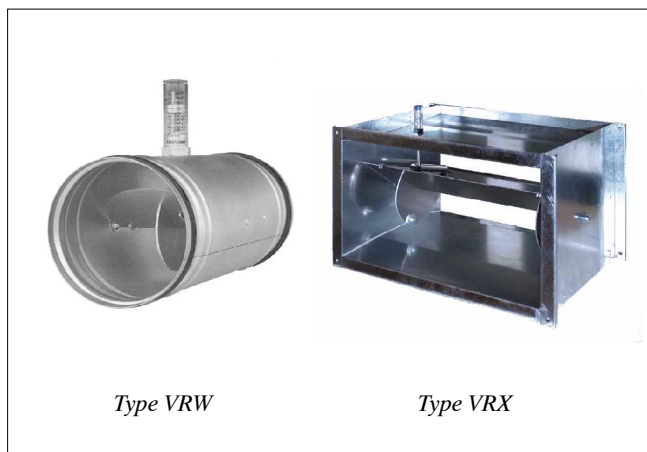


***LTG Aktiengesellschaft***

***Constant Flow Rate Controller  
mechanically self-operated  
Type VRW and VRX***



*Type VRW*

*Type VRX*

***LTG Aktiengesellschaft***

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## **The Program for Room Air Technology**

### **Components**

Air diffusers for walls, floors and ceilings · "LTG System clean<sup>®</sup>" · Coandatrol<sup>®</sup> and Coandavent<sup>®</sup> air diffusers · LTG cool wave<sup>®</sup> chilling fans · Klimavent<sup>®</sup> induction units · Raumluft<sup>®</sup> fan coil units · Facade fan coil units · Airflow control units · labair<sup>®</sup> system

### **Engineering services**

Technical services for investors, architects, engineers and plant builders during design, construction and operation of buildings. Reliable and precise data relating to the ventilation of air conditioning system are given already before realization of the project, determined by measurements, calculations, building simulations and experiments.

## **The Program for Process Air Technology**

### **Components**

Axial-flow, centrifugal and tangential fans · Collector system for: coarse and fine particle filtration, separating and compacting, compressing and humidifying.

### **Engineering services**

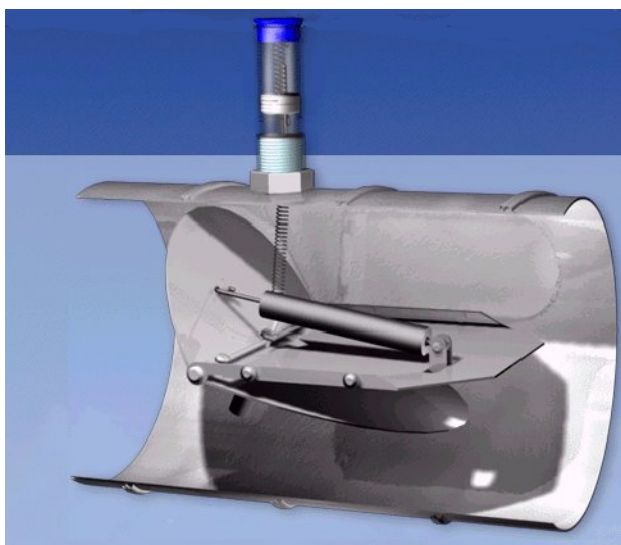
Technical services for construction engineers and plant designers during development and operation of assembly groups, machines and plants.

## Constant Flow Rate Controller Type VRW, round, self-operated

### Function

VRW dampers are self-operated constant flow rate controllers (without auxiliary power supply). Flow control is obtained through an asymmetrically angled regulating blade on friction-free bearings, ensuring a precision response and regulating action.

The air flow rate is either factory-set or defined by the customer in terms of a set value, with possible change of the flow rate on site, if requested. By modifying the preload of a tension spring, the flow rate may be changed via the air flow scale. As an option, the flow rate may be varied using an electric actuator.



*Schematic internal view*

### Application

When selecting the regulating unit and designing the duct system it should be considered that the flow speed inside the duct remains above 2.7 m/s. An unfavourable duct friction profile might affect the precision response and regulating action.

The upstream and downstream duct system to the regulating unit should be of the same diameter. We recommend an average air speed inside the duct of approx. 4.5 m/s as a reference value. However, the actual value may well vary within the full range of optimum flow rates.

Dampers selected with the above criteria and the defined air speed will result in lower heat loss and sound emission.

### Advantages

- The regulating blade is mounted on bearings in a low-friction, maintenance-free, blind, Teflon bushing (avoiding leakage and high-frequency whistling noises).
- Exact balancing of the regulating blade is realized through a counterweight, vertical to the regulating blade, ensuring a constant regulating action whatever the installation type.
- A pneumatic metal piston damper, optimized under any installation conditions, prevents the regulating blade from swinging and oscillating while maintaining an excellent response and regulating action.
- The controllers are insensitive to dust or temperature-related impacts.
- No rivets or bolts are required for a horizontal installation (using the self seal system).
- Thanks to the self sealing system, the components may be disassembled manually without the need of any tools.
- The controller components are aging and temperature resistant in a range of  $-15^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$ .
- The anti-aging snap-in rubber seal of EPDM material is resistant against slightly aggressive vapours or solvent vapours.
- Modern practical design.
- Flow controllers VRW may also be used for e.g. smoke removal by reversing the standard direction of flow. The damper will then be completely open.

### Installation

The snap-in rubber seal is more or less insensitive to potential damage during assembly of the plug connectors.

If, however, the seal should be damaged or lost, it may be replaced through a separate sealing ring without requiring any bonding.

In compliance with DIN 1946 T2, access to the duct system and to the flow controller is to be provided for adjustment and maintenance.

## Constant Flow Rate Controller Type VRW, round, self-operated

### Design / Accessories

The tube casings are made of hot galvanized sheet steel or alternatively stainless steel, laser butt welded without misalignment of the interior and exterior surfaces. The plug ends are pressure sized according to DIN 24147 TI, providing excellent dimensional stability and accuracy in fitting.

**Snap-in rubber seal system:** With this sealing type, connection to ductwork is made through simple insertion of the plug ends, a procedure by which a round, snap-in rubber sealing ring is pressed axially and radially against the tube wall to finally snap in a groove that has been provided for this purpose. During the insertion procedure the gap between the duct and the fitting is standardized.

The inserted component is locked in its end position. Thus, no bolts or rivets are required to hold the components together. Tolerances in conformance with DIN 24145 are to be considered to ensure proper sealing of the tube connection and meet tightness class 4 requirements.

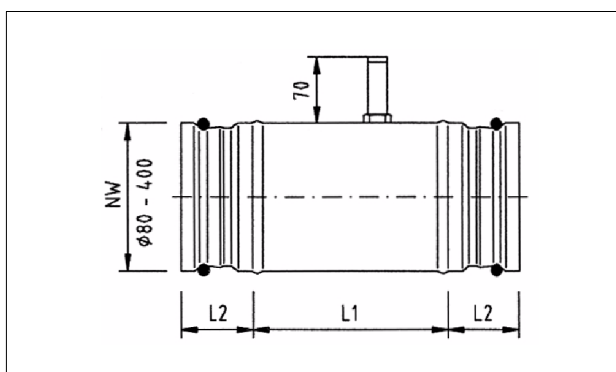
At extra cost, the constant flow rate controllers are available with a 50 mm sound or heat insulation jacket for all types.

Also available are suitable silencers, type SDE-A0 or SDE-S0.



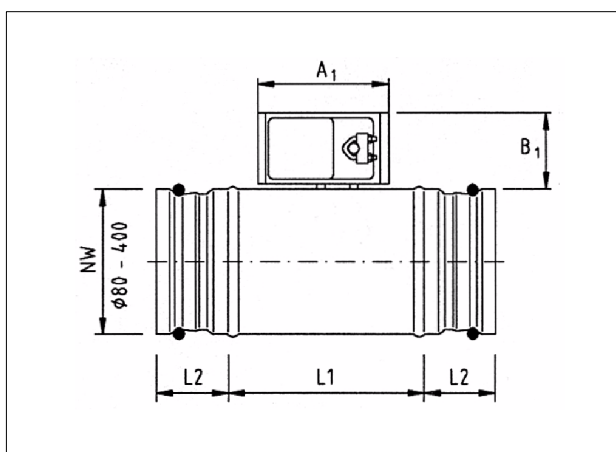
Constant Flow Rate Controller Type VRW

### Version I



- Constant flow rate controller with rubber seal connection (nominal size)
- Self-operated, factory-set (basic setting) or with flow rate set-point according to customer requirements.
- Flow rate adjustment on site via adjusting device.
- Maximum pressure difference across the controller: 1000 Pa
- Special version also available without adjusting device. Thus, no disturbing projections which may be more suitable for visible installations (however, without possibility to change the flow rate on site).
- $L1$  = installation length, total length =  $L1 + 2 \times L2$

### Version II



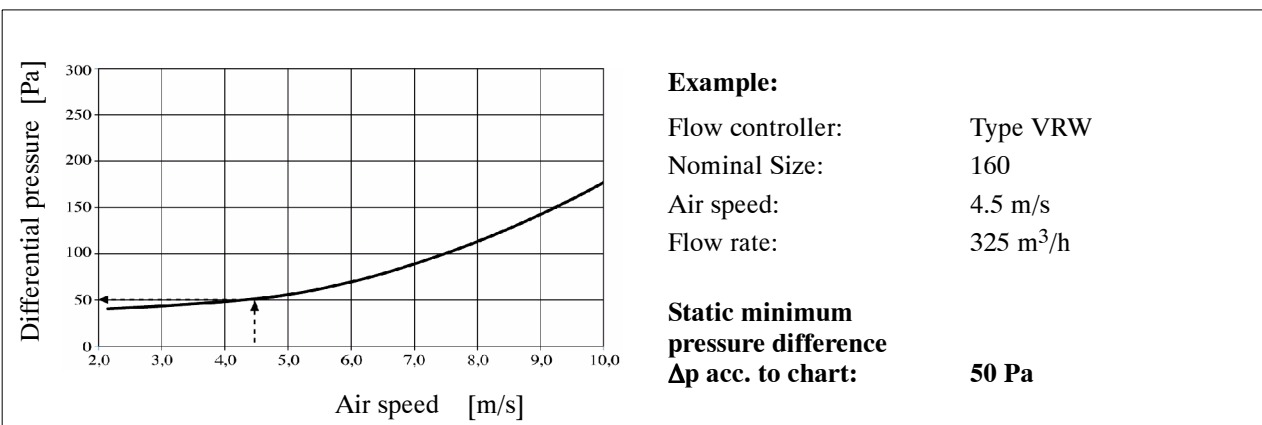
- Controller design and functions identical to version I
- Factory setting:  $\dot{V}_{\min} - \dot{V}_{\max}$  - regulation (without intermediate setting) via electric actuator for a 230 V / 50 Hz or 24 V / 50 Hz power voltage. Setpoint triggering through switching contacts.
- Motor type: Belimo LM 230 or LM 24  
or equivalent with NW 80 - 315 mm  
Belimo NM 230 or NM 24  
or equivalent with NW 400 mm

## Constant Flow Rate Controller Type VRW, round, self-operated

### Technical Characteristics

#### Static minimum response pressure difference

When designing the duct system, the static minimum response pressure difference of the flow controller should be considered (see chart).

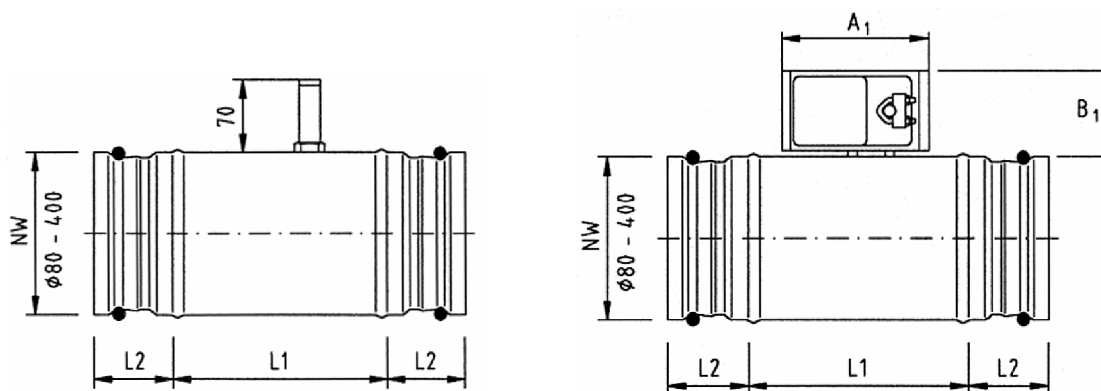


### Dimensions - Flow rate

Nom. size [mm]	Operating flow rate range [m <sup>3</sup> /h]		Max. static pressure difference [Pa]	Recommended duct air speed [m/s]	Dimensions [mm]			
	min.	max.			L <sub>1</sub>	L <sub>2</sub>	A <sub>1</sub>	B <sub>1</sub>
80	40	125	1000	2.7-6.0	120	40	155	105
100	70	200			170			
125	100	280			170			
140	140	400			170			
160	180	500			240			
200	250	900			240			
250	500	1500			240			
315	600	2800			220	60	230	160
400	1000	4600			295			

Dimensions with tolerances according to DIN EN 1506

Overall length tolerance = 0,05 x L (L = L<sub>1</sub> + 2 x L<sub>2</sub>)



Version I

Version II

## Constant Flow Rate Controller Type VRW, round, self-operated

### Airborne sound transmission and sound pressure level calculation

The sequence of sound classification starts at the sound source which may be of varying origin (e.g. fan and flow rate controller). Decisive for the different types of sound sources is the sound power level produced, illustrated in the chart below, according to classification. Specify the type and extent of sound insulation required, to remain within the required room sound pressure level.

Figure 1 shows a duct system without sound absorption. Highly varying air volumes and higher duct air speeds may result in an increased airborne sound transmission. This may be avoided through installation of an absorption damper (Figure 2) (duct system insertion loss). Figures 1-4 represent a hypothetical application as in practice there are many acoustic inputs

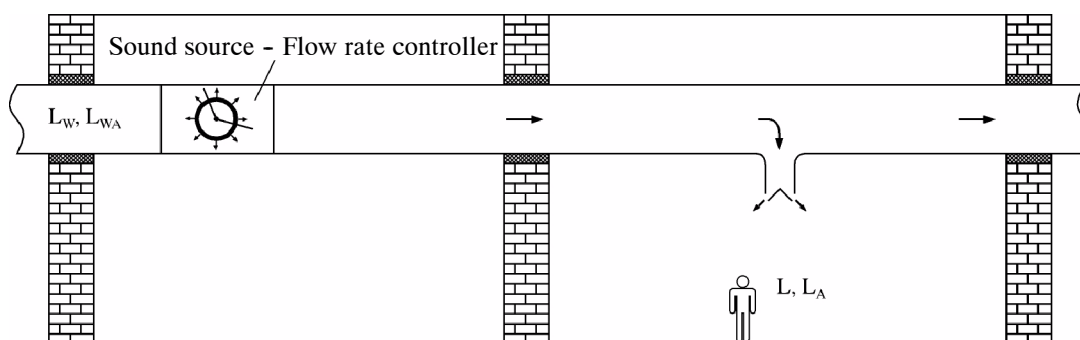


Figure 1: Schematic of a flow rate controller *without* sound absorption

$f_m$	Level in dB/Octave								A-weighted level
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
Airborne sound transmission $L_W$ (chart 1, page 10)	53	51	47	44	43	42	36	34	48
End reflection	21	16	10	4	2	0	0	0	-
Room absorption	4	4	4	4	4	4	4	4	-
A-weighted sound pressure level	2	15	24	33	37	39	33	29	42

#### Weighting example:

Required room sound pressure level: 42 dB(A)  
Flow rate controller: Type VRW  
Nominal size: 140  
Flow rate: 270 m<sup>3</sup>/h  
Static pressure difference: 100 Pa

**Calculated room sound pressure level: 42 dB(A)**

## Constant Flow Rate Controller Type VRW, round, self-operated

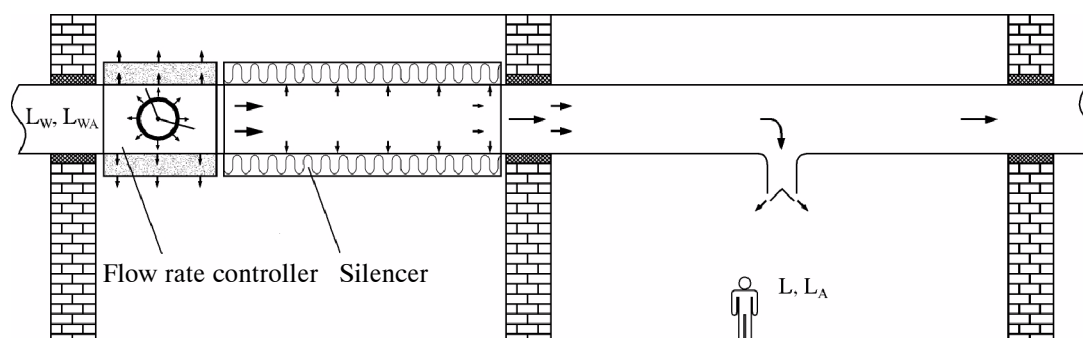


Figure 2: Schematic of a flow rate controller *with sound absorption*

$f_m$	Level in dB/Octave								A-weighted level
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
Airborne sound transmission $L_W$ (chart 1, page 10)	62	60	56	53	51	51	44	43	57
Insertion loss of the silencer	5	7	15	29	37	35	21	18	-
End reflection	20	14	9	3	1	0	0	0	-
Room absorption	4	4	4	4	4	4	4	4	-
A-weighted sound pressure level	7	19	19	15	9	13	20	20	26

### Weighting example:

Required room sound pressure level: 38 dB(A)  
 Flow rate controller: Type VRW  
 Nominal size: 140  
 Flow rate: 340 m<sup>3</sup>/h  
 Static pressure difference: 250 Pa  
 Sound absorber SDE-A0 160: 160/270 x 1000 mm

**Calculated room sound pressure level: 26 dB(A)**

## Constant Flow Rate Controller Type VRW, round, self-operated

### Casing Radiated Noise

If a duct with an internal sound source (e.g. flow rate controller, fan noise) is led through a room, a certain sound emission through the duct surface into the room will occur. However, the intensity of the sound pressure level perceived in the room depends on the sound pressure level inside the duct, the duct surface, the duct shape (round, rectangular), the duct wall thickness, the room absorption and the distance to the duct system.

In order to calculate the sound pressure level in the room, it is necessary to know by how much, the sound power level inside the duct (airborne sound transmission  $L_W$ /octave) is to be reduced (i.e. insulation value required). The sound insulation resulting from a possible intermediate ceiling between the emitting duct system and the utilized room should be considered (typically 4 dB). If the required maximum sound pressure level is exceeded, an insulated duct system with a higher sound reduction index may be required.

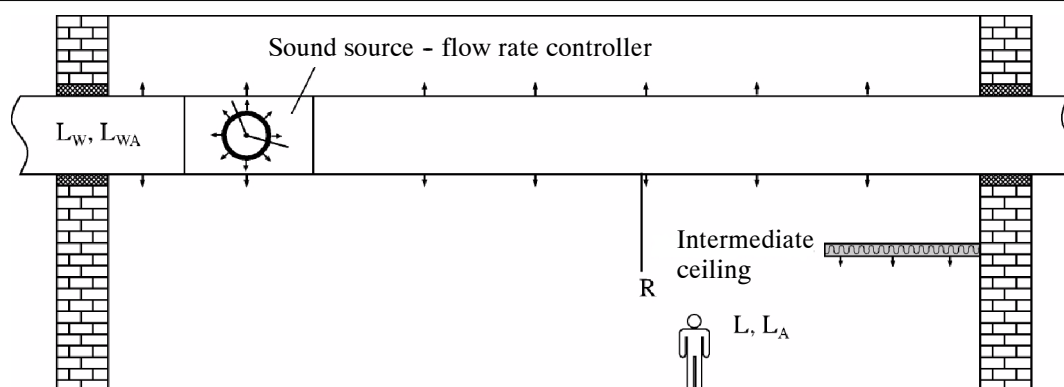


Figure 3: Radiated noise in the room - duct without insulating shell

$f_m$	Level in dB/Octave								A-weighted level
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
Airborne sound transmission $L_W$ (chart 1, page 10)	61	59	56	53	51	51	44	43	57
Level correction value (chart 2, page 11)	27	28	27	21	18	14	12	10	-
Room absorption	4	4	4	4	4	4	4	4	-
A-weighted sound pressure level	4	11	16	25	29	34	29	28	37

#### Weighting example:

Required room sound pressure level: 38 dB(A)  
 Flow rate controller: Type VRW  
 Nominal Size: 140  
 Flow rate: 270 m<sup>3</sup>/h  
 Static pressure difference: 250 Pa

**Calculated room sound pressure level: 37 dB(A)  
 with intermediate ceiling -4 dB**

## Constant Flow Rate Controller Type VRW, round, self-operated

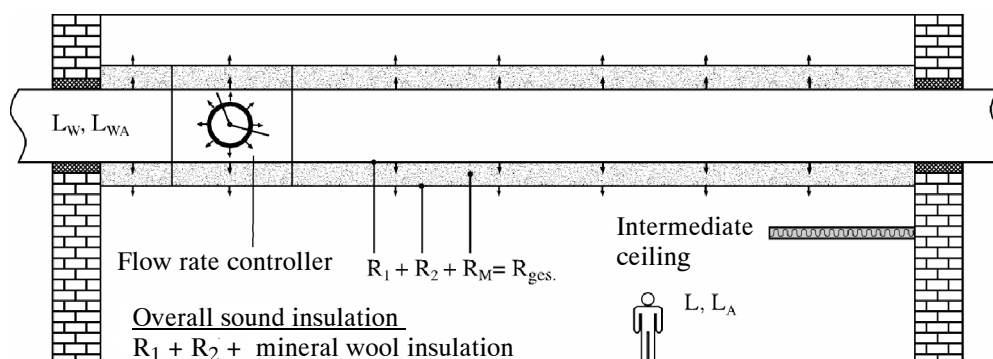


Figure 4: Radiated noise in the room - duct with insulated case

$f_m$	Level in dB/Octave								A-weighted level
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
Airborne sound transmission $L_W$ (chart 1, page 10)	72	70	67	64	62	62	56	54	68
Level correction value (chart 2, page 11)	29	28	35	40	44	51	54	44	-
Room absorption	4	4	4	4	4	4	4	4	-
A-weighted sound pressure level	13	22	19	17	14	8	-	5	25

### Weighting example:

Required room sound pressure level: 38 dB(A)  
 Flow rate controller: Type VRW  
 Nominal Size: 160  
 Flow rate: 500 m<sup>3</sup>/h  
 Static pressure difference: 500 Pa  
 Insulating shell: 50 mm

**Calculated room sound pressure level: 25 dB(A)**  
**with intermediate ceiling: -4 dB**

## Constant Flow Rate Controller Type VRW, round, self-operated

**Chart 1: Airborne sound transmission (In-duct or Outlet Noise)**

Nominal size in mm	Flow rate in m³/h	Static pressure difference at the controller in Pa																											
		100 Pa										250 Pa										500 Pa							
		Octave power level* L <sub>W</sub> in dB/octave								Sum power level L <sub>Wges</sub> A-weighted in dB(A)	Octave power level* L <sub>W</sub> in dB/octave								Sum power level L <sub>Wges</sub> A-weighted in dB(A)	Octave power level* L <sub>W</sub> in dB/octave								Sum power level L <sub>Wges</sub> A-weighted in dB(A)	
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz		
80	40	37	37	35	33	33	33	28	27	38	39	42	43	44	44	46	41	41	50	46	49	49	50	51	53	48	48	57	
	82	49	47	44	41	39	39	33	32	45	51	51	50	49	48	49	44	44	54	58	58	56	55	55	56	51	51	61	
	125	52	51	48	45	44	44	38	37	49	61	60	57	54	53	53	47	46	58	68	66	63	61	59	59	53	52	65	
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	200	54	52	49	47	45	45	39	38	51	63	61	58	55	54	54	48	47	59	70	68	65	62	61	60	54	53	66	
125	100	41	40	38	36	35	36	30	29	41	45	47	47	48	48	49	44	43	54	52	54	54	54	55	56	50	49	60	
	190	51	49	46	42	41	40	34	32	46	55	54	53	51	51	51	46	45	56	61	61	59	58	57	58	52	52	63	
	280	54	53	50	47	45	45	39	37	50	63	61	58	55	54	53	47	46	59	64	64	62	61	61	62	57	56	67	
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	400	56	55	52	49	47	47	41	39	52	65	63	60	57	56	55	49	48	61	72	70	67	64	62	62	56	55	68	
160	180	44	43	41	39	38	38	32	31	43	48	50	50	50	50	51	46	45	56	55	57	57	57	57	58	53	51	63	
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	500	57	55	52	49	47	47	40	39	52	66	64	61	58	56	55	49	48	61	72	70	67	64	62	62	56	54	68	
200	250	45	43	41	39	38	37	31	30	43	51	52	52	51	51	51	45	44	56	57	59	58	58	57	58	52	50	63	
	575	55	53	50	46	44	44	37	36	50	64	62	58	55	53	53	46	45	59	66	66	64	62	62	62	56	56	67	
	900	-	-	-	-	-	-	-	-	-	68	66	63	60	58	58	52	50	64	75	73	70	67	65	65	58	57	70	
250	500	48	47	45	43	41	41	35	34	47	54	56	55	55	54	55	49	48	60	61	62	62	61	61	62	56	54	66	
	1000	57	55	52	49	47	46	39	38	52	66	64	61	57	55	55	48	47	61	69	68	67	65	64	64	59	58	69	
	1500	-	-	-	-	-	-	-	-	-	70	68	65	62	60	60	53	52	65	77	75	72	68	67	66	60	58	72	
315	600	48	46	44	41	39	39	32	31	44	55	56	55	54	53	53	46	44	58	62	63	62	61	60	59	53	51	65	
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	2200	-	-	-	-	-	-	-	-	-	71	69	65	62	60	59	53	51	65	77	75	72	69	67	66	60	58	72	
400	100	50	48	45	42	41	40	33	31	46	58	59	57	56	55	54	47	45	59	65	65	64	62	61	61	54	51	66	
	2200	58	56	52	49	47	46	39	37	52	67	65	61	57	55	54	48	46	61	72	71	68	66	65	65	59	57	70	
	3800	-	-	-	-	-	-	-	-	-	73	71	67	64	62	61	55	53	67	79	77	74	70	68	68	61	60	74	

\* Sound power level in dB/octave referring to 10<sup>-12</sup> W

The flow rate controller's sound power may be increased in case of additional sound sources (e.g. fan, unfavourable flow conditions etc.). If this additional sound power level is by about 10 dB below the sound power level of the flow rate controller, it may neglected. The A-weighted sound power level (airborne sound transmission L<sub>Wges</sub>A) does not include the duct outlet and room absorption.

The room and outlet absorption may be calculated, but is generally around 8 dB. In order not to exceed the required sound pressure level of a room, installation of a suitably selected absorptive silencer between the flow rate controller and the room or insulation of the duct system is desirable.

Casing radiation depends on local conditions, the emitting duct surface (duct diameter and length) before the sound absorber and the sound insulation. In practice, values obtained in test labs do not necessarily comply with the actual conditions found in a duct system. Therefore, it is recommended not to design in too restrictive a manner.

## Constant Flow Rate Controller Type VRW, round, self-operated

**Chart 2: Sound Emission (Casing Radiated Noise)**

Nominal size in mm	Duct <b>non</b> jacketed Correction value in dB/octave								Duct with 50 mm insulating shell Correction value in dB/octave							
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
80	36	33	32	23	17	12	11	11	42	37	45	46	47	54	56	47
100	34	32	30	22	16	12	11	10	41	38	46	45	47	54	57	47
125	29	29	31	24	21	19	15	11	35	36	42	48	51	60	58	45
140	27	28	27	21	18	14	12	10	31	30	37	42	45	52	54	44
160	23	23	20	18	11	10	9	8	29	28	35	40	44	51	54	44
200	22	19	16	16	15	11	9	8	26	22	29	37	42	51	53	43
250	19	16	13	12	12	10	9	8	25	20	26	35	41	50	52	42
315	18	14	12	13	11	11	8	8	26	18	26	38	42	51	53	45
400	17	11	10	10	10	9	7	6	20	16	23	33	39	48	50	40

### Selection criteria to be observed:

Optimum selection of the most suitable flow rate controller should not only be based on the design duct air speed but consider other criteria as well. An air speed calculated too low or too high may result in over- or under-sized duct cross sections which may limit the space for installation of the duct system or - in case of cross sections designed too small - cause increased duct overall installation costs.

Heat and acoustic insulation should also be considered in this context.

### Legend:

(general, acoustically relevant indices)

$L_W$	[dB]	Sound power level
$L_{WA}$	[dB(A)]	Sound power level, A-weighted
$L$	[dB]	Sound pressure level
$L_A$	[dB(A)]	Sound pressure level, A-weighted
$S$	[m <sup>2</sup> ]	Duct cross section
$S_K$	[m <sup>2</sup> ]	Duct surface
$R$	[dB]	Sound reduction index
$R_{ges}$	[dB]	$R1_{(Insulated casing)} + R2_{(Insulated casing)} +$ Mineral wool
$A$	[m <sup>2</sup> ]	Equivalent absorption area (room)
$D$	[mm]	Thickness of insulating material

## Constant Flow Rate Controller Type VRW, round, self-operated

### Nomenclature

**VRW ... / . / . / ..**

**Constant flow rate controller, round**

**Size or diameter**

80  
100  
125  
140  
160  
200  
250  
315  
400

**Version**

S: steel, galvanized (regulating blade: aluminum)  
F: stainless steel V4A (1.4571)  
K: corrosion-protected, PUR finish

**Insulating shell**

-: without  
D: with

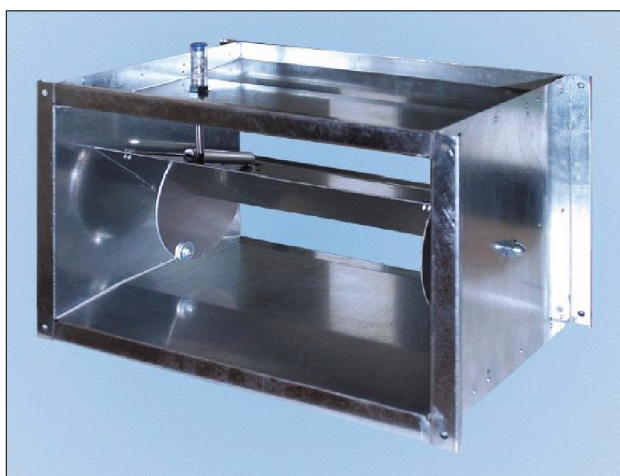
**Actuator**

-: without  
B1: Belimo LM 24  
B2: Belimo LM 230  
B3: Belimo NM 24  
B4: Belimo NM 230

## Constant Flow Rate Controller Type VRX, rectangular, self-operated

### Function

The flow rate controller VRX is a self-operated regulating device, maintaining a set flow rate within a specified pressure range. Control is realized through a regulating blade (on bearings) and a lever system with an adjusting spring. The geometry of the regulating blade ensures a prompt response even at low differential pressures at the controller. The type of spring and lever geometry selected ensures that each differential pressure is linked to a specified damper position so that the set flow rate is maintained at any time. Using the adjusting device, the flow rate may be varied. In case of the special versions, the flow rate may be changed between the minimum and maximum value using a servo-motor.



Constant Flow Rate Controller Type VRX

### Application

Essential elements are installed in the case, keeping the overall dimensions of the controller close to duct size. With this compact design, air ducts may be laid very close to one another and, without any additional transitions, providing a uniform appearance.

This general purpose controller may be used for supply and exhaust air in high and low pressure installations. With the regulating blade being balanced, any installation position is possible. However, to ensure a trouble-free operation, a proper flow profile and a favourable inflow are required, i.e. sharp-edged, cross-section reducing interior components are to be avoided.

In case of larger flow rates, parallel connections are possible.

### Advantages

- The controller frame and the attached parts are designed to meet the air-tightness requirements for cornered components or according to EN 1751 class C, respectively. Thus, leak loss and additional flow noises are effectively avoided.
- The easy-movement bearings of the regulating blade in combination with the blade projecting into the air stream ensure a high response sensitivity. Starting from the minimum response pressure, which represents a flow rate function (Diagram 2), up to the maximum pressure of 1000 Pa, the controller operates in a steady control range. Over this entire pressure range, the maximum flow rate deviation is  $\pm 10\%$ .
- All controllers are factory-set to customer-required flow rates. However, within certain limits, the customer may well change this preset flow rate to meet his personal requirements, using the adjusting device provided on the unit's outside.
- The controller may be used in a  $-20^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$  environment.
- Flow controllers VRX may also be used for e.g. smoke removal by inverting the standard direction of flow. The damper will then be completely open.

### Maintenance

Under standard conditions, all components are maintenance-free and resistant to aging and corrosion. According to general ventilation technology requirements DIN 1946, Part 2 (VDI ventilation requirements), accessibility to the duct system and to the flow rate controller is to be provided for adjustment and repair. For flow rate controllers with power adjustment observe the actuator manufacturer's instructions.

### Installation

Using a flanged profile, the controller may be connected very easily with the duct system. However, a basic requirement for proper functioning is the proper fastening of the duct system using rigid or semi-rigid connections (not loose flexibles). Furthermore, ensure that the duct is free of dirt and loose items such as cloths, papers, packaging material etc. since this would affect the controller's effectiveness. As the components essential for proper function of the flow rate controller are not attached to the outside but installed inside the frame, damage to these components is more or less excluded. However, the flow rate controller should not be distorted or otherwise deformed, and the components should always be stored protected from abrasive dirt such as sand and mortar.

## Constant Flow Rate Controller Type VRX, rectangular, self-operated

### Design

The flow rate controller frame is made of galvanized sheet steel. The frame may be manufactured according to customer requirements to meet any duct dimensions (height and width, one millimeter graduation). Thus, subsequent reductions that might affect the look of the duct system or result in a higher pressure loss or noise level are avoided. We recommend to select from the standard sizes (Chart 3) which may be delivered sooner.

The regulating blade is pivoted on special low-friction PTFE bearings.

In order to compensate any possible vibrations of the air, each flow rate controller is equipped with a piston-damper. This piston-damper is attached to the regulating

blade and disturbs the excitation frequency during quick closing and opening of the regulating blade so that no sympathetic oscillations are produced.

The flow rate controller may also be equipped with an electric actuator.

### Sound absorption and insulation

Silencers may be selected to fit any flow rate controller. In combination with the sound absorbers, favourable pressure release paths may be created. There also is a possibility to reduce emission noises through the use of an insulating shell consisting of a galvanized sheet steel jacket and a 30 mm insulating layer of mineral wool. For standard sizes a 50 mm insulation is used.

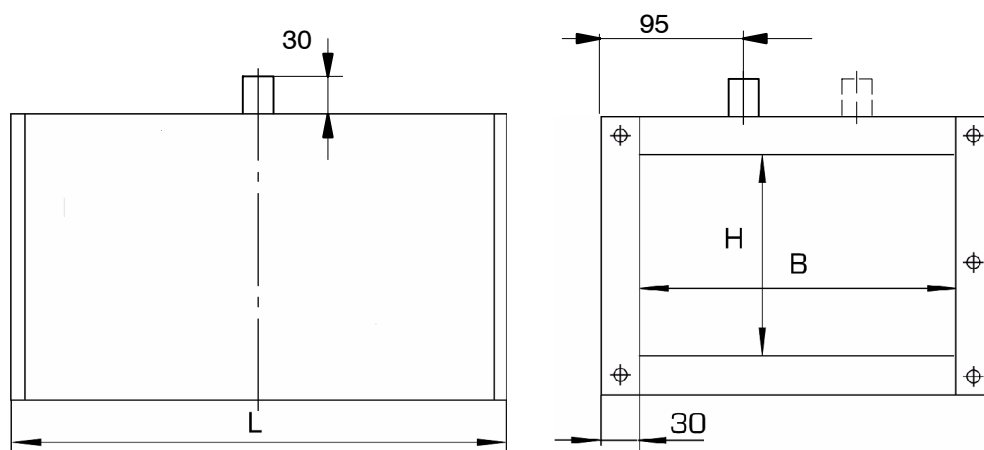


Chart 3: Dimensions

Width B	Height H	Length L	Flow speed v	Max. static pressure difference Δp
[mm]	[mm]	[mm]	[m/s]	[Pa]
150-300	150-200	385	3-10	1 000
301-400	150-200			
200-350	201-250			
351-500	201-250			
250-400	251-300			
401-500	251-300			
501-600	251-300			
Standard dimensions:				
160	160	385		
320	160			
400	200			
500	250			
600	300			

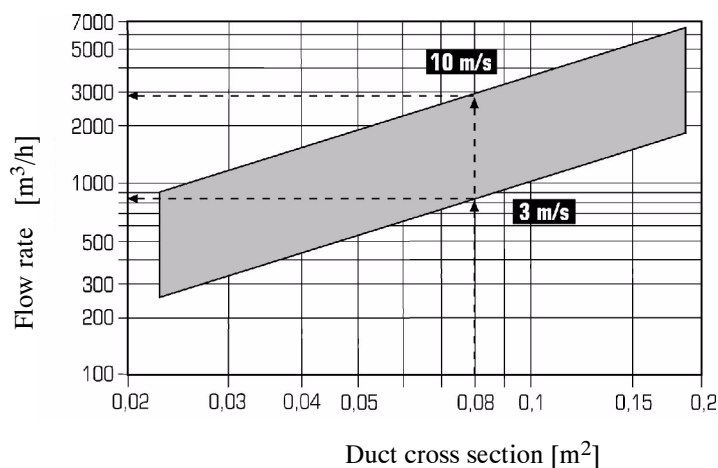
with  $H \leq B \leq 2H$

Dimensions with tolerances according to DIN EN 24190

# Constant Flow Rate Controller Type VRX, rectangular, self-operated

## Technical Characteristics

**Chart 1: Quick flow rate selection based on the duct cross section**



**Example:**

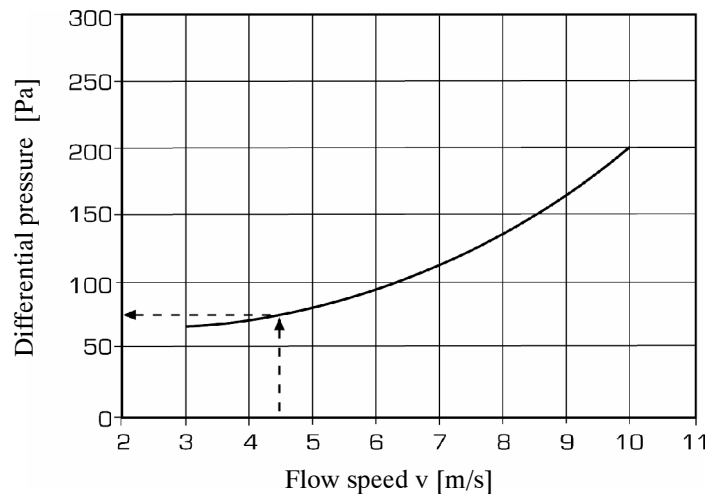
given: flow rate controller  
width 400 mm, height 200 mm  
(duct cross section 0,08m<sup>2</sup>)

required: flow rate to be selected

**Solution acc. to chart:**

$$\begin{aligned} V(3\text{m/s}) &= 865 \text{ m}^3/\text{h} \\ V(10\text{m/s}) &= 2880 \text{ m}^3/\text{h} \end{aligned}$$

**Chart 2: Static minimum response pressure difference at the flow rate controller**



**Example:**

given: flow rate controller  
width 250 mm, height 200 mm  
flow rate 810 m<sup>3</sup>/h  
(speed 4.5 m/s)

required: static minim. pressure difference  
 $\Delta p$  in Pa

**Solution acc. to chart:**

$$\Delta p = 80 \text{ Pa}$$

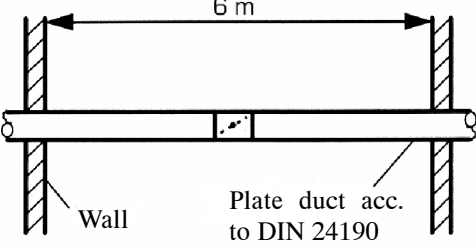
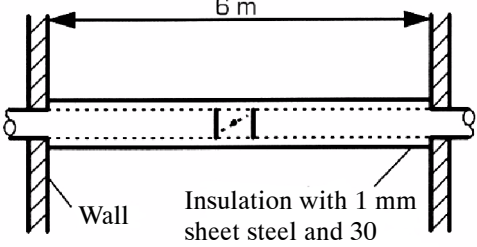
## Constant Flow Rate Controller Type VRX, rectangular, self-operated

Chart 4: Airborne sound transmission (In-duct or Outlet Noise)

Width in mm	Height in mm	Speed in m/s	Flow rate in m³/h	Static pressure difference at the controller in Pa																										
				100 Pa								250 Pa								500 Pa										
				Octave power level L <sub>W</sub> in dB/octave								Weighted power level L <sub>Wges</sub> A-weighted in dB(A)	Octave power level L <sub>W</sub> in dB/octave								Weighted power level L <sub>Wges</sub> A-weighted in dB(A)	Octave power level L <sub>W</sub> in dB/octave								Weighted power level L <sub>Wges</sub> A-weighted in dB(A)
				63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
160	160	3	276	50	49	47	46	44	42	39	36	49	58	57	55	54	52	49	47	44	57	64	63	61	60	58	55	53	50	63
		6	552	55	54	53	52	50	48	46	43	55	63	62	61	59	58	56	54	51	63	69	68	67	66	64	62	60	57	69
		9	829	57	57	56	55	53	51	49	47	59	65	65	64	63	61	59	57	55	67	71	71	70	69	67	65	63	61	73
320	160	3	553	52	51	49	48	45	43	40	37	51	60	59	57	55	53	51	48	45	59	66	65	63	61	59	57	54	51	65
		6	1106	57	56	55	53	52	49	47	44	57	65	64	63	61	60	57	55	52	65	71	70	69	67	66	63	61	58	71
		9	1659	60	59	58	57	55	53	51	48	61	68	67	66	65	63	61	59	56	69	74	73	72	71	69	67	65	62	75
400	200	3	864	54	52	51	49	47	44	41	38	52	62	60	59	57	55	52	49	46	60	68	66	65	63	61	58	55	52	66
		6	1728	59	58	56	55	53	51	48	45	58	67	66	64	63	61	59	56	53	66	73	72	70	69	67	65	62	59	72
		9	2592	61	61	60	58	56	54	52	49	62	69	69	68	66	64	62	60	57	70	75	75	74	72	70	68	66	63	76
500	250	3	1350	55	54	52	50	48	45	42	39	53	63	62	60	58	56	53	50	47	61	69	68	66	64	62	59	56	53	67
		6	2700	60	59	58	56	54	52	49	46	60	68	67	66	64	62	60	57	54	68	74	73	72	70	68	66	63	60	74
		9	4050	63	62	61	60	58	56	53	51	63	71	70	69	68	66	64	61	59	71	77	76	75	74	72	70	67	65	77
500	300	3	1620	56	53	53	51	48	46	43	40	54	64	62	61	59	56	54	51	48	62	70	68	67	65	62	60	57	54	68
		6	3240	61	60	59	57	55	52	50	47	60	69	68	67	65	63	60	58	55	68	75	74	73	71	69	66	64	61	74
		9	4860	64	63	62	60	58	56	54	51	64	72	71	70	68	66	64	62	59	72	78	77	76	74	72	70	68	65	78
600	300	3	1944	56	55	53	51	49	46	43	40	54	64	63	61	59	57	54	51	48	62	70	69	67	65	63	60	57	54	68
		6	3888	62	60	59	57	55	53	50	47	61	70	68	67	65	63	61	58	55	69	76	74	73	71	69	67	64	61	75
		9	5832	65	64	62	61	59	57	54	51	64	73	72	70	69	67	65	62	59	72	79	78	76	75	73	71	68	65	78

## Constant Flow Rate Controller Type VRX, rectangular, self-operated

**Chart 5: Correction values for calculating the emission noise of a 6 m long duct with integrated flow rate controller**

Width in mm	Height in mm																				
		without insulating shell										with insulating shell									
		Sound power level $L_W$ in dB/octave								Weighted level A-weighted in dB(A)		Sound power level $L_W$ in dB/octave								Weighted level A-weighted in dB(A)	
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz			63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz		
160	160	0	2	2	3	4	6	7	8	4		0	4	6	11	14	17	17	17	11	
320	160	0	4	5	6	8	9	11	11	8		0	6	9	14	18	20	21	20	14	
400	200	0	4	5	6	8	9	11	11	7		0	6	9	14	18	20	21	20	13	
500	250	0	4	4	6	7	9	10	12	7		0	6	8	14	17	20	20	21	13	
500	300	0	4	4	6	7	9	10	12	7		0	6	8	14	17	20	20	21	13	
600	300	0	4	4	6	7	9	10	12	6		0	6	8	14	17	20	20	21	12	

	Sound power level in dB/octave								Weighted power level A-weighted in dB(A)
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
Airborne sound transmission acc. to Chart 4	54	52	51	49	47	44	41	38	52
minus correction value acc. to Chart 5	0	6	9	14	18	20	21	20	14
minus room absorption acc. to VDI 2081	4	4	4	4	4	4	4	4	4
required casing radiated sound	50	42	38	31	25	20	16	14	34

**Example:**

given: flow rate controller  
width 400 mm, height 200 mm  
flow rate 864 m<sup>3</sup>/h  
(speed 3 m/s)  
static pressure difference  $\Delta p$  100 Pa

required: sound emission of a 6 m duct with integrated flow rate controller and 30 mm insulation

Consider insulation requirements acc. VDI 2081 data.

## Constant Flow Rate Controller Type VRX, rectangular, self-operated

### Nomenclature

**VRX ... x ... / . / . / ..**

**Constant flow rate controller,  
rectangular**

**Size**  
Width x height

**Version**  
S: steel, galvanized (regulating blade: aluminum)  
K: corrosion-protected, PUR finish

**Insulating shell**  
-: without  
D: with

**Actuator**  
-: without  
B1: Belimo LM 24  
B2: Belimo LM 230  
B3: Belimo NM 24  
B4: Belimo NM 230

## Constant Flow Rate Controller Type VRW, round, self-operated

### Specification and Schedule of Prices

Quantity	Specification	Unit price in €	Total in €
	<p><b><i>LTG Constant Flow Rate Controller Type VRW</i></b></p> <p><u>Features:</u></p> <p>Self-powered, mechanically self-acting constant flow rate controller VRW.  For installation independent of position. Compact design and shape.  Suitable for differential pressures of 50 to 1000 Pa.  Control accuracy: +/- 10%.  Subsequent adjustment of the factory-set flow rate possible through adjusting ring with scale.</p> <p><u>Flow rate controller VRW comprising of:</u></p> <p>Round casing of galvanized sheet steel.  Connection on both sides through interior transition pieces or directly with lock-seam.  Damper of aluminum, in plastic bearing for smooth movement, with vibration damper, protected against corrosion, resistant to ageing and maintenance-free.  Operation temperature range: - 20°C to 100°C.</p> <p><u>Sizes:</u></p> <p>o 80    o 100    o 125    o 140    o 160    o 200  o 250    o 315    o 400</p> <p><u>Accessories:</u></p> <p>o 1.4571 stainless steel version  o version with corrosion inhibiting PUR coating  o insulating shell 50 mm with jacket of galvanized sheet steel</p> <p><b>Manufacturer: LTG Aktiengesellschaft</b>  <b>Series: Flow Rate Controller</b>  <b>Type : VRW</b></p>		

## Constant Flow Rate Controller Type VRX, rectangular, self-operated

### Specification and Schedule of Prices

Quantity	Specification	Unit price in €	Total in €
	<p><b>LTG Constant Flow Rate Controller Type VRX</b></p> <p><u>Features:</u></p> <p>Self-powered, mechanically self-acting constant flow rate controller VRW.</p> <p>For installation independent of position. Compact design and shape. Suitable for differential pressures of 70 to 1000 Pa.</p> <p>Control accuracy: +/- 10%.</p> <p>Subsequent adjustment of the factory-set flow rate possible through adjusting device.</p> <p><u>Flow rate controller VRX comprising of:</u></p> <p>Rectangular casing of galvanized sheet steel with flanged connection C30 on both sides.</p> <p>Damper of aluminum, in plastic bearing for smooth movement, with vibration damper, protected against corrosion, resistant to ageing and maintenance-free.</p> <p>Operation temperature range: - 20°C to 110°C.</p> <p><u>Sizes:</u></p> <p>Width and height between 150 mm and 600 mm freely selectable in steps of 5 mm, with width <math>\leq 2 \times</math> height.</p> <p><u>Accessories:</u></p> <ul style="list-style-type: none"> <li>o 1.4571 stainless steel version</li> <li>o version with corrosion inhibiting PUR coating</li> <li>o insulating shell 30 mm with jacket of galvanized sheet steel</li> </ul> <p><b>Manufacturer: LTG Aktiengesellschaft</b></p> <p><b>Series: Flow Rate Controller</b></p> <p><b>Type : VRX</b></p>		