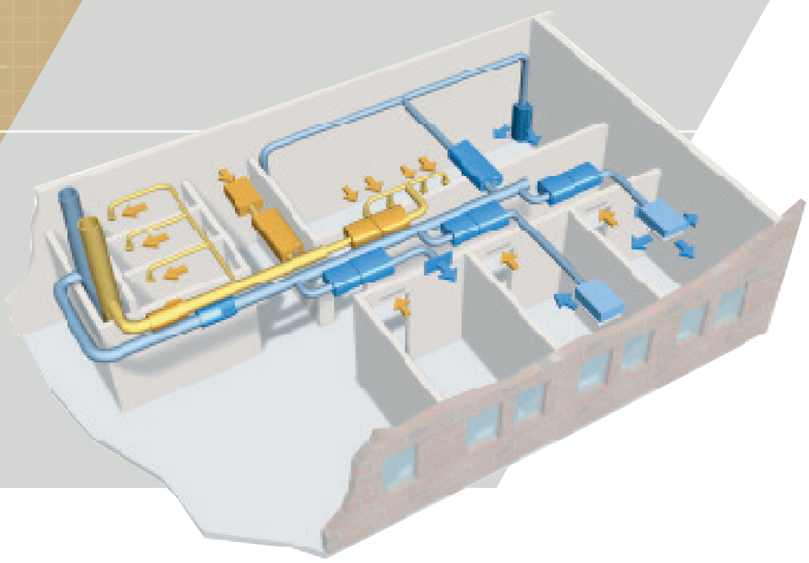
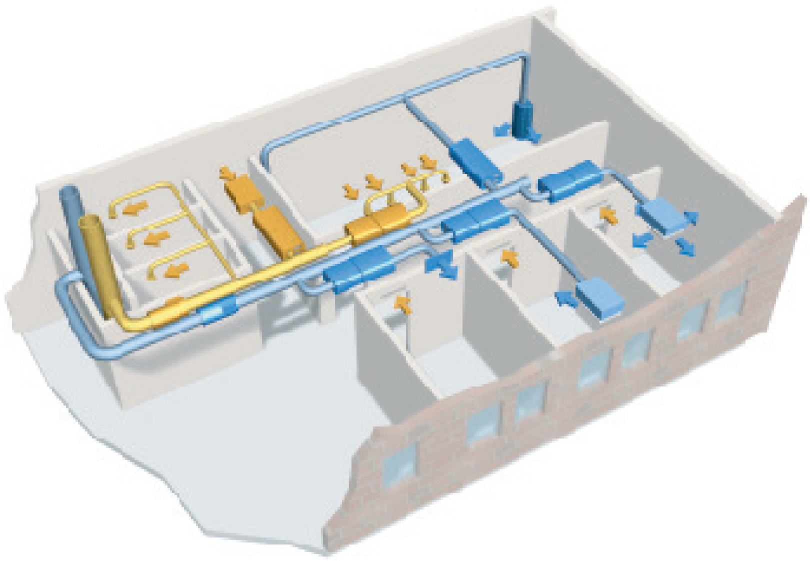
FläktGroup

Project design Optivent



PROJECT DESIGN OPTIVENT



VAV – Variable Air Volume system

VAV – Variable Air Volume system, is a system which supplies a variable air flow to and from a room. A demand-dependent indoor climate can be achieved with a VAV system.

At the heart of a VAV system is a flow variator which varies the air flow as required.

Why choose a VAV system?

- Interior air conditioning system with air as the cooling medium
- Utilizes the cold in the outdoor air
- Large outdoor air flow gives very good air quality
- Low energy cost - low LCCe value

Min and max flows to each room

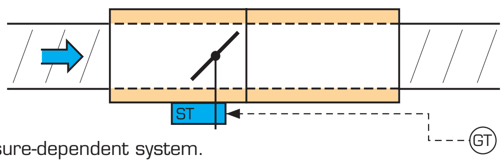
- Min air flow: Necessary fresh air flow for good air quality
- Max air flow: According to the required cooling capacity calculation

Remember that the extent of the required cooling capacity is influenced by the permitted room temperature shift, the operating period and any sun shading. Manual calculation methods very often lead to over-dimensioning, i.e. excessively high maximum air flows.

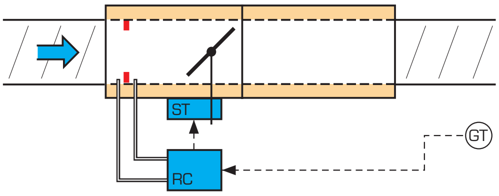
Recommendation:
Min air flow: 10 l/s fresh air per person.
Max air flow: A normal cell office often requires 35 - 50 l/s with a supply air temperature about 10° lower than the permitted room temperature.

Pressure-dependent or pressure-INdependent control

Pressure-independent control requires the air flow to be measured in the variator. This is not the case in a pressure-dependent system.



Pressure-dependent system.



Pressure-independent system.

Number of control zones

- Number of control zones influences the investment cost.
- If every room is a control zone, this allows individual control of the room temperature.
- Façade-specific control of room temperature gives poor temperature control when the internal loads dominate. In large control zones, e.g. in open-plan offices, it is not possible to control the room temperature to meet everyone's needs.

Recommendation:
Make every room a control zone, i.e. one flow variator per room.

PROJECT DESIGN OPTIVENT

System layout

- Decide where the supply and exhaust air terminal devices will be positioned.
- Lay out the ducting system as symmetrically as possible.
- Connect the branch ducts for the supply air to ring circuits wherever possible.
- Decide how the exhaust air flow will be controlled.
- Prepare a flow chart for the ducting system.

Duct system

- Dimension the ducting system for the lowest possible pressure drop.
  Small pressure differences give low sound levels.
- Use circular ducts wherever possible.
- Do not use an adjustment damper between the fan and the terminal device.
- Avoid mechanically acting constant flow devices.

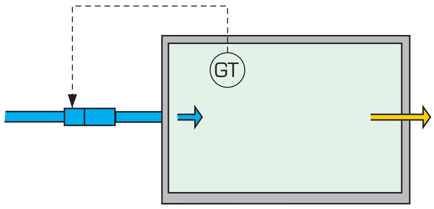
Supply air ducts

- Dimension according to the pressure regain method (30% method).
- Design with the necessary straight sections before each terminal device.
- Always install thermal insulation, usually with a 30 mm insulation thickness.
- Avoid laying ducts through unheated areas.

Exhaust air ducts

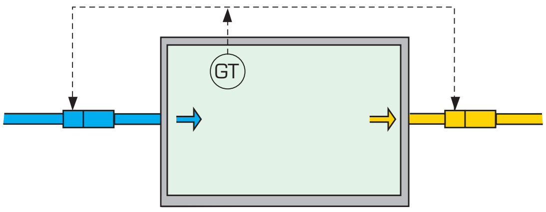
- Dimension according to the friction method.
- Dimension for lower air velocities than in the supply air ducts. As a rule, use a duct one size larger for the same air flow.
- If possible, avoid laying exhaust air ducts for heat recovery units in unheated areas.

Building up the optivent system



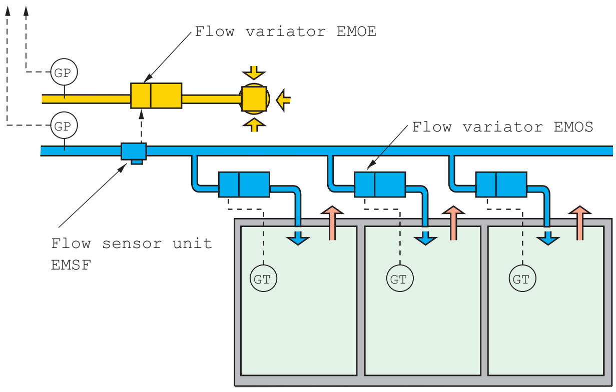
One flow variator on supply air, air to the corridor.

Suitable for smaller offices.

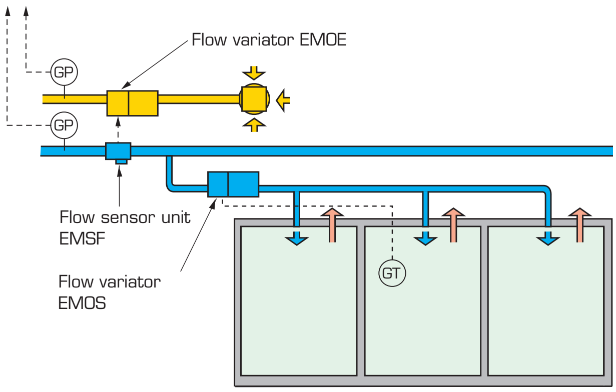


Control of exhaust air from each room.

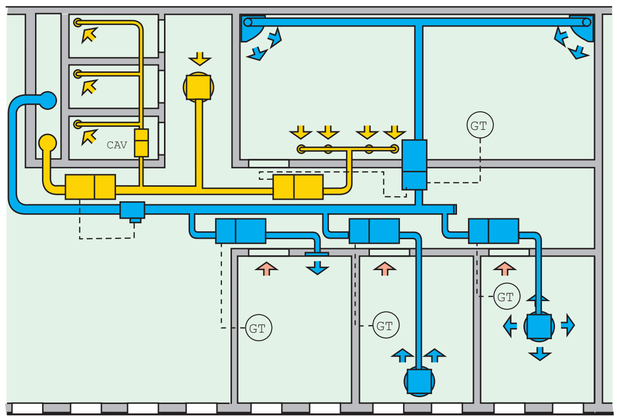
Suitable for conference rooms and larger offices.



Each room is an own control zone. Recommended.



One control zone for several rooms. The system requires nearby the same cooling demands for all rooms.



System layout for an Optivent VAV-design.

PROJECT DESIGN OPTIVENT

Recommended highest air velocities

Highest air velocity in supply air ducts (at the start of the duct at max flow):

Main ducts/shaft < 12 m/s (max Δp = 3 Pa/m).

Branch ducts < 8 m/s (max Δp = 2 Pa/m).

Highest velocity in exhaust air ducts (at the end of the duct at max flow):

Main ducts/shaft < 7.5 m/s (max Δp = 2 Pa/m).

Branch ducts < 5 m/s (max Δp = 1 Pa/m.

Recommendation:
Select a supply air terminal device capable of supplying the min flow while maintaining a good flow pattern.

Largest recommended undertemperature and air flow for different device positions:

- at rear edge 8° C up to 5 l/s, m^2
- at front edge 10° C up to 5 l/s, m^2
- at centre of room 12° C up to 8 l/s, m^2.

Flow variator

Pressure-independent VAV systems permit smaller duct dimensions, simpler project design and easier adjustment than pressure-dependent VAV systems.

Accessories

A complete VAV unit in general includes a sound attenuator and an reheater, if required, and a distribution box. The flow sensor unit EMSF can be used for flow measurement in certain applications.

Sound attenuator

Select a sound attenuator for the largest air flow and the largest pressure difference.

Correct layout and dimensioning will result in pressure differences not exceeding 150 Pa and 250 Pa for units with reheaters.

Control of static pressure in the duct

Why?

At a reduced air flow, the pressure drop both over the parts of the unit and in the ducting system will fall. The static pressure is thus controlled in order:

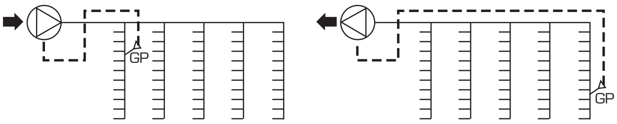
- to avoid an excessively high pressure in the ducting system
- to save fan energy

How?

By orifice control, guide rail control, blade angle control or with frequency invertors.

Where?

In the supply air and exhaust air. To achieve a low pressure level in the system at a reduced flow, a pressure sensor is located out in the system – not in the vicinity of the fan.



Air handling units and fans

Design max flow

Irregular use of certain rooms, e.g. conference and rest rooms, will affect the synchronism of the system and with it the design flow. Other factors which may affect this are absences on business, absences through illness and holidays. By taking these factors into account, the design max flow can be selected at a value below the sum of the combined sub-flows.

If, however, the design max flow is selected with the help of a synchronism factor calculated for the system, the opportunity for flexibility in future changes will be reduced.

Specify a central unit and fans for the design max flow and check that these also work effectively within the whole flow range of the system. This is particularly true for the medium flow of the system, which depends among other things on the proportion of the inner zone in relation to the total floor area.

Heat recovery devices

Use a rotary heat exchanger wherever possible. This will give up to 85% temperature and humidification efficiency at the reduced flow during the winter.

Air heater

The air heater should be dimensioned for heating to about
17° C at the medium flow of the unit.

Air cooler

The cooling coil should use chilled water, as the cooling effect can be easily controlled. The cooling coil, which determines the size of the unit, can be dimensioned for rather higher face velocities than in a constant flow system, since the unit operates at the design max flow during a short period of the year.

Points to consider:

- Supply air terminal device
- Flow variator
- Control of static pressure
- Control of exhaust air
- Duct system

PROJECT DESIGN OPTILAB

Project design Optilab

Optilab is based on the same principles as Optivent, but is used in premises with strict requirements for the rapid adjustment of air flows and the accurate maintenance of pressure in ducts and premises.

Typical applications for Optilab

- Laboratory premises with fume cupboards which require the rapid and accurate regulation of air flows and where corrosive substances may be present in the exhaust air.
- Production premises in the pharmaceuticals industry and operating theatres in hospitals which require the accurate regulation of pressure differences between rooms.

The project design guide for Optivent also applies on the whole to Optilab, and therefore only a few examples of common installations are described below.

Example of an installation with a fume cupboard and the requirement for constant pressure in all the air ducts in the room

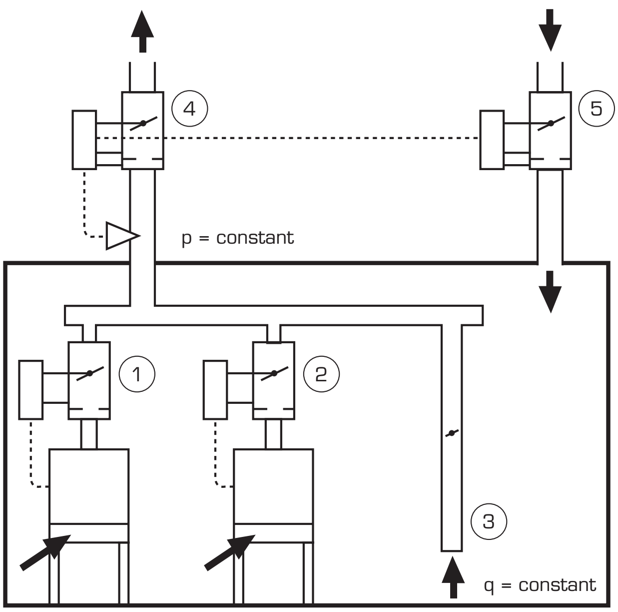


Figure 1. Example of an installation with a fume cupboard and the requirement for constant pressure in all the exhaust ducts in the room.

Figure 1 shows a laboratory with two fume cupboards and one air outlet with a constant exhaust air flow.

The air flow through the fume cupboards is controlled by hatch opening sensors which maintain the incoming air velocity constant regardless of the position of the hatch (between a minimum position and a maximum position).

The actual air flows through the fume cupboards are adjusted with Optilab ① and ②.

Air outlets with a constant exhaust air flow ③ require a constant negative pressure in the exhaust air duct. This is achieved with the help of an Optilab variator for the common exhaust air duct ④.

To match the variable exhaust air flow from the room, a flow variator ⑤ is positioned in the supply air duct to the room and it is controlled by the variator in the exhaust air ④.

Example of an installation for a room which requires accurate regulation of the room pressure

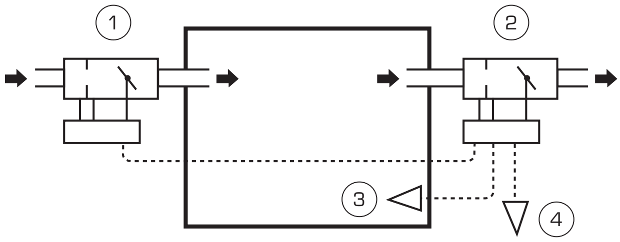


Figure 2. Example of an installation for a room which requires accurate regulation of the room pressure.

Figure 2 shows a room which must maintain a given differential pressure compared with a reference room.

The flow variator in the exhaust air is connected by hoses to the actual room ③ and to a reference room ④. The desired pressure difference in is set between the two rooms on the regulator.

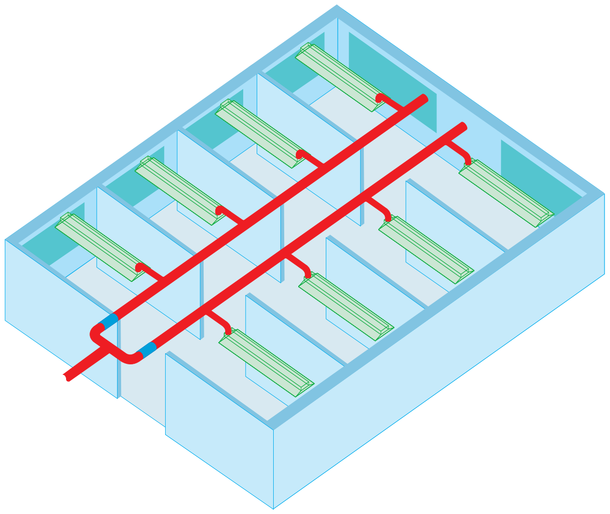
The flow variator in the supply air ① interacts with the variator in the exhaust air ② so that the set pressure difference is maintained by the air flows being displaced in relation to one another.

Special requirements for products included in the Optilab system

In Optilab installations with a fume cupboard, the exhaust air can be aggressive, which requires exposed parts of the flow variator to conform to corrosivity class C4.

Variators connected to fume cupboards are often subject to the requirement for rapid adjustment of the air flows. The balance between the supply air and the exhaust air in the room must similarly be restored within a very short time after a fume cupboard hatch has changed position. The position of the damper must change very rapidly, therefore, which imposes strict requirements on the damper shaft and its bearings.

PROJECT DESIGN EMPA/EMPD



System layout

- Decide where the supply and exhaust air terminal devices will be positioned.
- Lay out the ducting system as symmetrically as possible.
- Maximum zone length 30m.
- Decide how the exhaust air flow will be controlled.
- Prepare a flow chart for the ducting system.

Pressure-dependent air terminal devices require the use of constant pressure controllers.

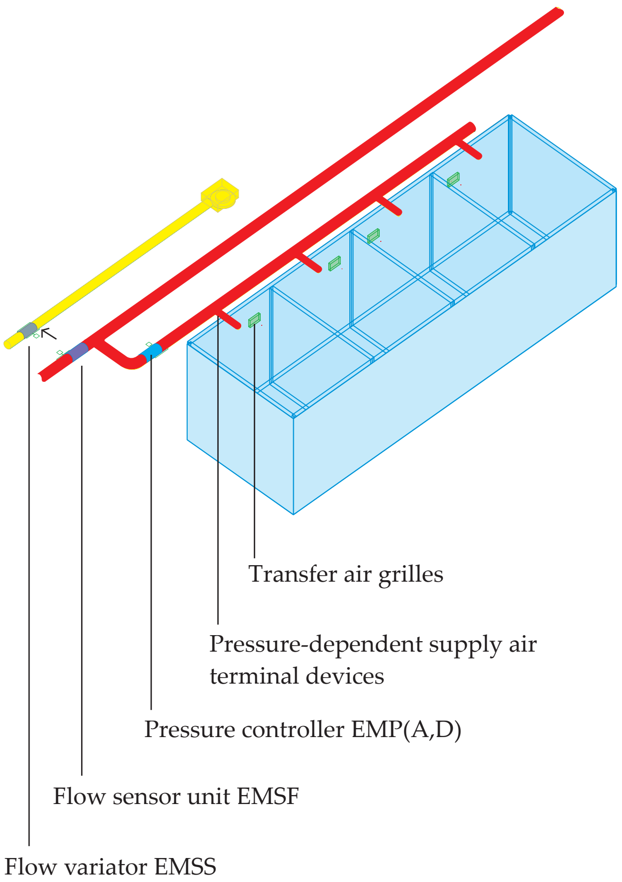
Example of a pressure-dependent system.

Pressure-dependent system

In constant pressure ducting systems, a change in the air flow at one device does not affect other parts of the system, which means greater system flexibility during both commissioning and operation. Pressure controllers can also be used in Variable Air Volume systems to ensure that a sufficiently high pressure is maintained.

Why choose a pressure-dependent system?

- Flexible solutions requiring no alterations to existing installations
- Individual control



PROJECT DESIGN EMPA/EMPD

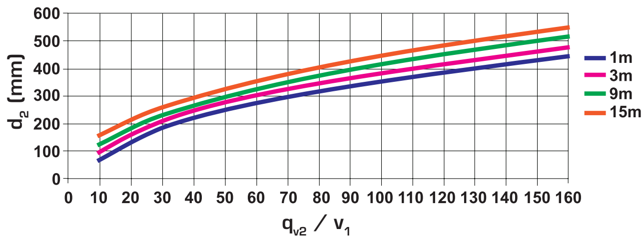
Duct system

- Dimension the ducting system for the lowest possible pressure drop. Small pressure differences give low sound levels.
- Use circular ducts wherever possible.

Supply air ducts

- Dimension according to the pressure regain method, or use a velocity of less than 4 m/s at the beginning of a branch with the rest of the duct having the same size.
- Design with the necessary straight sections before each terminal device.
- Avoid laying ducts through unheated areas.

Static pressure regain method



q_{v2} = volume flow after branch [dm^3/s]
v_1 = velocity in duct before branch [m/s]
l_2 = equivalent length of duct/fitting after branch [m]
d_2 = duct diameter after branch [cm]

Example of how to use the graph

v_1 = 4 m/s; q_{v2} = 96 l/s; l_2 = 3 m
96/4 = 24
- Move up from point 24 at the bottom to the 3 m line
- Read off the nearest duct size on the left
- The nearest duct size is 200 mm

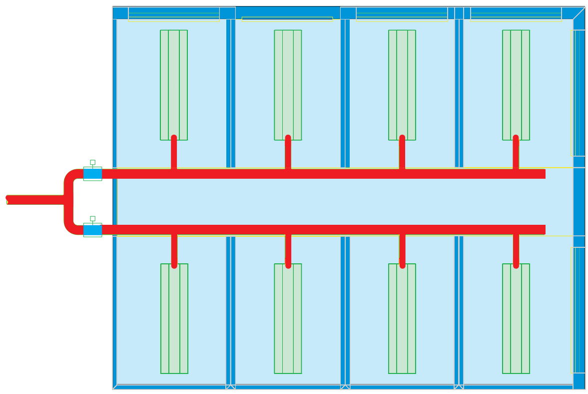
Control of static pressure in the duct

Why?
At a reduced air flow, the pressure drop both over the parts of the unit and in the ducting system will fall. The static pressure is thus controlled in order

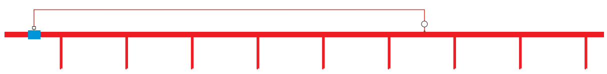
- to avoid an excessively high pressure in the ducting system
- to save fan energy.

How?
With a pressure controller and a frequency converter.

Where?
In short, symmetrical ducting systems, the measurement can be performed directly on the product, in more extensive systems, at the lowest point of pressure.



If the system is dynamic, the lowest point of pressure is not known, and the measurement can be performed directly on the product.



If the "lowest point" of pressure is known, the measurement should be performed there.

Air handling unit and fans

Design max flow

Irregular use of certain rooms, e.g. conference and employee break rooms, will affect the synchronism of the system and with it the design flow. Other factors which may affect this are absences on business, absences through illness and holidays. By taking these factors into account, the design max flow can be selected at a value below the sum of the combined sub-flows.

Even though the design max flow is selected with the help of a synchronism factor calculated for the system, the opportunity for flexibility in future changes will not be reduced in a pressure-dependent system.

Specify a central unit and fans for the design max flow and check that these also work effectively within the whole flow range of the system. This is particularly true for the medium flow of the system, which depends among other things on the proportion of the inner zone in relation to the total floor area.

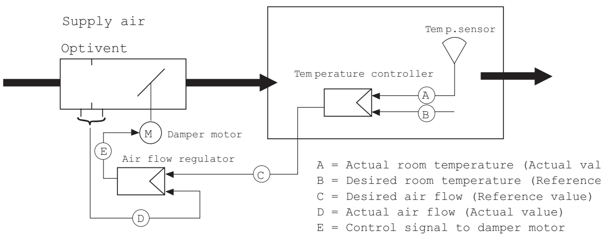
DESCRIPTION, VAV, CAV, FORCED CONTROL

Description

Air flow controllers are used with OPTIVENT and OPTILAB to measure and regulate the air flows in air treatment systems with both demand-controlled and constant air flows.

VAV (Variable Air Volume)

In a VAV system, the air flow varies in relation to the loads in the room. The system uses a small air flow at small loads and a large air flow at large loads. The determining factor is usually the temperature. The room temperature is controlled by changing the supply air flow via a temperature controller and an air flow controller. The temperature controller requests an air flow from the air flow controller to maintain the right temperature in the room. The air flow controller ensures that the requested air flow enters the room by adjusting the damper position via a damper motor. Any pressure changes in the duct system cause the air flow controller to make an adjustment via a damper motor so that the requested air flow is retained. Min and max air flow settings are programmed into the air flow controller.

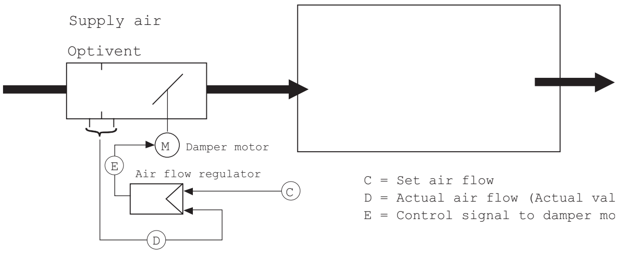


Function

The temperature controller receives a measurement value A from the temperature sensor which corresponds to the actual room temperature. The temperature controller compares this measurement value A with the desired room temperature B. If there is a difference between A and B, the temperature controller corrects this with a reference value C to the air flow controller. The air flow regulator compares the reference value C with the measurement value D which corresponds to the actual air flow. The air flow controller corrects any deviation between C and D with a control signal E to the damper motor, which in turn corrects the position of the damper blade.

CAV (Constant Air Volume)

The air flow controllers can also be used to maintain a constant air flow. If any pressure changes occur in the duct system, the controller will then adjust the damper position via a damper motor to maintain the set air flow.

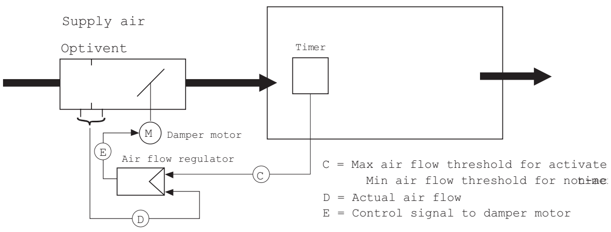


Function

The controller compares the set air flow setting C with measurement value D, which corresponds to the actual air flow. The air flow controller corrects any deviation between C and D with a control signal E to the damper motor, which in turn corrects the position of the damper blade.

Forced control

The air flow controller can be forced controlled to the set air flow settings and can fully close the damper mechanically. This can take place in combination with VAV control, or alternatively as a separate system. Forced control takes place via potential-free contacts. The control unit may be a timer or a presence detector, etc.



Function

Timer not activated, contact in the timer open. The specified air flow C is set as the minimum air flow setting. Timer activated, contact in the timer closed. The specified air flow C is set as the maximum air flow setting.

AIR FLOWS, CONTROL SIGNALS

Nominal air flow q_{nom}

Each device size has a nominal air flow, that the air flow controllers are calibrated to, i.e. the measurement range in the regulator is adapted so that the input and output signals correspond to the nominal air flow of the device.

Example electrical:

For size 160, the operating range (measurement range) is 0 – 250 Pa, which is equivalent to 0 – 160 l/s.

Example pneumatic:

For size 160, the operating range (measurement range) is 1 – 160 Pa, which is equivalent to 0 – 126 l/s.

Max air flow setting q_{max}

The maximum setting on the air flow controller is the maximum air flow which the controller can give for a maximum input signal. The setting can be changed, although never to a higher value than the nominal air flow q_{nom}.

Example electrical:

The max air flow setting is set to 60 % of the nominal air flow q_{nom} on a size 160 device. The max input signal (control signal) then gives 96 l/s (60 % of 160 l/s).

Example pneumatic:

The max air flow setting is set to 60 % of the nominal air flow q_{nom} on a size 160 device. The max input signal (control signal) then gives 76 l/s (60 % of 126 l/s).

Min air flow setting q_{min}

The min setting on the air flow controller is the minimum air flow which the controller can give for a minimum input signal. The setting can be changed and could be set to 0.

Example electrical:

The min air flow setting is set to 20% of the nominal air flow q_{nom} on a size 160 device. The min input signal (control signal) then gives 32 l/s (20 % of 160 l/s).

Example pneumatic:

The min air flow setting is set to 20% of the nominal air flow q_{nom} on a size 160 device. The min input signal (control signal) then gives 25 l/s (20 % of 126 l/s).

Control – input signal (control signal)

Control of the controllers normally takes place with a control signal of 0 - 10 V DC. The operating range differs, however, between the 227VM and EMBL controllers.

227VM

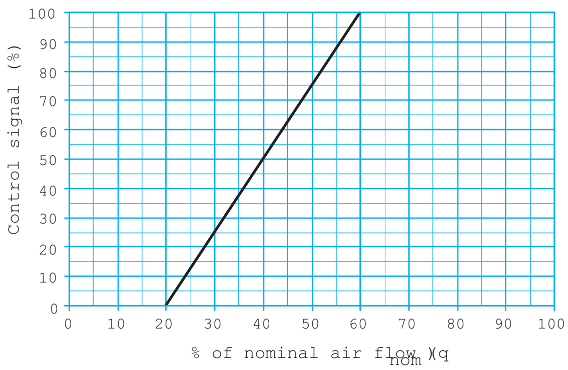
When the operating range of FläktGroup 227VM controllers is 2 - 10 V DC, it means that the min air flow is achieved at a 2 V input signal (control signal)and the max air flow at a 10 V input signal (control signal). An input signal of 0.8 - 2 V also gives a min air flow, and the damper closes fully at an input signal lower than 0.8 V.

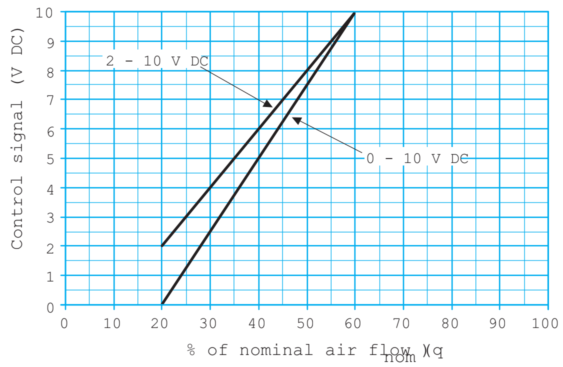
EMBL

The operating range of EMBL controllers is 2 - 10 V DC as standard, which means that the min air flow is achieved at a 2 V input signal (control signal)and the max air flow at a 10 V input signal (control signal). An input signal of 0.2 - 2 V also gives a min air flow, and the damper closes fully at an input signal lower than 0.2 V.

Size	q_{nom}, l/s
100	62
125	98
160	160
200	251
250	392
315	623
400	1005
500	1570
630	2493

Example





PNEUMATIC CONTROLLERS, MEASUREMENT VALUE

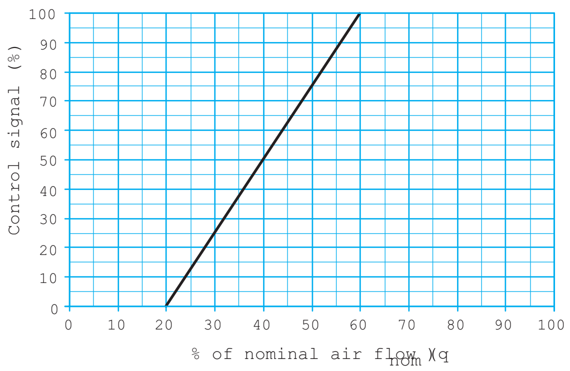
Pneumatic controllers

EMPS

The operating range of EMPS controllers is 0.2 - 1.0 bar, which means that the minimum air flow is obtained at 0.2 bar and the maximum air flow at 1.0 bar. An input signal of less than 0.2 bar gives the minimum air flow. The driving pressure is 1.3 bar.

Size	q_{nom}, l/s
100	51
125	75
160	126
200	202
250	316
315	505
400	810

Example pneumatic:

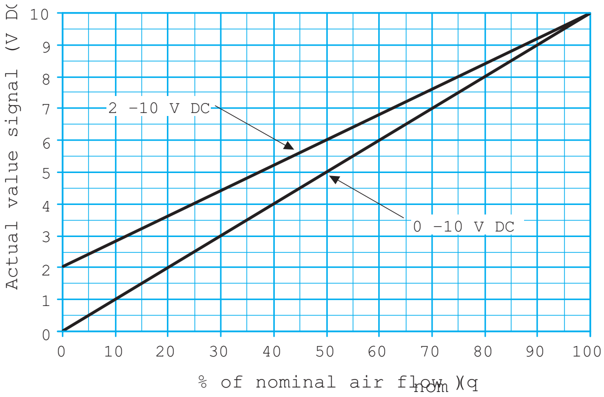


Measurement value signal (actual value signal)

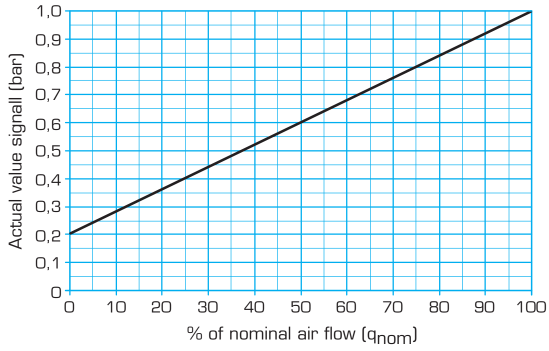
The air flow controllers have a measurement value signal (actual value signal) which is a flow-linear output signal from the controller which represents the actual air flow through the device.

The measurement value signal is not affected by the set maximum and minimum limits, but always indicates 0 - 100 % of the nominal air flow.

Electrical controllers



Pneumatic controllers



Example electrical:

Device size 160, where the nominal air flow q_{nom} is 160 l/s, gives a 100 % measurement value signal at 160 l/s, a 50 % measurement value signal at 80 l/s and a 0 % measurement value signal at 0 l/s.

The signal is used as a control signal for the slave regulator in a Master-Slave system, and it can also be used as feedback signal or as a reading of the actual air flow in the overriding system.

Example pneumatic:

Device size 160, where the nominal air flow qnom is 126 l/s, gives a 100 % measurement value signal at 126 l/s, a 50 % measurement value signal at 63 l/s and a 0 % measurement value signal at 0 l/s.

The signal is used as a control signal for the slave controller in a master-slave system, and it can also be used as a feedback signal or via an EP relay, EMPZ-02-01, as a reading of the actual air flow in overriding systems.

227VM and EMBL

When the measurement value signal for FläktGroup 227VM controller and EMBL is 2 ... 10 V, 2 V represents 0 l/s and 10 V represents the nominal air flow. The formula for estimating the air flow at a 2 ... 10 V signal:

$q = (\text{actual value signal} - 2) \times q_{nom}/8$

EMPS

The measurement value signal for EMPS is 0.2 - 1.0 bar as standard; where 0.2 bar represents 0 l/s and 1.0 bar represents the nominal air flow. The formula for estimating the air flow for a 0.2 - 1.0 bar signal is: q = (actual value signal – 2) x qnom/8.

PARALLEL CONTROL, MASTER-SLAVE CONTROL

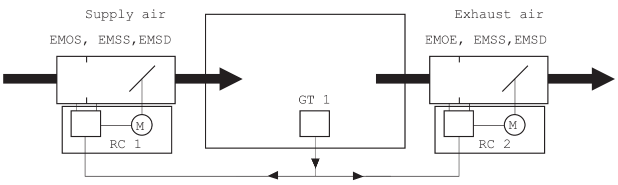
Parallel control

Parallel control is used:

- In zones where supply air and exhaust air devices must be of different sizes.
- In zones where the difference between the supply air and exhaust air flows must be constant at all flows.

In a parallel control system, the control signal from the temperature controller is connected in parallel to the controllers on the supply air and exhaust air devices.

This means that the air flow settings are set independently of one another in the supply air and exhaust air devices.



Function

Temperature controller GT1 with its built-in temperature sensor keeps the room temperature constant by increasing the air flow via the RC1 and RC2 air flow controllers as the cooling requirement increases. Its function is the opposite as the cooling requirement reduces. The max and min air flow settings are programmed into the respective air flow controller. If any pressure changes occur in the duct system, RC1 and RC2 adjust the damper's position to maintain the specified air flow from GT1.

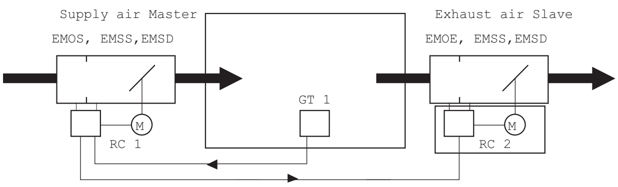
Master-Slave control

Master-Slave control is used:

- In zones where the supply and exhaust air devices must be of the same size, and the relationship between the supply air and exhaust air flows must be constant at all flows.

In a master-slave control system, the control signal from the temperature controller is connected to the master controller (located on the supply air device in this example). The actual value signal from the master controller is connected as a reference value to the slave controller.

When the actual value signal is limited via the set air settings on the master, no air flow settings must be set in the slave.



Function

Temperature controller GT1 with its built-in temperature sensor keeps the room temperature constant by increasing the air flow via air flow controller RC1 (Master) as the cooling requirement increases. Air flow controller RC2 (Slave) increases the air flow via the actual value signal from RC1. The air flow is reduced if the cooling requirement is reduced. Max and min air flow settings are programmed into the Master controller.

If any pressure changes occur in the duct system, RC1 and RC2 adjust the damper's position to maintain the specified air flow from GT1.

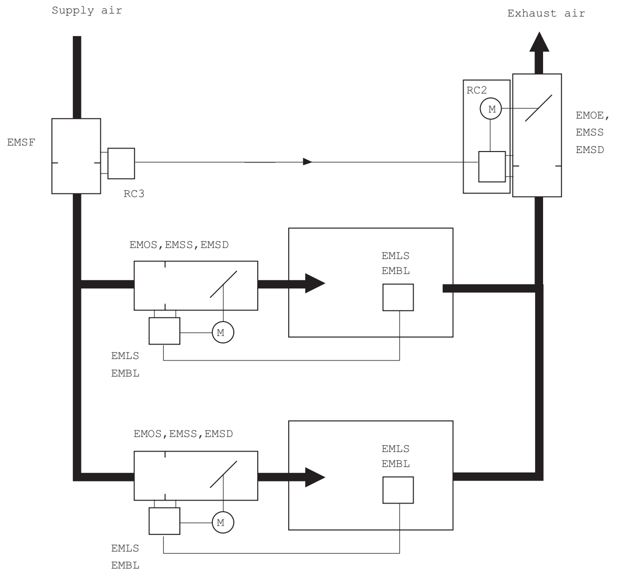
CONTROL SYSTEMS

Exhaust air via transfer air device

Supply air device EMSF must be of the same size as the exhaust air device. No air flow settings must be set when the exhaust air device is controlled by a measurement value signal from the supply air device.

Function

The air flow is measured in the supply air via air flow sensor RC3. Air flow regulator RC2 adjusts the exhaust air flow via the actual value signal from air flow sensor RC3 so that the exhaust air flow is the same as the supply air flow.



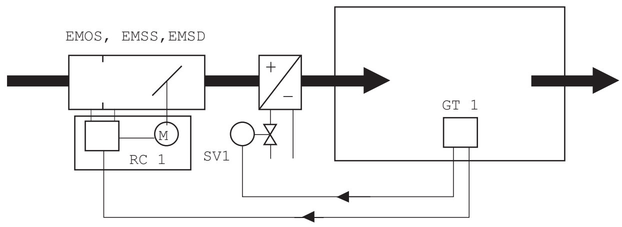
System with water reheater

A reheater is used in those cases where there is a need for an additional supply of heat to the premises.

Function

Temperature controller GT1 with its built-in temperature sensor keeps the room temperature constant as the cooling requirement increases by first closing the water valve via actuators SV1 and by then increasing the air flow via air flow regulator RC1. As the cooling requirement reduces, the air flow is first reduced via RC1, and then actuators SV1 open.

Max and min air flow settings are programmed into RC1. In the event of any pressure changes in the duct system, RC1 adjusts theposition of the damper to maintain the specified air flow from GT1.



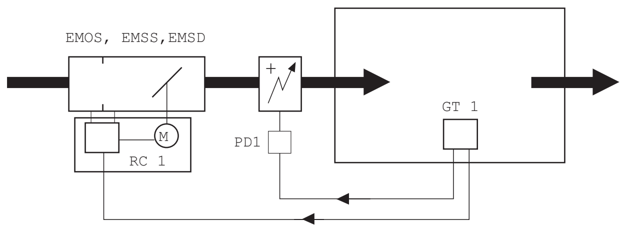
System with electric reheater

A reheater is used in those cases in which the need exists for an additional supply of heat to the premises.

Function

Temperature controller GT1 with its built-in temperature sensor keeps the room temperature constant as the cooling requirement increases by first shutting off the electric heating via pulsing device PD1 and by then increasing the air flow via air flow controller RC1. As the cooling requirement reduces, the air flow is first reduced via RC1 and then the output on the electric heater is increased via pulsing device PD1.

Max and min air flow settings are programmed into RC1. In the event of any pressurechanges in the duct system, RC1 adjusts the position of the damper to maintain the specified air flow from GT1.



FläktGroup

WWW.FLAKTGROUP.COM OPTIVENT 8460

EXCELLENCE IN SOLUTIONS

FläktGroup is the European market leader for smart and energy efficient Indoor Air and Critical Air solutions to support every application area. We offer our customers innovative technologies, high quality and outstanding performance supported by more than a century of accumulated industry experience. The widest product range in the market, and strong market presence in 65 countries worldwide, guarantee that we are always by your side, ready to deliver Excellence in Solutions.

PRODUCT FUNCTIONS BY FLÄKTGROUP

Air Treatment | Air Movement | Air Diffusion | Air Distribution | Air Filtration
Air Management & ATD's | Air Conditioning & Heating | Controls | Service

» *Learn more on* ***www.flaktgroup.com***
or contact one of our offices

Cooke Industries - Phone: +64 9 579 2185 Email: sales@cookeindustries.co.nz Web: www.cookeindustries.co.nz