

# 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

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### VFC system



### 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
<b>Min/Max actuators</b>			
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	
<b>Modulating actuators</b>			
E03	Actuator with potentiometers TROX/Gruner	24 V AC/DC	-

**Technical data**

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

Function

**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**

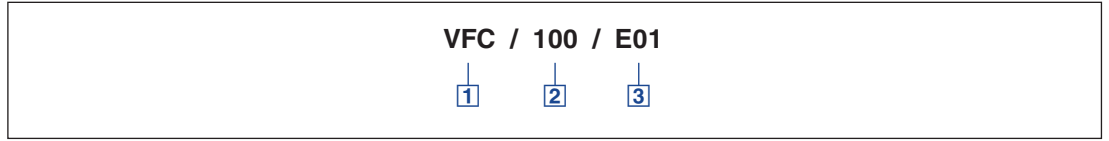
The volume flow rate setpoint value can be set quickly and easily using the pointer on the external scale; no measurements are required. The advantage over flow adjustment dampers is that there is no need for repeat measurements or adjustments by an air conditioning engineer. Should the system pressure 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**



Order code

VFC



**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/s	m <sup>3</sup> /h	L <sub>PA</sub>	L <sub>PA1</sub>			L <sub>PA2</sub>
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

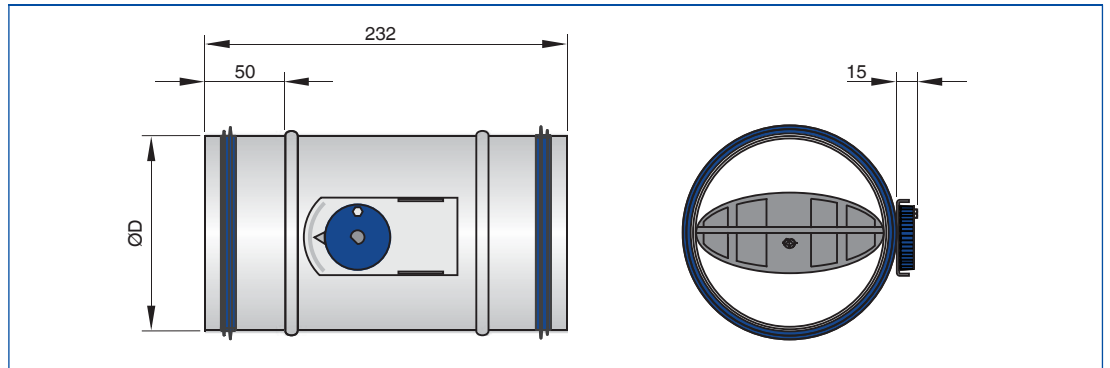
④ VFC with secondary silencer CS/CF, insulation thickness 50 mm, length 1500 mm

### Dimensions



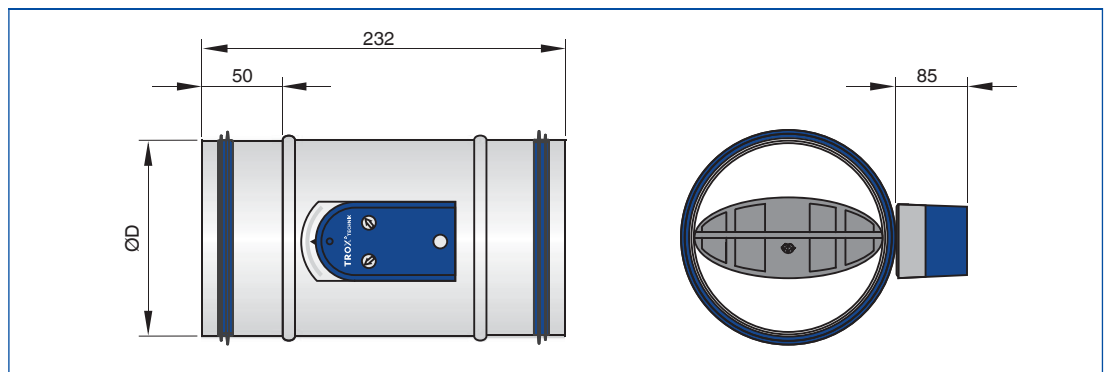
CAV controller variant VFC, with rotary knob

### VFC



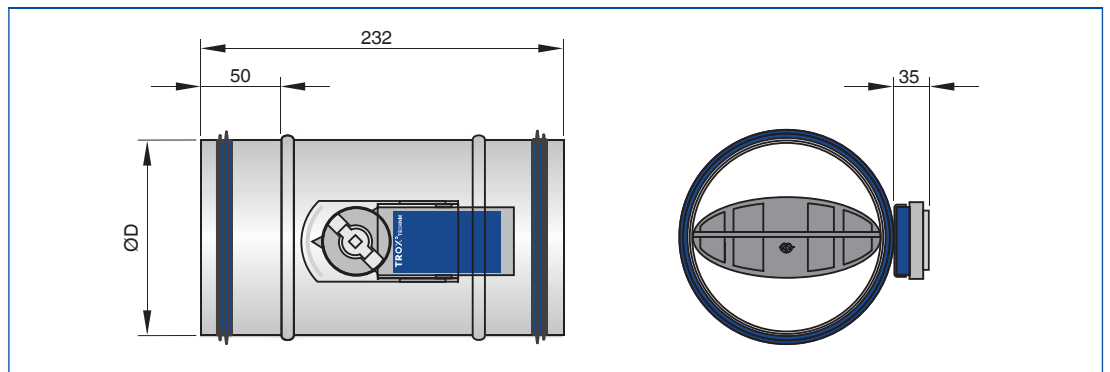
CAV controller variant VFC/.../E0\*, with actuator (potentiometer)

### VFC/.../E0\*



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

### VFC/.../M0\*



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

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

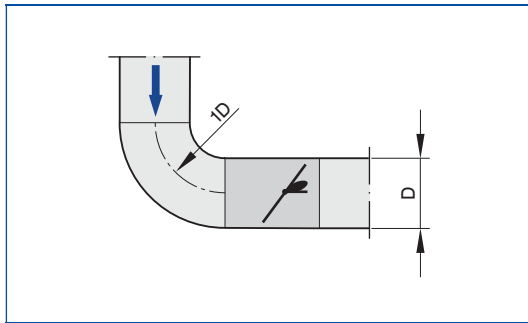
Nominal size	VFC	VFC/.../E0*	VFC/.../M0*	ØD
	m			
	kg			
160	0.8	1.1	1.0	159
200	1.0	1.3	1.2	199
250	1.3	1.6	1.5	249

## 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.

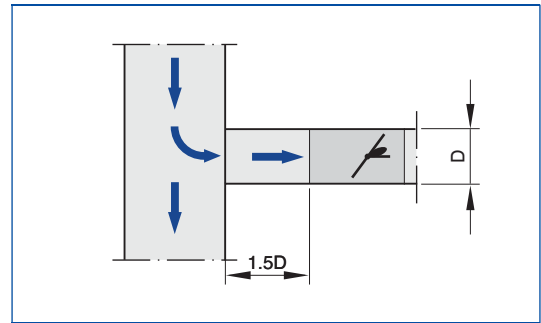
Free air intake only with a straight duct section of 1D upstream.

## 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

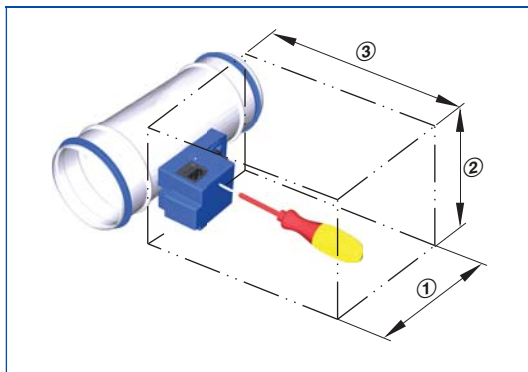


A junction causes strong turbulence. The stated volume flow rate accuracy  $\Delta\dot{V}$  can only be achieved with a straight duct section of at least 1.5D upstream. Shorter upstream sections require a perforated plate in the branch and before the CAV controller. If there is no straight upstream section 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 MO*	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 shipping

## 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<sup>3</sup>/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<sup>3</sup>/h]
- $\Delta p_{st}$  \_\_\_\_\_ [Pa]
- $L_{PA}$  air-regenerated noise \_\_\_\_\_ [dB(A)]
- $L_{PA}$  Case-radiated noise \_\_\_\_\_ [dB(A)]

## 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

# Constant volume flow control – CONSTANTFLOW

## Basic information and nomenclature

### Product selection

	Type					
	RN	EN	VFL	VFC	RN-Ex	EN-Ex
<b>Type of system</b>						
Supply air	●	●	●	●	●	●
Extract air	●	●	●	●	●	●
<b>Duct connection, fan end</b>						
Circular	●		●	●	●	
Rectangular		●				●
<b>Volume flow rate range</b>						
Up to [m <sup>3</sup> /h]	5040	12100	900	1330	5040	12100
Up to [l/s]	1400	3360	250	370	1400	3360
<b>Air quality</b>						
Filtered	●	●	●	●	●	●
Office extract air	●	●	●	●	●	●
Polluted	○	○	○	○	○	○
Contaminated	○	○	○	○	○	○
<b>Control function</b>						
Constant	●	●	●	●	●	●
Variable	○	○		○		
Min/Max	○	○		○		
<b>Acoustic requirements</b>						
High < 40 dB(A)	○	○		○	○	○
Low < 50 dB (A)	●	●	●	●	●	●
<b>Special areas</b>						
Areas with explosive atmospheres					●	●
●	Possible					
○	Possible under certain conditions: Robust unit variant and/or specific actuator or a useful additional product					
	Not possible					

# Constant volume flow control – CONSTANTFLOW

## Basic information and nomenclature

### Principal dimensions

#### $\varnothing D$ [mm]

Outside diameter of the spigot

#### $\varnothing D_1$ [mm]

Pitch circle diameter of flanges

#### $\varnothing D_2$ [mm]

Outside diameter of flanges

#### $\varnothing D_4$ [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)]

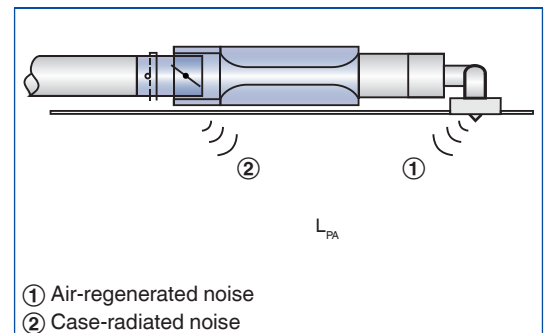
A-weighted sound pressure level of case-regenerated noise of the VAV terminal unit, system attenuation taken into account

#### $L_{PA3}$ [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  $\mu$ Pa.

#### Definition of noise



### Volume flow rates

#### $\dot{V}_{\text{nom}}$ [m<sup>3</sup>/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

#### $\dot{V}$ [m<sup>3</sup>/h] and [l/s]

Volume flow rate

#### $\Delta\dot{V}$ [± %]

Volume flow rate tolerance from setpoint value

### Differential pressure

#### $\Delta p_{\text{st}}$ [Pa]

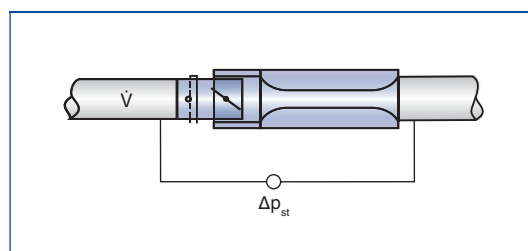
Static differential pressure

#### $\Delta p_{\text{st min}}$ [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)

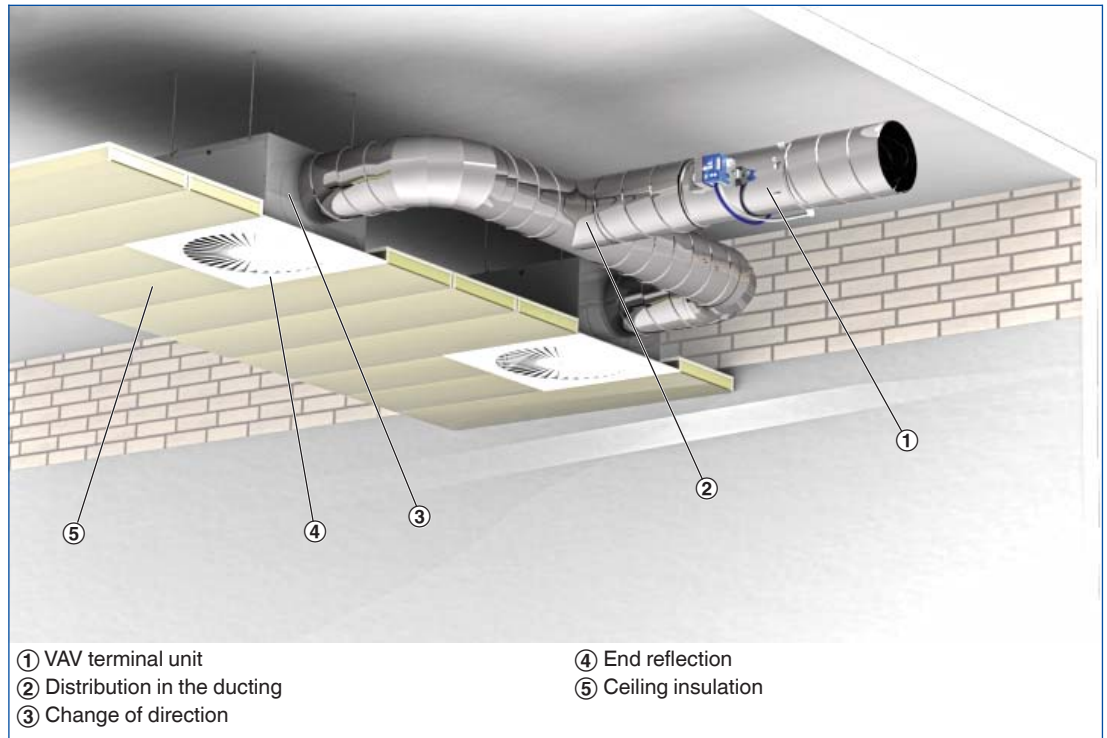
- Casing made of stainless steel 1.4201
- Parts in contact with the airflow are powder-coated or made of stainless steel
- External parts, e.g. mounting brackets or covers, are usually made of galvanised sheet steel

# Constant volume flow control – CONSTANTFLOW

## Basic information and nomenclature

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



### 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 m<sup>3</sup>/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 [m <sup>3</sup> /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
	$\Delta L$							
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
	$\Delta L$							
dB								
Ceiling insulation	4	4	4	4	4	4	4	4
Room attenuation	5	5	5	5	5	5	5	5

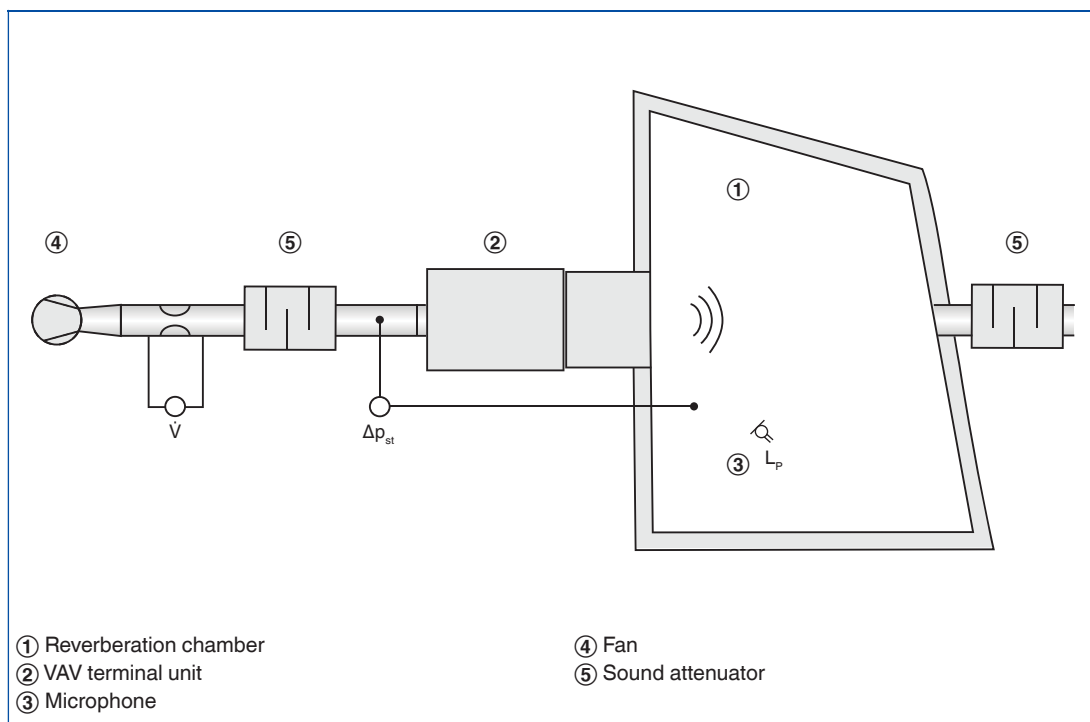
# Constant volume flow control – CONSTANTFLOW

## Basic information and nomenclature

### Measurements

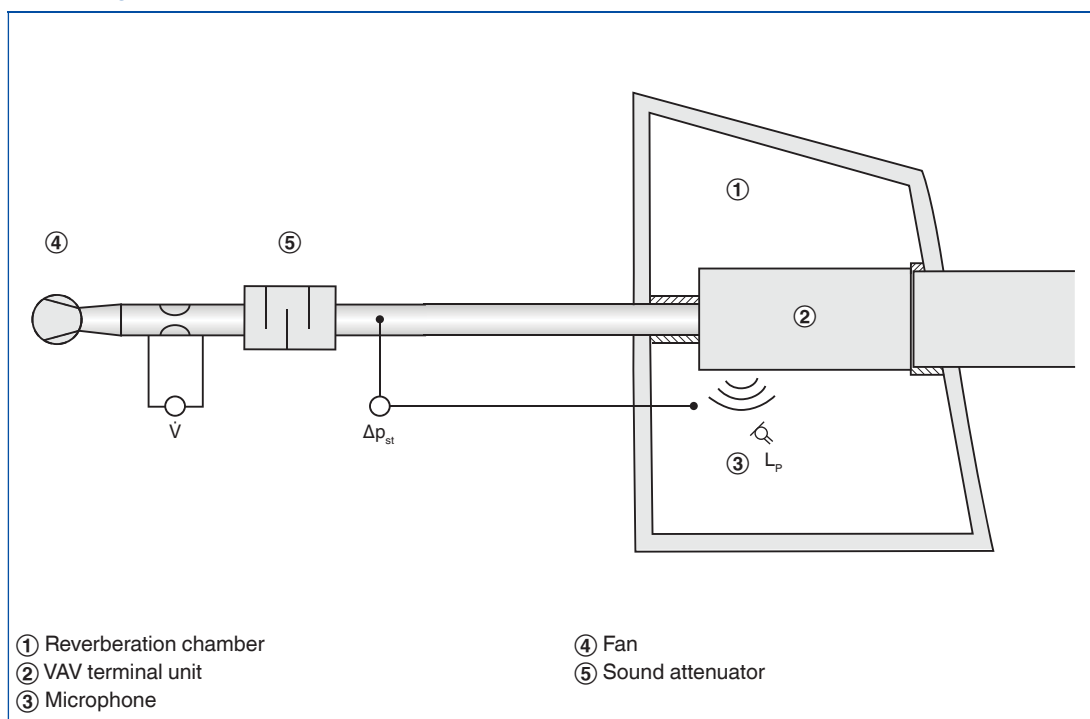
The acoustic data for the air-regenerated noise and case-radiated noise are determined according to EN ISO 5135. All measurements are carried out in a reverberation chamber to EN ISO 3741.

### Measuring the air-regenerated noise



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



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  $L_{PA2}$ .

# Constant volume flow control – CONSTANTFLOW

## Basic information and nomenclature

### 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

$\dot{V}_{\max} = 280 \text{ l/s}$  (1010 m<sup>3</sup>/h)

$\Delta p_{\text{st}} = 150 \text{ Pa}$

Required sound pressure level in the room 35 dB(A)

#### Quick sizing

RN/200 with circular silencer CS 050/200×1000

Air-regenerated noise  $L_{\text{PA}} = 26 \text{ dB(A)}$

Case-radiated noise  $L_{\text{PA}} = 31 \text{ dB(A)}$

### 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.

The screenshot shows the 'Easy Product Finder' software interface. The main window displays a table of product specifications and acoustic results. The table includes columns for 'Serie', 'Abmessung', 'V [m³/h]', 'Lp [dB(A)]', and 'Preis'. The results show that for a flow rate of 1010 m³/h and a differential pressure of 150 Pa, the selected product (RN-CS 050/200) has a noise level of 31 dB(A) and a price of 548.00 (incl. GST).

Serie	Abmessung	V [m³/h]		Lp [dB(A)]		Preis
		von	bis	Störungsgeräusch	Abstrahlgeräusch	
RN	200	324	1296	47	39	151,00
RN-CS 050/1000	200	324	1296	22	39	419,00 (inkl. GST)
RN	250	522	2088	42	34	185,00
RN-CS 050/1000	250	522	2088	28	34	474,00 (inkl. GST)
RN	315	828	3312	40	31	195,00
RN-CS 050/1000	315	828	3312	26	31	548,00 (inkl. GST)

Additional data from the screenshot:

- Flow rate: 1.010 m³/h (40.5040)
- Acoustic results:  $L_{\text{p, Störung}} = 47 \text{ dB(A)}$  (11 dB Dämpfung),  $L_{\text{p, Abstrahlung}} = 39 \text{ dB(A)}$  (9 dB Dämpfung)