Jet nozzles

Type DUE

TROX TECHNIK

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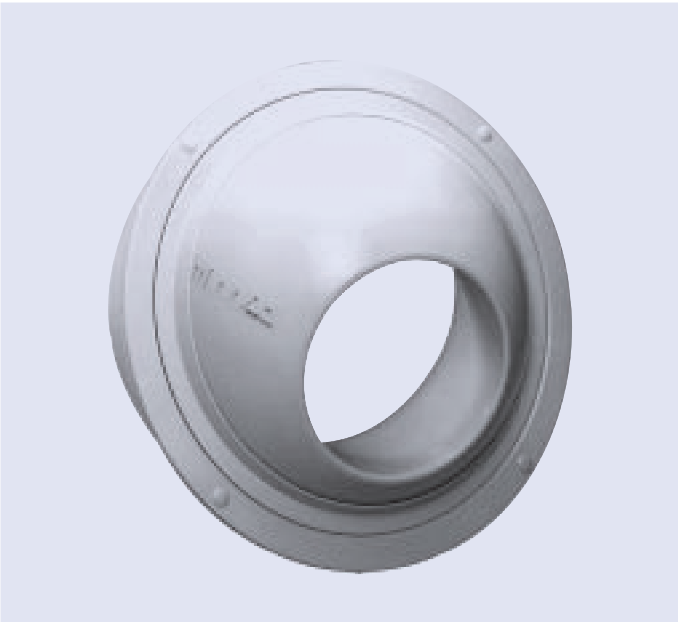
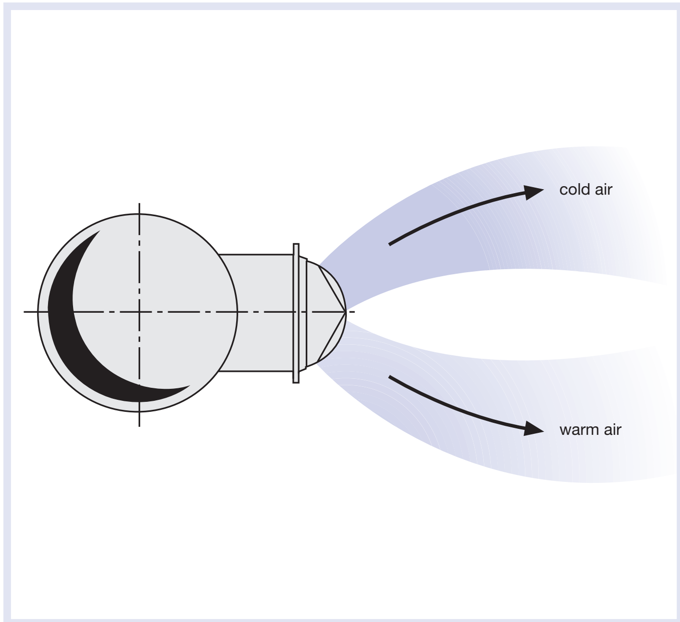
Contents · Description





Jet nozzles are used for preference where the supply air from the unit has to travel a large distance to the occupied zone. This is the case in large rooms (halls, assembly rooms, etc.), particularly when the distribution of air via conventional ceiling diffusers is not possible or not practical. Here jet nozzles are arranged in the side wall areas. When the temperature difference between the supply air and the room air changes, the supply air stream is deflected upwards (warm air) or downwards (cold air). The direction of the supply air flow is also affected by other influences such as local convection effects or draughts within the space. For this reason, TROX type DUE have adjustable discharge directions

The direction of the air stream can be easily adjusted manually to suit particular on site conditions. Also the pivoting movement, upwards and downwards, can be motorised with the range of +/– 30°. Depending on requirements TROX can offer pneumatic or electric actuators (see page 15).

The well-designed, aerodynamically efficient shape of TROX jet nozzles results in low noise characteristics. For this reason, and because of the sophisticated design, they can be used in critical areas such as concert halls, theatres, museums, etc.

The wide range of designs available, the flexibility in adapting to local conditions and compliance with low noise requirements mean that TROX jet nozzles can be used in almost any air conditioning system.

The table below gives a guide for selecting the size of jet nozzles. The values shown are determined for an isothermal, single free horizontal air stream. According to our extensive experience, air velocities of 0.2 m/s for example, with a throw of 30 m., are only possible in theory as many room parameters must be taken into account with such throw distances.

If the supply air temperature difference changes, the air stream deflection in diagram 2 (page 11) must be taken into account.

The noise levels apply to types DUE-S and DUE-V. For other design variants, corrections must be made.

In the table below no data is given for effective discharge velocities below 2 m/s nor are values given above a sound power level rating of 65 dB(A). If the values required lie outside the limits of this table, the procedures on page 14 should be followed.

Data for axial air flow, types DUE-S and DUE-V

Size	Throw												Air velocity
	10 m				20 m				30 m				
	$\dot{V}$ l/s	$\dot{V}$ m³/h	L_{WA} dB(A)	L_{WNC} NC	$\dot{V}$ l/s	$\dot{V}$ m³/h	L_{WA} dB(A)	L_{WNC} NC	$\dot{V}$ l/s	$\dot{V}$ m³/h	L_{WA} dB(A)	L_{WNC} NC	$\bar{v}_L$ m/s
50	8	29	<20	<20	15	54	30	26	23	83	41	37	0,2
75	10	36	<20	<20	19	70	27	<20	30	110	43	39	
100	11	40	<20	<20	22	80	20	<20	33	120	32	28	
125	15	54	<20	<20	30	108	20	<20	45	162	30	26	
160	18	66	<20	<20	37	132	<20	<20	55	199	27	23	
200	24	87	<20	<20	48	174	<20	<20	72	261	22	<20	
250	30	110	<20	<20	61	220	<20	<20	91	329	<20	<20	
315	44	160	<20	<20	78	280	<20	<20	117	421	<20	<20	
400	53	190	<20	<20	103	371	<20	<20	155	557	<20	<20	
450	72	260	<20	<20	130	470	<20	<20	200	720	<20	<20	
50	18	65	40	36	–	–	–	–	–	–	–	–	0,5
75	24	85	37	33	–	–	–	–	–	–	–	–	
100	32	115	32	28	55	198	50	46	–	–	–	–	
125	38	137	25	21	75	270	45	41	112	403	50	46	
160	46	165	20	<20	92	331	41	37	138	496	53	49	
200	60	218	<20	<20	121	436	36	32	182	654	48	44	
250	76	274	<20	<20	152	549	33	29	229	823	44	40	
315	97	351	<20	<20	195	702	28	24	293	1055	39	35	
400	129	464	<20	<20	258	928	25	20	387	1392	36	32	
450	150	540	<20	<20	305	1100	<20	<20	500	1800	37	33	
50	–	–	–	–	–	–	–	–	–	–	–	–	1,0
75	–	–	–	–	–	–	–	–	–	–	–	–	
100	56	202	50	44	–	–	–	–	–	–	–	–	
125	76	274	45	41	150	540	63	59	–	–	–	–	
160	92	330	42	38	157	662	61	57	–	–	–	–	
200	121	436	36	32	242	872	56	52	–	–	–	–	
250	152	548	33	29	305	1098	52	48	–	–	–	–	
315	195	702	28	24	390	1404	48	44	585	2106	58	54	
400	258	928	25	21	515	1856	45	41	773	2784	56	52	
450	278	1000	<20	<20	653	2350	40	36	972	3500	55	51	

Construction · Dimensions

Jet nozzles types DUE are suitable for almost all situations because of the wide range of variants available.
Type DUE-S is adjustable up and down, whilst the DUE-V in addition to this can rotate about the nozzle axis.

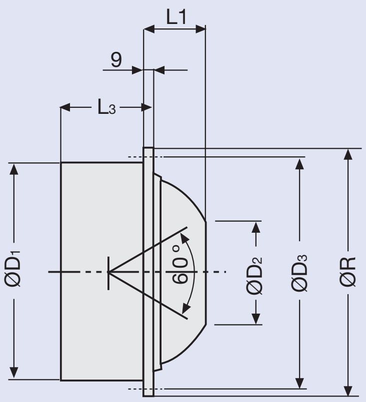
These basic types offer variations, according to the order code in page 15, both for fixing to the side of rectangular or circular ducts with either manual or automatic adjustment (pneumatic or electric actuator).

Size	D_1	D_2	D_3	L_1	L_2*	L_3	R	Drilling Details
25	–	21	48	–	–	28	58	2 x 180°
50	81	30	110	22	70	39	122	2 x 180°
75	107	40	138	32	75	44	158	2 x 180°
100	128	50	160	35	75	56	180	3 x 120°
125	158	65	190	44	85	59	210	3 x 120°
160	194	87	226	53	100	76	246	3 x 120°
200	242	113	274	67	120	81	294	3 x 120°
250	300	141	333	76	145	97	352	3 x 120°
315	376	181	408	93	175	111	428	4 x 90°
400	474	235	506	101	220	136	526	4 x 90°
450	593	290	625	129	240	176	645	4 x 90°

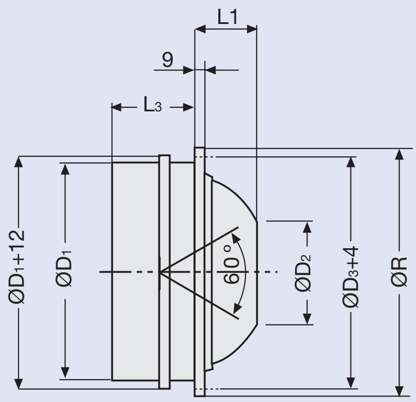
* For constructions with actuators L_2 = 315 mm irrespective of size.

Size	□R	ØR	L	L_1	ØD_1	ØD_2
50	125	108	48	70	81	30
75	168	133	55	76	107	40
100	190	155	65	85	128	50
125	220	185	68	103	158	65
160	265	221	85	129	194	87
200	300	269	90	148	242	113
250	360	327	106	173	300	141
315	435	403	120	204	376	181
400	535	501	145	245	474	235
450	655	620	215	325	593	290

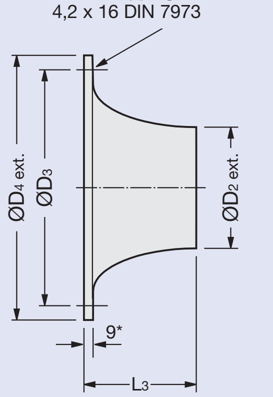
Not for size 25.



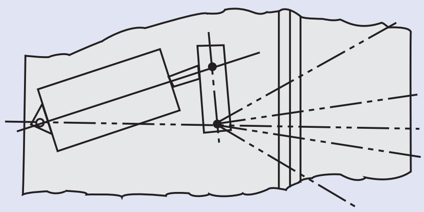
DUE-S



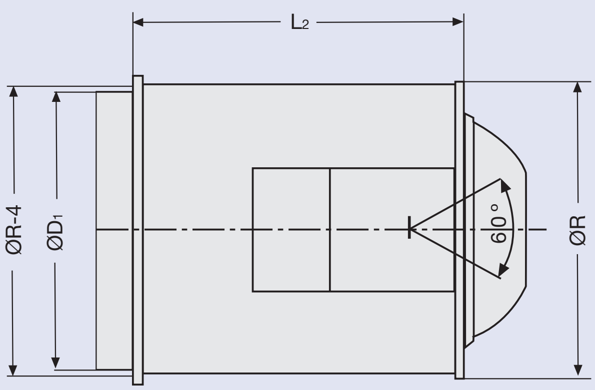
DUE-V



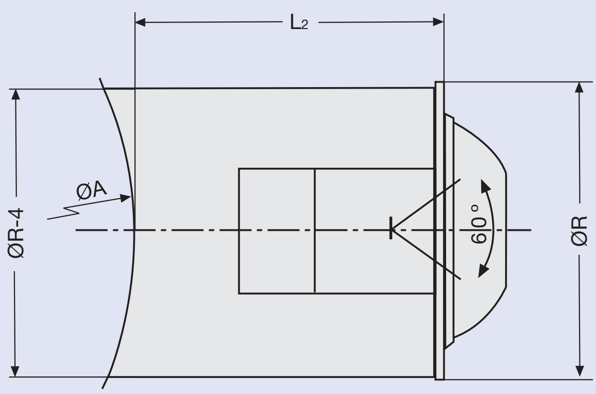
*1,5 size 25



Note:
Can be adjusted by an installed linear electric actuator



DUE-S-A-E (with circular connection spigot)
DUE-S-K-E (without circular spigot)

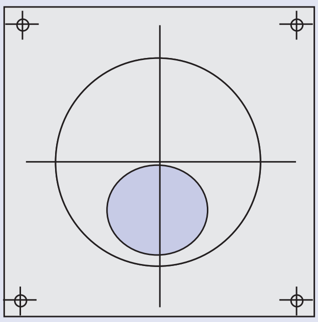


DUE-S-R-E
DUE-S-R (without actuator)

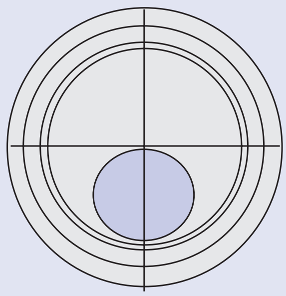
TROX jet nozzles are suitable for installation on both rectangular ducts (DUE-S/V and DUE-S/V-Q/R) and circular ducts (DUE-S/V-QR and DUE-S-RR). The last two configurations can only be adjusted manually as fitting of actuators is not possible.

Size	Possible Circular Duct Diameter Ø A											
	250		315		500		650		800		1,000	
	D	d	D	d	D	d	D	d	D	d	D	d
100	146	138	142	138	140	138	139	138	139	138	138	138
125	184	168	178	168	172	168	170	168	170	168	168	168
160			222	204	210	204	208	204	206	204	204	204
200					264	252	259	252	256	252	252	252
250					335	310	323	310	318	310	314	310
315					441	386	413	386	403	386	396	386
400							546	484	520	484	505	484
450									682	603	647	603

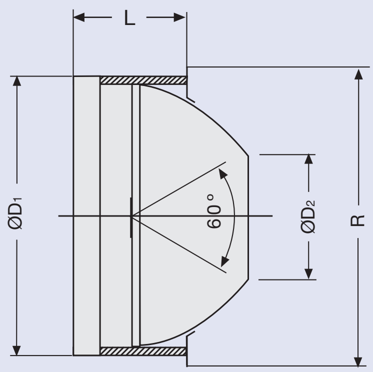
Size	Possible Circular Duct Diameter Ø A											
	250		315		500		650		800		1,000	
	B	H	B	H	B	H	B	H	B	H	B	H
100	200	232	200	217	200	206	200	203	200	202	200	202
125	230	292	230	258	230	239	230	235	230	233	230	232
160			275	344	275	291	275	284	275	280	275	278
200					310	334	310	324	310	318	310	316
250					370	416	370	394	370	384	370	380
315					445	548	445	490	445	472	445	462
400							545	646	545	600	545	576
450									665	785	665	727



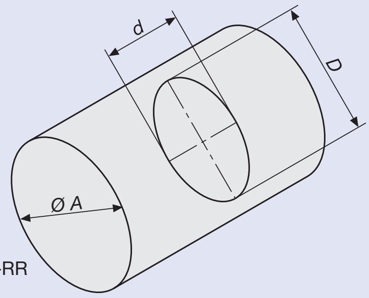
DUE-S-Q
DUE-V-Q



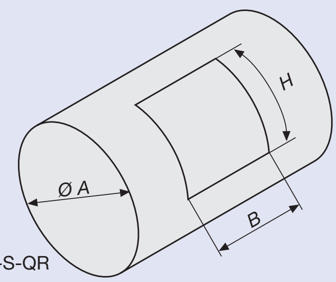
DUE-S-R
DUE-V-R



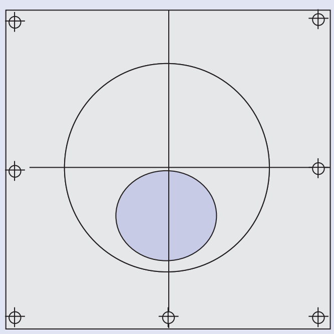
Section DUE-S/V-R
Section DUE-S/V-Q



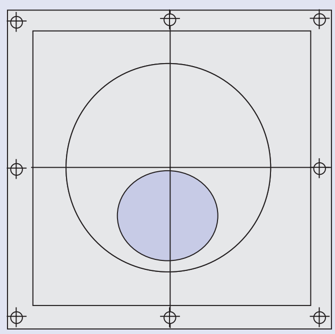
DUE-S-RR



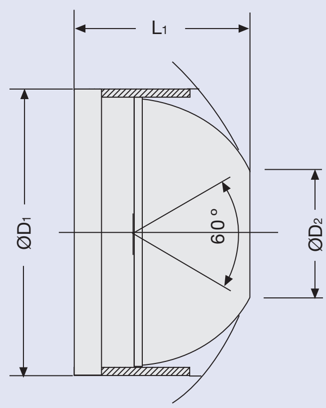
DUE-S-QR



DUE-S-RR
1) Only available in construction S



DUE-S-QR
DUE-V-QR



Section DUE-S-RR
Section DUE-S/V-QR

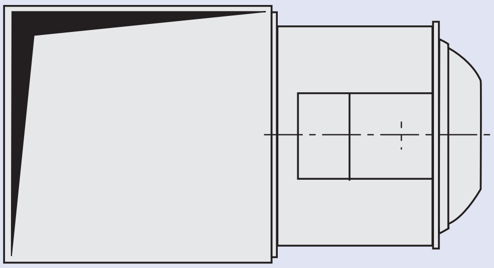
Installation · Materials

Installation

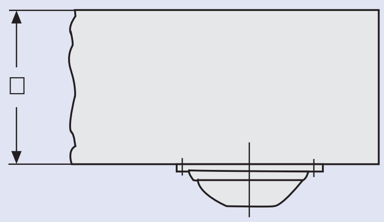
TROX jet nozzles are suitable for installation on rectangular or circular ducts.
With both types of connection, there is a circular drilled flange which can be used for either screw or rivet fixing (by others).
A perimeter sealing strip should preferably be fitted first.
The installation on circular duct can be made with a duct connection element (type DUE-S/V-R) or by a direct connection (type DUE-S/V-QR or DUE-S-RR).

Materials

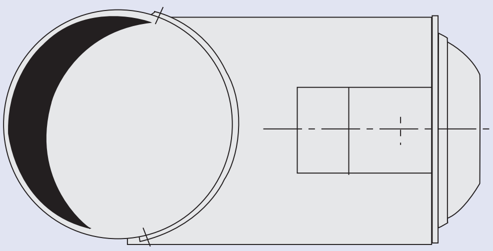
The discharge nozzle and face cover ring are in aluminium.
The duct connection element and duct connection pieces are in galvanised sheet steel, according to DIN 17162.
Standard finish powder coated white RAL 9010 options powder coated to other RAL colour or natural anodised.
Available with rear mounted perforated sheet steel plate for flow rate control painted black RAL 9005.



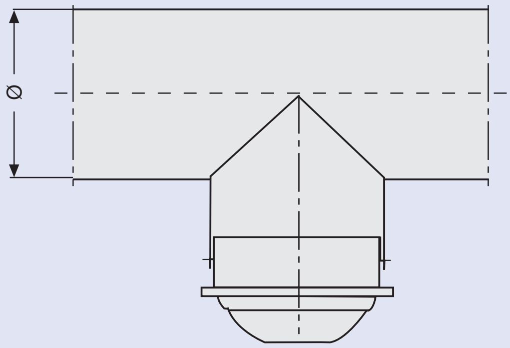
Example of rectangular duct installation



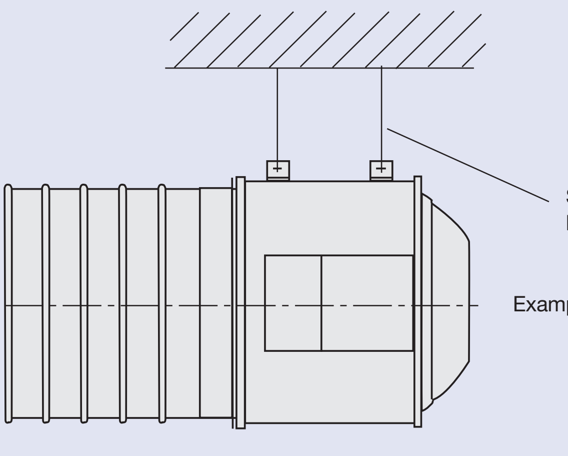
Jet nozzle directly on a rectangular duct



Example of connection onto a circular duct



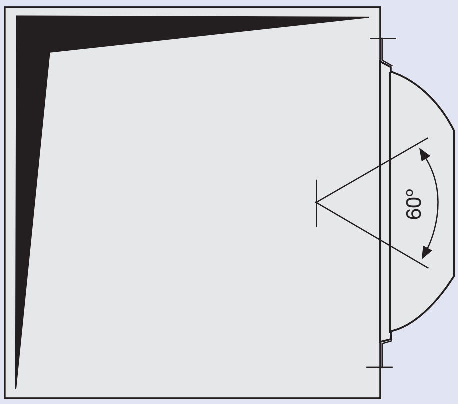
Pivoting or pivoting and rotating nozzle fitted to duct branch spigot



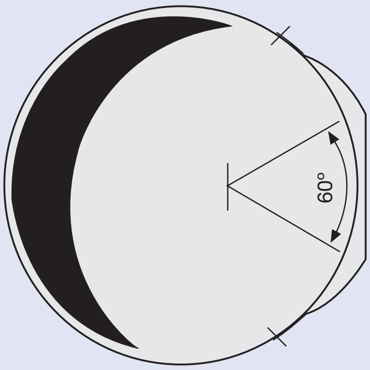
Example of cicular duct or flexible duct connection

Jet nozzles types DUE-S/V-Q, DUE-S/V-R, DUE-S/V-QR and DUE-S-RR are suitable for direct installation to rectangular or circular ducts without any additional element.
Jet nozzle flanges are predrilled for direct duct installation using fixing screws.

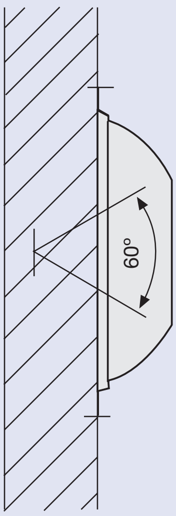
Also nozzle types DUE-S/V-R can be perfectly installed in walls or partitions, providing attention is given to sealing to the mounting surface using a sealing strip or other form of sealant.



Installation on a rectangular duct



Installation of jet nozzle on a circular duct

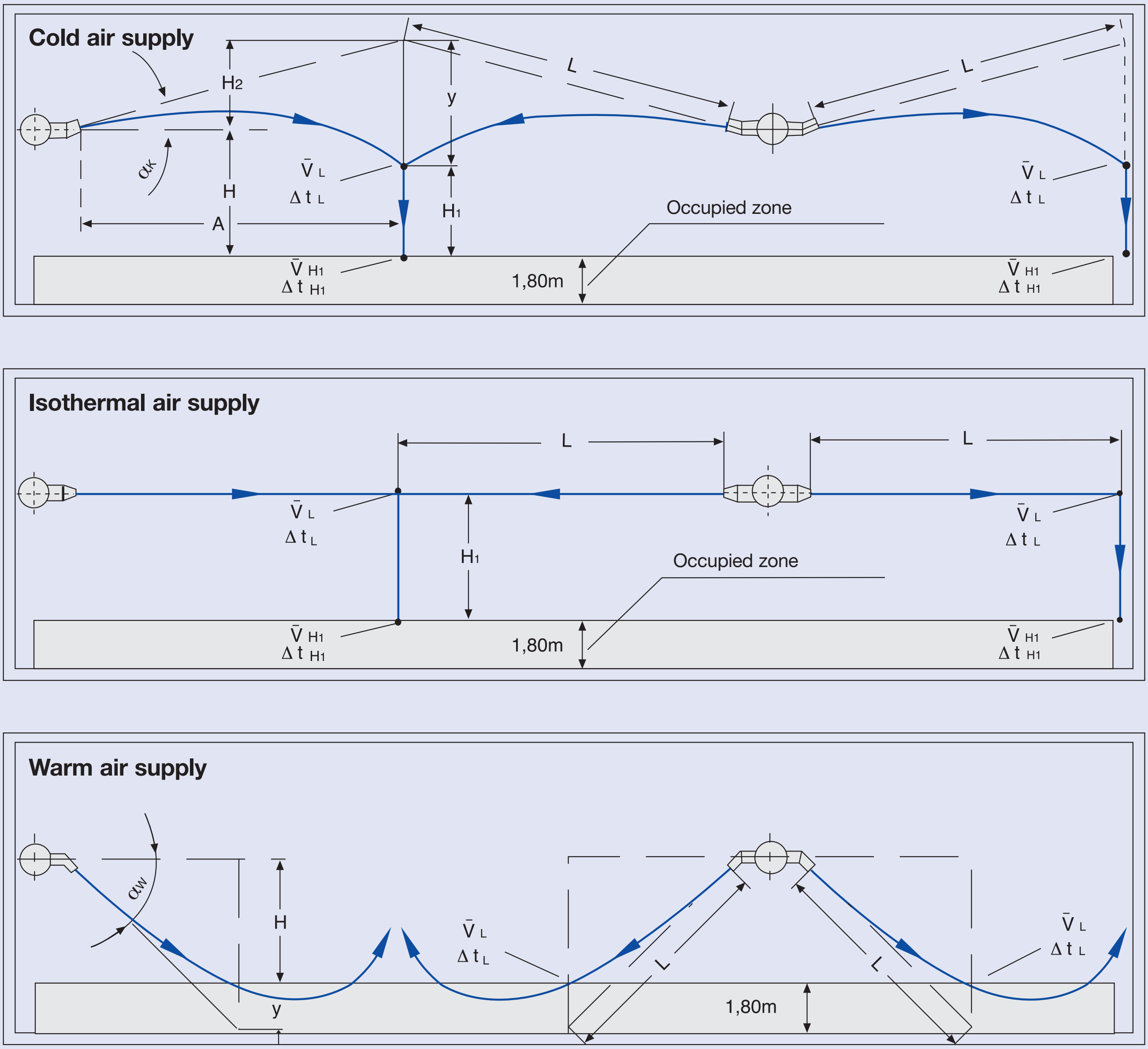


Special wall installation of jet nozzle DUE-S/V-R

Nomenclature

A in m: Horizontal distance from nozzles to the air stream collision point
B in m: Spacing distance between two nozzles in a row.
C, T, S : Variables function of α_K
H in m: Nozzle installation height above occupied zone
H_1 in m: Height of collision point of two air streams above occupied zone
H_2 in m: Height of collision point of two air streams above mounting position for nozzles for isothermal conditions
L in m: Length of air stream for isothermal conditions
$L_{max.}$ in m: Max. penetration depth of warm air stream directed vertically downwards
α_K in °: Discharge angle for cold air
α_W in °: Discharge for warm air
i : Air induction ratio at distance L
$\dot{V}$ in m³/h: Volume flow rate
$\dot{V}$ in l/s: Volume flow rate
y in m: Air stream deflection due to temperature difference from isothermal conditions

v_{eff} in m/s: Effective air discharge velocity at nozzle
v_K in m/s: Air velocity in duct
$\bar{v}_L$ in m/s: Mean air stream velocity
$\bar{v}_{H1}$ in m/s: Time average air velocity entering occupied zone
Δt_Z in K: Temperature difference between supply air and room air
Δt_L in K: Temperature difference between core and room air
Δt_{H1} in K: Temperature difference between core, when entering occupied zone, and room air
Δp_t in Pa: Total pressure drop
L_{WA} in dB(A): A-weighted sound power level in dB(A)
L_{WNC} : Noise criteria rating of sound power level spectrum in NC
L_{WNR} : $L_{WNR} = L_{WNC} + 1.5$
L_{pA}, L_{pNC} : A weighting or NC rating respectively of room sound pressure level
$L_{pA} \approx L_{WA} - 8$ dB, $L_{pNC} \approx L_{WNC} - 8$ dB



Given:

$A, H, \Delta t_{Z\ Heating}, \Delta t_{Z\ Cooling}, \dot{V}_W, \dot{V}_K$

Preliminary selection from table on page 3:

Volume flow rate $\dot{V}$ Size of jet nozzle DUE

Note:

If a line of nozzles the spacing B between the nozzles is < 0.15 · A then $\bar{v}_L$ and Δt_L must be multiplied by 1.4.

Table 1

α_K	C
0	1.00
5	1.00
10	0.98
15	0.97
20	0.94
25	0.91
30	0.87
35	0.82
40	0.77
45	0.71
50	0.64
55	0.57
60	0.50

Table 2

α_K	T
0	0.00
5	0.09
10	0.18
15	0.27
20	0.36
25	0.47
30	0.58
35	0.70
40	0.84
45	1.00
50	1.19
55	1.43
60	1.73

Table 3

α_W	S
0	0.00
5	0.09
10	0.17
15	0.26
20	0.34
25	0.42
30	0.50
35	0.57
40	0.64
45	0.71
50	0.77
55	0.82
60	0.87

Cold air

① α_K is selected: e.g. $\alpha_K = 30°$ — $\alpha_K = \ldots°$

② L is calculated: $L = A/C$ (c from table 1) — $L = \ldots m$

③ H_2 is calculated: $H_2 = T \cdot A$ (T from table 2) — $H_2 = \ldots m$

④ $\bar{v}_L$ from diagram 1 — $\bar{v}_L = \ldots m/s$

⑤ y from diagram 2 — $y = \ldots m$

⑥ H_1 is calculated: $H_1 = H + H_2 - y$ — $H_1 = \ldots m$

⑦ $\bar{v}_{H1}$ from diagram 3 — $\bar{v}_{H1} = \ldots m/s$

If $\bar{v}_{H1}$ differs from set value, procedure must be repeated with revised α_K!

⑧ Δt_{H1} from diagram 4: $\Delta t_{H1} = (\Delta t_{H1}/\Delta t_Z) \cdot \Delta t_Z$ — $\Delta t_{H1} = \ldots K$

Isothermal air

Horizontal discharge at $\alpha = 0°$

① $\bar{v}_L$ from diagram 1 — $\bar{v}_L = \ldots m/s$

② $\bar{v}_{H1}$ from diagram 3 — $\bar{v}_{H1} = \ldots m/s$

If $\bar{v}_{H1}$ deviates from the specified value, α must be corrected upwards or downwards.
Repeat the analysis in order to change L and H_1.

Warm air

① $\bar{v}_L$ is specified: e.g. $\bar{v}_L = 0.3$ m/s — $\bar{v}_L = \ldots m/s$

② L from diagram 1 — $L = \ldots m$

③ y from diagram 2 — $y = \ldots m$

④ α_W is calculated: $S = (H + y) / L$ (α_W from table 3) — $\alpha_W = \ldots°$
Note: $\alpha_W + \alpha_K$ = max. 60°

Motorised adjustment of the discharge angle on a change of supply air temperature is only possible up to max. $\alpha_W + \alpha_K = 60°$.

⑤ Δt_L from diagram 4: $\Delta t_L = (\Delta t_L/\Delta t_Z) \cdot \Delta t_Z$ — $\Delta t_L = \ldots K$

Example

Data given:
The nozzles are to be fitted at a spacing of 30 m (A = 15 m) and at a height of H = 6 m above the occupied zone, discharging towards each other.
The hall is very high, so free jet streams can be assumed.
For cooling, for each nozzle $\dot{V}_K$ = 280 l/s with $\Delta t_K = -8$ K and for heating, $\dot{V}_W$ = 70 l/s with $\Delta t_W = +4$ K.
A motorised up and down movement is required for the nozzles.
For the heating phase, there will be people in the occupied space, and air velocity of $\bar{v}_L$ = 0.3 m/s is assumed.

Solution

Procedure see on page 9.
From the pre-selection table on page 3 a 250 size is selected.

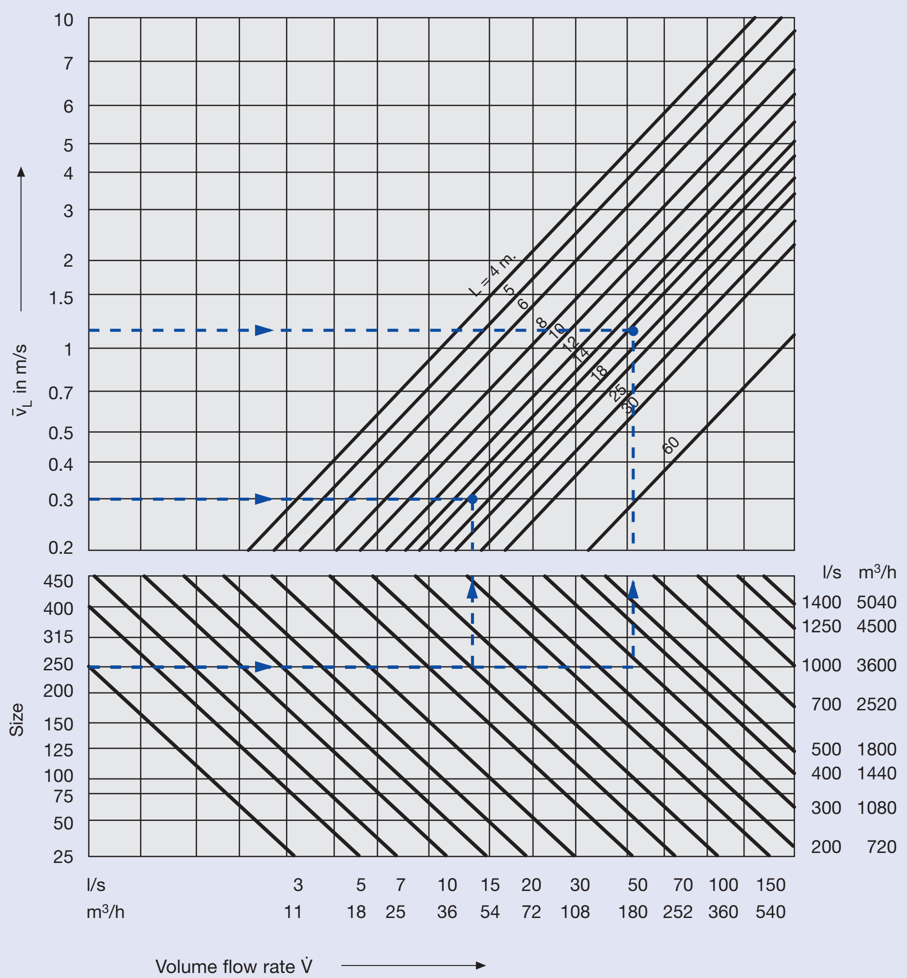
Cold air

① $\alpha_K = 30°$
② L = A/C = 15/0.87 = 17.2 m (C from table 1)
③ $H_2 = T \cdot A = 0.58 \cdot 15 = 8.7$ m (T from table 2)
④ from diagram 1: $\bar{v}_L$ = 1.1 m/s
⑤ from diagram 2: y = 0.32 m
⑥ $H_1 = H + H_2 - y = 6 + 8.7 - 0.32 = 14.4$ m
⑦ from diagram 3: $\bar{v}_{H1} < 0.05$ m/s

Warm air

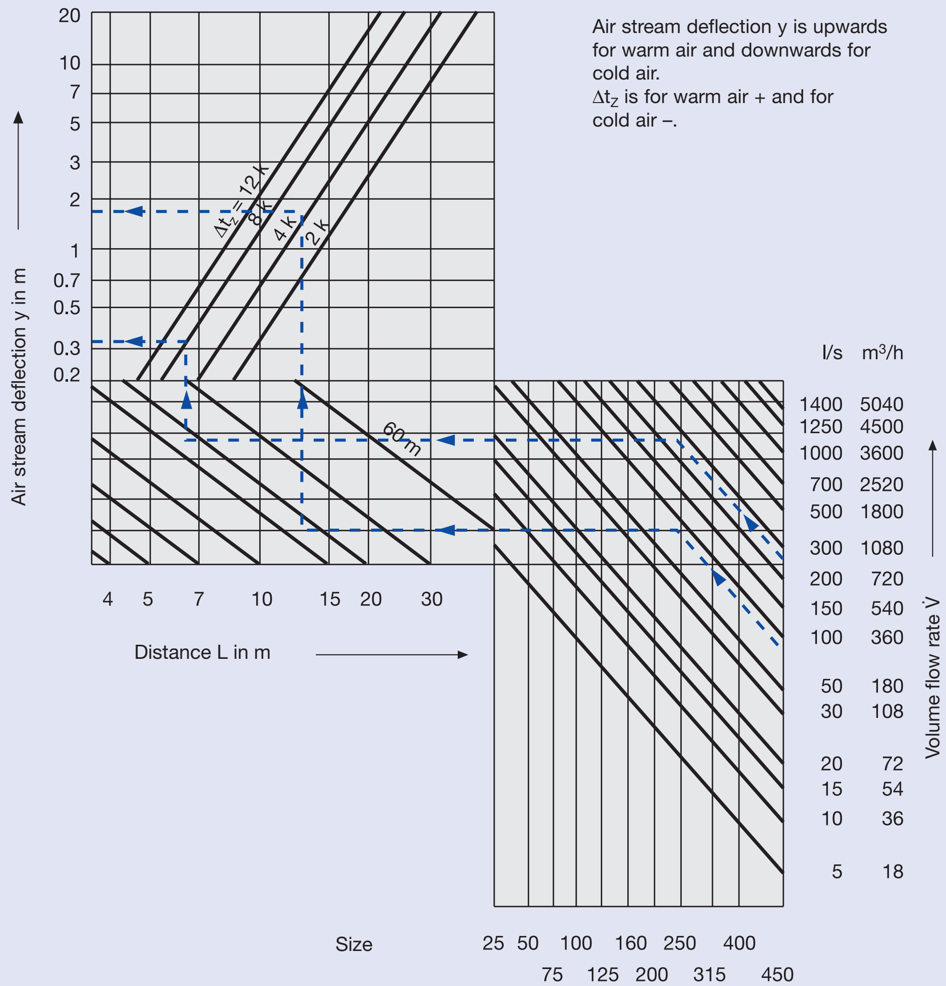
① data given: $\bar{v}_L$ = 0.3 m/s
② from diagram 1: L = 15.5 m
③ from diagram 2: y = 1.75 m
④ S = (H + y)/L = (6 + 1.75)/15.5 = 0.50
from table 3: $\alpha_W = 30°$
from diagram 7:
at $\dot{V}$ = 280 l/s L_{WA} = 49 + 1 = 50 dB(A)
Δp_t = 260 Pa
at $\dot{V}$ = 70 l/s L_{WA} = <20 dB(A)
Δp_t = 16 Pa

1 Core velocity and Throw

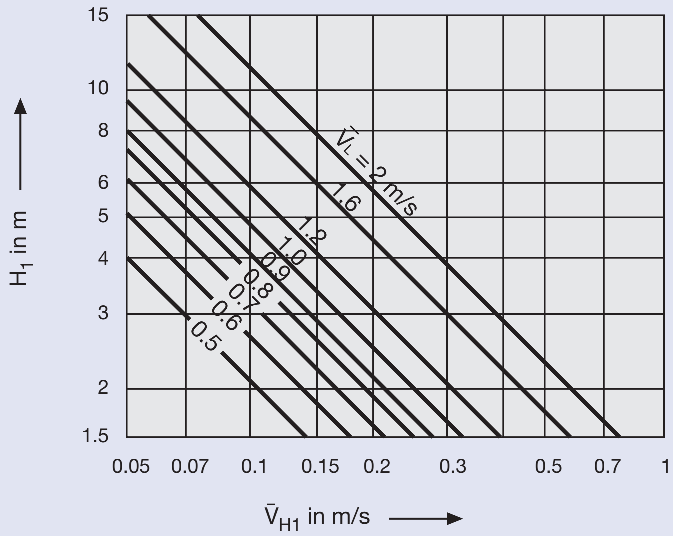


Result
Jet nozzles DUE size 250 must be installed horizontally with the motorised movement set such that an angular movement of 30° upwards occurs with cold air and 30° downwards for warm air.

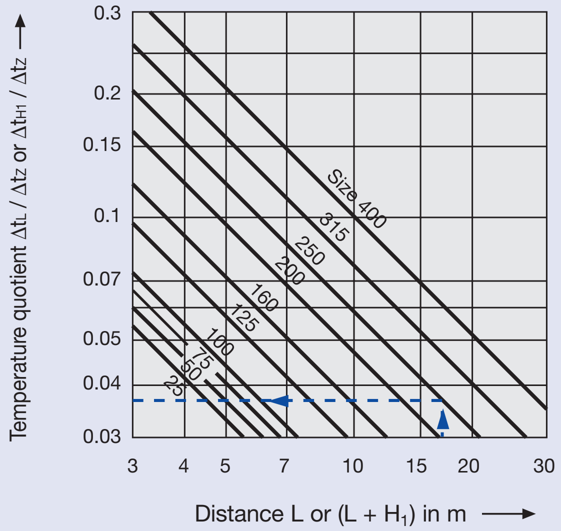
2 Air stream deflection



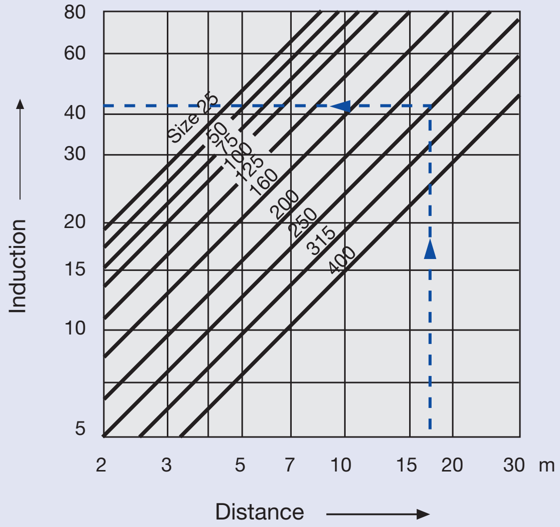
3 Air flow velocities



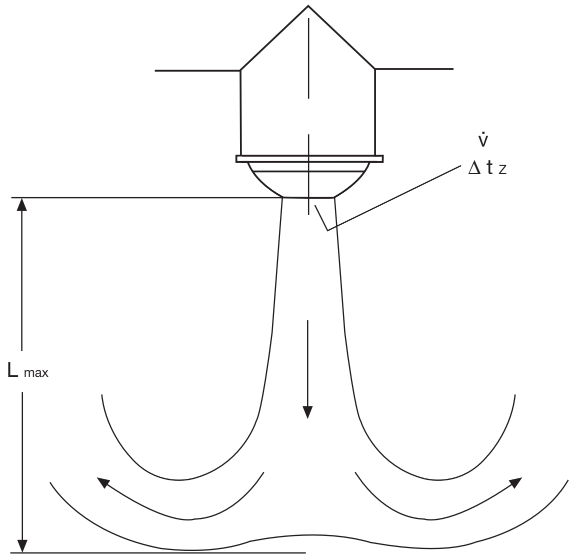
4 Temperatures quotient



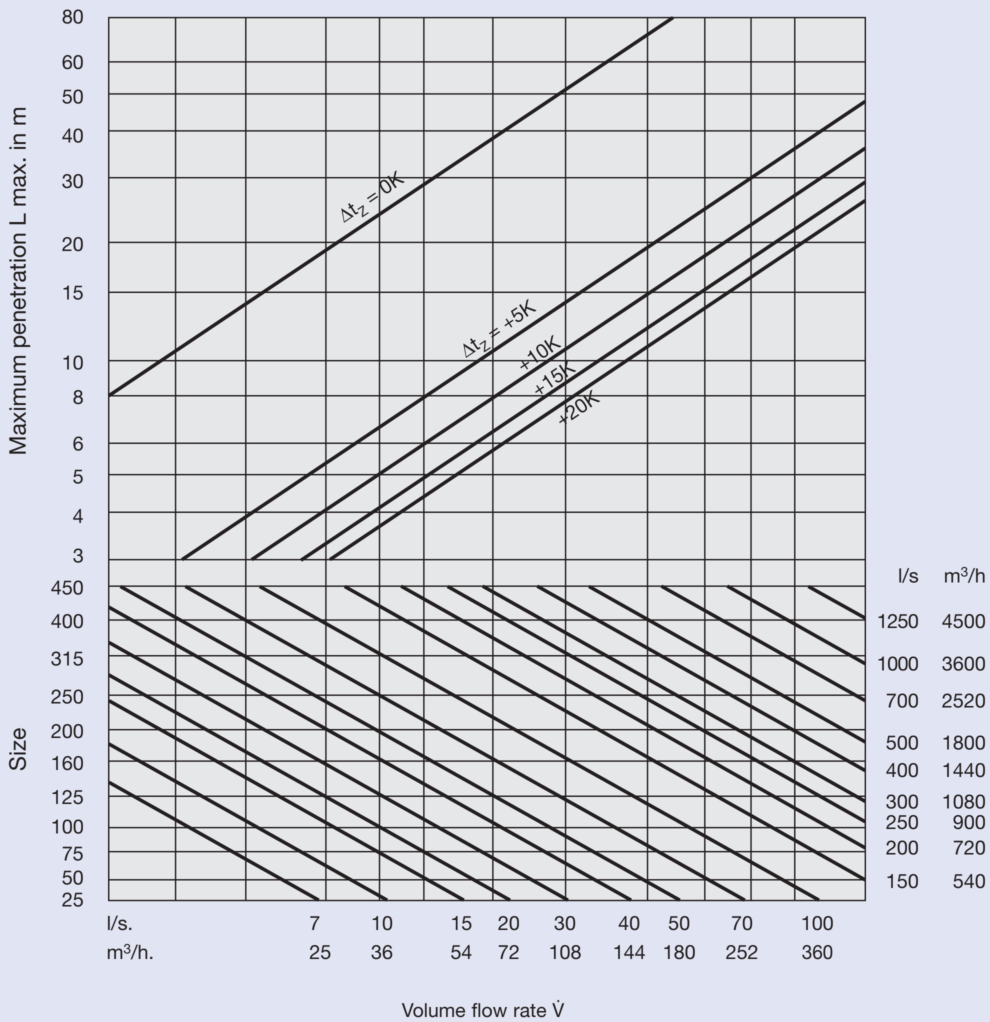
5 Induction



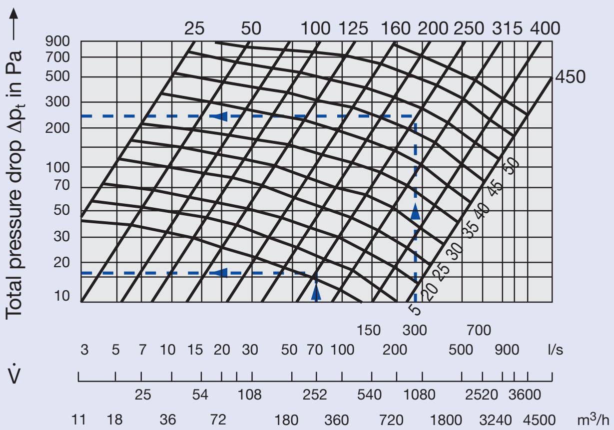
$L_{max.}$ is the maximum penetration depth to which a warm air stream can penetrate vertically downwards as a function of temperature difference.



6 Maximum penetration depth of a warm air stream, discharging vertically downwards



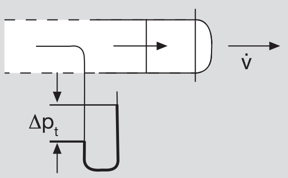
7 Sound power and pressure drop



Correction to diagram 7											
Size	25	50	75	100	125	160	200	250	315	400	450
L_{WA} / L_{WNC}	+ 2	+ 2	+ 2	+ 2	+ 2	+ 2	+ 2	+ 1	0	– 1	– 1

For the swivel angle α = +/– 30°

For adjustment of angle no additional correction is necessary.



Size	A_{eff} = in m²
25	0.000314
50	0.00070
75	0.001257
100	0.001744
125	0.00294
160	0.00469
200	0.00813
250	0.01289
315	0.02110
400	0.03686
450	0.0580

$$v_{eff} = \frac{\dot{V}}{1000 \cdot A_{eff}} \ (m/s)$$

$\dot{V}$ in l/s, A_{eff} in m²

$$v_{eff} = \frac{\dot{V}}{3600 \cdot A_{eff}} \ (m/s)$$

$\dot{V}$ in m³/h, A_{eff} in m²

Specification text

Jet nozzles type DUE suitable for long throw distances with optimum acoustic properties, preferably used for heating and cooling in critical areas. The adjustment facility – manual or automatic using an electric actuator – allows variation in discharge angle to compensate for changing temperature differences, adjustment angular range 30° upwards to 30° downwards in "S" configuration. The manually adjustable version "V" can also be rotated through 360°. Due to the wide range of constructions available, they are suitable for rectangular, circular duct or for wall installations.

Materials:
The discharge nozzle and face cover ring are in aluminium, the mounting plate for the eyeball is aluminium or sheet steel, depending on the type. The connection element and connection pieces are in galvanised sheet steel according to DIN 17162. Jet nozzle, cover ring, eyeball, mounting plates, are phosphate treated and powder coated in RAL 9010 colour, resistant to saturate environment for minimum 100 hours without deterioration (DIN 50017), other RAL colours available.
On request finish can be natural anodise, also can be provided with a rear mounted perforated steel plate for control of volume flow rate.

Order Code

DUE - S - Q - K - E1 / 250 / 0 / 0 / P 1 / RAL 9003

Fixed	F
Angular adjustment	S
Rotational and angular adjustment	V

Fitted on a square plate	Q
With flat circular flange	R
Fitted on a flat square plate with curved flanges for installation into a circular duct	QR
Fitted on a curved plate for installation onto a circular duct[1]	RR

Duct connection piece for rectangular duct[2]	K
As K plus rear circular spigot for direct connection to a circular duct[2]	A
Duct connection element for circular duct[2]	R
Perforated plate for control of air volume flow	LB

E1 linear motor	220 V, 50 Hz	Only for Ø, Q, R construction and connection K, A and R
E2 linear motor	24 V, 50 Hz	
E3 linear motor	24 V, 50 Hz, 0…10 V	
E4 rotary motor	220 V, 50 Hz	
E5 rotary motor	24 V, 50 Hz	
E6 rotary motor	24 V, 50 Hz, 0…10 V	

Size
25*
50
75
100
125
160
200
250
315
400
450

0 / 0: Not used

0	Standard RAL 9010
P1	Powder coated to RAL 9010
S1	Powder coated to RAL 9010
S2	Natural anodize E6-C-0

RAL 9003: State colour

1) Not available in construction V
2) Only for construction Q,R and plane nozzle Ø
* Only for construction DUE-F

Order Example:

Make: TROX
Type: DUE - S - Q - E1 / 250 / 0 / 0 / S1 / RAL 9003