
Ref. no.: 233

Volume flow controller

With lip sealing system



**Constant volume flow controller, model VRK - circular, self-regulating
with tight push-fit ends or screwless flange-system
spigot ends according to DIN 12237
laser-welded housing**

 Considerably lowers the costs of assembly and installation.

The original - 100% Aerotechnik quality



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Ref. no.: 233

Constant volume flow controller automatically regulating - circular

- Application:** The volume flow controllers VRK are used in complex piping systems for automatically controlling the amount of air distribution. Their task is to maintain a predetermined desired value of the air flow for the supply or exhaust air of a room sustainable and independent from fluctuating channel air pressure.
- Function:** In constant-volume controllers without auxiliary power, the flow control is achieved by an easy-moving, asymmetrical angled control panel that ensures a sensitive response and control behavior even for small amounts of air flow rates.
- Response and control accuracy:** The controller operates from the minimum pressure difference, which is a function of the volume flow (see diagram 1), up to the maximum pressure difference of 1000 Pa in a stable control range. Over this entire pressure range, the flow rate deviation is $\pm 10\%$ (less than $100 \text{ m}^3 / \text{h} \pm 10 \text{ m}^3/\text{h}$). For smaller air speeds below 4 m/s and horizontal installation, the flow deviation can easily be larger than indicated above. Unfavorable flow conditions, pollution or minor bracing during installation can also cause larger deviations.
- Temperature Range:** The components of the controller are largely resistant to aging and temperature resistant from -30°C to $+100^\circ\text{C}$. On request, the controller is also available in a special version with a temperature resistance up to 180°C . As for volume controllers with actuators the limiting operating temperatures of the actuators apply, which can be different depending on the type and make.
- Controller assembly:** The control panel is mounted in a smooth and maintenance-free PTFE bushing. The support is not guided through the pipe body shell, which means that no leaks or high-frequency whistling sounds occur. A pneumatic piston damper prevents overshoot and oscillation of the control plate and ensures an accurate response and control behavior.
- Installation:** The exact balancing of the control plate is ensured by a counterweight arranged vertically on the control plate, which ensures an accurate control response in all orientations. The flow profile in front of the flow controller should be cross-section-filling, since unfavorable flow conditions (such as asymmetric flow, necking, deflection around sharp edges) can negatively affect the response and control behavior.
- Setting:** The constant-volume flow controllers are shipped with either the volume flow required by the customer or with a reference flow rate set at the factory. The volume flow can be changed at any time by the customer and read on a scale by manual adjustment with an Allen wrench (2 mm). Optionally, the air flow setpoint can be varied by an electric or pneumatic actuator.
- Dimensions:** In the selection of the controller and the dimensioning of the pipeline system it should be noted that the flow rate should not be less than 2.7 m/s in the pipe system. The front and downstream piping system to the controller should have the same diameter. As a reference value, a mean air velocity in the pipe of about 4.5 m/s is recommended as central and orientation value.
- Insulation:** The flow controllers can be implemented with a sound and heat insulation in the thicknesses 25 or 50 mm with acoustic cladding.



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Constant volume flow controller automatically regulating - circular

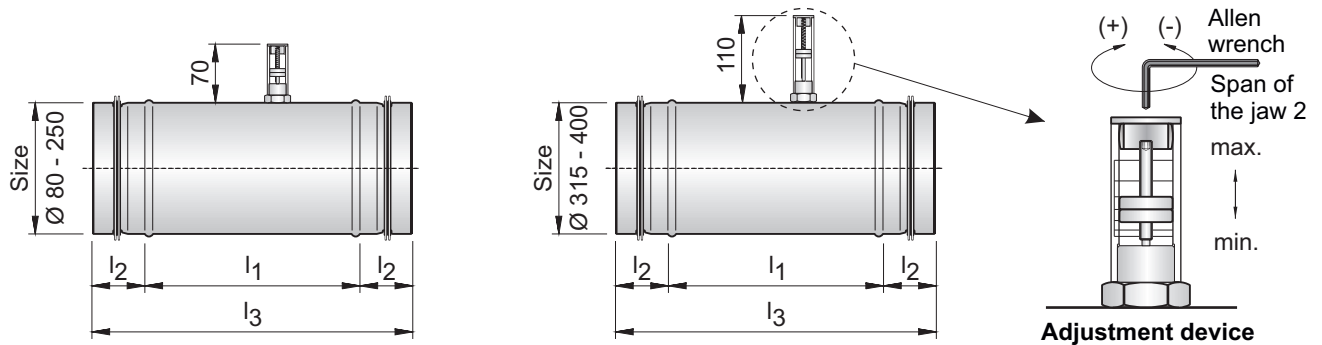
- Installation note:** According to DIN EN 12097 an accessibility to the piping system and the volume flow controller for operation and maintenance must be observed. For installation in vertical pipes an additional protection against withdrawal is needed, e.g. by pressing a wart. When installing behind redirections or junctions, the free flow section must be at least $2,5 \cdot ND$.
- Pipe body:** The body tubes are made of galvanized sheet steel or optionally of stainless steel. These are laser butt welded without disturbing misalignment of the inner and outer shell surface. The plug ends are dimensionally press calibrated according to DIN 12237 and are hereby dimensionally stable and fit accurately.
- Sealing systems of the connector:**
- Tightness:** The connector with rubber lip is air-tight according to DIN EN 12237 Class D.
- Replacement:** If the lip rubber seal is damaged or lost due to any unforeseen circumstance, a new sealing ring is easily slipped on
- Removal:** By the seal design, the components can be separated again.
- View Mounting:** There is no need for additional sealing means such as duct tape, hence the seal design with lip rubber seal is particularly suitable for visual montages. Contemporary, attractive, architectonic style.
- Hygiene:** The smooth surface of the laser-welded housing prevents the accumulation of dirt and dust particles.
- Resistance:** Ageing resistant rubber lip seal made of EPDM material, inert against weakly aggressive vapors and chemicals.
- ATEX:** The constant-flow regulator can also be manufactured in explosion-proof design according to ATEX. It can be used accordingly corresponding to the device category 2 in the gas-explosion protection zones 1 or 2, and in the dust explosion protection zones 21 and 22. The controller is characterized as follows: II 2GD c T 80° C.
- Packaging:** For the construction site storage or applications with elevated pure-safety requirements, the controllers can be supplied in a protective film for a small extra charge. Impurities in the interior of the controller, which may adversely affect the control behavior, are hereby avoided.



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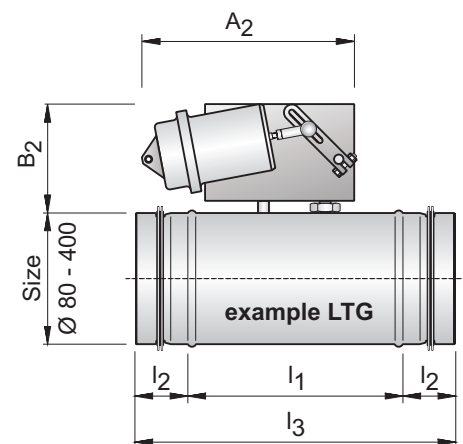


Version 1:

- Constant volume flow controller with proof plug connection (only fitting measure)
- automatically regulating without auxiliary energy, with the factory default settings or with settings predetermined by the customer set value setting the amount of air
- customers can change the amount of air by manual adjustment
- Controller in special design also available without adjustment, thereby no disturbing superior construction, thus e.g. suitable for visual montage (but air volume cannot be changed by the customer)
- l_1 = Insertion length $\text{total length} = l_1 + 2 \cdot l_2 = l_3$

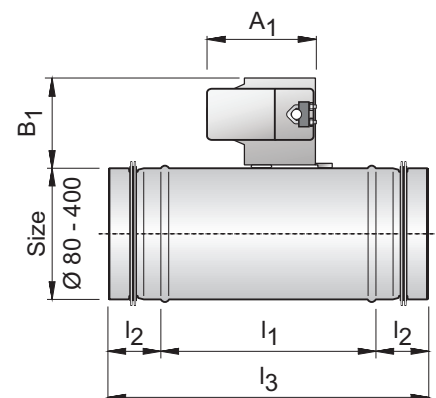
Version 2:

- Controller structure and functioning as before, factory default setting with variable control via pneumatic adjustment
- LTG controlled by a control pressure 0.2 to 1.0 bar (maximum allowable operating pressure 1.3 bar)
- Airtorque controlled by a control pressure 5.0 bar
- **Engine type:** **LTG SMA 1** or equivalent **ND ø 80 - 250 mm**
Airtorque or equivalent **ND ø 315 - 400 mm**



Version 3:

- Controller structure and functioning as before, factory default setting, two-setpoint control via electric adjustment for an operating voltage of 230 volts, 50 Hz, as a two-setpoint controller with no intermediate position, control of the setpoints via switching contacts.
- **Engine type:** **Belimo LM 230A** or equivalent **ND ø80 - 400 mm**



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Version 5:

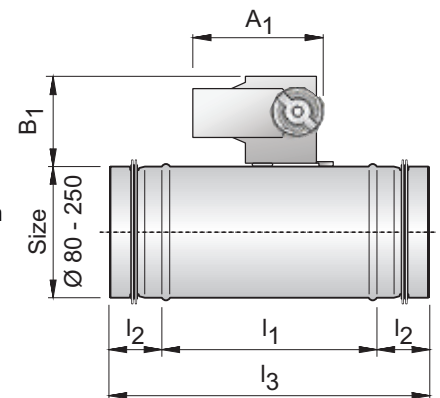
- Controller structure and functioning **analogous to version 3**, but with an operating voltage of 24 volts
- Engine type: **Belimo LM 24A** or equivalent ND ø 80 - 400 mm

Version 6:

- Controller structure and functioning **analogous to version 3**, but variable control via electric adjustment for an operating voltage of 24 volts, 50 Hz, with the control signal 2-10 VDC
- Engine type: **Belimo LM 24A-MF** or equivalent ND ø 80 - 400 mm

Version 7:

- Controller structure and functioning **analogous to version 3**.
- Engine type: **Belimo CM 230-L** or equivalent ND ø 80 - 250 mm



Version 8:

- Controller structure and functioning **analogous to version 7**, but with an operating voltage of 24 volts
- Engine type: **Belimo CM 24-L** or equivalent ND ø 80 - 250 mm

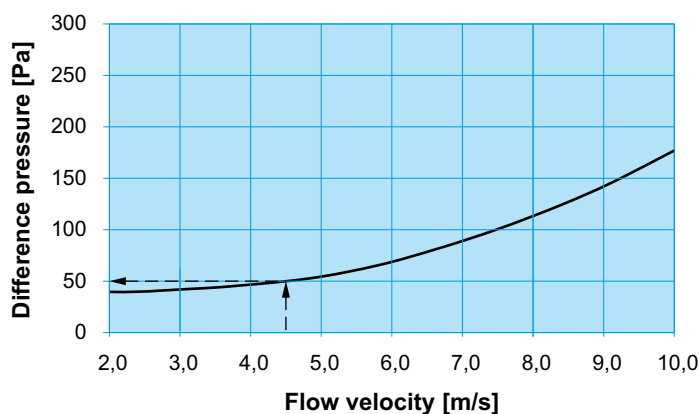
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Minimum response pressure difference

- When dimensioning the tube system, the static minimum response pressure difference of the flow regulator according to diagram 1 is to be observed

Diagram 1: Reference values for sensitivity



Example:

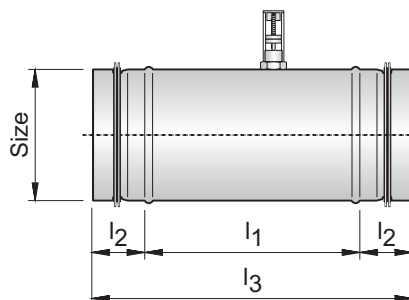
Flow Controller: Type 233
Nominal width: 160 mm
Flow velocity: 4,5 m/s
Flow rate: 325 m³/h

Minimum static pressure difference Pa:

Δp [Pa] according to Diagram 1: 50 Pa

Dimensions – volume flow

Size [mm]	Volume flow [m ³ /h]		Dimensions [mm]						
	min.	max.	l ₁	l ₂	l ₃	A ₁	B ₁	A ₂	B ₂
80	40	125	135	40	215	160	102	225	100
100	70	220	165	40	245	160	102	255	100
125	100	280	165	40	245	160	102	225	100
140	150	400	165	40	245	160	102	225	100
150	170	450	165	40	245	160	102	225	100
160	180	500	235	40	315	160	102	225	100
180	200	600	235	40	315	160	102	225	100
200	250	900	235	40	315	160	102	225	100
250	500	1600	235	40	315	160	102	225	100
300	700	2500	225	60	345	138	102	300	150
315	800	2800	225	60	345	138	102	300	150
355	900	3200	295	60	415	132	131	300	150
400	1000	4000	295	60	415	132	131	300	150



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Flow noise and calculation examples for room sound pressure level

The sound acoustic rating starts at the sound source which can be of various origins (e.g. fan and damper). Characteristic of a given sound source is the sound power level. This is numerically equal to the sound pressure level when the pressure level refers to the area of 1 m^2 . The task is fundamentally to achieve a given sound pressure level in the room, which yields for the specific application type and size of the sound insulation.

Figure 1 shows a pipe without a silencer, however, a silencer is fitted in Figure 2 and its effectiveness and impact identified. With very different volumes of air an increase of the flow noise can occur with larger air velocities in the pipe system.

In the example shown (Figure 2) this can be met by the installation of an absorption silencer (insertion loss in the pipe system). The representations (Figure 1-4) are not entitled to an accurate assessment in terms of the variety of different sound acoustic influences.

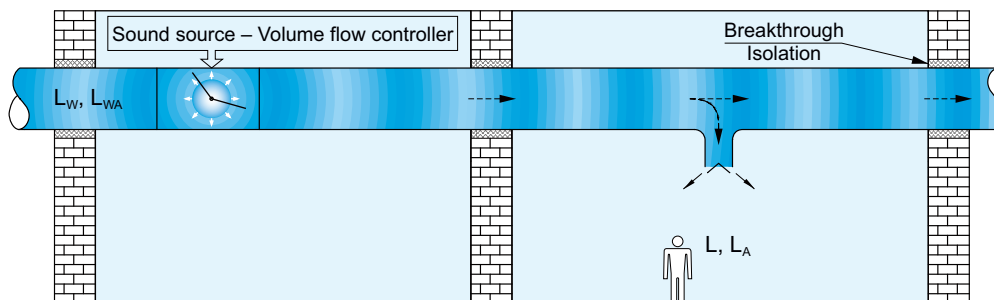


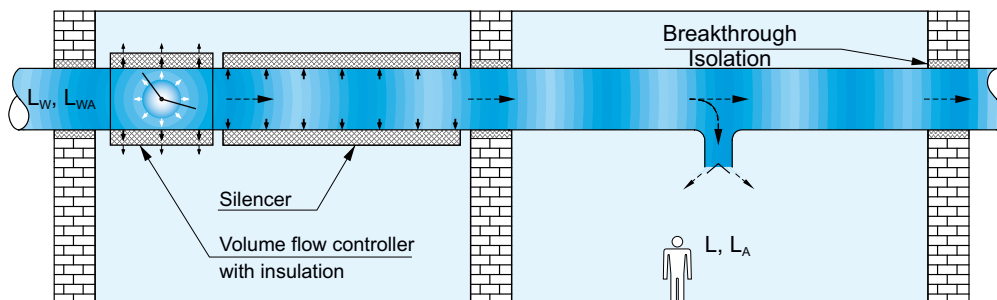
Figure 1: Presentation – Volume flow controller **without** silencer

f_m	Sound level [dB/octave]								Summation A-weighted dB (A)
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
Flow noise L_w acc. to table 1	53	51	47	44	43	42	36	34	48
Reflection attenuation	-21	-16	-10	-4	-2	0	0	0	-
Room attenuation	-4	-4	-4	-4	-4	-4	-4	-4	-
A-evaluated	-26	-16	-9	-3	0	1	1	-1	-
Corrected sound pressure level L_A	2	15	24	33	37	39	33	29	42

Evaluation Example:

Default for room sound pressure level:	42 dB (A)
Flow controller:	Type 233
Nominal:	140 mm
Flow rate:	270 m ³ /h
Minimum static pressure difference:	100 Pa

Calculated room sound pressure level = 42 dB (A)



Example 2: Calculation of noise-generated by air flow **with** attenuator

f_m	Sound level [dB/octave]								Summation A-weighted dB (A)
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
Flow noise L_w acc. to table 1	62	60	56	53	51	51	44	43	57
Attenuation by silencer	-1	-2	-5	-10	-25	-34	-17	-12	-
Reflection attenuation	-20	-14	-9	-3	-1	0	0	0	-
Room attenuation	-4	-4	-4	-4	-4	-4	-4	-4	-
A-evaluated	-26	-16	-9	-3	0	+1	+1	-1	-
Corrected sound pressure level L_A	11	24	29	33	21	14	24	26	35

Evaluation Example:

Default for room sound pressure level:	38 dB (A)
Flow controller:	Type 233
Nominal width:	160 mm
Flow rate:	340 m ³ /h
Minimum static pressure difference:	250 Pa
Silencer:	160 / 200 x 1000 mm

Calculated room sound pressure level = 35 dB (A)

Constant volume flow controller automatically regulating - circular

Table 1: Air flow noise generated by the controller

Size [mm]	Volume flow [m³/h]	Static pressure difference at the controller [Pa]																											
		100 Pa								Summation L _{w, sum} A-weighted dB(A)	250 Pa								Summation L _{w, sum} A-weighted dB(A)	500 Pa								Summation L _{w, sum} A-weighted dB(A)	
		Octave power level*									Octave power level*									Octave power level*									
		L _w [dB/octave]									L _w [dB/octave]									L _w [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		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	
100	70	40	39	38	36	35	36	30	29	41	43	45	46	46	47	49	44	43	53	49	52	52	53	54	55	50	50	60	
	135	50	48	45	42	41	40	34	33	46	59	57	54	51	50	49	43	42	55	60	60	58	57	57	58	53	52	63	
	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	
140	150	43	42	40	38	37	37	31	30	42	47	49	49	49	50	51	46	45	55	53	56	56	56	56	58	52	51	62	
	270	53	51	47	44	43	42	36	34	48	61	59	56	53	51	51	44	43	57	63	63	61	60	59	60	54	54	65	
	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	
150	150	43	42	40	38	37	37	31	30	42	47	49	49	49	50	51	45	44	55	54	56	56	56	56	57	52	51	62	
	270	52	50	46	43	41	41	34	33	47	56	56	54	52	52	52	46	46	57	63	62	60	59	58	59	53	52	64	
	400	56	54	50	47	46	45	39	38	51	64	62	59	56	54	54	48	46	60	65	65	64	62	62	63	57	57	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	
	340	53	51	48	44	43	42	36	34	48	62	60	56	53	51	51	44	43	57	64	64	62	60	60	60	55	54	65	
	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	800	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	
	1400	57	55	52	48	46	45	39	37	51	66	64	60	57	55	54	47	46	60	70	69	67	65	64	64	58	57	69	
	2200	-	-	-	-	-	-	-	-	-	71	69	65	62	60	59	53	51	65	77	75	72	69	67	66	60	58	72	
355	900	50	48	46	43	42	41	35	33	47	57	58	57	56	55	55	49	47	60	64	65	64	63	62	62	55	53	67	
	2000	59	57	53	50	48	47	40	39	53	68	66	62	59	57	56	49	47	62	72	71	69	67	66	66	60	59	71	
	3200	-	-	-	-	-	-	-	-	-	73	71	67	64	62	61	55	54	68	79	77	74	71	69	68	62	60	74	
400	1000	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 level in dB/octave in relation to 10⁻¹² W

If air is blown into a room, the tube orifice and the room absorption provide an additional damping and thus reduce the sound power level.

According to VDI 2081, the spatial and mouth damping can be calculated. Roughly, approximately 8 dB can be deducted. To comply with a required sound pressure level for the room, it may be necessary to mount a correspondingly to be designed absorption silencer between the volume flow controller and the room or to insulate the pipe.

The flow noise is highly dependent on local conditions, the radiating area of the pipe (pipe diameter and length) after the muffler and the sound insulation. The data reported here, which were determined in the laboratory, can only be an indication of value. The sound power can be increased by an additional sound source (e.g. a fan, unfavorable flow conditions or the like). If this additional sound power level is about 10 dB lower than the sound power level of the volume flow controller, it does not cause an increase in the addition.

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Radiated noise

If a pipe with an internal sound source (e.g. flow controller, fan noise) is led through a room, a sound radiation is emitted forcibly through the pipe surface into the room. The level of the sound pressure level felt in the room is dependent on the sound power level in the pipe, the pipe surface, the line shape (round, square), the wall thickness of the pipe and the space damping as well as the distance to the pipeline.

To calculate the expected sound pressure level in the room subtract from the sound power level inside the tube (flow noise L_W [dB / octave]) the appropriate level correction value. The sound insulation by a possibly retracted ceiling between the radiating pipe and the used space is to be considered, generally with about 4 dB.

If the required maximum sound pressure level is exceeded, provide a jacketed piping with a higher sound reduction, possibly with a hard shell.

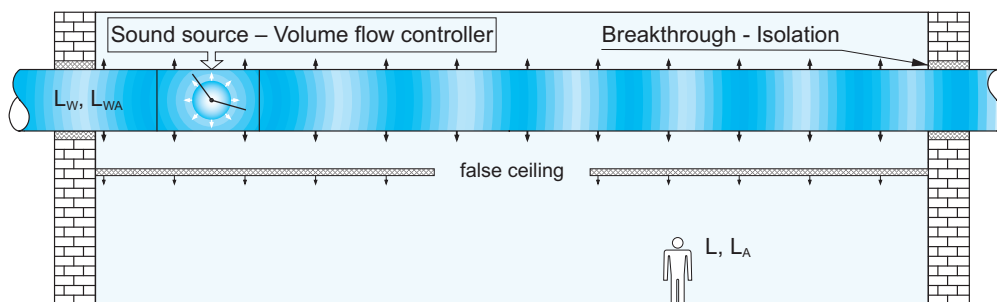
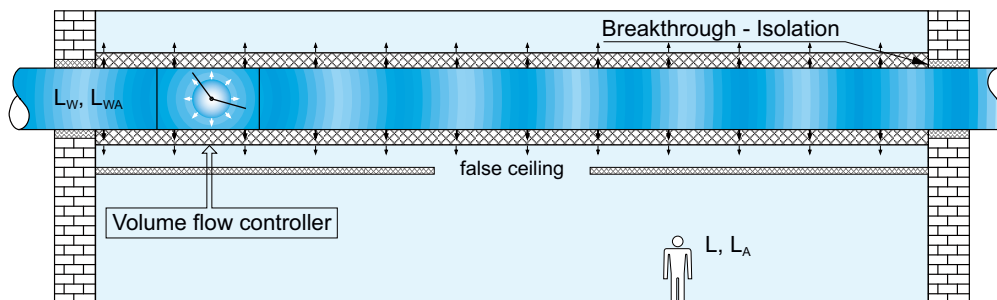


Figure 3: Representation - radiated noise in the room - pipe not covered

f_m	Sound level [dB/octave]								Summation A-weighted dB (A)
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
Flow noise L_W acc. to table 1	61	59	56	53	51	51	44	43	57
Reflection attenuation	-27	-28	-27	-21	-18	-14	-12	-10	-
Room attenuation	-4	-4	-4	-4	-4	-4	-4	-4	-
A-evaluated	-26	-16	-9	-3	0	+1	+1	-1	-
Corrected sound pressure level L_A	4	11	16	25	29	34	29	28	37

Evaluation Example:

Default for room sound pressure level:	38 dB (A)
Flow controller:	Typ 233
Nominal width:	140 mm
Flow rate:	270 m ³ /h
static pressure difference:	250 Pa
Calculated room sound pressure level:	37 dB (A)
in false ceiling:	-4 dB (A)



Example 3: Calculation of the radiating noise of an insulated pipe

f_m	Sound level [dB/octave]								Summation A-weighted dB (A)
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
Flow noise L_W acc. to table 1	72	70	67	64	62	62	56	54	68
Reflection attenuation	-27	-26	-28	-29	-27	-31	-31	-25	-
Room attenuation	-4	-4	-4	-4	-4	-4	-4	-4	-
A-evaluated	-26	-16	-9	-3	0	+1	+1	-1	-
Corrected sound pressure level L_A	15	24	26	28	31	28	22	24	35

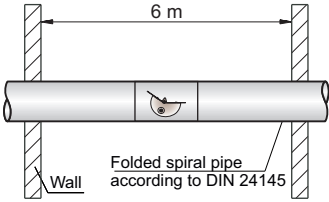
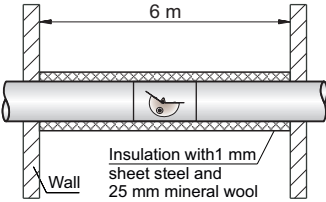
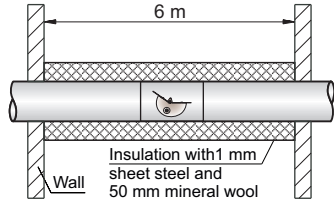
Evaluation Example:

Default for room sound pressure level:	38 dB (A)
Flow controller:	Type 233
Nominal width:	160 mm
Flow rate:	500 m ³ /h
static pressure difference:	500 Pa
Cladding:	25 mm
Calculated room sound pressure level =	35 dB (A)
in false ceiling	-4 dB(A)

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Table 2: level correction values to calculate the radiated noise of a 6 m long pipe with built-in flow-regulator

Size [mm]																								
	Correction value [dB/octave]								Correction value [dB/octave]								Correction value [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	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	39	35	39	35	32	33	34	29	42	37	45	46	47	54	56	47
100	34	32	30	22	16	12	11	10	38	35	38	34	31	33	34	28	41	38	46	45	47	54	57	47
125	29	29	31	24	21	19	15	11	35	33	37	36	32	33	36	27	35	36	42	48	51	60	58	45
140	27	28	27	21	18	14	12	10	29	29	32	32	32	33	33	26	31	30	37	42	45	52	54	44
150	25	25	23	19	14	12	11	9	28	27	30	30	29	32	32	25	30	29	36	41	44	51	54	44
160	23	23	20	18	11	10	9	8	27	26	28	29	27	31	31	25	29	28	35	40	44	51	54	44
180	22	21	18	17	12	10	9	8	25	22	25	27	27	30	30	24	27	25	32	38	43	51	53	43
200	22	19	16	16	15	11	9	8	23	18	23	26	29	29	29	24	26	22	29	37	42	51	53	43
250	19	16	13	12	12	10	9	8	23	18	20	24	26	30	28	24	25	20	26	35	41	50	52	42
315	18	14	12	13	11	11	8	8	22	17	19	23	27	29	28	24	26	18	26	38	42	51	53	45
355	17	12	11	11	10	10	7	7	20	15	18	22	26	28	27	23	23	17	24	35	40	49	51	42
400	17	11	10	10	10	9	7	6	19	14	17	22	25	28	27	23	20	16	23	33	39	48	50	40

Key to symbols

(general sound acoustically relevant indices)

L_W	[dB]	sound power level
L_{WA}	[dB (A)]	sound power level, A-evaluated
L	[dB]	sound pressure level
L_A	[dB (A)]	Sound pressure level, A-evaluated



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