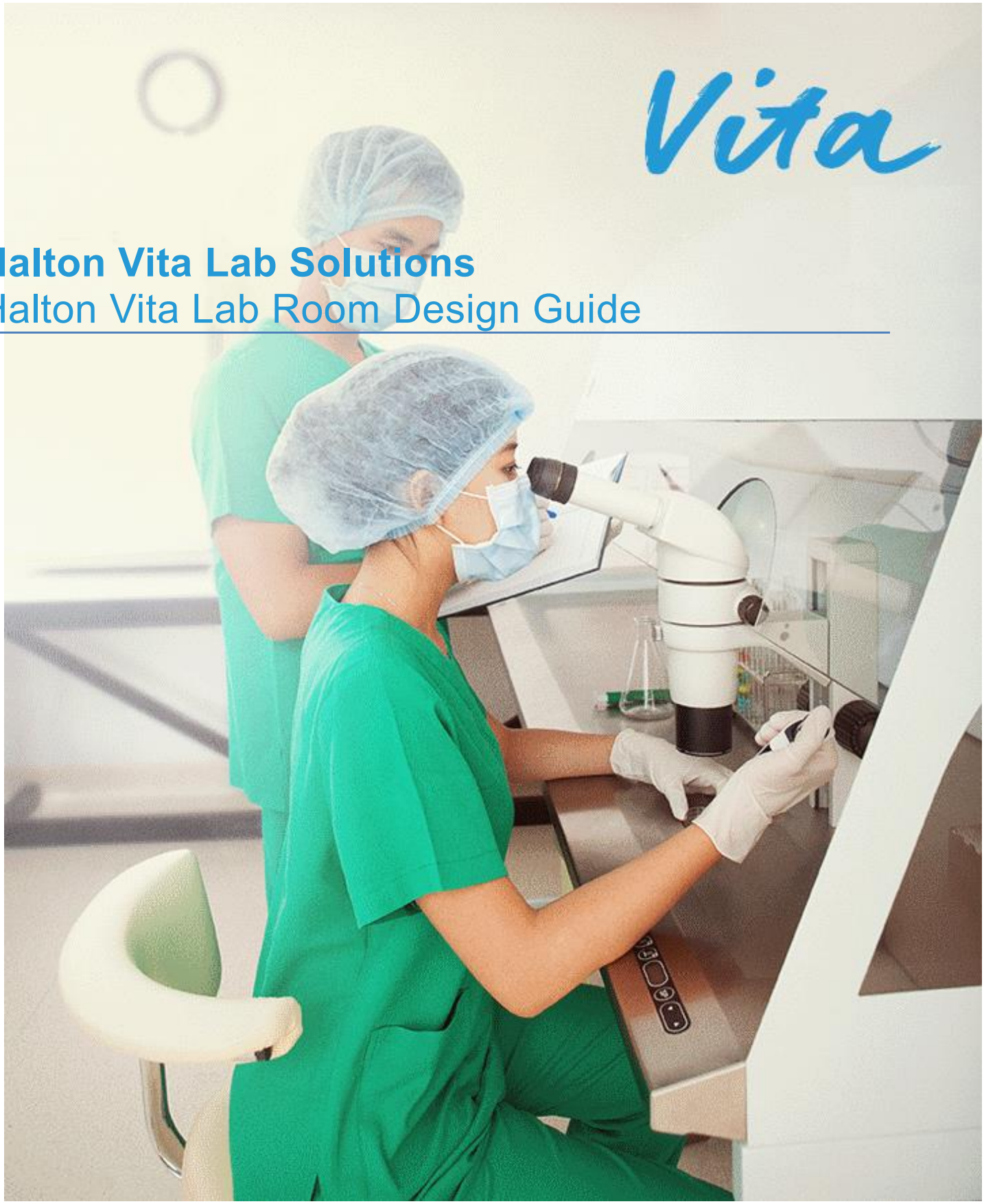


Halton Vita Lab Solutions

Halton Vita Lab Room Design Guide

Enabling Wellbeing

Contents

1 Introduction

Halton Vita Lab is a total solution 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

This document provides technical details and design guidelines for the Halton Vita Lab Room solution. 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.

The Halton Vita Lab Room solution allows the control of the room pressure and temperature in order to prevent the dispersal of contaminants and to ensure optimal air quality and comfort in the laboratory.

Due to the flexibility and precision of the pressure measuring mechanism, Halton Vita Lab Room enables a continuous control and monitoring of pressure in the laboratory.

The solution offers the following advantages

- Controlled over/underpressure conditions
- Safe operation at all times with an easy-to-use touch panel and audio-visual alarm
- Consistently optimal indoor air quality
- Optimal thermal comfort with minimum energy usage
- Total room control, integrating the Halton Vita Lab Solo units to the Vita Lab Room control system

1.1 Halton Vita Lab Room applications

There are three different application areas for Halton Vita Lab Room, depending on the design of the space and the required level of pressure control:

- Room Airflow Control for spaces where the need for pressure control less rigorous. The solution adjusts the room pressure by measuring and controlling the difference in the airflow between the supply and exhaust. The airflow can be controlled by the supply damper only or by both supply and exhaust dampers.

- Total Exhaust Measurement for spaces with zonal management for increased energy efficiency. The airflow is controlled based on measurements from the Halton Vita Lab Zone damper. The airflow can be controlled by the supply damper only or by both supply and exhaust dampers.
- Room Pressure Control for spaces where safety requirements are exceptionally high. The room pressure is adjusted based on measurements from a room pressure sensor.

1.2 Halton Vita Lab Room features

Halton Vita Lab Room offers a range of features on the system level, configuration level and for end-users.

1.2.1 Feature summary

The system-level features of Halton Vita Lab Room applications are summarised in the table below:

	Room Airflow Control		Total Exhaust Measurement		Room Pressure Control
	Supply control	Supply and exhaust control	Supply control	Supply and exhaust control	
System-level features					
Indirect pressure (airflow difference) control	•	•	•	•	
Direct pressure control (with room pressure sensor)					•
Air exchange rate control		•		•	•
Temperature control		•		•	•
Advanced temp control (with heating/cooling element)		o		o	o
Automatic ECO-mode (with occupancy sensor)	o	o	o	o	o
Duct pressure control (with VLZ)	o	o	•	•	o
Zonal airflow management			•	•	
Cascade control					•
Control freeze *					•
No. of fume cupboards / VLC room master controller	10	No limit	No limit	No limit	No limit
Exhaust design solution					
Single exhaust ventilation	•	•			•
Centralised exhaust ventilation	•	•			•
Centralised, integrated with general room exhaust	•	•	•	•	•

• = standard
o = optional, requires an additional component
* Door switch required, not provided by Halton

Table: System-level features for Halton Vita Lab Room applications

Features available for the end-user through the the Halton HTP touch panel user interface:

- System on/off
- Audio-visual alarm
- MAX mode
- Manual ECO mode
- Manual temperature control
- Manual pressure control (in Room Pressure Control application only)

The Halton Vita Lab Room end-user features are enabled and configured through the configuration menu. In addition, the manual mode feature for configuration and maintenance tasks is available from the HTP configuration menu.

See section 1.3 for more information about the Halton HTP touch panel.

1.2.2 Feature descriptions

Indirect pressure (airflow difference) control

Indirect pressure control maintains pressure levels by measuring the airflow difference between the supply and exhaust dampers. This maintains the desired directional airflow (into or out of the space).

Direct pressure control

Direct pressure control maintains the desired pressure level based on measurements from a room pressure sensor. This provides rigorous pressure control for spaces where safety requirements are exceptionally high. The system is configured for overpressure or underpressure mode depending on the type of laboratory.

Air exchange rate control

Air exchange rate control is used to ensure a minimum room air exchange rate, when the exhaust equipment is not sufficient to guarantee a minimum air exchange rate in the space. The system measures the differential pressure in the room and adapts either the supply or exhaust to guarantee a constant air exchange rate inside the room.

Temperature control

Temperature in the laboratory can be controlled both manually and automatically.

The system monitors the room temperature using either a temperature sensor integrated into the HTP or with an external temperature probe, installed nearby. End users can manually control the room temperature from the Halton HTP touch panel, if the feature has been activated from the configuration menu.

With the standard temperature control feature, the temperature is controlled by adjusting the airflow rate, while for advanced temperature control, an additional heating or cooling element is required.

Duct pressure control

Constant duct pressure controls the exhaust airflow with the Vita Lab Zone damper, providing a constant response time for the Halton Vita Lab Solo fume cupboard control system. This guarantees the safety of the user regardless of the conditions outside the laboratory and enhances energy efficiency.

Zonal airflow management

Zonal airflow management uses the Halton VLZ zone damper to measure the total exhaust airflow in the space. This prevents zone-to-zone fluctuation, giving a steady airflow. It can also be used to decrease the total room exhaust airflow when the consumption is too high within the space.

Cascade control

Cascade control is available for Room Pressure Control applications. It combines the room pressure and room airflow controls by calculating the setpoint of the supply or exhaust airflow (depending on which one is controlling the pressure) from the measurement of the room pressure and an estimated airflow. This provides a faster control reaction time.

Control freeze

In order to avoid excessive loss of room pressure, the control can be frozen during the opening of the door. Note that the required door switch is not provided by Halton.

Alarm

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

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. The feature is enabled and adjusted from the configuration menu.

The automatic ECO mode is an optional feature and requires an occupancy sensor.

MAX mode

The MAX mode 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.

Manual mode

Manual mode allows the manual control of the exhaust and supply VAV damper positions during commissioning and servicing. This mode is enabled from the Halton HTP configuration menu.

1.3 Halton Vita Lab Room component overview

The Halton Vita Lab Room solution consists of the Halton HTP touch panel user interface, the Halton Vita Lab Controller as a room controller (VLC/RC), exhaust and/or supply dampers and sensors. Additional heating/cooling elements can be added if desired.

The VLR system can be integrated with the Halton Vita Lab Solo (VLS) system. These work seamlessly together providing safe and stable room airflow and pressure conditions, ideal thermal conditions and enhanced energy efficiency.

1.3.1 Component summary

The VLR configuration varies according to the application. The components included in the different configurations are summarised in the following table.

	Room Airflow Control		Total Exhaust Measurement		Room Pressure Control
	Supply control	Supply and exhaust control	Supply control	Supply and exhaust control	
Halton HTP touch panel	•	•	•	•	•
Halton VLC room controller*	•	•	•	•	•
Supply damper	•	•	•	•	•
Exhaust damper		•		•	•
Halton VLZ zone damper	o	o	•	•	o
Occupancy sensor	o	o	o	o	o
Room pressure sensor					•
External temperature sensor unit		o		o	o
Heating/cooling elements		o		o	o

• = standard
o = optional
* The Halton VLC room controller is mounted on the master damper

Table: Components for Halton Vita Lab Room configurations

1.3.2 Component descriptions

This section gives a brief description of the Halton Vita Lab Room components. For a list of component datasheets with more technical details, see 5.1 in the Appendix.

Halton Touch Panel

The Halton HTP touch panel is a multi-tool that allows the control of end-user functions, configuration parameters and maintenance functions:

- Visual digital display
- Easy-to-use touch screen end-user functions
- Servicing tool
- Configuration tool
- Maintenance tool
- Buzzer alarm
- Temperature sensor

The HTP has a 3.5" touch screen that can display different settings and controls for the user. A three-level menu structure provides access to end-user functions, configuration parameters and maintenance functions.

Access level	Description	Note
User	User display	default
Service	Configuration for start-up & service	password protected
Factory Settings	Initial settings and possible modifications	password protected

Figure: HTP access levels

A dedicated HTP is provided for the Halton Vita Lab Room configuration and for each Halton Vita Lab Solo fume cupboard.

Controllers

The Halton Vita Lab Controller (VLC) is a multi-purpose component for different Halton Vita Lab solutions.

In Vita Lab Room, the controller functions as a room controller (VLC/RC) and is delivered pre-mounted on the master damper, with a transformer as an option. The VLC is available in two versions: VLC/RC 15 I/O and 28 I/O.

When integrated with the VLS system, the VLR/RC functions as the master controller and the Halton Vita Lab fume cupboard controllers (VLC/FC) as slaves.

Dampers

The Halton Vita Lab Room solution includes supply and/or exhaust dampers, depending on the application. Depending on the system configuration, the supply and exhaust dampers can assume a master or a slave role in the system.

The dampers are available in PVC/PPS (VFP), galvanised steel (VFH) and stainless steel (VFI).

Integrated actuators with fast response times control the dampers. A differential pressure sensor is included with each slave damper for measuring the airflow rate.

To select the correct type and size of the damper, see the HIT Design tool or the Dampers and Measuring Units document available from Halton Sales.

Sensors

A differential pressure sensor is included with each slave damper for measuring the airflow rate.

A room pressure sensor is used to measure the room pressure level in Room Pressure Control applications.

An occupancy sensor is used to decrease the room air exchange rate when the space is not occupied.

Heating/cooling elements

For advanced temperature control, heating and/or cooling elements are required.

1.4 Design considerations

1.4.1 Requirements on laboratory ventilation design

Demanding laboratory environments set strict requirements on the ventilation system. The most important of them is uncompromised safety, which can be achieved by

- stable room airflow and pressure conditions
- high adaptability of the system to variable airflows and conditions in the room
- reliable alarm system
- a system that is easy to use and maintain

The flexibility and precision of the pressure measuring mechanism of the Halton Vita Lab Room solution ensures high safety levels at all times, while the easy-to-use touch panel and the audio-visual alarm minimise the risk of human errors.

Energy efficiency is considered increasingly important in the design of laboratory ventilation systems. In Halton Vita Lab Room, variable airflow control improves energy efficiency. It can be further enhanced with the automatic ECO mode, an optional feature that uses an occupancy sensor to minimise ventilation during off-peak hours.

1.4.2 Communication

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. Through the local protocol, the user has access 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 requirement for BACnet IP: for the connection to the room master controller a shielded RJ45-cable must be used.

1.4.3 Centralised and single exhaust fan ventilation design

All the Halton Vita Lab Room applications can be used in centralised exhaust ventilation integrated with the general room exhaust system, whereas in case of single fan exhaust and centralised exhaust without general room exhaust designs, there are restrictions. See the feature table in section1.2 Halton Vita Lab Room features for more details.

In centralised ventilation systems, the fume cupboard exhausts are connected to one common fan. The general room exhaust can be either separated from or connected to the fume cupboard exhaust:

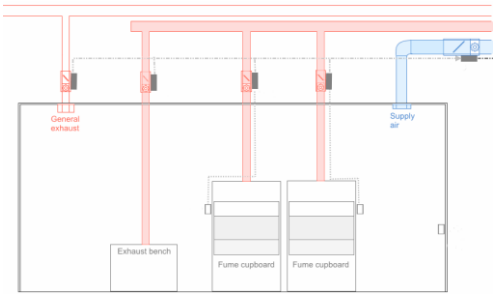
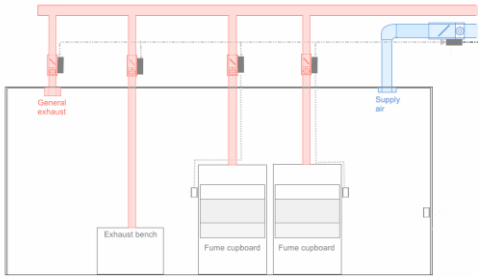


Fig: Centralised exhaust



Centralised exhaust integrated with general room exhaust

In single exhaust fan ventilation design, each fume cupboard is connected to its own exhaust fan. General room exhaust, if there is any, is separated from the fume cupboards exhausts:

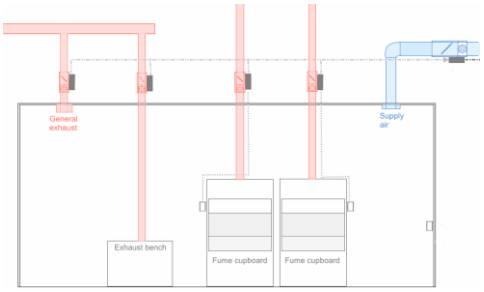


Figure: Single exhaust fan ventilation

2 Room Airflow Control applications

VLR Room Airflow Control is a solution that controls the room pressure indirectly by measuring and controlling the difference in the airflow between the supply and exhaust. It is used in applications where the main requirement is to ensure the desired (positive or negative) directional airflow.

The system provides stable room airflow conditions through

- continuous control and monitoring of the room conditions
- seamless interaction between the room and fume cupboard exhaust units

2.1 Room Airflow Control Concepts

The control concepts available are:

- Supply control
  - The ventilation and pressure levels in the room are adjusted by controlling the supply airflow rate only
- Supply and exhaust control
  - The ventilation and pressure levels in the room are adjusted by controlling both the supply and the exhaust airflow rates
  - This control concept can be applied in several different kinds of system configurations.
  - In addition to controlling the airflow difference, it also allows the control of room air exchange rate and room temperature.

For more details, see the following section on Room Airflow control system configurations.

2.2 Room Airflow Control system configurations

2.2.1 Supply Control Configuration

The Room Airflow Control system configuration with the Supply Control Concept is used in applications where the supply damper controls the airflow.

The standard features are

- Indirect pressure control through control of difference in airflow
- End-user functions enabled from the configuration menu (alarm, Manual ECO mode and MAX mode
- Manual mode for configuration and maintenance

Optional features include

- Automatic ECO mode (occupancy sensor required)
- Duct pressure control (VLZ zone damper required)

This configuration is suitable for all exhaust design solutions (single fan and centralised with/without general room exhaust). There is a limitation of 10 fume cupboards for the configuration.

The standard delivery includes

- supply VAV damper
- Halton VLC room controller (transformer optional), mounted on the master damper
- Halton HTP touch panel

Optional components: occupancy sensor, VLZ

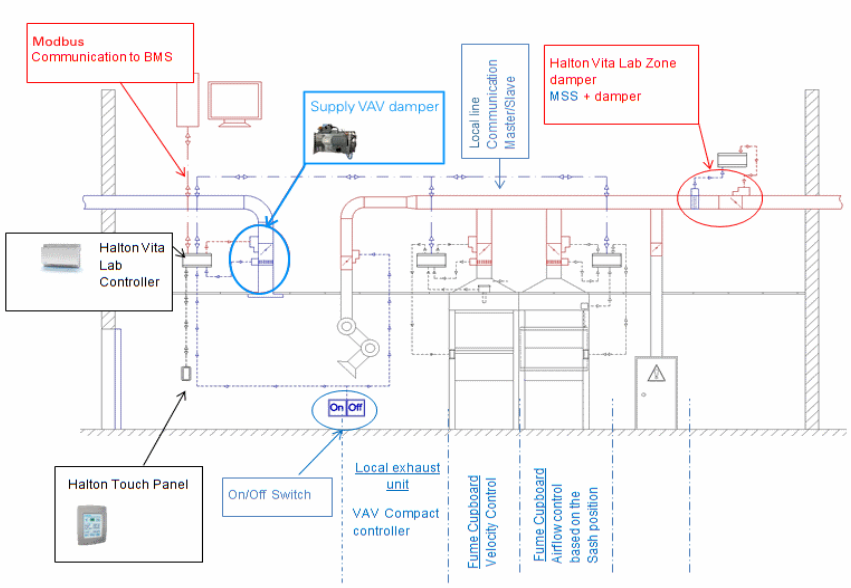


Figure: Room Airflow Control with Supply Control configuration

The Halton Vita Lab Room Controller (VLC/RC) retrieves the total airflow data from the supply and exhaust equipment and sends a compensation calculation signal to the supply damper, which in turn adapts its position to maintain the required airflow difference.

2.2.2 Supply and Exhaust Control configuration

The standard system configuration using the Supply and Exhaust Control Concept is one that uses variable air volume (VAV) dampers for both supply and general room exhaust. In this configuration:

- the room airflow rate difference (ΔQ) is controlled by the supply VAV damper (master), which maintains a constant under/overpressure inside the laboratory
- the air exchange rate is controlled by the general exhaust VAV damper (slave), which ensures a minimum room exchange air rate when the exhaust equipment airflow is insufficient to maintain the room air exchange rate

The standard features available are

- Indirect pressure control through control of difference in airflow
- Air exchange rate control
- End-user functions enabled from the configuration menu: alarm, manual temperature control, manual ECO mode and MAX mode
- Manual mode for configuration and maintenance

Optional features include

- Advanced temperature control (additional heating/cooling elements required)
- Automatic ECO mode (additional occupancy sensor required)
- Duct pressure control (VLZ zone damper required)

This configuration is suitable for all exhaust design solutions (single fan design and centralised design with/without general room exhaust). There is no limitation to the number of fume cupboards for the configuration.

The standard delivery includes

- VAV supply (master) damper
- VAV exhaust (slave) damper
- Halton VLC room controller (transformer, optional), mounted on the master damper
- Halton HTP touch panel for room control

Components for optional features

- Occupancy sensor
- Heating element (control valve is not provided by Halton)
- Cooling element (control valve is not provided by Halton, only with VLC/RC 28 I/O)
- External temperature sensor unit (used in special cases, only with VLC/RC 28 I/O)
- VLZ

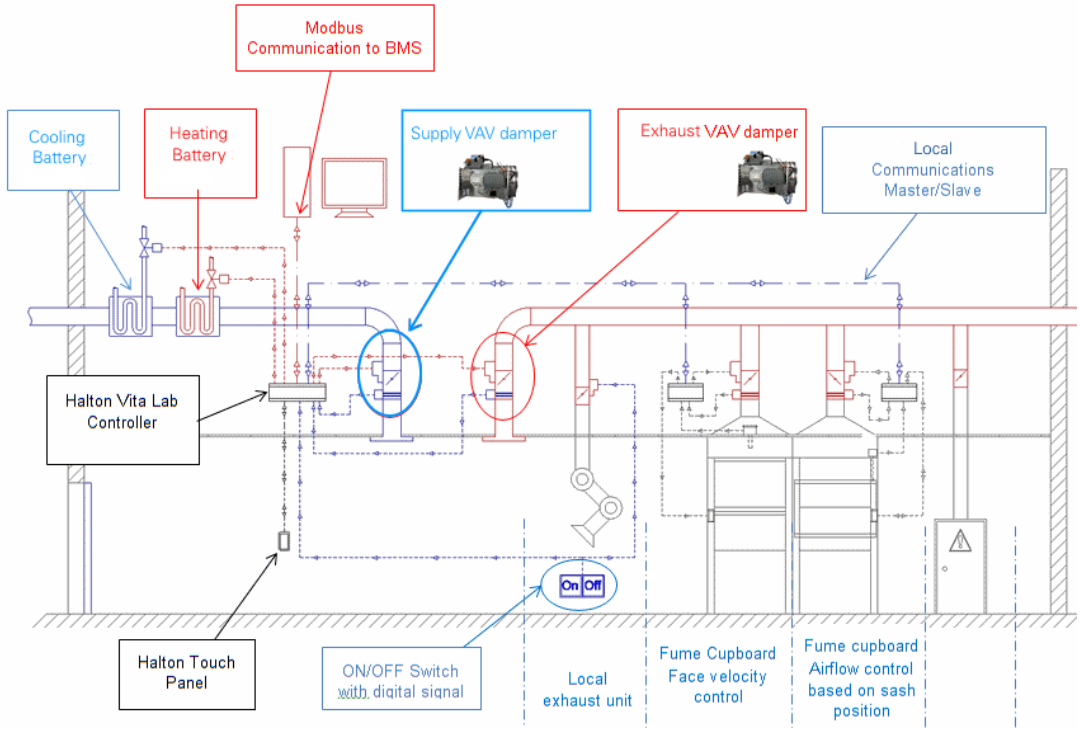


Figure: Room Airflow Control - Supply and Exhaust Control configuration

The Halton Vita Lab Room Controller (VLC/RC) retrieves the total airflow data from the supply and exhaust equipment. It then sends a compensation calculation signal to

- the supply damper, which adapts its position to maintain the required airflow difference
- the exhaust damper, which adapts its position to maintain the required air exchange rate

2.2.3 Special Room Airflow Control applications

Other system configurations using the Supply and Exhaust Control Concept are, for example:

- Room airflow control with constant supply (CAV) and variable exhaust (VAV) airflow, where the room airflow difference is controlled by the Exhaust VAV damper and the air exchange rate is controlled by a constant supply airflow

- Room airflow control with multiple supply and exhaust control

For more information about special configurations, please contact your Halton sales representative.

2.3 Room Airflow Control operating principle

The following figure shows the operating principle and the communication between the different components of the system.

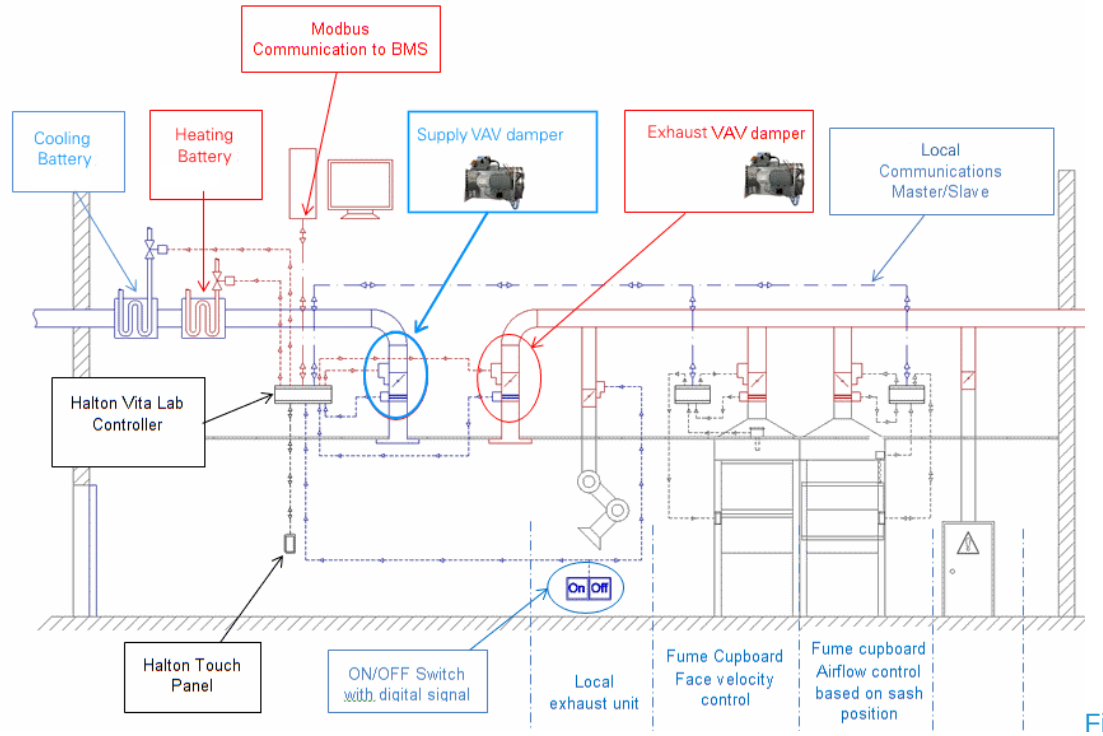


Figure: Fig. Room airflow control communication

In the communication between the system components, local protocol is used. The Halton Vita Lab Room Controller (VLC/RC) functions as the master controller and the fume cupboard controllers (VLC/FC) as slaves. The Halton Vita Lab room master controller coordinates the communication as follows:

- Retrieval of the total exhaust airflow rate
  - The Halton Vita Lab Room Controller (VLC/RC) retrieves the total exhaust airflow data from the fume cupboards, on/off exhaust equipment and other exhaust equipment, and calculates the total exhaust airflow
- Control of the airflow difference
  - The VLC/RC sends a signal to the supply damper (master) based on the total exhaust calculation
  - The supply VAV damper measures the supply airflow rates (using a differential pressure sensor) and adapts its position to maintain the set airflow difference
- Control of the air exchange rate
  - The VLC/RC sends a signal to the exhaust damper (slave) based on the total exhaust calculation
  - The exhaust VAV damper (using a differential pressure sensor) and adapts its position to maintain the set air exchange rate
- Automatic ECO-mode

    - When the occupancy sensor detects that there is no presence in the room, the ventilation is automatically set to a minimum
- Temperature control (automatic)
    - Using a temperature sensor (integrated into the HTP or an external unit), the VLC/RC detects if the room needs to be heated or cooled
    - the VLC/RC sends a signal to the heating/cooling valve or the supply damper to increase the airflow

See the following sections (2.3.1-2.3.5) for more details on the operating principle of these functions.

2.3.1 Retrieval of total exhaust airflow rate

In Room Airflow Control, the Halton VLC room controller retrieves all the information about the airflow rate supplied and extracted from the room as follows:

$$Q_{Total\ exhaust\ equipment} = \sum Q_{Fume\ hood} + \sum Q_{On/Off\ equipment} + \sum Q_{Cst\ equipment}$$

Exhaust and supply airflow data is retrieved the following equipment:

- The fume cupboard through the Local communication wired onto the fume cupboard controller.(max 10 fume cupboard)
- The On/Off exhaust equipment wired onto the DI port of the controller (max 4 On/Off equipment)
- A specific exhaust equipment wired on the AI port of the controller (max 2 specific exhaust equipment)
- A constant exhaust by putting the airflow in a controller parameter
- The supply and exhaust dampers

The VLC/RC retrieves the exhaust airflow data from all the exhaust equipment and calculates the total exhaust airflow.

2.3.2 Indirect pressure (airflow rate difference) control

The difference in airflow is controlled by the supply damper. This feature is available for all Room Airflow Control system configurations.

Using the “Q Total exhaust equipment” calculation, the supply VAV damper supplies the right amount of air to maintain an airflow rate difference, ΔQ, between the room exhaust and the supply airflow.

In case of the Supply airflow control configuration, the calculation formula used by the system is:

$$Supply\ SP = Q_{Total\ exhaust\ equipment} + \Delta Q_{SP}$$

In case of Supply and Exhaust Airflow control:

$$Supply\ VAV\ SP = Q_{Total\ exhaust\ equipment} + \Delta Q_{SP} + Q_{Exhaust\ VAV}$$

The following figure demonstrates an example of how the system tracks changes in the airflow while maintaining constant underpressure, when a fume cupboard door is opened and closed.

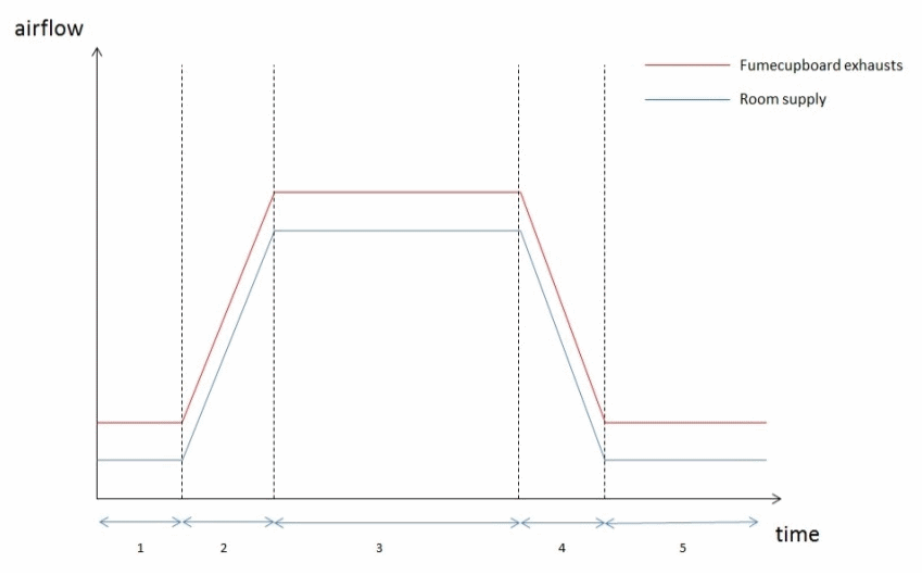


Figure: Room airflow control

1. Fume cupboard exhaust airflow is at minimum
2. Fume cupboard exhaust airflow increases / Supply damper tracks exhaust rates
3. Fume cupboard exhaust airflow is at maximum
4. Fume cupboard exhaust airflow decreases / Supply damper tracks exhaust rates
5. Fume cupboard exhaust airflow is at minimum

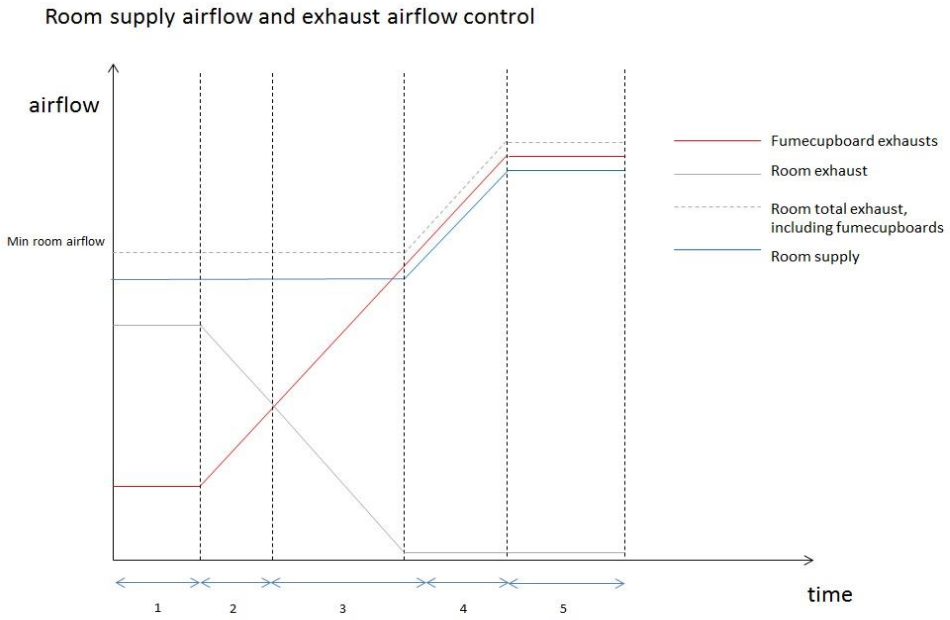
2.3.3 Control of air exchange rate

Air exchange rate control is used to ensure a minimum room air exchange rate, when the exhaust equipment is not able to guarantee a minimum air exchange rate in the space. This feature is available with the Supply and Exhaust Airflow control concept configuration.

The air exchange rate is usually controlled by the exhaust damper. The system measures the differential pressure in the room and adapts either the supply or exhaust to guarantee a constant air exchange rate inside the room.

Using the “Q Total exhaust equipment” calculated, the exhaust VAV damper supplies the right amount of air to maintain a constant air exchange rate inside the room when the fume cupboards are closed:

$$Exhaust\ VAV\ SP = Exchange\ rate\ SP - Q_{Total\ exhaust\ equipement}$$



1. Fume cupboard exhaust airflow is at minimum

- Room exhaust is opened in order to reach minimum room total airflow setpoint
- Supply airflow = ∑ (fume cupboard exhaust airflow) - dQ (constant airflow)

2 and 3. Fume cupboard exhaust airflow increases

- Room exhaust is closing
- Supply airflow = ∑ (fume cupboard exhaust airflow) - dQ (constant airflow)

4. Fume cupboard exhaust airflow continues to increase

- Room exhaust is closed
- Supply airflow = ∑ (fume cupboard exhaust airflow) - dQ (constant airflow)

5. Fume cupboard exhaust airflow is at maximum

- Room exhaust is closed
- Supply airflow = ∑ (fume cupboard exhaust airflow) - dQ (constant airflow)

2.3.4 Temperature control

The Supply and Exhaust Control configuration can be complemented with temperature control. The system monitors the room temperature with either an integrated temperature sensor on the HTP or with an external temperature probe, installed nearby. Users can manually control the room temperature from the Halton HTP touch panel, if the feature has been activated from the configuration menu.

For heating, an additional heating element is required, while cooling can be controlled with or without a separate cooling element.

The VLC/RC detects if the room needs to be heated or cooled to match the selected setpoint.

In case of heat demand the VLC controls the valve position of a heating coil to increase the temperature of the air supplied inside the room.

In case of cool demand

- if there is no cooling element, the VLC increases the exhaust VAV and, due to the ΔQ control, also the Supply VAV damper positions to increase the fresh airflow supplied into the room.
- if a cooling element is included, the VLC controls the valve position of a cooling coil to decrease the temperature of the air supplied inside the room

2.3.5 Occupancy control

In the Room Airflow Control application, users can manually control the ECO mode from the Halton HTP touch panel, if the feature has been activated from the configuration menu.

The automatic ECO mode requires an occupancy sensor (optional feature). The occupancy sensor detects the occupancy inside the room, and activates the ECO mode when the room is unoccupied.

2.4 Room Airflow Control - HTP functions

2.4.1 Halton HTP touch panel end-user functions

The end-user view displays the functions that are available to the user in the day-to-day operation of the system. The screen displays only the icons for those features that are enabled for the system in question. The features are enabled from the configuration menu.

The following figure shows examples of the end-user views for VLR Room Airflow Control (Supply control only, Supply and Exhaust control, Supply and Exhaust with temperature control).

Fig. Halton HTP end-user views for VLR Room Airflow Control

The icons correspond to the following functions:

System On/Off to turn the ventilation on or off. When the ventilation is on, the icon is green and displays the following values:

- For Room Airflow Control
  - **Supply airflow:** displays the set value for supply airflow
  - **Exhaust airflow:** displays the set value for exhaust airflow

- **dQ actual:** displays the measured airflow difference between supply and exhaust airflow

Alarm. Sound and visual (red blinking) alarm signal. Turns off sound alarm.

Temperature control to increase (red arrow) or to lower (blue arrow) the temperature. The actual temperature is displayed in Celcius on the screen beside the control icon.

MAX-mode to boost the ventilation. Sets the ventilation directly to the max position.

ECO-mode to save energy. Sets the ventilation directly to the minimum position.

Settings. Access to service and configuration menus (requires password)

2.4.2 Configuration menu options

The HTP provides all the configuration parameters that are necessary in the commissioning and servicing of the system, such as enabling HTP end-user functions and manual mode, alarm parameters, sensor parameters etc.

For a more detailed description of the configuration menus, see the VLR Configuration Guide.

2.5 Installing Room Airflow Control

The damper needs to be installed at a safe distance from any duct obstacle in order to have a good measurement of the airflow rate. See the HIT Design tool or the Dampers and Measuring Units document available from Halton Sales for more details.

Wiring

In the standard solution, the Halton Vita Lab Room solution is delivered mounted onto the master damper and the internal wiring has been done in the factory. However, the following components need to be wired on site during installation:

- Halton HTP touch panel (10-meter cable included)
- Local communication to the controller with a shielded, twisted pair cable (i.e. BELDEN:3105A)
- For the BMS communication, the type of wire depends on the communication protocol (see1.4.2)
- 230 V power supply of the transformer situated on the supply VAV damper (2 wires, Ø1.5 mm² cable)
- Exhaust damper control, from VLC to exhaust VAV actuator (2G Ø 0.75 mm² cable)
- Exhaust differential pressure sensor, from the exhaust VAV damper to the VLC (2G Ø 0.75 mm² cable)

Optional components

- Halton Occupancy sensor (cable included)
- Special exhaust equipment, airflow measured on AI3 and AI4, from the differential pressure sensor to the VLC (2G Ø 0.75 mm²)
- 0/24 V_{DC} and power of On/Off equipment (3G Ø 0.75 mm²)

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 room controller.

Wiring diagrams are available for all configurations. See the following figure for an example of a wiring diagram.

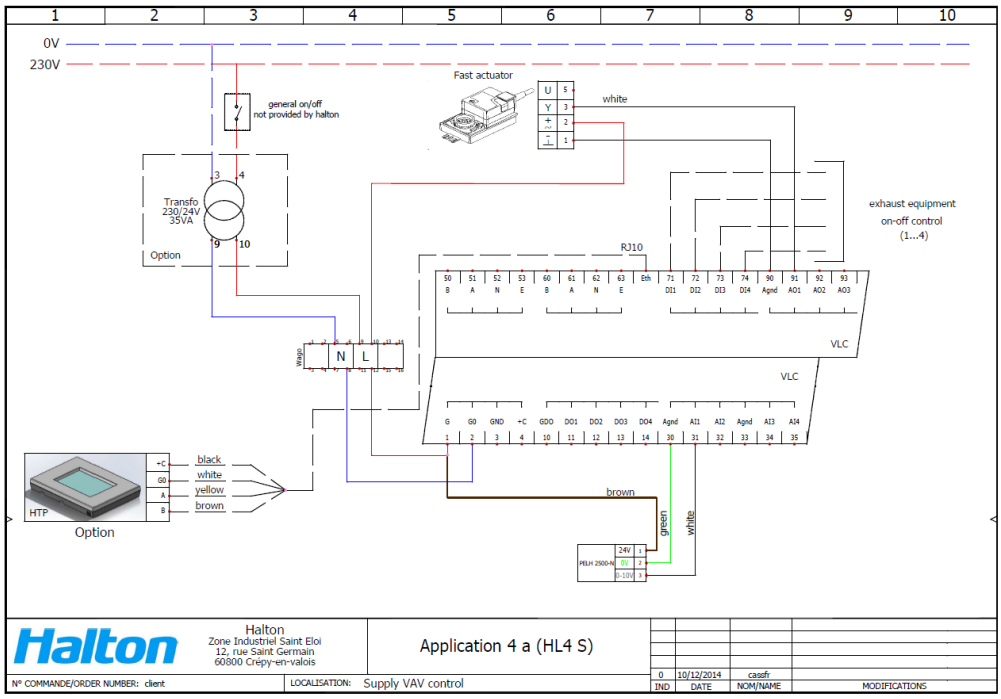


Figure: Supply Airflow Control wiring diagram

3 Total Exhaust Measurement applications

Total Exhaust Measurement is used in spaces with zonal management to manage the duct pressure. Furthermore, it increases the energy efficiency of Room Airflow Control applications by enabling the limitation of airflow.

The Total Exhaust Measurement solution controls pressure by measuring the total exhaust airflow rate from the Halton VLZ zone damper and adapting the supply airflow to create the desired airflow rate difference.

As the Total Exhaust Measurement solution is based on the same principles as Room Airflow Control applications, this section will only describe the differences between Total Exhaust Measurement and Room Airflow Control.

3.1 Control concepts

Total Exhaust Measurement solution is based on the same principle as the Room Airflow Control solution, complemented by Halton Vita Lab Zone VLZ. Thus the airflow can be controlled by

- supply damper only
- both supply and exhaust dampers

See section 2, Room Airflow Control for more details about the differences between the control concepts.

3.2 Total Exhaust Measurement system configurations

In the Total Exhaust Measurement system configuration, a VLZ zone damper is added for controlling the airflow measurements. See figure below for an example of a Total Exhaust Measurement configuration with Supply and Exhaust control and temperature control.

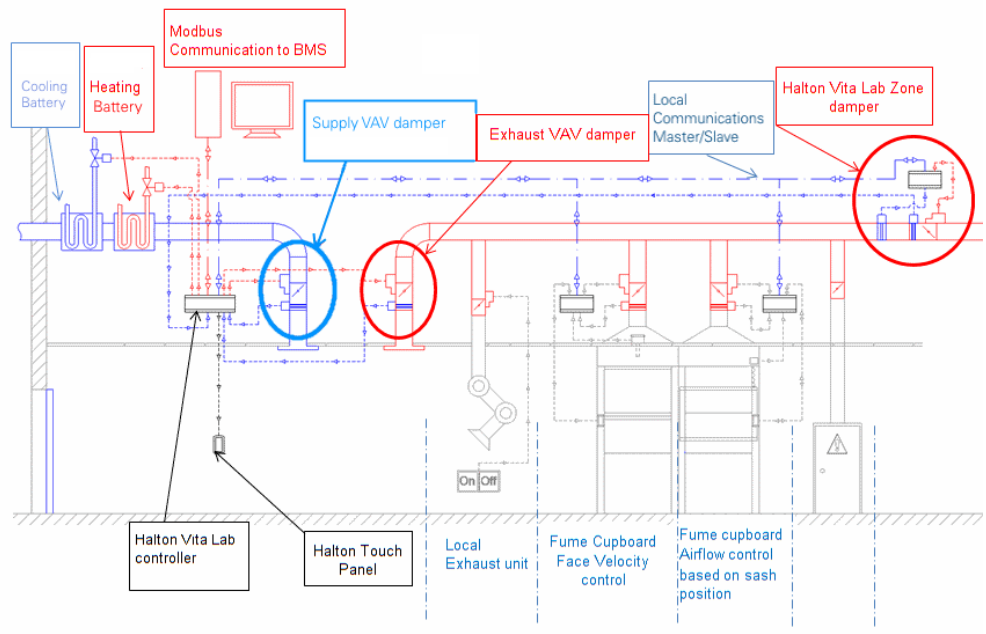


Fig. Total Exhaust Measurement with Supply and Exhaust control and temperature control

In comparison to the Room Airflow Control configurations, Total Exhaust Measurement configurations

- offer duct pressure control and zonal airflow management as standard features
- require centralised ventilation design integrated with general room exhaust
- have no limitation in the number of fume cupboards for the configuration.
- include the Halton VLZ zone damper in the standard delivery ´

For more details, see the Feature table in section 1.2.1and Room Airflow Control system configurations in section 2.2

3.3 Total Exhaust Measurement operating principle

The main operating principle of Total Exhaust Measurement is based on Room Airflow Control. See section 2.3 for a more detailed description. This section describes the differences.

3.3.1 Retrieval of total exhaust airflow rate

Unlike in Room Airflow control, where the total exhaust airflow is calculated as a sum of the total exhaust equipment, in Total Exhaust Measurement the Halton VLZ zone damper is used to measure the total exhaust airflow rate from the laboratory.

3.3.2 Air exchange rate control

For minimum air exchange rate control, the system controls the exhaust damper as follows:

If the total room exhaust < min zone airflow

$$Exhaust\ VAV\ SP = Min\ exchange\ rate\ SP + (Total\ room\ exhaust\ - Zone\ min\ airflow)$$

If the total room exhaust > min zone airflow and <zone max airflow

$$Exhaust\ VAV\ SP = Min\ exchange\ rate$$

If the total room exhaust > zone max airflow

$$Exhaust\ VAV\ SP = Min\ exchange\ rate - (Total\ room\ exhaust - Zone \max\ airflow)$$

3.3.3 Zonal airflow management

The Halton VLZ zone damper measures the total exhaust airflow rate from the laboratory and then sends the data to the Halton VLC room controller in order to maintain a constant duct pressure. If the zone alarm is triggered and the minimum air exchange rate is SP =0 m3/h, the zone damper then reduces its position until the zone alarm goes off.

3.3.4 Duct pressure control

In order to avoid too much airflow being extracted from the room, this feature can lower the zone airflow by closing the zone damper if the total exhaust airflow is too high. As a result, the airflow is insufficient in the fume cupboard, which triggers the alarm and forces the user to decrease the number of equipement in use.

3.4 Total Exhaust Measurement - HTP functions

The Halton Touch Panel functions are the same as in Room Airflow control. See section 2.4 for more details.

3.5 Installing Total Exhaust Measurement

The damper needs to be installed at a safe distance from any duct obstacle in order to have a good measurement of the airflow rate. See the HIT Design tool or the Dampers and Measuring Units document available from Halton Sales for more details.

Wiring

The following components need to be wired on site, during installation:

- Halton HTP touch panel (10-meter cable included)
- Local communication to the controller with a shielded, twisted pair cable (i.e. BELDEN:3105A)
- For the BMS communication, the type of wire depends on the communication protocol (see1.4.2)
- 24 V_{AC} power and feedback signal from the differential pressure sensor onto the exhaust zone damper (2m wire or a Ø 0.75 mm² cable)
- 230 V_{AC} power supply to the transformer situated on the supply damper (2m wire or a Ø 1.5 mm² cable)
- 24 V_{AC} Power and control signal of the exhaust damper actuator (1m wire or a Ø 0.75 mm² cable)
- 24 V_{AC} Power and feedback signal of the exhaust damper differential pressure sensor (1m wire or a Ø 0.75 mm² cable)

Optional

- 24 V_{AC} power and 0/24 V_{DC} feedback signal of the occupancy sensor
- 24 V_{AC} power and 0-10 V control signal of the heat coil valve

4 Room Pressure Control applications

The VLR Room Pressure Control is a solution that controls the pressure levels in the room directly by using a room pressure sensor. This provides rigorous pressure control for spaces where safety requirements are exceptionally high. It can also control the room air exchange rate and the room temperature.

It provides stable and precise room pressure conditions through

- fast and accurate pressure measuring mechanism
- seamless interaction between the room and fume cupboard exhaust units

4.1 Room Pressure Control Concepts

The VLR Room Pressure Control solution provides two ways to control room pressure:

- Overpressure control:
  - the exhaust VAV damper (master) controls the airflow, providing overpressure mode
  - Air exchange rate controlled by the supply VAV damper (slave)
- Underpressure control:
  - the supply VAV damper (master) controls the airflow, providing underpressure mode
  - Air exchange rate is controlled by the exhaust VAV damper (slave)

The control concept mode is selected at the design phase and activated during commissioning.

4.2 Room Pressure Control system configurations

The VLR Room Pressure control system configuration is defined by the control concept. The features are the same for both overpressure and underpressure modes.

The standard features available are

- Direct room pressure control (over- or underpressure) through room pressure sensor
- Air exchange rate control
- Cascade control
- Control freeze (door switch not provided by Halton)
- End-user functions enabled from the configuration menu (manual pressure control, alarm, manual temperature control, manual ECO mode and MAX mode)
- Manual mode for commissioning and servicing

Optional features include

- Advanced temperature control (additional heating/cooling elements required)
- Automatic ECO mode (additional occupancy sensor required)
- Duct pressure control (VLZ zone damper required)

The configurations are suitable for all exhaust design solutions (single fan design and centralised design with/without general room exhaust. There is no limitation to the number of fume cupboards for the configurations.

4.2.1 Overpressure mode configuration

Overpressure is used to keep the contaminants outside the laboratory room. The configuration is used in laboratories where the laboratory instruments or materials are highly susceptible to outside contaminants or environmental factors. Such facilities may include maternity wards, genetic testing sites, nuclear and aerospace laboratories.

The standard delivery includes

- Exhaust VAV damper (master)
- Supply VAV damper (slave)
- VLC/RC room controller (transformer optional), mounted on the master damper
- Room pressure sensor
- Halton HTP touch panel

Components for optional features

- Occupancy sensor
- VLZ zone damper
- Heating element (control valve is not provided by Halton)
- Cooling element (control valve is not provided by Halton, only with VLC/RC 28 I/O)
- External temperature sensor unit (used in special cases, only with VLC/RC 28 I/O)

4.2.2 Underpressure mode configuration

Underpressure ensures that contaminants stay inside the laboratory room. Underpressure laboratories are facilities where the laboratory instruments or materials are highly contaminated or pose a serious risk of spreading if released into the outside air. Such facilities may include infectious disease research centres, genetic testing sites, nuclear facilities and hazardous chemical laboratories.

The standard delivery includes

- Supply VAV damper (master)
- Exhaust VAV damper (slave)
- VLC/RC room controller (transformer optional), mounted on the master damper
- Room pressure sensor
- Halton HTP touch panel

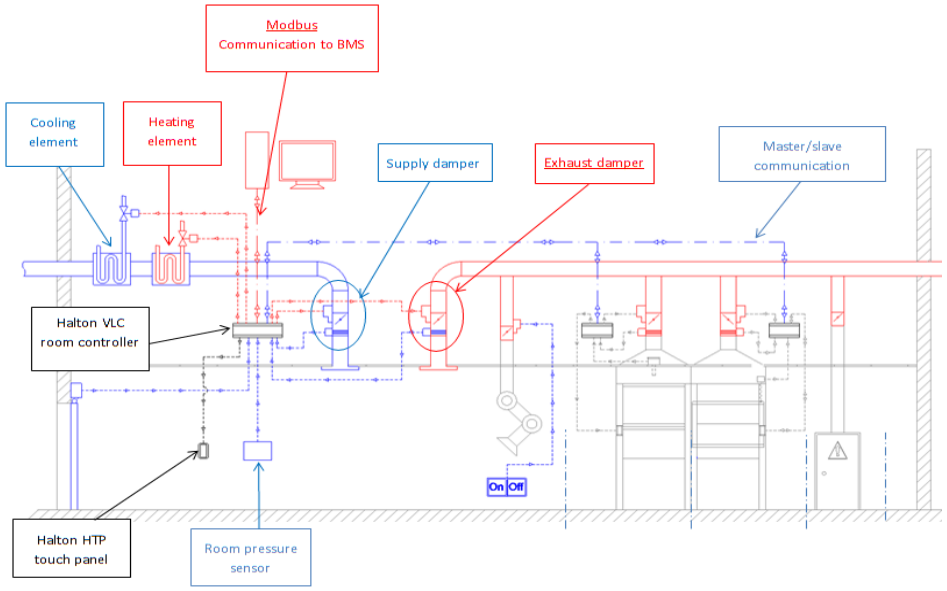
Components for optional features

- Occupancy sensor
- VLZ zone damper
- Heating element (control valve is not provided by Halton)
- Cooling element (control valve is not provided by Halton, only with VLC/RC 28 I/O)
- External temperature sensor unit (used in special cases, only with VLC/RC 28 I/O)

4.3 Room Pressure Control operating principle

In the VLR Room Pressure Control solution, the desired pressure level is achieved based on measurements from a room pressure sensor.

The following figure shows the operating principle and the communication between the different components:



In the communication between the system components, local communication is used. The Halton Vita Lab Room Controller (VLC/RC) is mounted on the master damper (supply in case of underpressure mode, and exhaust in case of overpressure mode). The VLC/RC functions as the master controller and the fume cupboard controllers (VLC/FC) as slaves. The Halton Vita Lab room master controller coordinates the communication as follows

- Retrieval of pressure sensory data
    - The pressure levels are continuously monitored and the sensory data sent in analog form to the Halton VLC room Lab controller
    - The VLC receives the sensory data from the room pressure sensor and the differential pressure sensors measuring the supply and exhaust airflow
    - The VLC then compares the received data with the set point for each value and adapts the master damper
- Control of the air exchange rate
    - The VLC/RC sends a signal to the slave damper based on the total exhaust calculation
    - The damper, using a differential pressure sensor, adapts its position to maintain the set air exchange rate

4.3.1 Overpressure mode

In the Halton Vita Lab with Room pressure control, in the overpressure mode:

- Room pressure is controlled by the exhaust VAV damper (master)
- Air exchange rate is controlled by the supply VAV damper (slave)

In the following figure, the graph on the left on overpressure mode shows how the exhaust damper maintains a constant pressure in the room:

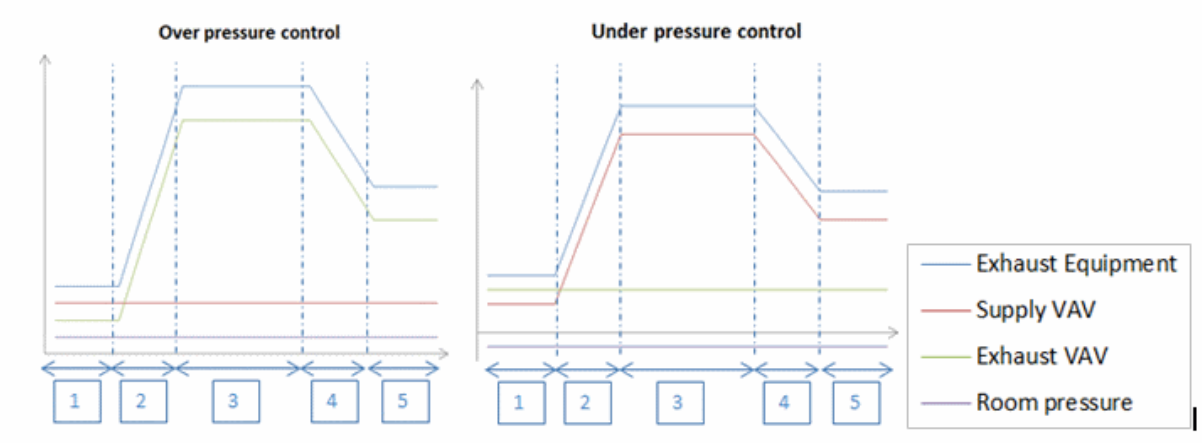


Figure: Room pressure Controls

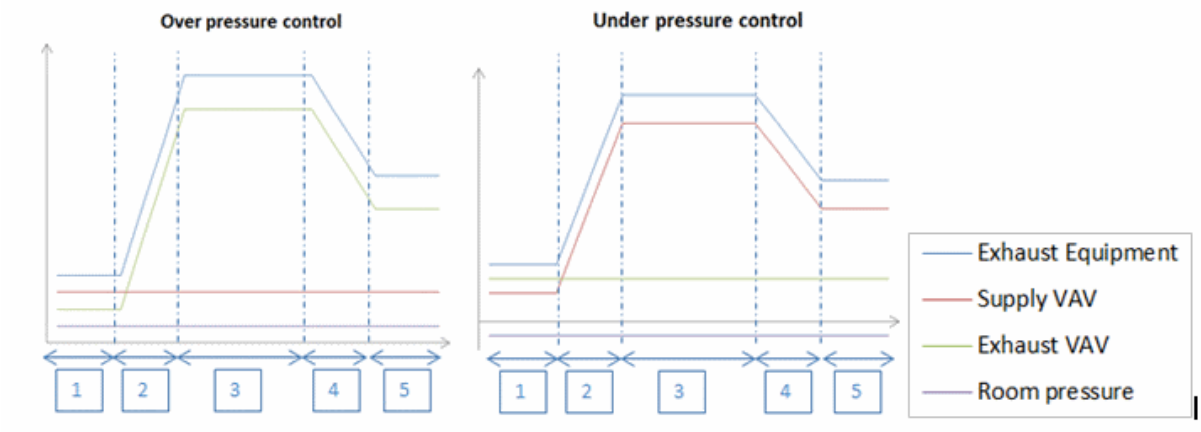
1. General exhaust equipment airflow is at minimum > The VLC maintains a constant room pressure and air exchange rate
2. General exhaust equipment airflow increases > The exhaust VAV damper follows the increase of the equipment airflow to maintain a constant room pressure
3. General exhaust equipment airflow is at maximum > The VLC maintains a constant room pressure and air exchange rate
4. General exhaust equipment airflow decreases > The exhaust VAV damper follows the decrease of the equipment airflow to maintain a constant room pressure
5. General exhaust equipment airflow is at medium > The VLC maintains a constant room pressure and air exchange rate

4.3.2 Underpressure mode

In the Halton Vita Lab with Room pressure control, in the underpressure mode:

- Room pressure controlled by the supply VAV damper (master)
- Air exchange rate controlled by the exhaust VAV damper (slave)

In the following figure, the graph on the right for underpressure mode shows how the supply damper maintains a constant pressure in the room:



1.General exhaust equipment airflow is at minimum > The VLC maintains a constant room pressure and air exchange rate

2.General exhaust equipment airflow increases > The supply VAV damper follows the increase of the equipment airflow to maintain a constant room pressure

3.General exhaust equipment airflow is at maximum > The VLC maintains a constant room pressure and air exchange rate

4.General exhaust equipment airflow decreases > The supply VAV damper follows the decrease of the equipment airflow to maintain a constant room pressure

5.General exhaust equipment airflow is at medium > The VLC maintains a constant room pressure and air exchange rate

4.3.3 Temperature control

The Room Pressure Control application can be complemented with temperature control. The system monitors the room temperature with either an integrated temperature sensor on the HTP or with an external temperature probe, installed nearby. Users can manually control the room temperature from the Halton HTP touch panel, if the feature has been activated from the configuration menu.

For heating, an additional heating element is required, while cooling can be controlled by with or without a separate cooling element.

The VLC/RC detects if the room needs to be warmed or cooled to match the selected setpoint.

In case of heat demand the VLC controls the valve position of a heating coil to increase the temperature of the air supplied inside the room.

In case of cool demand

- if there is no cooling element, the VLC increases the exhaust VAV and, due to the ΔQ control, also the Supply VAV damper positions to increase the fresh airflow supplied into the room.
- if a cooling element is present, the VLC controls the valve position of a cooling coil to decrease the temperature of the air supplied inside the room

4.3.4 Cascade control

Cascade control is a combination of room pressure and room airflow controls. It calculates the setpoint of the supply or exhaust airflow (depending on which one is controlling the pressure) from the measurement of the room pressure and an estimated airflow. This provides a faster control reaction time.

4.4 Room Pressure Control - HTP functions

4.4.1 Halton HTP touch panel end-user functions

The end-user view displays the functions that are available to the user in the day-to-day operation of the system. The screen displays only the icons for those features that are enabled for the system in question. The features are enabled from the configuration menu.

The following figure shows examples of the end-user views for VLR Room Pressure Control (Underpressure mode with manual temperature control, Overpressure mode with manual pressure and temperature controls).

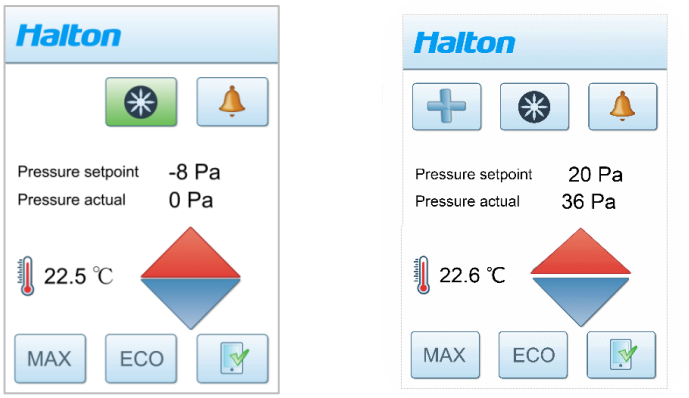


Fig. Halton HTP end-user views for VLR Room Pressure Control

The icons correspond to the following functions:

System On/Off to turn the ventilation on or off. When the ventilation is on, the icon is green and displays the following values:

- **Pressure setpoint:** displays the set value for room pressure in Pa
- **Pressure Actual:** displays the measured pressure value in Pa

Alarm. Sound and visual (red blinking) alarm signal. Turns off sound alarm.

Temperature control to increase (red arrow) or to lower (blue arrow) the temperature. The actual temperature is displayed in Celcius on the screen beside the control icon.

MAX-mode to boost the ventilation. Sets the ventilation directly to the max position.

ECO-mode to save energy. Sets the ventilation directly to the minimum position.

Settings. Access to service and configuration menus (requires password)

4.4.2 Configuration menu options

The HTP provides all the configuration parameters that are necessary in the commissioning and servicing of the system, such as enabling HTP end-user functions and manual mode, alarm parameters, sensor parameters etc.

For a more detailed description of the configuration menus, see the VLR Configuration Guide.

4.5 Installing Room Pressure Control

The damper needs to be installed at a safety distance from any duct obstacle in order to have a good measurement of the flow rate. See the HIT Design tool or the Dampers and Measuring Units document available from Halton Sales for more details.

Wiring

In the standard solution, the Halton Vita Lab Solo system is delivered mounted onto the damper controlling the room pressure and the internal wiring is done in the factory. However, the following components need to be wired on site during installation:

- Halton HTP touch panel (10-meter cable included)

- Local communication to the controller with a shielded, twisted pair cable (i.e. BELDEN:3105A)
- For the BMS communication, the type of wire depends on the communication protocol (see the BMS communication protocol specification)
- A 24 V_{DC} power and 0-10V feedback signal for the room pressure sensor (Ø0.75 mm² cable)
- Power and control of the heating coil valve (Ø 0.75 mm² cable) (optional)
- 230 VAC power of the transformer mounted on the damper (Ø 0.75 mm² cable) (optional)

In case of the Underpressure mode

- 24 V_{DC} power and 0-10 control signal of the exhaust damper actuator (Ø 0.75 mm² cable)
- 24 V_{DC} power and 0-10 feedback signal of the exhaust damper differential pressure sensor (Ø 0.75 mm² cable)

In case of the Overpressure mode

- 24 V_{DC} power and 0-10 control signal of the supply damper actuator (Ø 0.75 mm² cable)
- 24 V_{DC} power and 0-10 feedback signal of the supply damper differential pressure sensor (Ø 0.75 mm² cable)

Optional

- Power and control of the cooling valve (Ø 0.75 mm² cable)

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 room controller.

Wiring diagrams are available for all configurations upon request.

5 Appendices

5.1 Component Datasheets

Component datasheets provide detailed information about the components such as model and technical data, dimensions, installation and wiring. The following datasheets are available from Halton Sales:

- Halton HTP touch panel
- Halton VLC controller
- HaltonVPT room pressure sensor
- Halton HOS-OE1 occupancy sensor
- Halton HAC-L24A-SR actuator
- Halton HDP-PE differential pressure sensor

5.2 Other technical documentation

The following technical documentation is available from Halton Sales:

- Vita Lab Solo Design Guide
- VLR Configuration Guide
- Vita Lab Dampers and Measuring Units
- HIT Design tool