# CAV controllers
## Type VFC

Variant with rotary knob

Actuator
with mechanical stops

Actuator
with potentiometers

Tested to VDI 6022


## For low airflow velocities

Circular mechanical self-powered volume flow controllers for the control of supply air or extract air in constant air volume systems with low airflow velocities

- Suitable for airflow velocities from 0.8 m/s
- Very simple commissioning
- Volume flow rate can be set using a rotary knob and a scale on the outside of the casing
- Simple retrofit of an actuator for variable volume flows
- Any installation orientation; maintenance-free
- Casing air leakage to EN 1751, class C

Optional equipment and accessories

- Secondary silencer Type CA, CS or CF for the reduction of air-regenerated noise
- Hot water heat exchanger Type WL and electric air heater Type EL for reheating the airflow
- Actuator for variable volume flows or for $\dot{V}_{min}$ / $\dot{V}_{max}$ switching

2



## VFC system


① CAV controller with rotary knob
② Actuator E0* with potentiometers
③ Actuator M0* with mechanical stops

## Description

CAV controller variant VFC, with rotary knob

For detailed information on actuators see Chapter K5 – 2.2.

## Application

- Circular CAV controllers of Type VFC for the precise supply air or extract air flow control in constant air volume systems
- Mechanical self-powered volume flow control without external power supply
- For low airflow velocities
- Simplified project handling with orders based on nominal size

## Nominal sizes

- 80, 100, 125, 160, 200, 250

## Attachments

- Min/Max actuators: Actuators for switching between minimum and maximum volume flow rate setpoint values
- Modulating actuators: Actuators for the stepless adjustment of volume flow rates

## Useful additions

- Secondary silencer Type CA, CS or CF
- Heat exchanger Type WL
- Electric air heater Type EL

## Special features

- Volume flow rate can be set using an external scale; no tools required
- Simple retrofit of an actuator is possible
- Correct operation even under unfavourable upstream or downstream conditions (1.5 D straight section required upstream)
- Any installation orientation
- Aerodynamic function testing of each unit on a special test rig prior to shipping

## Parts and characteristics

- Ready-to-commission controller
- Damper blade with low-friction bearings
- Bellows that acts as an oscillation damper
- Leaf spring
- Rotary knob with pointer for setting the volume flow rate
- Lip seal

## Construction features

- Circular casing
- Spigot with lip seal, for circular connecting ducts to EN 1506 or EN 13180
- Damper blade with low-friction bearings and special bellows

### Materials and surfaces
- Casing made of galvanised sheet steel
- Damper blade and other parts made of high-quality plastic, to UL 94, V1; to DIN 4102, material classification B2
- Leaf spring made of stainless steel
- Polyurethane bellows

### Installation and commissioning
- Any installation orientation
- Take the adjustment value from the characteristic on the sticker (on each volume flow controller)
- Volume flow rate setpoint can be set on external scale

### Standards and guidelines
- Hygiene conforms to VDI 6022
- Casing air leakage to EN 1751, class C

### Maintenance
- Maintenance-free as construction and materials are not subject to wear

### Attachments

| Order code detail | Actuator | Supply voltage | Auxiliary switch |
|---|---|---|---|
| **Min/Max actuators** | | | |
| E01 | Actuator with potentiometers TROX/Gruner | 24 V AC/DC | – |
| E02 | | 230 V AC | |
| M01 | Actuator with mechanical stops TROX/Belimo | 24 V AC/DC | |
| M02 | | 230 V AC | |
| **Modulating actuators** | | | |
| E03 | Actuator with potentiometers TROX/Gruner | 24 V AC/DC | – |

### Technical data

| | |
|---|---|
| **Nominal sizes** | 80 – 250 mm |
| **Volume flow rate range** | 6 – 370 l/s or 22 – 1332 $m^3/h$ |
| **Volume flow rate control range** | Approx. 10 to 100 % of the nominal volume flow rate |
| **Volume flow rate accuracy** | approx. ± 10 % of the nominal volume flow rate |
| **Minimum differential pressure** | 30 Pa |
| **Maximum differential pressure** | 500 Pa |
| **Operating temperature** | 10 – 50 °C |

Function

2

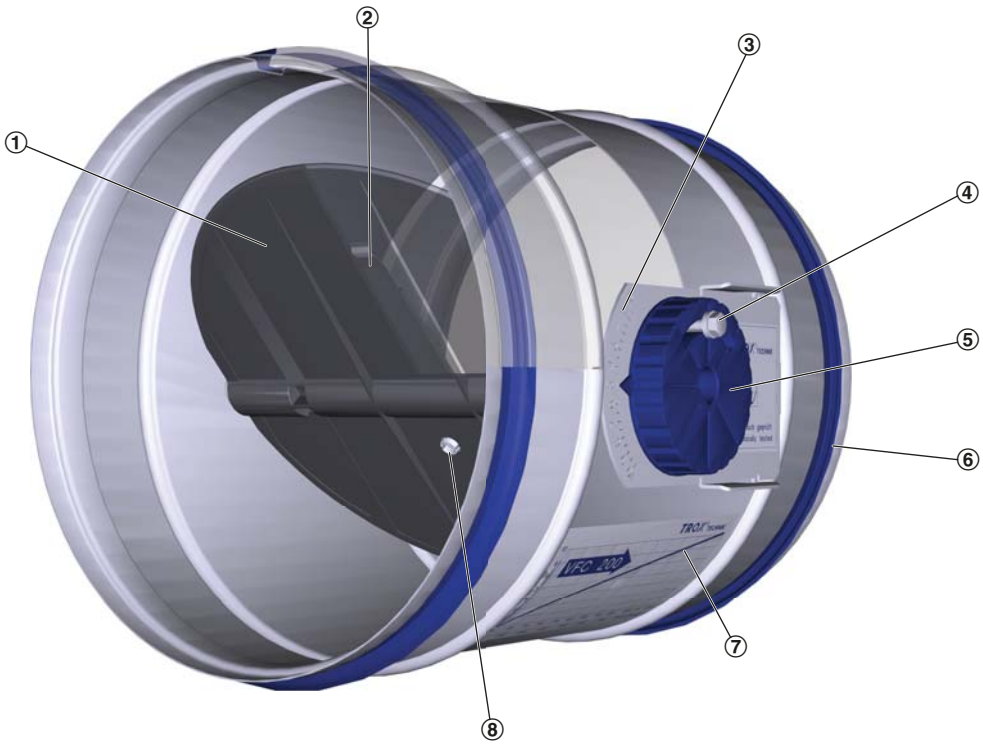
## Functional description

The volume flow controllers work without an external power supply. A damper blade with low-friction bearings is adjusted by aerodynamic forces such that a set volume flow rate is maintained within the differential pressure range. The aerodynamic forces of the airflow create a closing torque on the damper blade. The bellows extends and increases this force while at the same time acting as an oscillation damper.
The closing force is countered by a leaf spring. As the differential pressure changes, the leaf spring adjusts the position of the damper blade such that the volume flow rate is maintained almost exactly.

## Efficient commissioning

The volume flow rate setpoint value can be set quickly and easily using the pointer on the external scale; no measurements are required. The advantage over flow adjustment dampers is that there is no need for repeat measurements or adjustments by an air conditioning engineer. Should the system pressure change, e.g. by opening or closing of duct sections, the flow rates in the entire system will also change if flow adjustment dampers are used; however, this is not the case with mechanical self-powered volume flow controllers A mechanical self-powered controller reacts immediately and adjusts the damper blade such that the set constant volume flow rate is maintained.

## Schematic illustration of the VFC




① Damper blade
② Leaf spring
③ Volume flow rate scale
④ Rotary knob locking screw
⑤ Rotary knob
⑥ Lip seal
⑦ Diagram with setting values
⑧ Bellows inlet

## Order code

**VFC**

**VFC / 100 / E01**
1 2 3

**1 Type**
**VFC** Volume flow controller

**2 Nominal size [mm]**
**80**
**100**
**125**
**160**
**200**
**250**

**3 Actuator**
No entry: manual operation
For example
**E01** 24 V AC/DC, 3-point, potentiometer
**E03** 24 V AC/DC, modulating 2 – 10 V DC, potentiometer
**M01** 24 V AC/DC, 3-point, mechanical stops

## Order example

**VFC/100/E03**

| | |
|---|---|
| **Nominal size** | 100 mm |
| **Actuator** | Variable volume flow, 24 V AC/DC, potentiometer, control signal 0 to 10 V DC |

### Air-regenerated noise

Quick sizing tables provide a good overview of the room sound pressure levels that can be expected. Approximate intermediate values can be interpolated. Precise intermediate values and spectral data can be calculated with our Easy Product Finder design programme.

The first selection criteria for the nominal size are the actual volume flow rates $\dot{V}_{min}$ and $\dot{V}_{max}$. The quick sizing tables are based on normally accepted attenuation levels. If the sound pressure level exceeds the required level, a larger VAV terminal unit and/or a silencer is required.

### Quick sizing: Sound pressure level at differential pressure 50 Pa

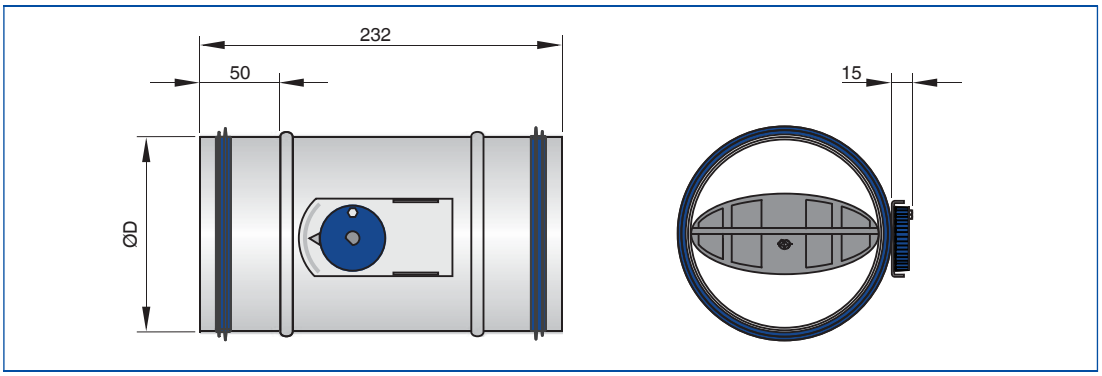
| Nominal size | $\dot{V}$ | | Air-regenerated noise | | | | Case-radiated noise |
|---|---|---|---|---|---|---|---|
| | | | ① | ② | ③ | ④ | ① |
| | | | $L_{PA}$ | $L_{PA1}$ | | | $L_{PA2}$ |
| | l/s | $m^3/h$ | dB(A) | | | | |
| 80 | **6** | **22** | 25 | <15 | <15 | <15 | <15 |
| | **10** | **36** | 28 | 16 | <15 | <15 | <15 |
| | **20** | **72** | 33 | 21 | <15 | <15 | <15 |
| | **42** | **151** | 39 | 27 | 18 | 16 | 17 |
| 100 | **6** | **22** | 29 | 15 | <15 | <15 | <15 |
| | **15** | **54** | 33 | 20 | <15 | <15 | 15 |
| | **30** | **108** | 37 | 26 | 18 | 17 | 18 |
| | **65** | **234** | 41 | 33 | 26 | 25 | 21 |
| 125 | **10** | **36** | 22 | <15 | <15 | <15 | <15 |
| | **20** | **72** | 27 | 16 | <15 | <15 | <15 |
| | **45** | **162** | 34 | 25 | 18 | 16 | <15 |
| | **100** | **360** | 41 | 34 | 29 | 27 | 16 |
| 160 | **18** | **65** | 25 | 16 | <15 | <15 | <15 |
| | **45** | **162** | 32 | 24 | 18 | 16 | 18 |
| | **85** | **306** | 36 | 29 | 24 | 22 | 22 |
| | **185** | **666** | 41 | 35 | 30 | 28 | 27 |
| 200 | **25** | **90** | 27 | 16 | <15 | <15 | <15 |
| | **60** | **216** | 31 | 22 | 16 | <15 | 18 |
| | **120** | **432** | 35 | 27 | 21 | 19 | 22 |
| | **250** | **900** | 37 | 30 | 25 | 24 | 26 |
| 250 | **37** | **133** | 31 | 21 | <15 | <15 | 18 |
| | **100** | **360** | 35 | 25 | 18 | 16 | 22 |
| | **185** | **666** | 36 | 28 | 21 | 19 | 25 |
| | **370** | **1332** | 37 | 29 | 23 | 22 | 29 |

① VFC
② VFC with secondary silencer CS/CF, insulation thickness 50 mm, length 500 mm
③ VFC with secondary silencer CS/CF, insulation thickness 50 mm, length 1000 mm
④ VFC with secondary silencer CS/CF, insulation thickness 50 mm, length 1500 mm

## Dimensions

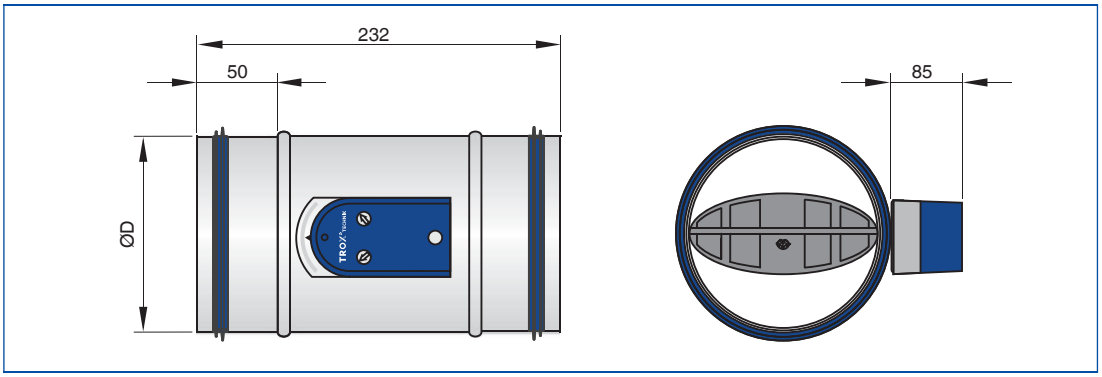
CAV controller variant VFC, with rotary knob

### VFC



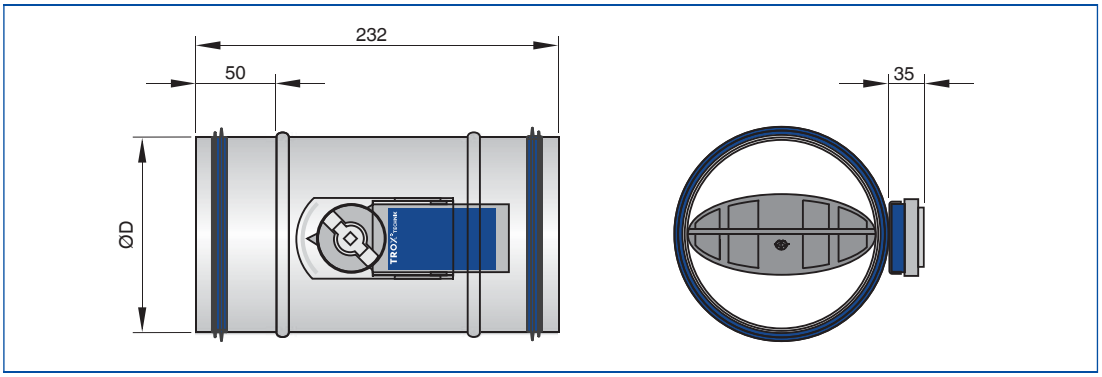

CAV controller variant VFC/.../E0*, with actuator (potentiometer)

### VFC/.../E0*




CAV conotroller variant VFC/.../M0* with actuator (mechanical stops)

### VFC/.../M0*




### Dimensions [mm] and weight [kg]

| Nominal size | VFC | VFC/.../E0* | VFC/.../M0* | ØD |
|---|---|---|---|---|
| | m | | | |
| | kg | | | mm |
| 80 | 0.5 | 0.8 | 0.7 | 79 |
| 100 | 0.6 | 0.9 | 0.8 | 99 |
| 125 | 0.7 | 1.0 | 0.9 | 124 |

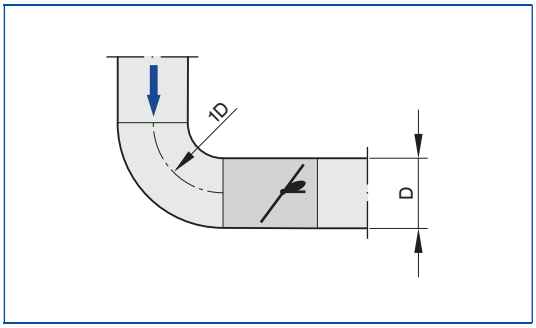
| Nominal size | VFC | VFC/.../E0* | VFC/.../M0* | ØD |
|---|---|---|---|---|
| | m | | | |
| | kg | | | mm |
| 160 | 0.8 | 1.1 | 1.0 | 159 |
| 200 | 1.0 | 1.3 | 1.2 | 199 |
| 250 | 1.3 | 1.6 | 1.5 | 249 |

### Upstream conditions

The volume flow rate accuracy $\Delta\dot{V}$ applies to a straight upstream section of the duct. Bends, junctions or a narrowing or widening of the duct cause turbulence that may affect measurement. Duct connections, e.g. branches off the main duct, must comply with EN 1505. Some installation situations require straight duct sections upstream.

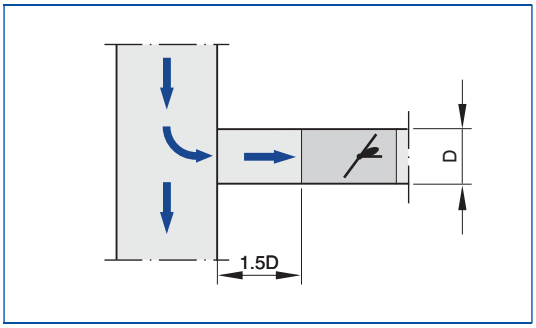
Free air intake only with a straight duct section of 1D upstream.

### Bend




A bend with a curvature radius of at least 1D – without an additional straight duct section upstream of the CAV controller – has only a negligible effect on the volume flow rate accuracy.

### Junction

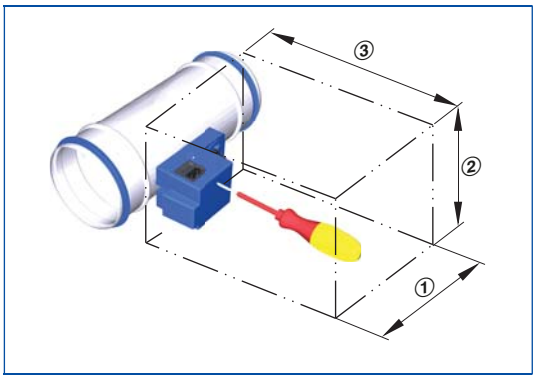



A junction causes strong turbulence. The stated volume flow rate accuracy $\Delta\dot{V}$ can only be achieved with a straight duct section of at least 1.5D upstream. Shorter upstream sections require a perforated plate in the branch and before the CAV controller. If there is no straight upstream section at all, the control will not be stable, even with a perforated plate.

### Space requirement for commissioning and maintenance

Sufficient space must be kept clear near any attachments to allow for commissioning and maintenance. It may be necessary to provide sufficiently sized inspection access openings.

### Access to attachments




### Space required

| Attachments | ① | ② | ③ |
|---|---|---|---|
| | mm | | |
| Without actuator | 200 | 200 | 200 |
| With actuator E0* | 200 | 200 | 300 |
| With actuator M0* | 200 | 200 | 230 |

### Standard text

This specification text describes the general properties of the product. Texts for variants can be generated with our Easy Product Finder design programme.

Circular volume flow controllers for constant and variable air volume systems with low airflow velocities, mechanical self-powered, without external power supply, suitable for supply or extract air, available in 6 nominal sizes. Ready-to-commission unit consists of the casing containing a damper blade with low-friction bearings, bellows, leaf spring, and a rotary knob to set the volume flow rate setpoint.
Differential pressure: 30 – 500 Pa
Volume flow rate: max. 10 : 1
Spigot with lip seal, for circular connecting ducts to EN 1506 or EN 13180.
Casing air leakage to EN 1751, class C.

### Special features

- Volume flow rate can be set using an external scale; no tools required
- Simple retrofit of an actuator is possible
- Correct operation even under unfavourable upstream or downstream conditions (1.5 D straight section required upstream)
- Any installation orientation
- Aerodynamic function testing of each unit on a special test rig prior to shippin

### Materials and surfaces

- Casing made of galvanised sheet steel
- Damper blade and other parts made of high-quality plastic, to UL 94, V1; to DIN 4102, material classification B2
- Leaf spring made of stainless steel
- Polyurethane bellows

### Technical data

- Nominal sizes: 80 to 250 mm
- Volume flow rate range: 6 to 370 l/s or 22 to 1332 $m^3/h$
- Volume flow rate control range: approx. 10 – 100 % of the nominal volume flow rate
- Volume flow rate accuracy: approx. ± 10 % of the nominal volume flow rate
- Minimum differential pressure: 30 Pa
- Maximum differential pressure: 500 Pa

### Sizing data

- $\dot{V}$ _____ [$m^3/h$]
- $\Delta p_{st}$ _____ [Pa]
- $L_{PA}$ air-regenerated noise _____ [dB(A)]
- $L_{PA}$ Case-radiated noise _____ [dB(A)]

2

---

### Order options

**1 Type**
**VFC** Volume flow controller

**2 Nominal size [mm]**
☐ **80**
☐ **100**
☐ **125**
☐ **160**
☐ **200**
☐ **250**

**3 Actuator**
No entry: manual operation
For example
☐ **E01** 24 V AC/DC, 3-point, potentiometer
☐ **E03** 24 V AC/DC, modulating 2 – 10 V DC, potentiometer
☐ **M01** 24 V AC/DC, 3-point, mechanical stops

# Constant volume flow control – CONSTANTFLOW

## Basic information and nomenclature

2

- Product selection
- Principal dimensions
- Nomenclature
- Construction
- Correction values for system attenuation
- Measurements
- Sizing and sizing example

## Product selection

| | Type | | | | | |
|---|---|---|---|---|---|---|
| | RN | EN | VFL | VFC | RN-Ex | EN-Ex |
| **Type of system** | | | | | | |
| Supply air | ● | ● | ● | ● | ● | ● |
| Extract air | ● | ● | ● | ● | ● | ● |
| **Duct connection, fan end** | | | | | | |
| Circular | ● | | ● | ● | ● | |
| Rectangular | | ● | | | | ● |
| **Volume flow rate range** | | | | | | |
| Up to [$m^3/h$] | 5040 | 12100 | 900 | 1330 | 5040 | 12100 |
| Up to [l/s] | 1400 | 3360 | 250 | 370 | 1400 | 3360 |
| **Air quality** | | | | | | |
| Filtered | ● | ● | ● | ● | ● | ● |
| Office extract air | ● | ● | ● | ● | ● | ● |
| Polluted | ○ | ○ | ○ | ○ | ○ | ○ |
| Contaminated | ○ | ○ | ○ | ○ | ○ | ○ |
| **Control function** | | | | | | |
| Constant | ● | ● | ● | ● | ● | ● |
| Variable | ○ | ○ | | ○ | | |
| Min/Max | ○ | ○ | | ○ | | |
| **Acoustic requirements** | | | | | | |
| High < 40 dB(A) | ○ | ○ | | ○ | ○ | ○ |
| Low < 50 dB (A) | ● | ● | ● | ● | ● | ● |
| **Special areas** | | | | | | |
| Areas with explosive atmospheres | | | | | ● | ● |

| | |
|---|---|
| ● | Possible |
| ○ | Possible under certain conditions: Robust unit variant and/or specific actuator or a useful additional product |
| | Not possible |

# Basic information and nomenclature



## Principal dimensions

**ØD [mm]**
Outside diameter of the spigot

**$ØD_1$ [mm]**
Pitch circle diameter of flanges

**$ØD_2$ [mm]**
Outside diameter of flanges

**$ØD_4$ [mm]**
Inside diameter of the screw holes of flanges

**L [mm]**
Length of unit including connecting spigot

**$L_1$ [mm]**
Length of casing or acoustic cladding

**B [mm]**
Duct width

**$B_1$ [mm]**
Screw hole pitch of flange (horizontal)

**$B_2$ [mm]**
Outside dimension of flange (width)

**$B_3$ [mm]**
Width of device

**H [mm]**
Duct height

**$H_1$ [mm]**
Screw hole pitch of flange (vertical)

**$H_2$ [mm]**
Outside dimension of flange (height)

**$H_3$ [mm]**
Unit height

**n [ ]**
Number of flange screw holes

**T [mm]**
Flange thickness

**m [kg]**
Unit weight including the minimum required attachments for manual adjustment

## Nomenclature

### Acoustic data

**$f_m$ [Hz]**
Octave band centre frequency

**$L_{PA}$ [dB(A)]**
A-weighted sound pressure level of air-regenerated noise of the VAV terminal unit, system attenuation taken into account

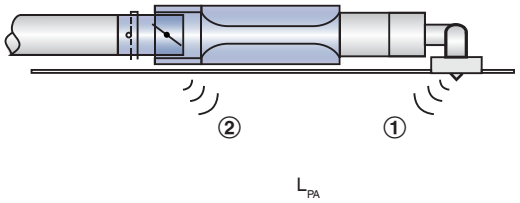
**$L_{PA1}$ [dB(A)]**
A-weighted sound pressure level of air-regenerated noise of the VAV terminal unit with secondary silencer, system attenuation taken into account

**$L_{PA2}$ [dB(A)]**
A-weighted sound pressure level of case-regenerated noise of the VAV terminal unit, system attenuation taken into account

**$L_{PA3}$ [dB(A)]**
A-weighted sound pressure level of case-regenerated noise of the VAV terminal unit with acoustic cladding, system attenuation taken into account

All sound pressure levels are based on 20 µPa.

### Definition of noise




① Air-regenerated noise
② Case-radiated noise

### Volume flow rates

**$\dot{V}_{nom}$ [m³/h] and [l/s]**
Nominal volume flow rate (100 %)
- The value depends on product type and nominal size
- Values are published on the internet and in technical leaflets, and stored in the Easy Product Finder design software.
- Upper limit of the setting range and maximum volume flow rate setpoint value for the CAV controller

**$\dot{V}$ [m³/h] and [l/s]**
Volume flow rate

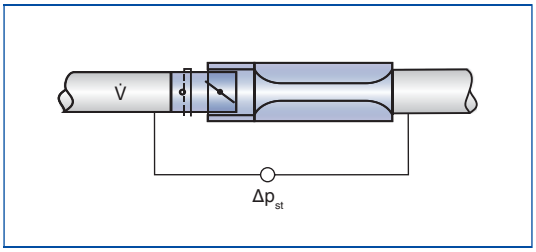
**$\Delta\dot{V}$ [± %]**
Volume flow rate tolerance from setpoint value

### Differential pressure

**$\Delta p_{st}$ [Pa]**
Static differential pressure

**$\Delta p_{st\ min}$ [Pa]**
Static differential pressure, minimum
- The static minimum differential pressure is equal to the pressure loss of the CAV controller when the damper blade is open, caused by flow resistance (bellows, crossbar)
- If the pressure on the CAV controller is too low, the setpoint volume flow rate may not be achieved, not even when the damper blade is open
- Important factor in designing the ductwork and in rating the fan including speed control
- Sufficient duct pressure must be ensured for all operating conditions and for all controllers, and the measurement point or points for speed control must have been selected accordingly to achieve this

### Static differential pressure




## Constructions

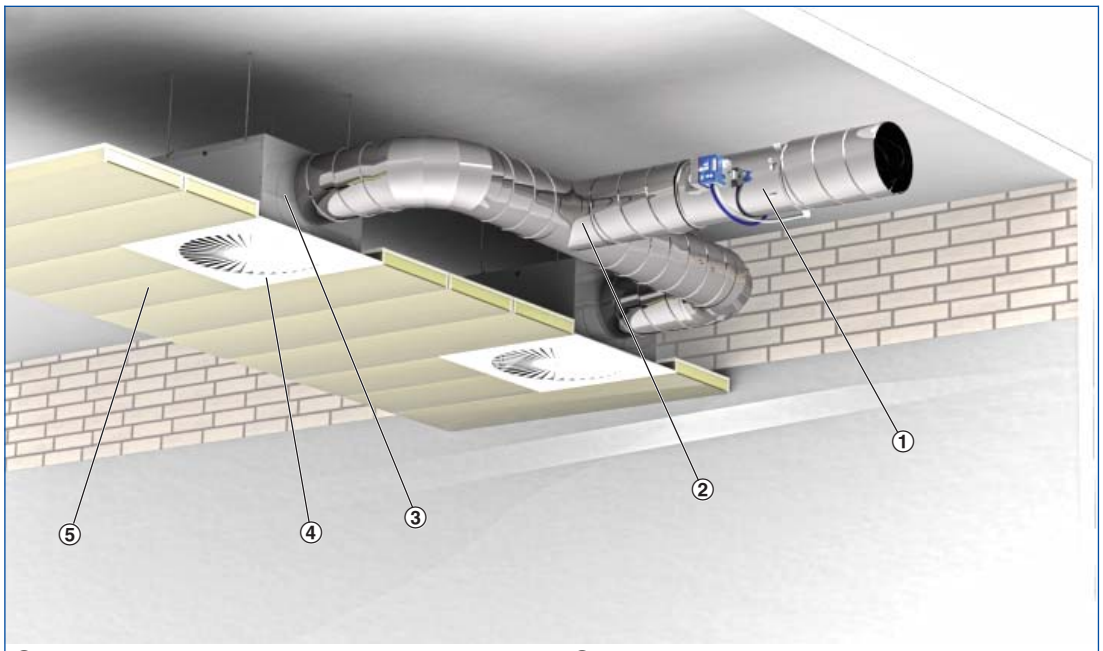
### Galvanised sheet steel
- Casing made of galvanised sheet steel
- Parts in contact with the airflow as described for the product type
- External parts, e.g. mounting brackets or covers, are usually made of galvanised sheet steel

### Powder-coated surface (P1)
- Casing made of galvanised sheet steel, powder-coated RAL 7001, silver grey
- Parts in contact with the airflow are powder-coated or made of plastic
- Due to production, some parts that come into contact with the airflow may be stainless steel or aluminium, powder-coated
- External parts, e.g. mounting brackets or covers, are usually made of galvanised sheet steel

### Stainless steel (A2)
- Casing made of stainless steel 1.4201
- Parts in contact with the airflow are powder-coated or made of stainless steel
- External parts, e.g. mounting brackets or covers, are usually made of galvanised sheet steel

The quick sizing tables show the sound pressure levels that can be expected in a room both for the air-regenerated noise and for the case-radiated noise. The sound pressure level in a room results from the sound power level of the products – for a given volume flow rate and differential pressure – and the attenuation and insulation on site. Generally accepted attenuation and insulation values have been taken into account.
The distribution of air across the ductwork, changes of direction, end reflection, and room attenuation all affect the sound pressure level of the air-regenerated noise. Ceiling insulation and room attenuation influence the sound pressure level of the case-radiated noise.

## Reducing the sound pressure level of the air-regenerated noise




① VAV terminal unit
② Distribution in the ducting
③ Change of direction
④ End reflection
⑤ Ceiling insulation

### Correction values for acoustic quick sizing

The correction values for the distribution in the ducting are based on the number of diffusers assigned to any one air terminal unit. If there is just one diffuser (assumption: 140 l/s or 500 m³/h), no correction is necessary.

One change of direction, e.g. at the horizontal connection of the diffuser plenum box, has been taken into consideration for the system attenuation values. Vertical connection of the plenum box does not result in a system attenuation. Additional bends result in lower sound pressure levels.

## Octave correction for the distribution in the ducting, used to calculate the air-regenerated noise

| $\dot{V}$ in [m³/h] | 500 | 1000 | 1500 | 2000 | 2500 | 3000 | 4000 | 5000 |
|---|---|---|---|---|---|---|---|---|
| [l/s] | 140 | 280 | 420 | 550 | 700 | 840 | 1100 | 1400 |
| [dB] | 0 | 3 | 5 | 6 | 7 | 8 | 9 | 10 |

## System attenuation per octave to VDI 2081 for the calculation of the air-regenerated noise

| Centre frequency [Hz] | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
|---|---|---|---|---|---|---|---|---|
| | ΔL | | | | | | | |
| | dB | | | | | | | |
| Change of direction | 0 | 0 | 1 | 2 | 3 | 3 | 3 | 3 |
| Mündungsreflexion | 10 | 5 | 2 | 0 | 0 | 0 | 0 | 0 |
| Room attenuation | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

The calculation is based on the end reflection for nominal size 250

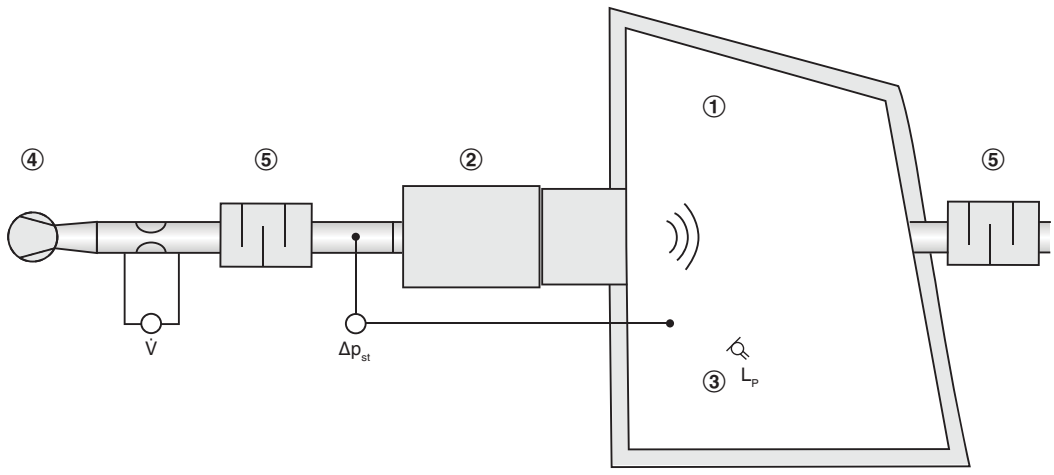
## Octave correction for the calculation of case-radiated noise

| Centre frequency [Hz] | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
|---|---|---|---|---|---|---|---|---|
| | ΔL | | | | | | | |
| | dB | | | | | | | |
| Ceiling insulation | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Room attenuation | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

### Measurements

The acoustic data for the air-regenerated noise and case-radiated noise are determined according to EN ISO 5135. All measurements are carried out in a reverberation chamber to EN ISO 3741.

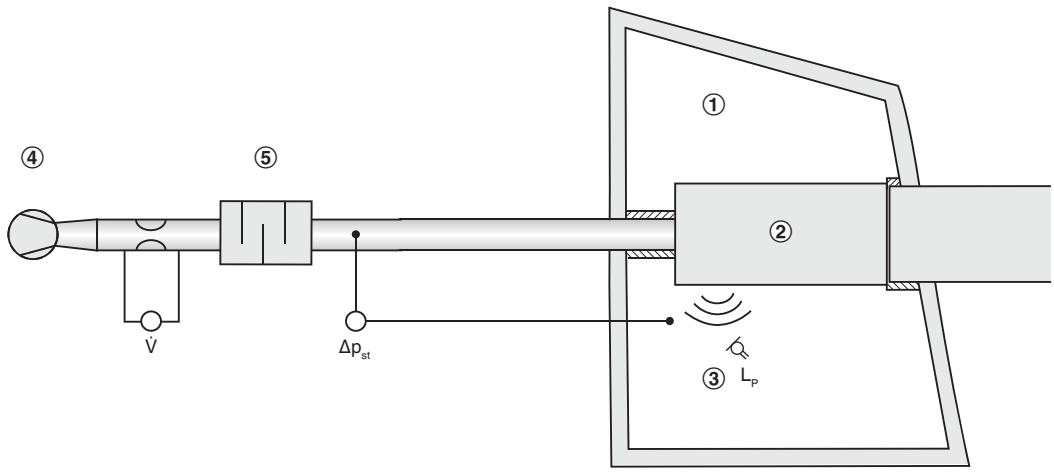
### Measuring the air-regenerated noise




① Reverberation chamber
② VAV terminal unit
③ Microphone
④ Fan
⑤ Sound attenuator

The sound pressure levels for air-regenerated noise $L_{PA}$ given by us result from measurements in a reverberation chamber. The sound pressure $L_P$ is measured for the entire frequency range. The evaluation of the measurements, including system attenuation and A-weighting, results in the sound pressure level $L_{PA}$.

### Measuring the case-radiated noise




① Reverberation chamber
② VAV terminal unit
③ Microphone
④ Fan
⑤ Sound attenuator

The sound pressure levels for case-radiated noise $L_{PA2}$ given by us result from measurements in a reverberation chamber. The sound pressure $L_P$ is measured for the entire frequency range. The evaluation of the measurements, including system attenuation and A-weighting, results in the sound pressure level $L_{PA2}$.

### Sizing with the help of this catalogue

This catalogue provides convenient quick sizing tables for CAV controllers. The sound pressure levels for air-regenerated noise and for case-radiated noise are provided for all nominal sizes. In addition, generally accepted attenuation and insulation values have been taken into account. Sizing data for other volume flow rates and differential pressures can be determined quickly and precisely using the Easy Product Finder design programme.

### Sizing example

#### Given data

$\dot{V}_{max}$ = 280 l/s (1010 m³/h)
$\Delta p_{st}$ = 150 Pa
Required sound pressure level in the room 35 dB(A)

#### Quick sizing

RN/200 with circular silencer CS 050/200×1000
Air-regenerated noise $L_{PA}$ = 26 dB(A)
Case-radiated noise $L_{PA}$ = 31 dB(A)

### Easy Product Finder


The Easy Product Finder allows you to size products using your project-specific data.

You will find the Easy Product Finder on our website.