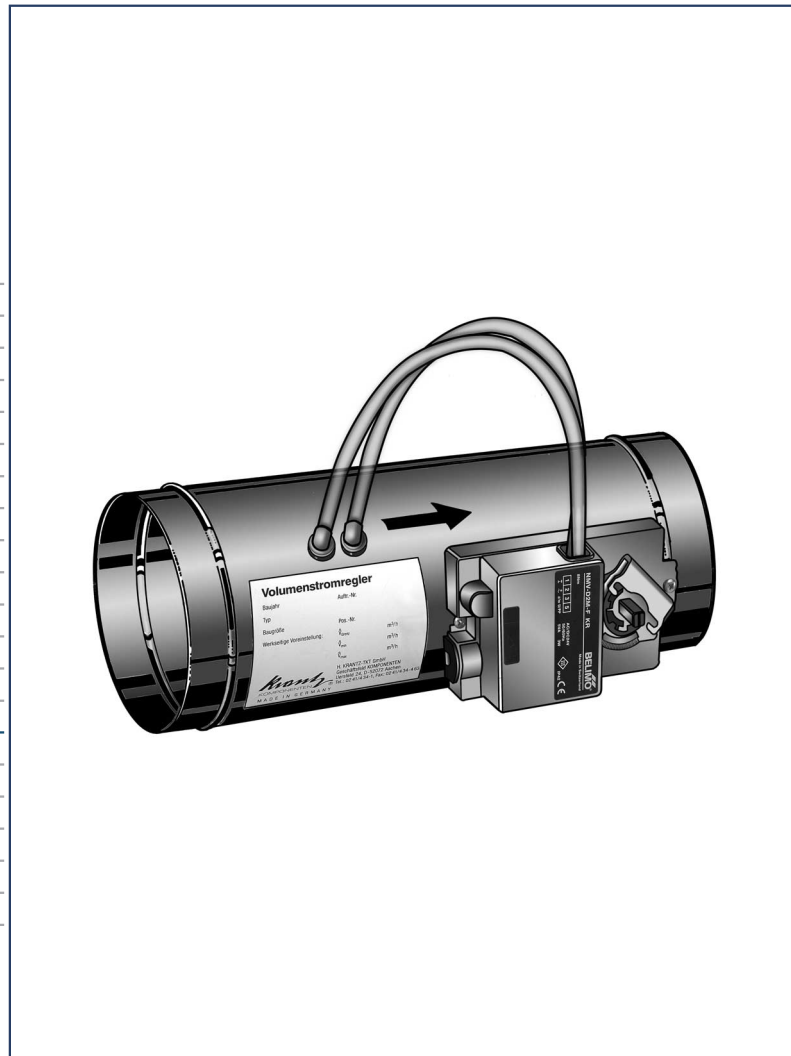


Please note,
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see last page.

Technical Selection



**Volume flow controller with built-in
measured-value recording VRI-DN....**

Volume flow controller

Construction and mode of operation

The main components of the volume flow controller (\dot{V} controller) with built-in measured-value recording are the housing 1, damper blade 2, measuring cross 3, shutoff plate 4, differential pressure sensor 5, controller 6 and servomotor 7. The housing is made of galvanized sheet steel for connection to ducts to DIN 24145 as well as DIN 24146, and the damper blade consists of two sheet steel discs with interjacent silicon seal ¹⁾.

In built-in measured-value recording the dynamic pressure is measured at the measuring cross to obtain a mean, and compared with the set point. Depending on the discrepancy the controller gives a control signal to the servomotor which adjusts the damper till the set point has been reached.

Measured-value recording

The dynamic pressure is measured at the measuring cross using the dynamic method (Figure 1).

To record the dynamic pressure the central tube of the measuring cross is closed by the shutoff plate 4.

In the dynamic method both pressure gauge spigots – in front of and behind the shutoff plate – are connected together to form a bypass. The velocity of air flow in the bypass is proportional to the root of the dynamic pressure. It is measured by the differential pressure sensor 5 and transmitted to the controller 6 as a measured-value signal.

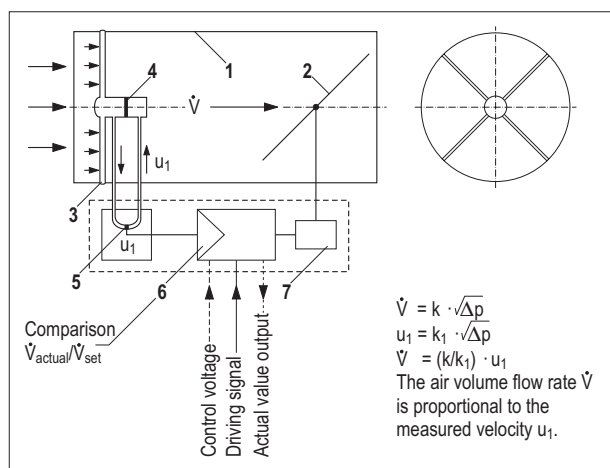


Fig. 1: \dot{V} controller with dynamic pressure recording using the dynamic method

Key	3 Measuring cross	6 Controller
1 Housing	4 Shutoff plate	7 Servomotor
2 Damper blade	5 Differential pressure sensor	8 Insulating shell

1) Other materials on request

Size

Nine different sizes are available, ranging from DN 100 to DN 450. \dot{V} controllers are available with or without insulating shells.

Size DN	D_a mm	D_{a1} mm	L mm	L_1 mm
100	99	180	350	270
125	124	205	350	270
160	159	240	370	290
200	199	280	430	350
224	223	304	460	380
250	249	330	500	420
315	314	395	580	500
400	399	480	670	590
450	449	530	730	650

Table 1: Dimensions of \dot{V} controller

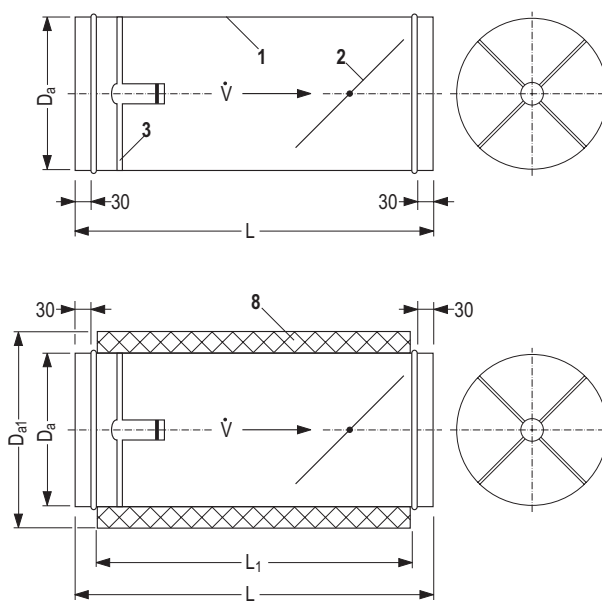


Fig. 2: Construction design of \dot{V} controller
Above: Without insulating shell
Below: With insulating shell

The volume flow rate is calculated from the air flow velocity in relation to the respective nominal cross-section. For normal acoustic requirements we recommend limiting the air flow velocity to a range of 1.5 to 10 m/s.

Higher velocities (up to 15 m/s) are quite possible for applications without acoustic requirements. The graph in Figure 3 shows the volume flow rate in correlation to air flow velocity for the various sizes.

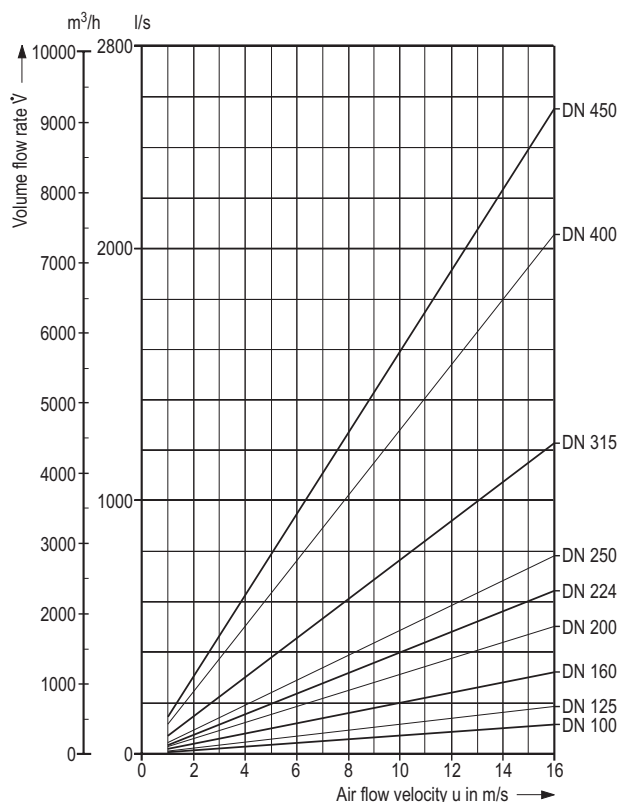


Fig. 3: Size and volume flow rates

Control functions

\dot{V} controllers can perform the following control functions:

- Maintaining a constant nominal volume flow rate in constant air volume (CAV) systems,
- Step switching between \dot{V}_{\max} and \dot{V}_{\min} ,
- Altering the volume flow rate in response to the cooling load in variable air volume (VAV) systems,
- Forced control:
 - Damper 'closed' ($\dot{V} = 0$), e.g. if windows are opened during operation or a room is unoccupied, at 2 – 10 V working range and 0 V driving range
 - \dot{V}_{\max} or \dot{V}_{\min} ,
- Cascade control of supply air and return air to ensure the desired positive or negative pressure,
- Parallel connection of several \dot{V} controllers in the supply air or return air system of a room or control zone.

The actual value of the controlled volume flow rate is available as an output signal for other functions, e.g.

- for the sequential and parallel operation of several \dot{V} controllers,
- to actuate the adjusting device of air outlets,
- as information in building management systems.

The controllers are set to the limit volume flow rate¹⁾ at the manufacturer's works. The limit volume flow rate is the maximum measurable volume flow rate (maximum working range). The volume flow rate is controlled with an accuracy of $\pm 5\%$ in relation to the limit volume flow rate.

The lowest measurable volume flow rate is at an air velocity in the duct of about 1.5 m/s.

The setpoint is input via a linear signal (0 – 10 V or 2 – 10 V) between the set values for \dot{V}_{\min} (0 V or 2 V) and \dot{V}_{\max} (10 V).

The actual value is indicated via a linear signal (0 – 10 V or 2 – 10 V) between 0 l/s (m^3/h) (0 V or 2 V) and the limit volume flow rate set at the manufacturer's works to Table 2 (10 V). Please note that the limit volume flow rate is usually higher than the set maximum volume flow rate and therefore the setpoint signal and the actual-value signal are different. For example, for a setting of

$\dot{V}_{\max} = 80\%$ with a driving signal w at the controller = 10 V and $\dot{V}_{\min} = 0\%$, the actual-value signal U_5 at the controller amounts to

- 8 V in a working range of 0 – 10 V and
- 8.4 V in a working range of 2 – 10 V.

(See Figure 4 on page 4 and Figure 5 on page 5)

As standard the volume flow controller is fitted with a Belimo controller of type NMV-D2M.

1) See Table 2, page 5

Volume flow controller

Function, mode of operation

Function

The volume flow controller of type VRI works as an independent control loop, i.e. pressure variations in the ductwork are sensed and automatically compensated for.

NMV-D2M controller

The controller, sensor and servomotor are accommodated in a common housing. The controller is set to the power range L 10 or L 13 (see Table 2) at the manufacturer's works. The driving signal is input either via a 0 – 10 V signal or via a 2 – 10 V signal.

The volume flow actual-value signal U_5 shows the current volume flow rate measured by the measuring cross. It corresponds to 0 – 100 % of the set limit volume flow (\dot{V}_{limit}).

The \dot{V}_{min} and \dot{V}_{max} values can be set via a Belimo setting unit of type ZEV.

Details on wiring and control functions, particularly on possibilities of forced control, are contained in the technical documentation from Belimo.

All Belimo components require 24 V~ supply voltage.

Mode of operation

Constant Air Volume (CAV) systems

In CAV applications the volume flow controller adjusts and controls the required constant volume flow. Depending on the requirements it is possible to set one or several operating steps.

The following operating steps are available (Working range 2 – 10 V):

CLOSED / \dot{V}_{min} / \dot{V}_{MID} / \dot{V}_{max} / OPEN

- Shutoff mode – Damper CLOSED:
The damper is moved to defined 'CLOSED' (0 %).
- Operating steps \dot{V}_{min} / \dot{V}_{MID} / \dot{V}_{max} :
The volume flow controller provides fixed regulation of the preset volume flow.
- Full ventilation mode – Damper OPEN:
For maximum ventilation the damper can be fully opened (100 %); the volume flow controller is then inoperative.

Variable Air Volume (VAV) systems

In VAV applications the requested volume flow rate is set via a driving signal 0/2 – 10 V (setting range) or via the bus system. The required volume flow rate is linearized within the setting range \dot{V}_{min} to \dot{V}_{max} .

- Shutoff mode (CLOSED) with \dot{V}_{min} 0 %
If shutoff is required in a VAV application, it can be achieved by setting \dot{V}_{min} to 0 %.
- Shutoff mode (CLOSED) with 0 - 10 V control in working range 2 - 10 V
In the working range 2 – 10 V the following functions can be achieved with a 0 – 10 V signal:

Driving signal w	Volume flow	Function
< 0.1 V	CLOSED	Damper CLOSED, control inactive
0.2 – 2 V	\dot{V}_{min}	Operating step \dot{V}_{min} active
2 – 10 V	\dot{V}_{min} to \dot{V}_{max}	Continuous operation \dot{V}_{min} to \dot{V}_{max}

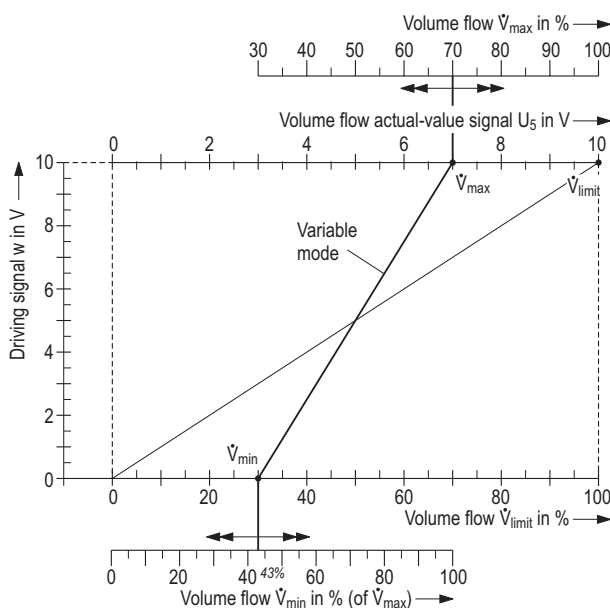


Fig. 4: Example with working range 0 – 10 V

Measured-value recording	Controller		Size DN									
			100	125	160	200	224	250	315	400	450	
Power range L10	Belimo NMV-D2M	Limit volume flow rate	l/s	65	108	189	308	394	500	833	1397	1805
			m ³ /h	235	390	680	1110	1420	1800	3000	5030	6500
Air velocity		m/s	8.3	8.8	9.4	9.8	10.1	10.3	10.7	11.2	11.4	
L13		Limit volume flow rate	l/s	85	142	247	400	511	650	1078	1808	2336
		m ³ /h	305	510	890	1440	1840	2340	3880	6510	8410	
	Air velocity	m/s	10.8	11.5	12.3	12.8	13.0	13.3	13.9	14.4	14.7	

Table 2: Limit volume flow rates and limit velocities

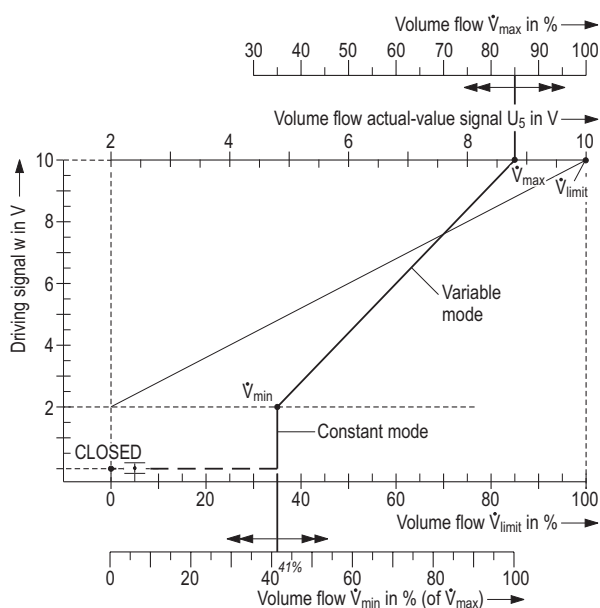


Fig. 5: Example with working range 2 – 10 V

'MP-Bus' linking to LonWorks® or DDC systems

Through the integrated communication facility the volume flow controller can be linked to as many as 8 Belimo MFT2 driving elements (damper actuators, valve actuators, 'VAV-Compact' controllers) via Belimo's 'MP-Bus' system. Linking can be made either to LonWorks® via the UK24LON interface of Belimo, or to a DDC system via Belimo's 'MP-Bus' system.

Mounting instructions

Mounting position

The VRI controller of KRANTZ KOMponenten can be mounted in any axial position.

Minimum spacing

So as not to restrict the accuracy of measurement a straight length of at least 2 x DN shall be maintained upstream from the \dot{V} controller, and of at least 1 x DN downstream (Figure 6), DN being the nominal diameter of the volume flow controller.

The volume flow controller is fitted with a nameplate stating its size and the preset volume flow rate. The \dot{V} controller shall be mounted in such a way that the nameplate can be easily read during commissioning and inspection.

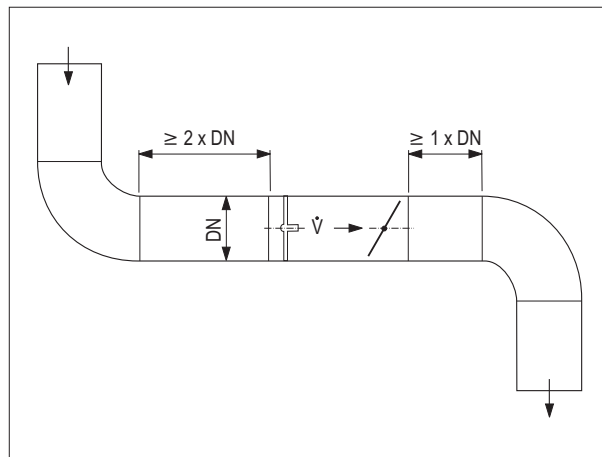


Fig. 6: Minimum spacing to a bend or a branch duct



Fig. 7: Photograph of a VRI volume flow controller

Nominal Ø	Volume flow rate		Air flow velocity	Static differential pressure Δp in Pa																															
				100								300								500								1000							
				Sound power level L_W in dB								Sound power level L_W in dB								Sound power level L_W in dB								Sound power level L_W in dB							
				Octave band centre frequency in Hz								Octave band centre frequency in Hz								Octave band centre frequency in Hz								Octave band centre frequency in Hz							
DN	l/s	m ³ /h	m/s	125	250	500	1000	2000	4000	8000	L_{WA} in dB(A)	125	250	500	1000	2000	4000	8000	L_{WA} in dB(A)	125	250	500	1000	2000	4000	8000	L_{WA} in dB(A)	125	250	500	1000	2000	4000	8000	L_{WA} in dB(A)
100	15	55	2	28	21	16	10	10	9	8	20	34	29	24	17	17	16	16	27	38	33	28	22	21	19	18	32	41	37	32	30	27	24	23	37
	30	110	4	31	26	20	14	14	14	12	23	36	33	26	21	21	19	18	30	39	36	30	26	26	24	20	35	42	40	34	33	30	27	25	39
	47	170	6	35	31	25	19	19	18	16	28	39	36	29	25	25	23	20	34	40	39	33	30	30	29	23	38	43	42	37	36	33	30	28	42
	61	220	8	36	36	30	25	25	21	19	33	40	41	34	30	29	26	22	38	43	44	38	34	33	31	25	41	47	46	41	39	38	35	32	46
	78	280	10	37	41	35	30	30	25	21	38	41	47	39	34	33	29	24	42	46	49	42	37	37	33	29	45	51	50	46	42	43	39	36	50
125	25	90	2	29	21	16	10	10	9	9	20	37	31	26	19	18	17	17	29	40	34	29	24	23	20	19	33	44	39	34	32	30	27	26	39
	50	180	4	32	24	19	13	13	12	12	23	38	35	29	23	22	20	19	32	42	37	33	28	27	25	22	36	45	41	36	35	32	29	28	41
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	161	580	8	37	33	31	27	26	22	21	33	43	42	38	34	32	30	25	41	47	44	41	39	37	34	29	45	51	48	45	44	42	38	35	49
	201	725	10	40	40	37	32	31	27	25	39	44	45	41	36	35	33	28	44	48	45	42	39	38	37	31	46	53	53	49	47	45	42	38	53
200	63	225	2	31	24	17	12	10	10	9	21	41	33	28	24	22	20	19	33	44	39	36	32	30	26	23	39	49	42	39	37	35	30	29	43
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	1590	5725	10	58	52	52	47	48	43	41	54	59	54	54	48	48	46	42	56	62	57	56	53	52	52	46	60	65	60	59	56	55	55	50	63

Volume flow controller



Sound power level of housing sound radiation (with insulating shell)

Nominal Ø DN	Volume flow rate l/s m³/h		Air flow velocity m/s	Static differential pressure Δp in Pa																															
				100								300								500								1000							
				Sound power level L _W in dB								Sound power level L _W in dB								Sound power level L _W in dB								Sound power level L _W in dB							
				Octave band centre frequency in Hz								Octave band centre frequency in Hz								Octave band centre frequency in Hz								Octave band centre frequency in Hz							
			125	250	500	1000	2000	4000	8000	L _{WA} in dB(A)	125	250	500	1000	2000	4000	8000	L _{WA} in dB(A)	125	250	500	1000	2000	4000	8000	L _{WA} in dB(A)	125	250	500	1000	2000	4000	8000	L _{WA} in dB(A)	
100	15	55	2	23	16	13	10	10	9	8	18	29	24	20	12	11	10	10	22	33	28	23	17	13	11	11	25	36	32	27	23	16	17	13	29
	30	110	4	26	20	17	11	11	11	10	20	31	28	21	14	13	12	11	24	34	31	24	18	14	14	12	27	37	35	28	24	19	17	14	31
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200	63	225	2	26	20	15	10	10	10	9	19	36	27	20	14	12	12	10	24	39	33	28	22	15	14	11	30	44	36	31	27	20	15	12	33
	125	450	4	29	22	16	12	11	11	10	21	37	30	23	19	14	14	11	27	41	35	30	26	18	16	13	32	46	39	34	30	23	17	14	36
	189	680	6	35	25	18	17	14	12	10	24	39	32	27	24	17	15	12	30	43	37	33	30	21	18	13	34	47	42	37	33	26	19	15	38
	250	900	8	37	25	23	20	19	17	14	27	41	34	31	26	20	16	14	33	44	43	34	31	22	19	15	37	47	44	40	36	28	20	18	42
	314	1130	10	40	33	31	26	26	21	20	34	43	37	35	28	23	17	15	36	45	39	36	31	25	20	16	38	50	37	42	38	31	24	20	43
224	78	280	2	30	21	16	11	11	11	10	21	39	31	22	15	13	13	12	27	41	36	32	24	18	15	14	33	46	40	36	31	23	16	15	38
	156	560	4	33	24	18	14	13	13	12	23	41	36	26	20	15	14	13	30	43	38	34	27	22	14	13	35	47	42	38	32	26	17	14	39
	236	850	6	35	28	23	18	16	14	13	26	43	37	30	24	19	15	14	33	44	39	36	30	26	17	13	37	49	44	40	36	28	20	17	42
	311	1120	8	39	33	29	22	20	18	16	31	45	38	36	28	21	19	18	36	45	40	36	31	28	20	18	38	50	46	42	38	31	23	20	43
	394	1420	10	43	37	36	28	27	20	18	37	46	39	38	30	26	23	21	38	46	41	37	32	30	23	21	39	51	48	43	40	33	26	22	45
250	97	350	2	33	24	17	12	12	12	10	22	40	34	25	21	13	13	12	30	43	39	36	28	22	13	13	36	48	45	42	35	28	17	14	42
	194	700	4	35	26	22	15	14	14	12	24	40	34	30	25	19	14	12	32	43	39	37	30	26	19	13	37	50	47	44	37	31	21	17	44
	294	1060	6	36	28	27	21	17	14	13	28	40	34	32	27	25	19	13	34	43	40	37	32	30	26	18	39	52	49	45	40	34	25	21	46
	389	1400	8	40	33	31	25	21	16	13	31	43	42	35	29	27	21	13	38	47	42	39	33	31	26	19	40	53	50	45	41	35	28	23	47
	492	1770	10	45	38	37	29	25	18	14	37	47	41	40	32	28	22	17	40	49	43	40	35	32	27	20	42	54	51	46	42	36	30	25	48
315	156	560	2	36	28	20	12	11	11	11	24	46	37	29	26	17	13	10	34	48	41	39	31	26	15	10	40	50	45	43	36	29	19	15	43
	311	1120	4	39	31	23	17	14	14	11	28	47	39	33	30	21	17	11	36	50	43	41	34	29	20	15	42	52	47	45	39	32	22	18	46
	467	1680	6	43	34	27	24	19	14	11	32	48	42	37	34	26	18	12	38	52	45	43	38	32	26	19	44	54	49	46	42	36	25	22	48
	622	2240	8	44	36	32	27	23	15	12	34	48	43	39	34	28	21	15	41	52	46	44	38	33	27	20	45	55	50	46	42	37	28	23	48
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	1000	3600	8	49	41	37	31	26	18	13	39	52	46	44	37	30	24	18	44	55	49	47	42	36	29	24	48	58	53	51	45	40	32	25	52
	1260	4520	10	50	42	42	34	31	21	16	42	53	47	45	37	32	27	21	45	56	50	48	42	37	31	25	49	58	54	51	45	40	34	27	52
450	318	1145	2	45	38	29	19	15	11	10	33	53	43	36	33	23	18	12	41	55	47	44	37	23	24	18	45	57	51	48	41	37	27	23	49
	636	2290	4	48	41	33	21	21	14	11	37	54	46	40	36	27	21	16	43	56	49	47	41	30	28	21	48	59	53	50	44	40	32	26	51
	954	3435	6	52	45	37	34	28	19	16	41	55	48	44	40	31	25	22	46	57	49	49	45	38	32	24	50	61	54	52	47	42	36	30	53
	1272	4580	8	53	47	42	36	32	23	19	44	55	49	47	40	33	27	24	47	58	52	50	45	39	34	26	51	62	56	53	48	42	37	31	54
	1590	5725	10	55	48	47	39	36	27	23	47	56	50	49	40	36	30	26	49	59	53	51	45	40	36	28	52	62	56	54	48	43	39	32	55

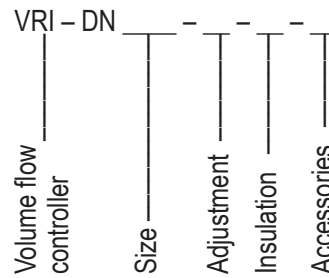
Nom. Ø	Volume flow rate		Velocity	Static differential pressure Δp in Pa											
				Sound power level of air flow noise in dB(A) ref. 10^{-12} W				Sound power level of housing sound radiation in dB(A) ref. 10^{-12} W without insulating shell				Sound power level of housing sound radiation in dB(A) ref. 10^{-12} W with insulating shell			
				100	300	500	1000	100	300	500	1000	100	300	500	1000
100	94	340	12	59	65	68	72	41	46	48	54	36	39	42	45
	110	395	14	62	66	69	73	47	50	53	57	40	43	46	48
	138	495	16	64	68	70	74	51	54	57	62	43	47	50	52
125	147	530	12	60	66	69	74	42	47	50	56	36	39	42	46
	172	620	14	63	67	71	75	47	52	54	60	39	43	45	49
	197	710	16	65	69	72	76	52	56	58	63	43	46	49	52
160	242	870	12	61	67	70	74	43	47	50	55	36	39	42	47
	282	1015	14	53	69	71	76	47	51	53	58	39	43	45	50
	322	1160	16	66	70	72	77	51	55	57	62	43	46	48	53
200	378	1360	12	62	67	70	75	44	49	51	57	37	40	42	48
	440	1585	14	64	69	72	76	48	52	54	59	41	43	46	50
	503	1810	16	66	70	73	77	51	55	57	62	44	46	48	53
224	472	1700	12	62	68	71	75	46	50	53	58	38	41	43	48
	551	1985	14	65	69	72	76	51	53	55	60	42	43	46	50
	630	2270	16	67	71	73	77	54	56	58	63	45	46	48	53
250	589	2120	12	63	68	71	76	47	52	55	59	40	43	46	50
	688	2475	14	65	69	73	77	52	54	56	61	43	45	48	52
	786	2830	16	68	71	74	78	55	57	59	63	46	48	50	54
315	935	3365	12	64	69	72	77	48	52	57	60	41	45	48	51
	1092	3930	14	66	70	74	78	52	54	58	62	44	47	50	54
	1247	4490	16	69	72	75	79	55	57	60	63	47	49	52	56
400	1508	5430	12	65	70	74	78	52	56	60	63	45	48	51	55
	1760	6335	14	67	71	75	79	55	58	62	64	47	50	53	56
	2011	7240	16	70	73	77	80	57	60	63	66	49	52	55	57
450	1908	6870	12	67	71	75	79	56	58	62	65	49	51	53	56
	2226	8015	14	69	73	77	80	58	60	63	66	51	53	55	57
	2544	9160	16	72	75	78	81	60	61	65	68	53	55	56	58

Table 6: Sound power level of air flow noise and housing sound radiation in dB(A) ref. 10^{-12} W for $u = 12 - 16$ m/s



Volume flow controller

Type code



Size

- 100 = DN 100
- 125 = DN 125
- 160 = DN 160
- 200 = DN 200
- 224 = DN 224
- 250 = DN 250
- 315 = DN 315
- 400 = DN 400
- 450 = DN 450

Adjustment

- C1 = Belimo compact controller, type LMV-D2-MP (up to DN 250)
- C2 = Belimo compact controller, type NMV-D2-MP (from DN 315 upwards)

Insulation

- O = no insulation
- D = with insulating shell

Accessories

- F = Flange connection to DIN EN 12220

Subject to technical alteration.

For circular ducts to EN 1506 the basic model is fitted with a push-in fitting