160	20	161	20	160	18	142
	72	579	72	576	65	510
200	31	251	32	256	28	225
	113	905	115	922	102	810
250	49	393	49	392	44	353
	177	1414	176	1411	160	1270
315	78	623	78	624	70	561
	281	2244	281	2246	252	2018
400	126	1005	126	1008		
	452	3619	454	3629		
500	196	1571	197	1576		
	707	5655	709	5674		

Figure: Min and max airflow ranges per exhaust unit size

8.3 Related technical documentation

The following technical documentation is available from Halton Sales:

- Halton Vita Lab Room Design Guide
- Halton Vita Lab Exhaust Units - Dampers and Measuring Units
- Halton HIT Design tool
- Component datasheets
    - Halton VLC controller
    - Halton HTP touch panel
    - Halton HSS sash sensor
    - Halton HVS-VE1 velocity sensor
    - Halton HOS-OE1 occupancy sensor
    - Halton HAC-L24A-SR actuator

The component datasheets provide detailed information such as product models, technical data, dimensions, installation and wiring.