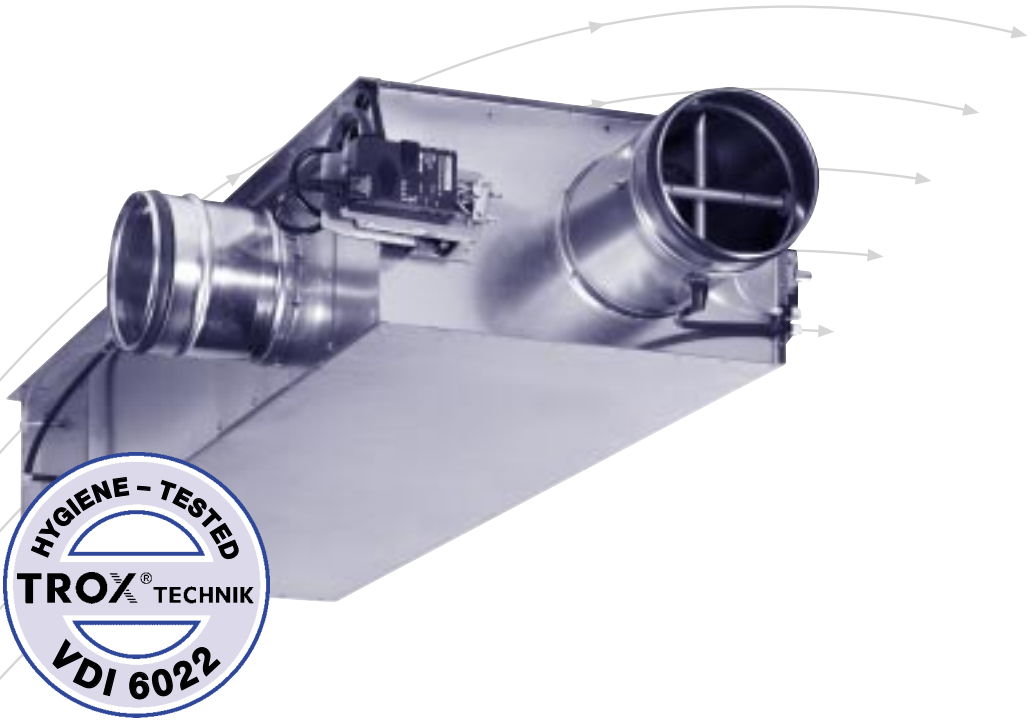
VARYCONTROL VAV Dual Duct Terminal Units

for variable volume flow systems
Type TVM

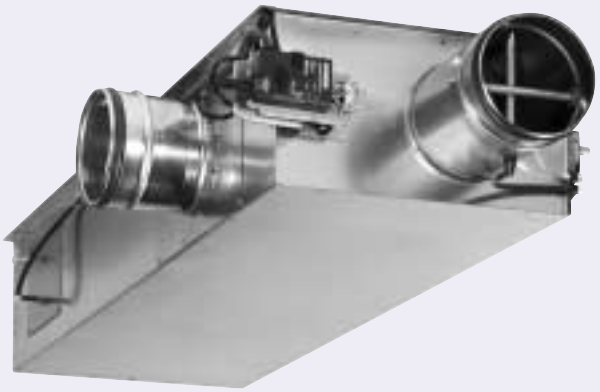


TROX® TECHNIK

The art of handling air

Contents · Description

Type TVM VAV dual duct terminal box



TROX VARYCONTROL VAV dual duct terminal boxes types TVM and TVMD have been developed for the control of air flows, especially in dual duct variable volume systems.

A special feature of these types is the outstanding acoustic qualities that show themselves to the best advantage in buildings with critical comfort criteria. The boxes meet the hygiene requirements of VDI 6022.

TVM: VAV dual duct terminal box
TVMD: dual duct terminal box with additional acoustic cladding

The mechanical components and electronic components, which are factory fitted, form the controls package. Each box is set up to the required flow rates and is subjected to an aerodynamic function test.

The boxes contain an averaging differential pressure sensor in both the cold spigot and the attenuator section for air flow measurement, control dampers and an integral sound attenuator for reducing the air-regenerated noise. The control damper blades with plastic seal when closed complies with the air tightness requirements of DIN EN 1751.

There are circular spigot connections on the fan (high pressure) end with a rectangular flange connection on the room (low pressure) end.

The boxes with additional acoustic cladding and/or a TS secondary silencer are suitable for very demanding acoustic requirements.

The flow rate controls are closed loop systems with external power supply. The pressure transducers, controllers and actuators are selected to meet the controls requirements and operational conditions. The TROX dual duct boxes can be supplied with control components from any reputable manufacturer to suit the project specification.

Further, current information on application, selection as well as control components available can be found in the “Technical Documentation” download area of our website.

Also available on the internet is the online design programme “Air terminal units” for the design and selection of our units.

Functional Description

Room temperature controller

In VAV systems, the room temperature control takes the form of a cascade control. The primary controlled variable is the room temperature. The output signal of the room temperature controller acts on the cold flow rate control loop in the TVM

TVM control principle

The room temperature controller alters the setpoint for the cold air flow rate between 0 and the maximum flow rate which is set in the factory as a function of the room temperature.

If there is a control variation, the cold air flow rate is kept constant over the full pressure range by adjustment of the control damper blade within tight tolerances. At the same time, a differential pressure sensor determines the total flow rate at the box outlet and passes the value measured to the warm/total controller. This controller is set to the maximum warm air flow rate (e.g. 50 %) and controls the warm damper blade. A corresponding proportion of warm air is added in this way. As the demand for cooling increases, the warm damper blade closes and only cold air flows.

Flow rate measurement

A sensor is necessary for the positive measurement of air flows, this is achieved by pressure measurement at several points distributed over the cross-section and provision of the resulting average value. The TROX differential pressure sensor is an optimum solution in terms of economics and product technology. This sensor delivers exact results for most room air conditioning applications based on normal upstream flow conditions.

Volume flow control

The control of the volume flow rate takes place in a closed control loop, i.e. measurement – comparison – control.

A pressure transducer converts the pressure differential into an electrical signal, which is interpreted as the actual value by the controller. In most applications, the setpoint value comes from a room temperature controller.

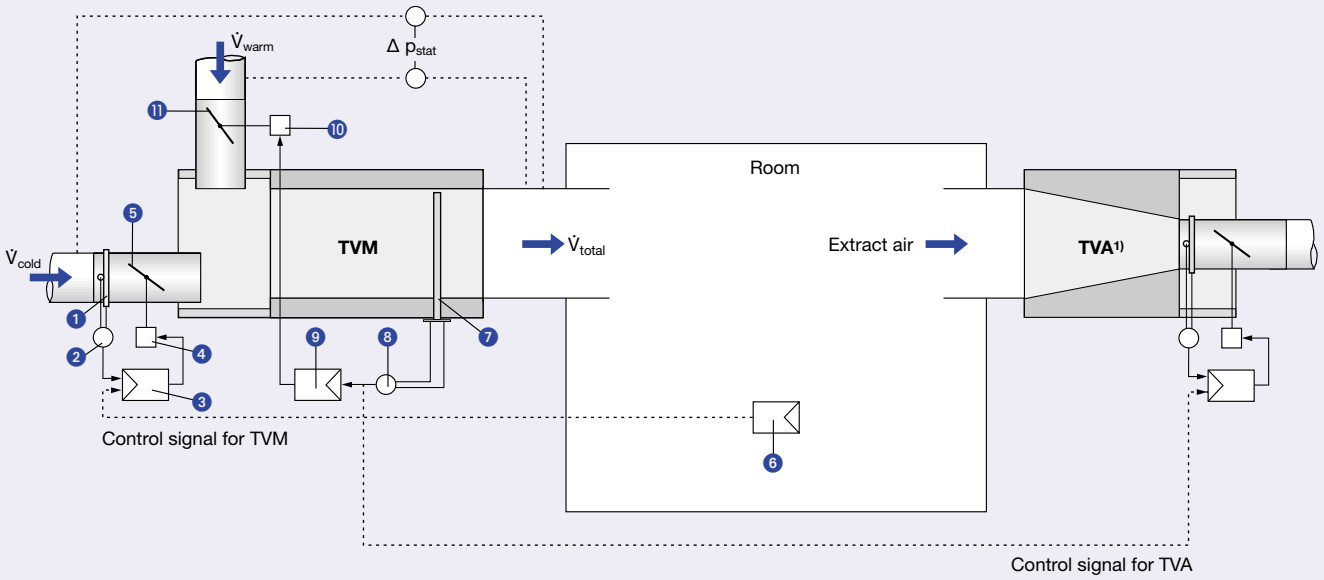
The controller compares the actual value with the setpoint value and from the difference between these two alters the control signal to the damper actuator.

Supply/extract air tracking control

The balance between supply and extract air flow rate has to be maintained in individual rooms and closed-off office areas. Otherwise, annoying whistling noises can occur at door gaps, and the doors can be difficult to open. For this reason, the extract air should also have variable control in a VAV system.

The actual value of the supply air is fed as an input signal to the extract air controller (slave controller). In this way, the extract air flow rate automatically follows the supply air flow rate, even in the case where this has not reached its setpoint value.

System diagram

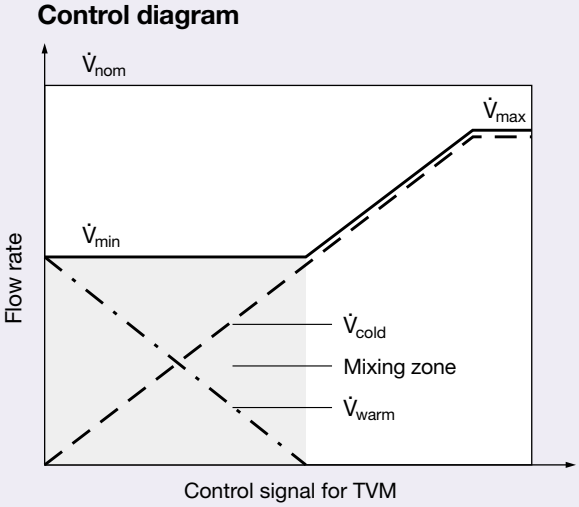


1) See document 5/1/EN/…

Legend

1. Differential pressure sensor for $\dot{V}_{cold}$
2. Pressure transducer for $\dot{V}_{cold}$
3. Flow rate controller for $\dot{V}_{cold}$
4. Actuator for cold duct
5. Control damper blade for cold duct
6. Room temperature controller (supplied by others)
7. Differential pressure sensor for $\dot{V}_{total}$
8. Pressure transducer for $\dot{V}_{total}$
9. Flow rate controller for $\dot{V}_{warm}$ and $\dot{V}_{total}$
10. Actuator for warm duct
11. Control damper blade for warm duct

Control diagram



Construction · Dimensions

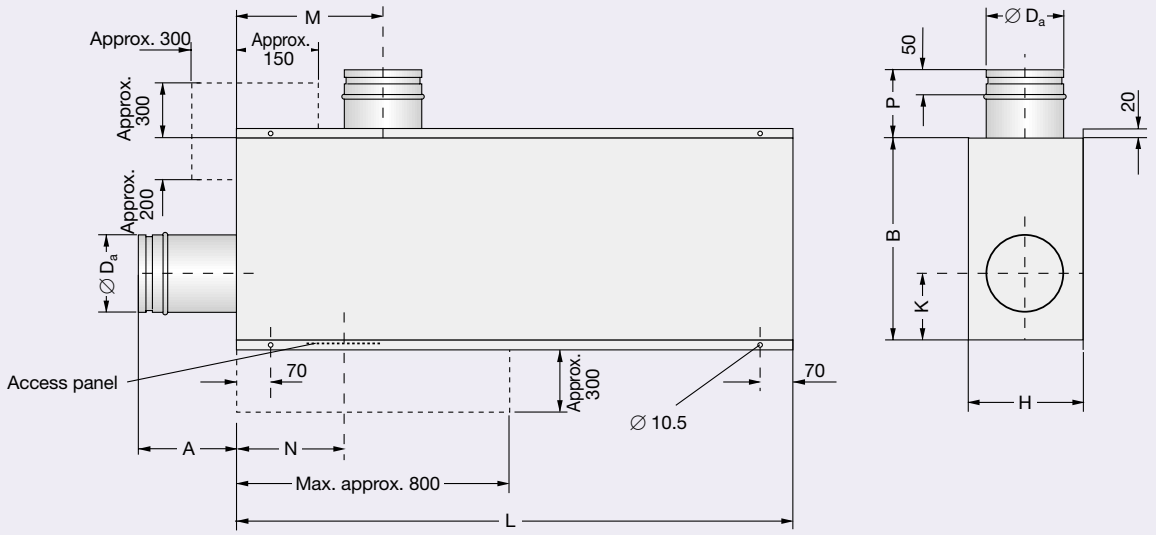
Characteristics

- Electronic flow rate control
- Very close control accuracy for the flow rate settings, even with upstream bend at R = 1 D. Please ensure the most favourable aerodynamic configuration of ductwork is used
- Differential pressure range from 150 to 1500 Pa
- Full shut-off from ductwork system
- Control damper closed blade airtightness to DIN EN 1751, class 4 (exception nominal size 125, class 3)
- Baffle plates are fitted after the control damper for optimum acoustic and aerodynamic performance
- Integral sound attenuator with at least 26 dB insertion loss at 250 Hz
- Independent of orientation
- Factory set up of flow rate. This includes aerodynamic function test of each box using a dedicated test rig. Data covering set up is given on a test label attached to each box
- Flow rate can be measured and subsequently reset on site; an additional adjuster unit may be necessary
- Actual value signal referred to $\dot{V}_{Nom}$
- The boxes are, in terms of their mechanical parts, maintenance-free
- Operating temperature range 10 to 50 °C

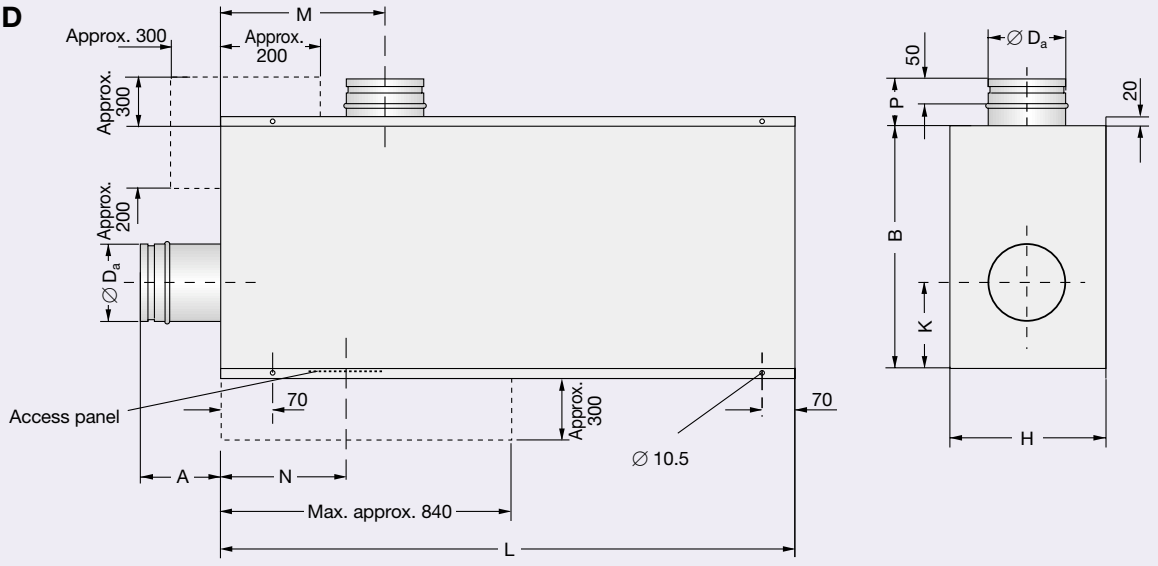
Constructional features

- Circular spigots on the fan (high pressure) side, this includes a groove for the use of a lip seal, suitable for circular connecting ducts to DIN EN 1506 or DIN EN 13180 (if lip seals are required, these will be factory fitted)
- Room (low pressure) side suitable for attachment of connecting flanges
- Holes in the return edges of the casing for support rods
- Casing air leakage complies with DIN EN 1751, class A
- Fulfills VDI 2083, clean room class 3 and US Federal standard 209E, class 100
- Fulfills the hygiene requirements according to VDI 6022, DIN 1946, part 4, DIN EN 13779 and VDI 3803, with access panel for cleaning

TVM



TVMD



--- Keep clear to provide access to control components

Control components are situated on the right hand side when seen from the direction of airflow (with the folded seam upper most)!

Materials

Casing

- Casing in galvanised sheet steel
- Lining in the sound attenuator section and in the control damper chamber with mineral wool conforming to DIN 4102, fire rating class A2, with RAL quality mark RAL-GZ 388, biodegradable pursuant to TRGS 905 and EU directive 97/69/EG
- Mineral wool faced with fibreglass as protection against erosion, suitable for air velocities up to 20 m/s, inert to fungal and bacterial growth
- Control damper blade in galvanised sheet steel with thermoplastic elastomer seal
- Sensor tubes in aluminium
- Plastic plain bearings

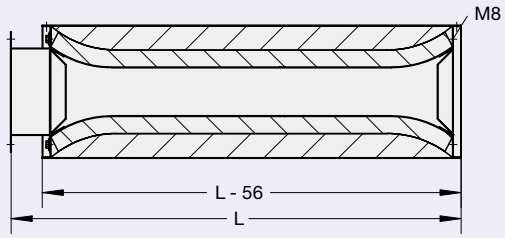
Additional acoustic cladding

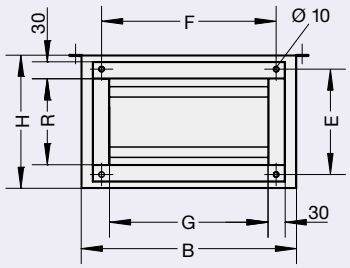
- Outer cover in galvanised sheet steel
- Sound-absorbent lining
- Rubber isolators for the insulation of structure-borne noise
- Cannot be retro-fitted

TS secondary silencer

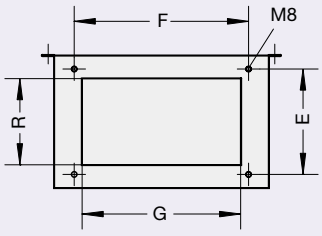
- Casing in galvanised sheet steel
- Lining with mineral wool conforming to DIN 4102, fire rating class A2, with RAL quality mark RAL-GZ 388, biodegradable pursuant to TRGS 905 and EU directive 97/69/EC
- Mineral wool faced with fibreglass as protection against erosion, suitable for air velocities up to 20 m/s, inert to fungal and bacterial growth
- Suitable for the TVM box
- Suitable for attachment of connecting flanges

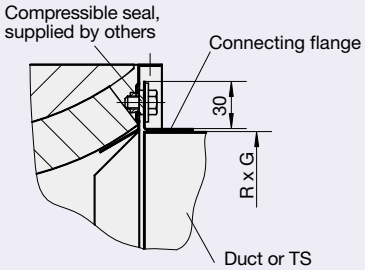
TS secondary silencer





Room (low pressure) side connection





Dimensions in mm																									Weight in kg		
Nom. size		TVM									TVMD								TS									
	Ø D_a	L	B	H	A	K	M	N	P	L	B	H	A	K	M	N	P	L	B	H	E	F	R	G	TVM	TVMD	TS
125	124	1205	300	236	150	125	240	280	170	1245	380	316	110	165	280	320	130	806	300	236	186	232	152	198	28	42	10
160	159	1255	410	236	200	145	295	360	150	1295	490	316	160	185	335	400	110	806	410	236	186	342	152	308	34	51	15
200	199	1590	560	281	200	170	350	440	125	1630	640	361	160	210	390	480	85	956	560	281	244	492	210	458	50	78	22
250	249	1765	700	311	250	200	415	540	160	1805	780	391	210	240	455	580	120	956	700	311	235	632	201	598	65	103	37
315	314	1840	900	361	310	240	535	665	130	1880	980	441	170	280	575	705	90	1056	900	361	286	832	252	798	90	140	42
400	399	2325	1000	446	390	290	625	840	180	2365	1080	526	350	330	665	880	140	1306	1000	446	388	932	354	898	130	200	50

Nomenclature · Aerodynamic Data

Nomenclature

f_m in Hz: Octave band centre frequency

L_W in dB: Sound power level of air-regenerated noise in the room (low pressure) side ducting

L_{W1} in dB: Sound power level of air-regenerated noise with TS secondary silencer

L_{W2} in dB(A): Sound power level of case-radiated noise

L_{W3} in dB(A): Sound power level of case-radiated noise with additional acoustic cladding

L_{pA} in dB(A): A-weighted sound pressure level of air-regenerated noise, system attenuation taken into account

L_{pA1} in dB(A): A-weighted sound pressure level of air-regenerated noise with TS secondary silencer, system attenuation taken into account

L_{pA2} in dB(A): A-weighted sound pressure level of case-radiated noise, system attenuation taken into account

L_{pA3} in dB(A): A-weighted sound pressure level of case-radiated noise with additional acoustic cladding, system attenuation taken into account

$\dot{V}_{Nom}$ in m³/h or l/s: Nominal flow rate (100 %)

$\dot{V}$ in l/s or m³/h: Flow rate

$\dot{V}_{total}$ in l/s or m³/h: Total flow rate

$\Delta \dot{V}$ in ± %: Flow rate tolerance from setpoint value for duct pressures changing between 150 and 1500 Pa

Δp_{st} in Pa: Static pressure differential

$\Delta p_{st\ min}$ in Pa: Minimum static pressure differential between cold duct or warm duct and discharge

All noise levels determined in a reverberation chamber. The sound power data was determined and corrected according to DIN EN ISO 5135, February 1999.

All sound power levels are based on 1 pW, all sound pressure levels on 20 µPa.

For further information on the fan (high pressure) side air-regenerated noise, see leaflet 5/1/EN/...

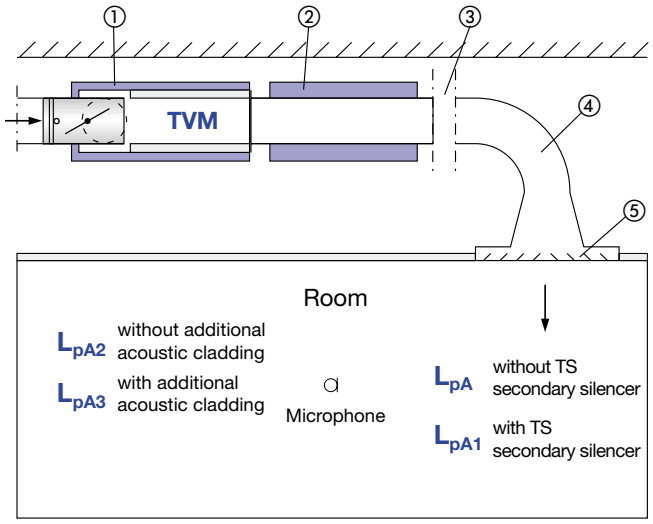
Flow rate ranges and minimum pressure differentials

Nominal size	$\dot{V}$ 1)		$\Delta \dot{V}$ 1) in ± %		$\Delta p_{st\ min}$ in Pa	
	l/s	m³/h	Cold air	Warm air 2)	TVM(D)	TS 3)
125	45	162	8	17	150	–
	75	270	6	14		10
	105	378	5	11		20
	150	540	5	7		40
160	75	270	8	17	150	–
	110	396	7	15		5
	145	522	5	12		10
	250	900	5	7		20
200	120	432	8	17	150	–
	205	738	6	14		5
	310	1116	5	10		10
	405	1458	5	7		20
250	185	666	8	17	150	5
	330	1188	6	13		10
	470	1692	5	10		15
	615	2214	5	7		25
315	310	1116	8	17	150	5
	525	1890	6	13		10
	740	2664	5	10		20
	1025	3690	5	7		40
400	505	1818	8	17	150	5
	880	3168	6	13		10
	1250	4500	5	10		20
	1680	6048	5	7		40

1) Typical figures
2) Within the mixing zone
3) Additional pressure differential to be taken into account

For further information on the entry flow conditions to the cold air duct, insertion loss and air-regenerated noise in the circular duct, see leaflet 5/1/EN/...

Acoustic Quick Selection



① Additional acoustic cladding
② TS secondary silencer
③ Air distributed between several diffusers
④ Duct bend
⑤ End reflection based on diffuser

Nomenclature, see page 6

System attenuation in dB/Oct. acc. to VDI 2081 (taken into account in the quick selection table)

f_m in Hz	63	125	250	500	1000	2000	4000	8000
Duct bend attenuation	0	0	1	2	3	3	3	3
Room attenuation	5	5	5	5	5	5	5	5
End reflection	10	5	2	0	0	0	0	0

Correction for distribution into the low pressure duct system (taken into account in the quick selection table)

$\dot{V}$	m³/h	500	1000	1500	2000	2500	3000	4000	5000	6000
	l/s	139	278	417	556	695	834	1111	1389	1667
dB per octave		0	3	5	6	7	8	9	10	11

Quick selection sound pressure level in dB(A)

Nominal size	$\dot{V}$ l/s	$\dot{V}$ m³/h	Δ p_{st} = 200 Pa Air-regenerated noise TVM L_{pA}	Δ p_{st} = 200 Pa Air-regenerated noise TVM + TS L_{pA1}	Δ p_{st} = 200 Pa Case-radiated noise[1] TVM L_{pA2}	Δ p_{st} = 200 Pa Case-radiated noise[1] TVMD L_{pA3}	Δ p_{st} = 500 Pa Air-regenerated noise TVM L_{pA}	Δ p_{st} = 500 Pa Air-regenerated noise TVM + TS L_{pA1}	Δ p_{st} = 500 Pa Case-radiated noise[1] TVM L_{pA2}	Δ p_{st} = 500 Pa Case-radiated noise[1] TVMD L_{pA3}	Δ p_{st} = 1000 Pa Air-regenerated noise TVM L_{pA}	Δ p_{st} = 1000 Pa Air-regenerated noise TVM + TS L_{pA1}	Δ p_{st} = 1000 Pa Case-radiated noise[1] TVM L_{pA2}	Δ p_{st} = 1000 Pa Case-radiated noise[1] TVMD L_{pA3}
125	45	162	20	<	25	15	22	<	32	20	26	17	35	23
	60	216	21	18	26	17	25	19	34	23	28	20	38	26
	100	360	26	22	30	20	30	24	37	27	33	26	43	32
	150	540	33	30	37	26	35	32	40	30	38	33	46	40
160	75	270	23	22	25	17	28	19	32	22	30	24	35	26
	100	360	26	19	26	18	30	24	34	24	34	27	38	29
	170	612	29	22	30	23	34	27	37	27	37	31	43	32
	250	900	36	29	37	28	38	31	40	31	40	34	46	35
200	120	432	21	<	25	17	25	17	32	23	26	19	37	26
	180	648	23	16	27	20	28	19	33	26	31	23	39	30
	280	1008	28	19	30	23	31	21	36	28	35	24	41	33
	405	1458	34	26	36	29	37	27	40	32	39	28	44	36
250	185	666	18	<	26	17	21	<	33	24	23	21	38	29
	270	972	20	<	27	18	25	15	35	26	28	19	41	32
	470	1692	29	21	31	24	31	21	37	29	34	23	43	35
	615	2214	35	29	36	29	39	29	41	32	39	29	45	36
315	310	1116	28	22	32	24	35	28	42	32	36	29	48	38
	420	1512	27	21	34	26	36	29	44	34	37	30	50	40
	720	2592	30	23	40	32	37	30	48	38	41	34	53	43
	1025	3690	35	28	45	36	40	34	50	42	44	36	55	46
400	505	1818	24	19	35	27	33	27	45	36	38	32	51	42
	710	2556	26	21	37	29	34	28	47	38	39	33	53	44
	1250	4500	33	27	42	36	37	31	48	40	41	34	55	46
	1680	6048	38	33	50	45	42	36	53	47	45	39	56	49

< indicates values below 15

1) 4 dB/octave ceiling reduction and 5 dB/octave room attenuation have been allowed for in the calculation of case-radiated noise.

Air-regenerated Noise

without TS secondary silencer

Example

Given: $\dot{V}_{max}$ = 280 l/s (1008 m³/h)
Δp_{st} = 500 Pa
Required sound pressure level in the room 35dB(A)
For further assumptions, see calculation procedure

Calculation procedure

Quick selection:
TVMD 200
L_{pA} = 31 dB(A)
L_{pA3} = 28 dB(A)

Total sound pressure level in the room = 33 dB(A)
(after logarithmic addition, as the box is in the false ceiling of the room, see sketch on page 7)

Air-regenerated noise calculation procedure

f_m	63	125	250	500	1000	2000	4000	8000
L_W (page 8)	56	55	44	38	32	24	15	27
Distribution	3	3	3	3	3	3	3	3
Duct bend	0	0	1	2	3	3	3	3
End reflection	10	5	2	0	0	0	0	0
Sound power level to room	43	47	38	33	26	18	9	21
Room attenuation	6	6	5	5	4	4	4	4
A-weighting	−26	−16	−9	−3	0	1	1	−1
Corrected level	**11**	**25**	**24**	**25**	**22**	**15**	**6**	**16**

Sound pressure level of air-regenerated noise **L_{pA} = 31 dB(A)**

Air-regenerated noise without TS secondary silencer

Nominal size	$\dot{V}_{total}$		Δp_{st} = 200 Pa, L_W in dB, f_m in Hz								Δp_{st} = 500 Pa, L_W in dB, f_m in Hz								Δp_{st} = 1000 Pa, L_W in dB, f_m in Hz							
	l/s	m³/h	63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000
125	45	162	42	38	34	20	<	<	<	<	42	38	35	26	<	<	<	24	54	38	35	26	17	<	20	33
	60	216	43	34	37	21	<	<	<	<	46	38	39	28	15	<	<	27	56	40	39	29	20	15	23	34
	100	360	52	44	41	27	19	<	<	15	47	46	44	33	22	<	15	27	54	47	46	36	26	18	25	37
	150	540	55	50	46	37	33	27	19	17	51	52	49	38	32	26	21	30	62	53	52	41	33	27	26	37
160	75	270	56	45	34	22	<	<	<	<	56	46	40	33	<	<	<	28	56	48	41	34	19	16	19	34
	100	360	57	49	38	25	<	<	<	16	55	52	42	32	15	<	<	27	60	54	45	37	21	17	22	36
	170	612	59	53	42	32	23	17	<	19	59	58	46	36	25	18	17	29	62	60	50	41	27	21	26	38
	250	900	61	59	50	40	34	31	24	17	62	62	51	42	34	31	25	32	63	65	54	44	35	31	29	39
200	120	432	52	44	31	19	<	<	<	<	51	48	36	27	<	<	<	19	57	47	36	29	15	<	<	28
	180	648	56	47	35	25	16	<	<	<	54	52	41	31	21	<	<	24	56	55	42	36	23	15	18	31
	280	1008	54	53	41	35	30	22	<	15	56	55	44	38	32	24	15	27	58	60	47	41	35	27	21	33
	405	1458	59	59	49	44	40	35	30	21	59	61	53	47	43	38	32	32	64	64	53	49	44	39	33	35
250	185	666	49	43	29	16	<	<	<	<	48	43	33	25	<	<	<	21	51	44	35	26	19	<	<	27
	270	972	50	44	33	27	21	<	<	<	52	50	39	31	23	15	<	22	56	51	42	34	26	18	<	31
	470	1692	54	52	42	40	36	31	24	19	57	54	44	41	37	32	24	25	60	58	48	44	39	34	26	32
	615	2214	62	57	49	47	43	40	35	31	62	59	52	51	47	43	38	34	65	62	53	51	47	43	37	34
315	310	1116	57	52	45	26	17	<	16	30	59	57	51	33	31	28	32	39	65	57	52	37	34	31	33	42
	420	1512	57	53	45	26	18	16	19	33	65	62	53	37	35	33	34	41	67	61	55	41	38	35	36	44
	720	2592	64	56	47	34	30	24	31	41	69	64	55	43	41	39	39	46	72	68	60	47	44	40	42	48
	1025	3690	71	62	57	45	41	38	38	42	76	69	58	51	49	46	45	49	77	72	64	54	50	47	49	52
400	505	1818	56	52	41	27	24	23	26	30	60	57	53	35	31	31	36	40	62	59	55	40	37	35	43	49
	710	2556	58	55	43	31	28	27	30	34	62	60	54	38	35	34	38	42	65	63	57	42	39	38	45	50
	1250	4500	71	60	51	43	41	37	38	43	73	65	56	44	42	40	43	48	74	68	60	48	45	43	48	53
	1680	6048	82	69	54	49	46	45	45	49	82	71	61	54	53	50	50	54	82	74	65	56	54	51	54	58

< indicates values below 15

Air-regenerated Noise

with TS secondary silencer

Case-radiated noise calculation procedure

f_m	63	125	250	500	1000	2000	4000	8000
L_{W3} (page 11)	54	47	40	34	24	23	17	18
Ceiling reduction	4	4	4	4	4	4	4	4
Sound power level to room	50	43	36	30	20	19	13	14
Room attenuation	6	6	5	5	4	4	4	4
A-weighting	−26	−16	−9	−3	0	1	1	−1
Corrected level	**18**	**21**	**22**	**22**	**16**	**16**	**10**	**9**

Sound pressure level of case-radiated noise L_{pA} = **28 dB(A)**

Result: Note the above deviates from the room correction on page 7, here other values have been assumed. The result lies, however, within that required.

Air-regenerated noise with TS secondary silencer

Nominal size	$\dot{V}_{total}$		Δp_{st} = 200 Pa								Δp_{st} = 500 Pa								Δp_{st} = 1000 Pa							
			L_{W1} in dB								L_{W1} in dB								L_{W1} in dB							
			f_m in Hz								f_m in Hz								f_m in Hz							
	l/s	m³/h	63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000
125	45	162	46	29	26	<	<	<	<	<	49	29	27	<	<	<	<	<	47	36	30	17	<	<	<	23
	60	216	44	37	32	16	<	<	<	<	46	41	32	17	<	<	<	15	46	41	33	19	<	<	<	23
	100	360	46	42	34	25	19	<	<	<	55	44	37	26	18	<	<	18	57	46	39	27	21	<	<	26
	150	540	56	48	41	35	32	24	<	<	59	50	43	35	33	25	<	18	64	52	46	36	33	25	<	26
160	75	270	50	47	29	<	<	<	<	<	50	40	32	18	<	<	<	<	61	44	34	20	<	<	<	23
	100	360	46	42	31	15	<	<	<	<	56	46	35	20	<	<	<	19	59	49	38	23	<	<	<	27
	170	612	55	46	35	18	<	<	<	<	59	52	39	22	<	<	<	23	60	55	43	27	16	<	<	28
	250	900	59	55	43	29	23	16	<	<	60	57	45	30	23	17	<	23	62	60	47	31	24	18	<	29
200	120	432	39	36	23	<	<	<	<	<	40	40	28	16	<	<	<	<	51	40	29	17	<	<	<	21
	180	648	41	40	27	15	<	<	<	<	45	44	30	19	<	<	<	15	57	47	34	22	<	<	<	22
	280	1008	41	47	31	17	<	<	<	<	54	48	34	21	<	<	<	16	53	50	37	25	16	<	<	25
	405	1458	59	54	41	30	26	19	<	<	58	56	43	31	26	19	<	18	59	57	44	32	27	20	<	26
250	185	666	41	32	19	<	<	<	<	<	46	34	21	16	<	<	<	<	50	47	27	19	<	<	<	21
	270	972	50	38	22	15	<	<	<	<	48	41	27	19	<	<	<	<	56	44	31	24	15	<	<	22
	470	1692	56	45	34	32	26	16	<	<	56	47	34	32	26	16	<	<	59	50	36	33	27	17	<	<
	615	2214	64	53	42	40	37	30	22	<	67	55	42	40	36	30	<	<	64	55	42	40	37	30	<	<
315	310	1116	55	48	36	18	<	<	17	25	57	53	42	21	18	<	22	33	63	53	43	25	22	18	22	36
	420	1512	55	49	36	18	16	<	18	27	63	58	44	24	23	21	23	35	65	57	46	28	25	23	25	38
	720	2592	62	52	38	22	19	16	21	35	67	60	46	33	30	27	28	40	70	64	51	34	31	27	31	42
	1025	3690	69	58	48	32	29	26	27	36	74	65	50	43	39	35	35	43	75	68	55	41	37	34	38	46
400	505	1818	54	48	32	19	17	<	20	26	58	53	44	25	22	22	29	36	60	55	46	30	27	26	36	45
	710	2556	56	51	34	22	19	19	24	30	60	56	45	28	25	24	31	38	63	59	48	32	29	28	38	46
	1250	4500	69	56	42	33	31	27	31	39	71	61	47	35	33	30	36	44	72	64	51	38	35	33	31	49
	1680	6048	80	65	45	39	36	35	38	45	80	67	52	45	44	40	43	50	80	70	56	46	44	41	47	54

< indicates values below 15

Case-radiated Noise

without additional acoustic cladding

Example

Given: TVM nominal size 250
$\dot{V}_{total}$ = 270 to 615 l/s or 972 to 2214 m³/h
Δp_{st} = 500 Pa
Requireded sound pressure level in the room 40 dB(A) with 6 dB/octave room attenuation

Sought: Sound pressure level of case-radiated noise in the room at $\dot{V}_{total}$ = 615 l/s or 2214 m³/h

Case-radiated noise calculation procedure without additional acoustic cladding

f_m	63	125	250	500	1000	2000	4000	8000
L_{W2}	59	55	51	49	42	39	39	35
Ceiling reduction	3	3	3	3	3	3	3	3
Sound power level to room	36	52	48	46	39	36	36	32
Room attenuation	6	6	6	6	6	6	6	6
A-weighting	−26	−16	−9	−3	0	+1	+1	−1
Corrected level	**24**	**30**	**33**	**37**	**33**	**31**	**31**	**25**

Result: **L_{pA2} approx. 42 dB(A)** after logarithmic addition, requirement not achieved without additional acoustic cladding.

See page 11 for calculation procedure repeated with additional acoustic cladding.

Case-radiated noise without additional acoustic cladding

Nominal size	$\dot{V}_{total}$		Δp_{st} = 200 Pa, L_{W2} in dB, f_m in Hz								Δp_{st} = 500 Pa, L_{W2} in dB, f_m in Hz								Δp_{st} = 1000 Pa, L_{W2} in dB, f_m in Hz							
	l/s	m³/h	63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000
125	45	162	39	34	35	31	29	25	16	<	38	35	35	39	34	34	29	26	44	36	35	39	38	38	37	35
	60	216	36	38	38	32	30	26	18	15	45	40	40	42	36	35	32	29	45	41	40	44	41	39	39	37
	100	360	44	42	39	36	34	32	24	19	45	46	46	46	38	37	33	31	51	48	52	50	46	41	41	39
	150	540	49	49	45	43	40	37	34	28	51	51	48	48	41	40	38	36	54	53	53	54	48	43	43	43
160	75	270	44	43	36	31	27	25	17	15	40	43	39	39	35	33	27	23	44	45	43	43	41	39	36	32
	100	360	42	44	37	33	28	26	18	15	47	48	42	40	36	34	29	26	48	49	46	46	42	40	38	33
	170	612	46	48	42	36	30	30	21	17	50	51	46	43	37	35	33	28	52	55	51	48	43	41	40	35
	250	900	52	54	48	43	34	32	27	25	55	55	50	48	40	38	36	31	56	59	54	52	46	42	42	39
200	120	432	44	40	36	33	28	24	15	15	51	45	41	41	37	33	28	26	50	45	42	42	42	40	36	39
	180	648	53	42	38	33	29	26	17	16	52	50	45	43	37	34	30	29	55	51	48	48	44	41	39	38
	280	1008	53	47	43	36	32	29	22	21	56	50	47	45	38	36	32	32	58	55	51	50	45	41	40	40
	405	1458	59	53	48	43	35	32	29	27	60	55	51	50	40	38	35	35	63	58	53	54	47	43	42	42
250	185	666	42	37	38	33	29	24	18	18	42	41	41	43	38	34	31	29	46	43	43	46	45	42	39	38
	270	972	44	41	37	34	31	27	21	19	48	46	45	44	38	36	33	31	54	51	49	51	46	42	41	40
	470	1692	52	49	44	37	33	32	26	20	57	51	48	46	40	38	36	35	59	55	53	52	47	43	43	42
	615	2214	57	54	47	42	35	33	28	23	59	55	51	49	42	39	39	35	62	58	55	53	48	44	45	44
315	310	1116	55	50	44	38	34	30	26	<	57	55	52	48	44	41	39	35	57	58	57	54	50	48	47	45
	420	1512	57	51	47	39	34	32	29	25	61	58	55	50	45	43	41	38	64	61	60	56	53	49	49	47
	720	2592	63	56	52	47	38	38	34	35	66	63	60	53	47	46	45	42	69	66	64	59	55	51	52	49
	1025	3690	69	60	58	49	41	44	40	39	73	67	62	56	48	47	48	44	76	70	67	61	55	52	54	51
400	505	1818	58	51	48	40	36	34	29	24	63	59	58	51	45	44	44	35	63	60	55	59	53	51	52	44
	710	2556	61	52	48	40	37	37	32	35	64	61	60	52	46	45	45	36	67	64	64	60	54	51	53	45
	1250	4500	72	57	52	44	39	42	37	35	72	64	60	53	47	47	48	36	74	68	66	61	55	52	55	46
	1680	6048	82	67	60	53	42	46	42	41	84	68	63	56	47	49	51	41	84	71	67	62	53	52	55	48

< indicates values below 15

Case-radiated Noise

with additional acoustic cladding

Case-radiated noise calculation procedure with additional acoustic cladding

f_m	63	125	250	500	1000	2000	4000	8000
L_{W3}	57	51	44	39	29	26	25	22
Ceiling reduction	3	3	3	3	3	3	3	3
Sound power level to room	54	48	41	36	26	23	22	19
Room attenuation	6	6	6	6	6	6	6	6
A-weighting	−26	−16	−9	−3	0	+1	+1	−1
Corrected level	**22**	**26**	**26**	**27**	**20**	**18**	**17**	**12**

Result: **L_{pA3} approx. 32 dB(A)** after logarithmic addition, requirement is met.

Case-radiated noise with additional acoustic cladding

Nominal size	$\dot{V}_{total}$		Δp_{st} = 200 Pa								Δp_{st} = 500 Pa								Δp_{st} = 1000 Pa							
			L_{W3} in dB								L_{W3} in dB								L_{W3} in dB							
			f_m in Hz								f_m in Hz								f_m in Hz							
	l/s	m³/h	63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000
125	45	162	37	25	28	21	17	<	<	<	36	26	28	29	22	21	<	<	42	27	28	29	26	25	22	21
	60	216	34	29	31	22	18	<	<	<	43	31	33	32	24	22	17	15	43	32	33	34	29	26	24	23
	100	360	42	33	32	26	22	19	<	<	43	37	39	36	26	24	18	17	49	39	45	40	34	28	26	25
	150	540	47	40	38	33	28	24	19	<	49	42	41	38	29	27	23	22	52	44	46	44	36	31	28	29
160	75	270	42	37	30	22	<	<	<	<	38	37	33	30	22	21	<	<	42	39	37	34	28	26	21	18
	100	360	40	38	31	24	15	<	<	<	45	42	36	31	23	22	<	<	46	43	40	37	29	28	23	19
	170	612	44	42	36	27	17	18	<	<	48	45	40	34	24	23	18	<	50	49	45	39	30	29	25	21
	250	900	50	48	42	34	21	20	<	<	53	49	44	39	27	26	21	17	54	53	48	43	33	30	27	25
200	120	432	42	37	29	22	<	<	<	<	49	42	34	30	23	20	<	<	48	42	35	31	28	27	21	25
	180	648	51	39	31	22	15	<	<	<	50	47	38	32	23	21	15	15	53	48	41	37	30	28	23	25
	280	1008	51	44	36	25	18	16	<	<	54	47	40	34	24	23	17	18	56	52	44	39	31	28	25	26
	405	1458	57	51	41	32	21	19	15	<	58	52	44	39	26	25	20	21	61	55	46	43	33	30	27	28
250	185	666	40	33	31	23	16	<	<	<	40	37	34	33	25	21	17	16	44	39	36	36	32	29	25	25
	270	972	42	37	30	24	18	<	<	<	46	42	38	34	25	23	19	18	52	47	42	41	33	29	27	27
	470	1692	50	45	37	27	20	19	<	<	55	47	41	36	27	25	22	22	57	51	46	42	34	30	29	29
	615	2214	55	50	40	32	22	20	<	<	57	51	44	39	29	26	25	22	60	54	48	43	35	31	31	31
315	310	1116	52	44	35	27	23	<	<	<	54	49	43	37	33	30	29	25	54	52	48	43	39	37	37	35
	420	1512	54	45	38	28	23	21	<	<	58	52	46	39	34	32	31	28	61	55	51	45	42	38	39	37
	720	2592	60	50	43	36	27	27	24	25	63	57	51	42	36	35	35	32	66	60	55	48	44	40	42	39
	1025	3690	66	54	49	38	30	33	30	29	70	61	53	45	37	36	38	34	73	64	58	50	44	41	44	41
400	505	1818	55	45	38	28	27	25	21	<	60	53	48	39	36	35	36	27	60	54	52	47	44	42	44	36
	710	2556	58	46	38	28	28	28	24	27	61	55	50	40	37	36	37	28	64	58	54	48	45	42	45	37
	1250	4500	69	51	42	32	30	33	29	27	69	58	50	41	38	38	40	28	71	62	56	49	46	43	47	38
	1680	6048	79	61	50	41	33	37	34	33	81	62	53	44	38	40	43	33	81	65	57	50	44	43	47	40

< indicates values below 15

Order Details

Specification text *

VAV dual duct terminal boxes for variable air volume systems, in 6 nominal sizes. Consisting of a casing with control damper in the cold and warm spigots, closed control damper blade airtightness to DIN EN 1751, class 4 (exception nominal size 125, class 3). Position of the control damper blade visible from the outside on the shaft extension. Averaging differential pressure sensor in cold air duct and in the integral attenuator with 3 mm measuring holes, and so resistant to contamination.

Special characteristics:
- Integral sound attenuator with at least 26 dB insertion loss at 250 Hz
- Hygienically tested and certified according to VDI 6022, with access panel
- Factory set up of flow rate. This includes aerodynamic function test of each box using a dedicated test rig. Data covering set up is given on a test label attached to each box.

On site measurement and resetting of minimum and maximum air flow rates possible. The actual value signals are referred to the nominal flow rate so simplifying any subsequent adjustment to volume flow.

Baffle plates are fitted behind the control damper for optimum acoustic and aerodynamic qualities. Casing with acoustic and thermal lining. Circular spigot on the fan (high pressure) side, this includes a groove for the use of a lip seal, suitable for circular connecting ducts to DIN EN 1506 or DIN EN 13180. Room (low pressure) side suitable for attachment of connecting flanges.

Casing air leakage complies with DIN EN 1751, class A, with VDI 2083, clean room class 3 and US Federal Standard 209E. Hygiene requirements conform to VDI 6022, DIN 1946, part 4, DIN EN 13779 and VDI 3803.

Differential pressure range 150 to 1500 Pa, flow rate range dependent on the controls supplied. The temperature deviation of mixed air is approximately 10 % in relation to the temperature differential between the cold and warm air supplies.

Control:
- Variable flow rate control with electronic controller for the connection of the control signal, actual value signals related to $\dot{V}_{Nom}$ may be read.
- 24 VAC power supply.
- Signal voltages 0 to 10 VDC.
- Dynamic differential pressure measurement

Materials:
Casing made of galvanised sheet steel. Lining in the sound attenuator section and mixing chamber with mineral wool conforming to DIN 4102, fire rating class A2, with RAL quality mark RAL-GZ 388, bio-degradable pursuant to TRGS 905 and EU directive 97/69/EG. Mineral wool faced with fibreglass as protection against erosion, suitable for air velocities up to 20 m/s, inert to fungal and bacterial growth. Control damper blade with thermoplastic elastomer seal, sensor tubes in aluminium, plastic plain bearings.

Options:
Additional acoustic cladding, for the reduction of case-radiated noise with structure-borne noise isolation, insulation of minimum 5 dB, consists of 40 mm mineral wool and outer cover consisting of 1 mm galvanised sheet steel, non-retrofittable.

TS secondary silencer, for the reduction of air-regenerated noise, entire insertion loss of the basic unit with TS at least 32 dB at 250 Hz. Lining of mineral wool conforming to DIN 4102, fire rating class A2, with RAL quality mark RAL-GZ 388, bio-degradable pursuant to TRGS 905 and EU directive 97/69/EG.

Mineral wool faced with fibreglass as protection against erosion, suitable for air velocities up to 20 m/s, inert to fungal and bacterial growth.

* Text for a basic construction,
for control components, see the design programme or price list

Order code

TVM / **160** / **[ ]** / **XG0** / **M0** – **270-900 m³/h**

Type
Dual duct box TVM
With additional acoustic cladding TVMD

Nom. size

Flow rates $\dot{V}_{min}$ – $\dot{V}_{max}$

Operating mode
M0 Master 0-10 VDC
M2 Master 2-10 VDC
F0 Constant flow rate 0-10 VDC
F2 Constant flow rate 2-10 VDC

Control function
Components

Accessories
No accessories, no entry
Lip seals D2

see design programme or price list

TS order code

TS / **160**

Type
Secondary silencer TS

Nom. size

Order example TVM

Make: TROX
Type: TVM / 160 / XG0 / M0 – 270-900 m³/h

TS order example

Make: TROX
Type: TS / 160