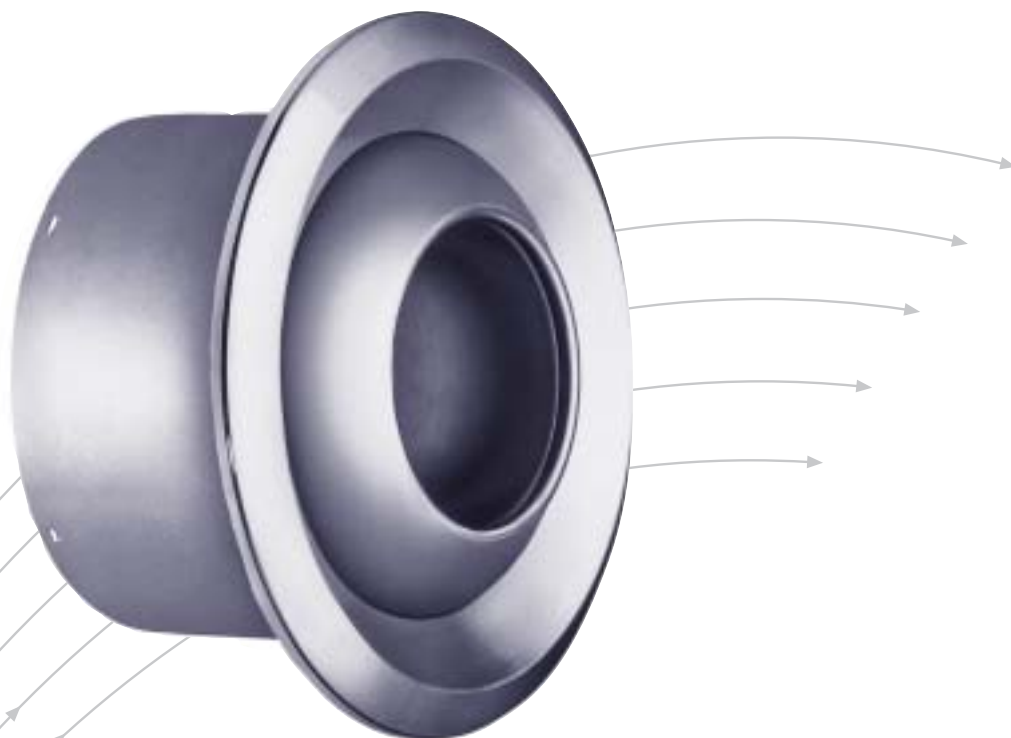


# Jet nozzles

Type DUK



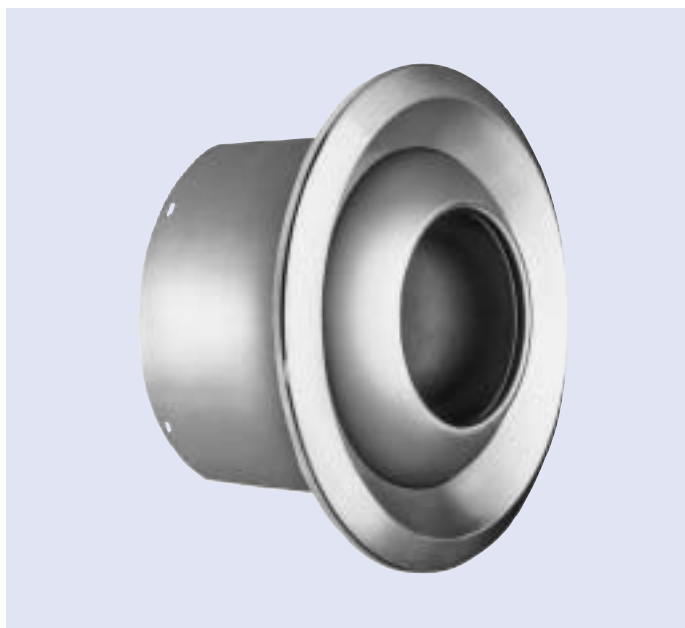
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# Contents · Description

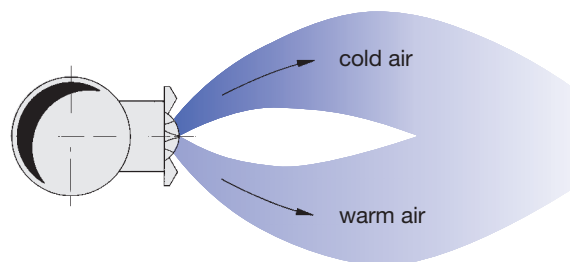
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Jet nozzles are used for preference where the supply air from the diffuser has to travel a large distance to the occupied zone.

This is the case in large rooms (halls, assembly rooms etc.), particularly when the distribution of air via ceiling diffusers is not possible or not practical. Here jet diffusers 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 room.

The direction of the air stream from the type DUK-V jet nozzle can be easily adjusted manually to suit particular on site conditions.



Also the pivoting movement can be motorised within the range of  $\pm 30^\circ$ .

The electric actuators for this can be externally or internally mounted.

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.

# Preliminary Selection

- 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 0.25 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 9) must be taken into account.

The noise levels apply to types DUK-F and DUK-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 55 dB(A). If the values required lie outside the limits of this table the procedures on page 8 should be followed.  
On our web site [www.trox.de](http://www.trox.de) we offer an electronic selection programme.

**Data for axial air flow, types DUK-F and DUK-V**

Size	Throw															Air Velocity $\bar{v}_L$ m/s
	10 m					20 m					30 m					
	$\dot{V}$ l/s	$L_{WA}$ dB(A)		$L_{WNC}$ NC		$\dot{V}$ l/s	$L_{WA}$ dB(A)		$L_{WNC}$ NC		$\dot{V}$ l/s	$L_{WA}$ dB(A)		$L_{WNC}$ NC		
		...-F	...-V*	...-F	...-V*		...-F	...-V*	...-F	...-V*		...-F	...-V*	...-F	...-V*	
100	–	–	–	–	–	26	31	29	30	23	39	42	41	41	35	
125	–	–	–	–	–	34	27	25	26	22	50	37	36	37	30	
160	23	<20	<20	<20	<20	46	<20	<20	<20	<20	69	32	35	33	28	
200	29	<20	<20	<20	<20	61	<20	<20	<20	<20	85	26	27	25	20	0.25
250	37	<20	<20	<20	<20	76	<20	<20	<20	<20	106	23	22	23	< 20	
315	50	<20	<20	<20	<20	98	<20	<20	<20	<20	150	21	20	22	< 20	
400	65	<20	<20	<20	<20	129	<20	<20	<20	<20	195	< 20	< 20	21	< 20	
100	26	31	29	30	23	52	50	50	49	45	–	–	–	–	–	
125	34	27	25	26	22	68	46	46	45	40	–	–	–	–	–	
160	46	<20	<20	<20	<20	92	39	44	40	37	138	50	55	51	49	
200	61	<20	<20	<20	<20	121	36	38	35	31	182	47	50	47	44	0.5
250	76	<20	<20	<20	<20	152	32	34	32	26	229	43	45	43	39	
315	98	<20	<20	<20	<20	195	27	28	28	20	293	39	40	40	32	
400	129	<20	<20	<20	<20	258	27	20	28	< 20	387	37	33	39	26	
100	52	50	50	49	45	–	–	–	–	–	–	–	–	–	–	
125	68	46	46	45	40	–	–	–	–	–	–	–	–	–	–	
160	92	39	44	40	37	–	–	–	–	–	–	–	–	–	–	
200	121	36	38	35	31	242	49	–	49	–	–	–	–	–	–	1.0
250	152	32	34	32	26	305	51	53	51	47	–	–	–	–	–	
315	195	27	28	28	20	390	47	48	48	41	585	53	–	54	–	
400	258	27	20	28	< 20	516	45	42	43	35	773	51	53	53	47	

\* See p. 11 for corrections for deflection angle

# Construction · Dimensions

Jet nozzles type DUK are suitable for almost all situations because of the wide range of variants available.

Fixed construction type DUK-F consists of a nozzle with fixing holes.

Adjustable construction type DUK-V consists of a spherical discharge nozzle mounted in a housing and is complete with a front mounting flange and circular spigot for direct connection to a circular duct. The nozzle can be adjusted manually up to max. 30° in any direction.

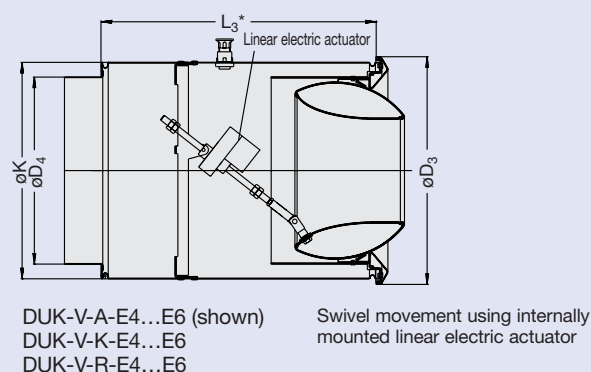
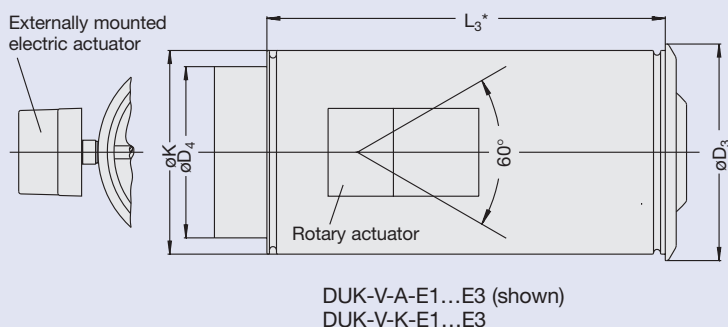
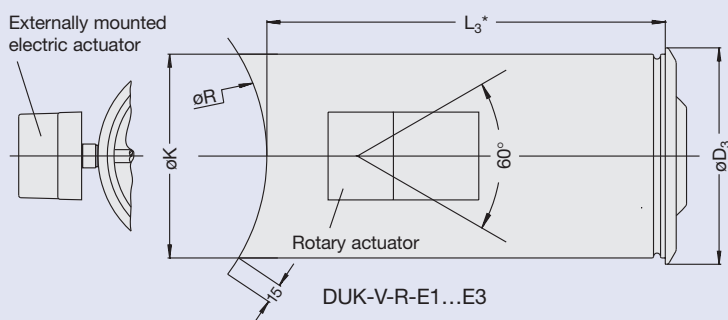
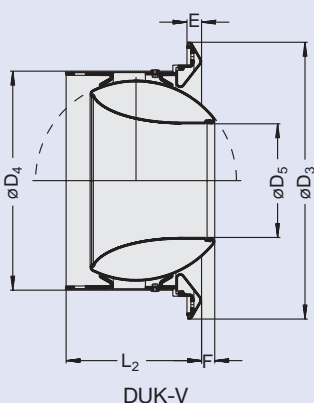
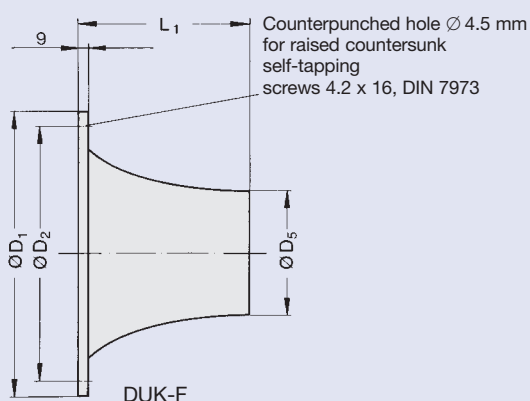
Size	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	D <sub>5</sub>	E	F	K	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub> *
100	136	115	146	98	50	11	- 3	134	94	87	84
125	159	138	169	123	64	11	3	157	112	96	94
160	225	201	200	158	82	11	9	188	122	105	114
200	265	241	257	198	108	16	9	242	153	126	143
250	315	291	302	248	136	16	21	287	187	162	172
315	400	376	384	313	174	23	23	358	224	196	223
400	485	461	467	398	230	24	45	441	287	201	262

\* For constructions with actuators, L<sub>3</sub> = 365 mm irrespective of size.

The adjustment can also be made with an electric actuator.

With an actuator the nozzle can only be rotated in one plane up to 30° upwards (cooling) up to 30° downwards (heating). A rear duct connection element with a peripheral flange and optional spigot or a saddle connector with flange are available as options for fixing to the side of rectangular or circular ducts.

Size	Possible Circular Duct Diameters R					
	200	250	315	500	630	800
100	●					
125		●				
160			●	●	●	●
200				●	●	●
250				●	●	●
315				●	●	●
400					●	●



## Materials

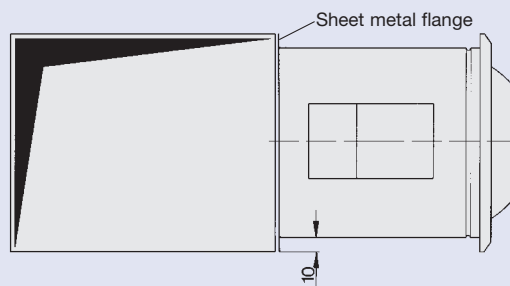
The discharge nozzle and face cover ring are in aluminium (natural finish).  
The mounting for the eyeball is with two plastic rings colour white RAL 9010. Temperature resistant up to max. 50°C.  
The duct connection element and saddle connection are in galvanised sheet steel.  
The surface can be painted if required, powder coated in white (RAL 9010) or other RAL colours.

## Installation

Trox jet nozzles are suitable for mounting on rectangular or circular ducts.  
With both types of connection, there is a circular undrilled flange which can be used for either screw or rivet fixing, by others.  
A sealing strip should preferably be fitted first.  
A spigot is provided for direct connection to spiral or flexible circular ducts.  
The spigot diameter accepts standard circular duct sizes (see table page 4).

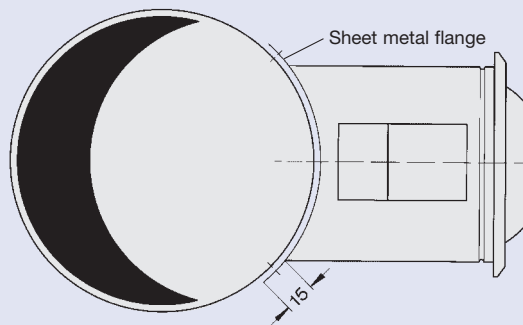
### DUK-V-K

Example of rectangular duct connection



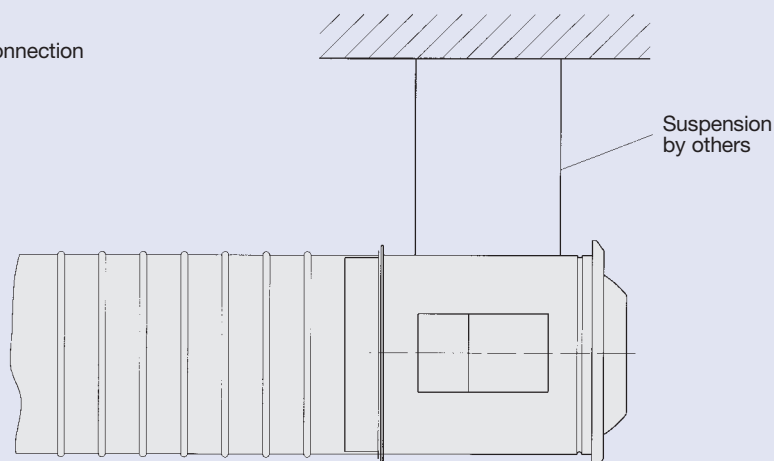
### DUK-V-R

Example of circular duct connection



### DUK-V-A

Example of duct or flexible duct connection

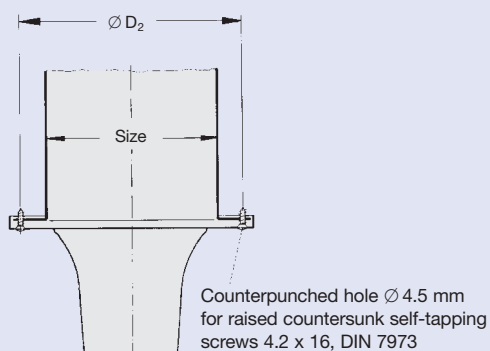


# Installation · Assembly

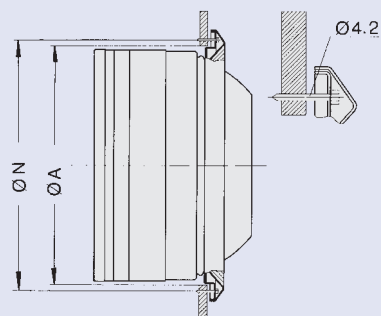
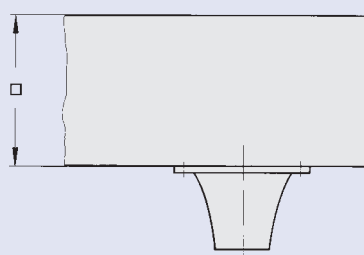
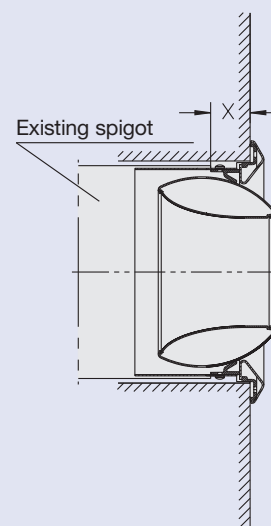
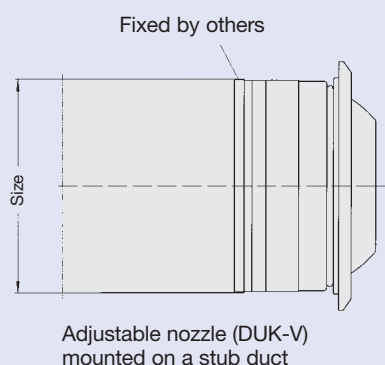
A fixed nozzle type DUK-F can be mounted on a stub duct or directly on the duct side.

An adjustable jet nozzle type DUK-V can be inserted into an existing connecting spigot up to a depth of dimension X and then screw fixed to the spigot, alternatively it can be screw fixed to the wall. To hide the screws, a cover ring with a bayonet twist fixing can be fitted.

Size	DUK-F		DUK-V			
	D <sub>2</sub> (mm)	No. holes	A (mm)	N (mm)	No. holes	X (mm)
100	115	3	115	125	3	30
125	138	3	138	148	3	40
160	201	4	169	179	4	40
200	241	4	220	232,5	4	50
250	291	4	265	277,5	4	50
315	376	8	330	349	6	55
400	461	8	415	432	6	70

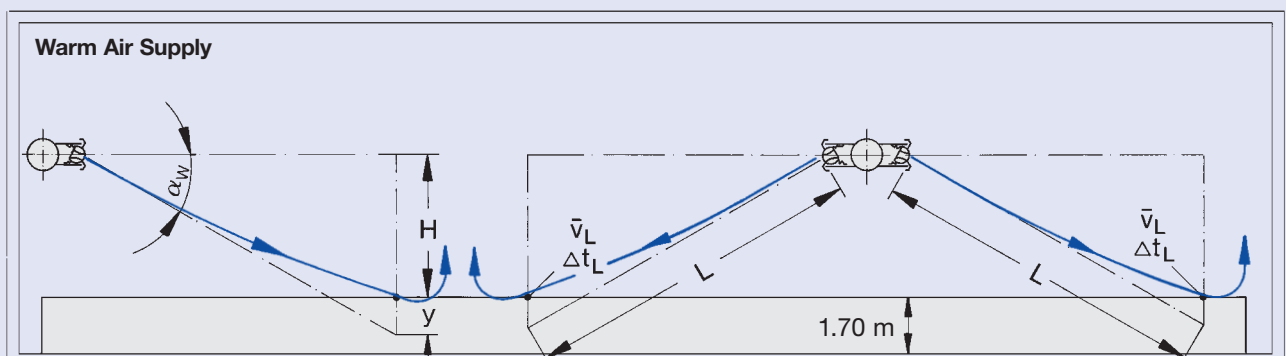
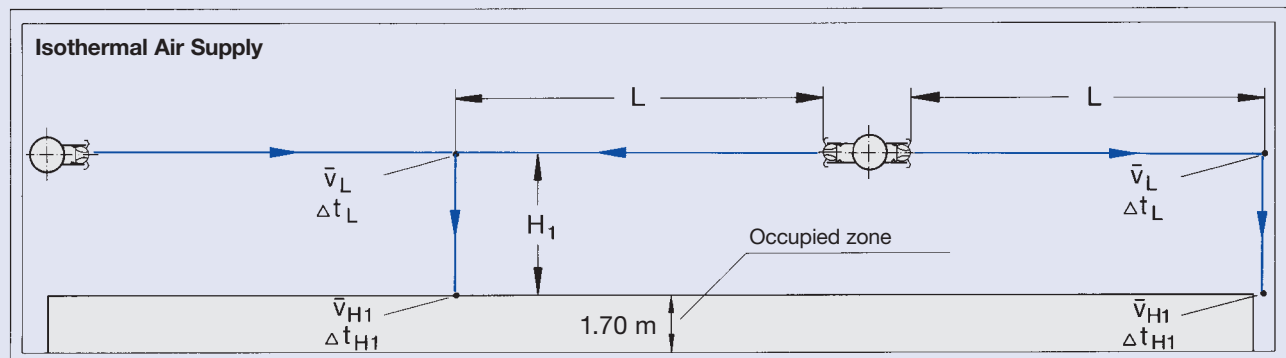
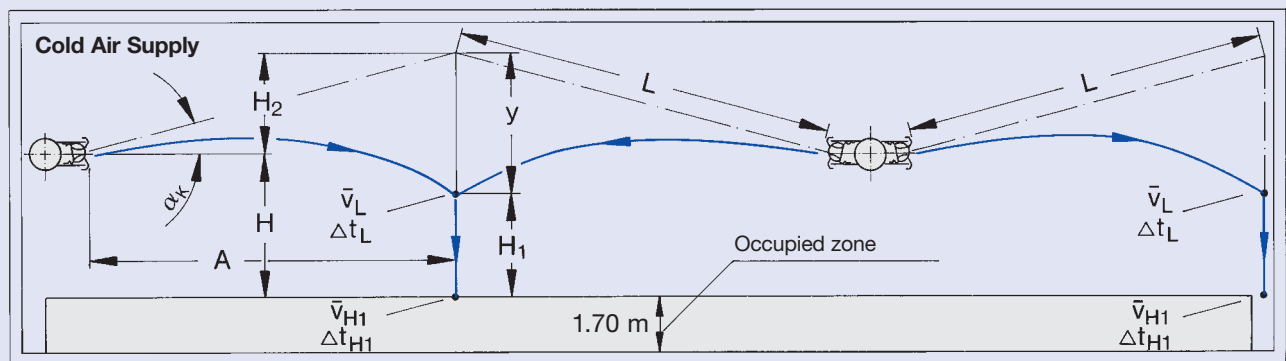


Fixed nozzle (DUK-F)  
mounted on a stub duct



# Nomenclature

A	in m:	Horizontal distance from nozzles to the airstream collision point	$v_K$	in m/s:	Air velocity in duct
B	in m:	Spacing distance between two nozzles in a row	$\bar{v}_L$	in m/s:	Mean air stream velocity
H	in m:	Nozzle installation height above occupied zone	$\bar{v}_{H1}$	in m/s:	Time average air velocity entering occupied zone
$H_1$	in m:	Height of collision point of two air streams above occupied zone	$\Delta t_Z$	in K:	Temperature difference between supply air and room air
$H_2$	in m:	Height of collision point of two air streams above mounting position of nozzles, for isothermal conditions	$\Delta t_L$	in K:	Temperature difference between core and room air at distance L
L	in m:	Length of air stream for isothermal conditions	$\Delta t_{H1}$	in K:	Temperature difference between core, when entering occupied zone, and room air
$L_{max}$	in m:	Max. penetration depth of warm air stream directed vertically downwards	$\Delta p_t$	in Pa:	Total pressure drop
$\alpha_K$	in °:	Discharge angle for cold air	$L_{WA}$	in dB(A):	A-weighted sound power level
$\alpha_W$	in °:	Discharge angle for warm air	$L_{W NC}$	:	Noise criteria rating of sound power level spectrum
i	:	Air induction ratio at distance L	$L_{W NR}$	:	$L_{W NR} = L_{W NC} + 1.5$
$\dot{V}$	in l/s:	Volume flow rate	$L_{pA}, L_{pNC}$	:	A-weighting or NC-rating respectively of room sound pressure level
$\dot{V}$	in m³/h:	Volume flow rate			$L_{pA} \approx L_{WA} - 8 \text{ dB}$
y	in m:	Air stream deflection due to temperature difference from isothermal conditions			$L_{pNC} \approx L_{W NC} - 8 \text{ dB}$
$v_{eff}$	in m/s:	Effective air discharge velocity at nozzle			



# Selection Method

## Example

Data given:

2 nozzles are to be fitted at a spacing of 20 m ( $A = 10$  m) and at a height of  $H = 5$  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  $\dot{V}_K = 150$  l/s with  $\Delta t_K = -8$  K and for heating,  $\dot{V}_W = 150$  l/s with  $\Delta t_W = +4$  K.

A motorised swivel movement is required for the nozzles. For the heating phase, an air speed of  $\bar{v}_L = 1.0$  m/s is assumed.

Solution:

Procedure see below.

Taking into account the acoustics, a jet nozzle type DUK-V size 200 is selected.

Result:

Jet nozzles DUK-V, size 200, must be installed horizontally with the motorised movement set such that a swivel angle of  $30^\circ$  upwards occurs with cold air and  $25^\circ$  downwards for warm air.

Cold air

$$\textcircled{1} \alpha_K = 30^\circ$$

$$\textcircled{2} L = \frac{A}{\cos \alpha_K} = 11.5 \text{ m}$$

$$\textcircled{3} H_2 = \tan \alpha_K \cdot A = 5.8 \text{ m}$$

$$\textcircled{4} \text{ from diagram 1: } \bar{v}_L = 1.2 \text{ m/s}$$

$$\textcircled{5} \text{ from diagram 2: } y = 0.72 \text{ m}$$

$$\textcircled{6} H_1 = H + H_2 - y = 5 + 5.8 - 0.72 = 10.1 \text{ m}$$

$$\textcircled{7} \text{ from diagram 3: } \bar{v}_{H1} < 0.07 \text{ m/s}$$

Warm air

$$\textcircled{1} \text{ Given: } \bar{v}_L = 1.0 \text{ m/s}$$

$$\textcircled{2} \text{ from diagram 1: } L = 13 \text{ m}$$

$$\textcircled{3} \text{ from diagram 2: } y = 0.51 \text{ m}$$

$$\textcircled{4} \alpha_W = \sin^{-1} ((H + y) / L) = 25^\circ$$

from diagram 8 (with axial connection):

$$\text{at } \dot{V} = 150 \text{ l/s} \quad L_{WA} = 44 + 3^* = 47 \text{ dB(A)}$$

$$L_{WNC} = 37 + 3^* = 40 \text{ NC}$$

$$\Delta p_t = 160 \text{ Pa}$$

from diagram 9 (with branch connection):

$$\text{at } 150 \text{ l/s} \quad L_{WA} \approx 45 \text{ to } 50 \text{ dB(A)} + 2 = 47\text{--}52 \text{ dB(A)}$$

$$\text{and } \dot{V}_K = 6 \text{ m/s} \quad L_{WNC} \approx 41 \text{ to } 46 \text{ NC}$$

$$\Delta p_t = 130 \text{ Pa} \times 1.2^* \approx 16 \text{ Pa}$$

\* Corrections from table page 11

Given:

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

Preliminary selection from table on page 3:

$$\text{Volume flow rate } \dot{V}$$

$$\text{Size of jet nozzle DUK-V}$$

Note:

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

### Cold Air

$$\textcircled{1} \alpha_K \text{ is selected: e.g. } \alpha_K = 30^\circ$$

$$\alpha_K = \dots^\circ$$

$$\textcircled{2} L \text{ is calculated: } L = \frac{A}{\cos \alpha_K}$$

$$L = \dots \text{ m}$$

$$\textcircled{3} H_2 \text{ is calculated: } H_2 = \tan \alpha_K \cdot A$$

$$H_2 = \dots \text{ m}$$

$$\textcircled{4} \bar{v}_L \text{ from diagram 1}$$

$$\bar{v}_L = \dots \text{ m/s}$$

$$\textcircled{5} y \text{ from diagram 2}$$

$$y = \dots \text{ m}$$

$$\textcircled{6} H_1 \text{ is calculated: } H_1 = H + H_2 - y$$

$$H_1 = \dots \text{ m}$$

$$\textcircled{7} \bar{v}_{H1} \text{ from diagram 3}$$

$$\bar{v}_{H1} = \dots \text{ m/s}$$

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

$$\textcircled{8} \Delta t_{H1} \text{ from diagram 4:}$$

$$\Delta t_{H1} = (\Delta t_{H1} / \Delta t_Z) \cdot \Delta t_Z$$

$$\Delta t_{H1} = \dots \text{ K}$$

### Isothermal Air

Horizontal discharge at  $\alpha = 0^\circ$

$$\textcircled{1} \bar{v}_L \text{ from diagram 1 (} L = A \text{)}$$

$$\bar{v}_L = \dots \text{ m/s}$$

$$\textcircled{2} \bar{v}_{H1} \text{ from diagram 3 (} H = H_1 \text{)}$$

$$\bar{v}_{H1} = \dots \text{ m/s}$$

If  $\bar{v}_{H1}$  deviates from the specified value,  $\alpha$  must be corrected upwards or downwards.  $L$  and  $H_1$  are changed as a result. Repeat the analysis.

### Warm Air

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

$$\bar{v}_L = \dots \text{ m/s}$$

$$\textcircled{2} L \text{ from diagram 1}$$

$$L = \dots \text{ m}$$

$$\textcircled{3} y \text{ from diagram 2}$$

$$y = \dots \text{ m}$$

$$\textcircled{4} \alpha_W \text{ is calculated:}$$

$$(\alpha_W = \sin^{-1} ((H + y) / L))$$

$$\alpha_W = \dots^\circ$$

Note:  $\alpha_W + \alpha_K = \text{max. } 60^\circ$

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

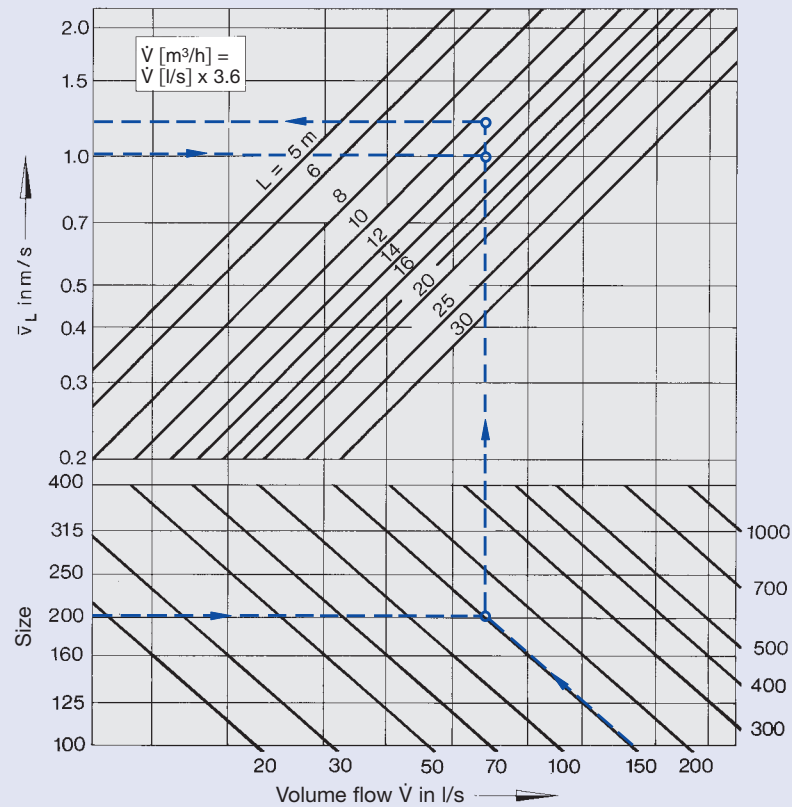
$$\textcircled{5} \Delta t_L \text{ from diagram 4:}$$

$$\Delta t_L = (\Delta t_L / \Delta t_Z) \cdot \Delta t_Z$$

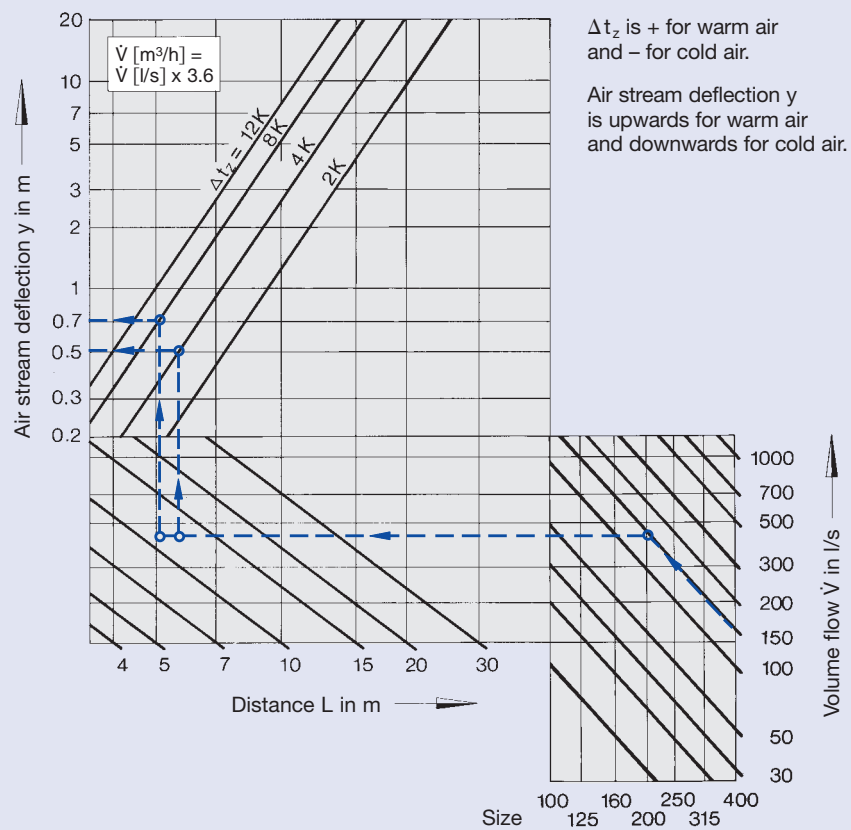
$$\Delta t_L = \dots \text{ K}$$



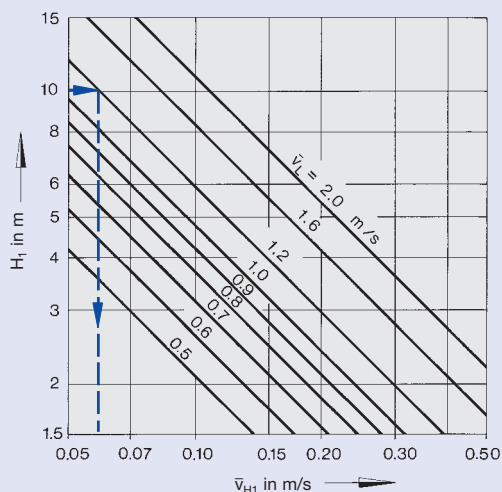
## 1 Core velocity and Throw



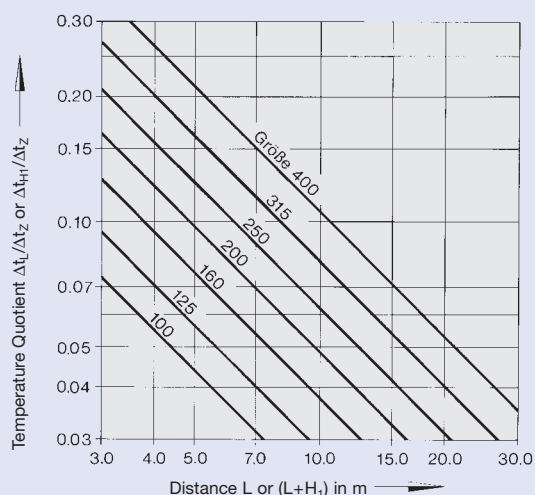
## 2 Air Stream Deflection



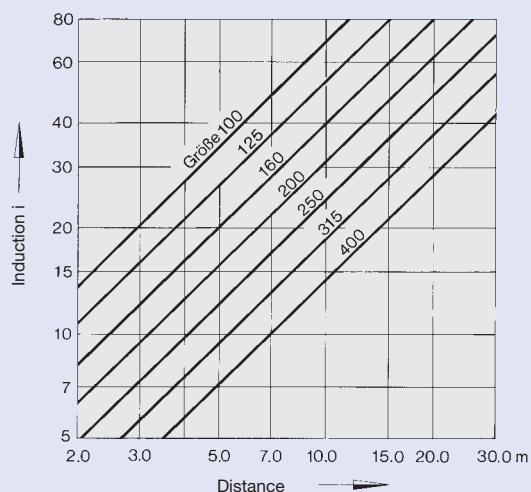
## 3 Core Velocity



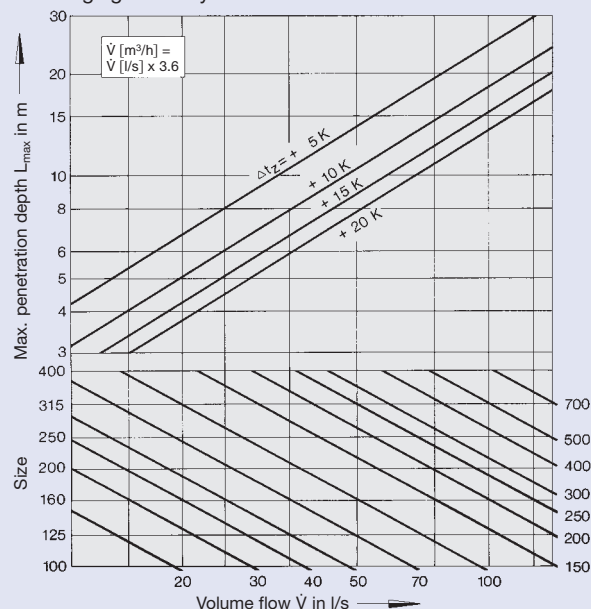
## 4 Temperature Quotient



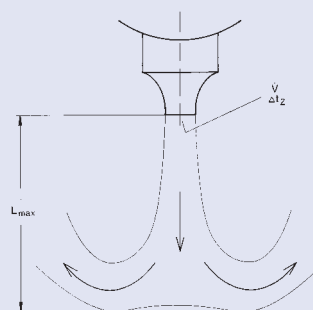
## 5 Induction



## 6 Maximum penetration depth of a warm airstream, discharging vertically downwards



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



## Effective Area

Size	$A_{\text{eff}}$ in $\text{m}^2$	
	DUK-F	DUK-V
100	0.00174	0.0019
125	0.00277	0.0031
160	0.00469	0.0050
200	0.00813	0.0085
250	0.01289	0.0135
315	0.02110	0.0225
400	0.03683	0.0385

## Effective Discharge Velocity

$$v_{\text{eff}} = \frac{\dot{V}}{1000 \cdot A_{\text{eff}}} [\text{m/s}]$$

$\dot{V}$  in l/s,  $A_{\text{eff}}$  in  $\text{m}^2$

$$v_{\text{eff}} = \frac{\dot{V}}{3600 \cdot A_{\text{eff}}} [\text{m/s}]$$

$\dot{V}$  in  $\text{m}^3/\text{h}$ ,  $A_{\text{eff}}$  in  $\text{m}^2$

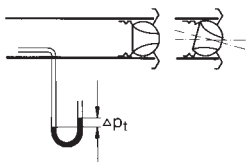
The diagrams below apply to the installations shown:

Jet nozzles attached to circular duct (axial installation)

Type DUK-F-...



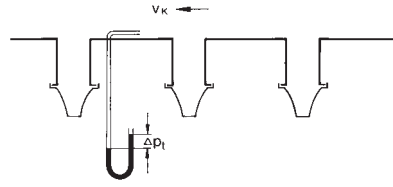
Type DUK-V-...



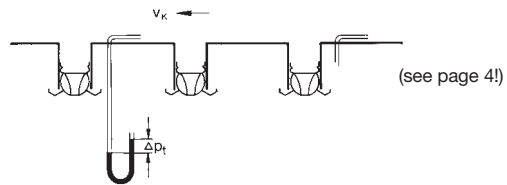
$L_{WA}$  = diagram value - 3 dB(A)  
 $\Delta p_t$  = diagram value x 0.9 Pa

Jet nozzles attached to the side of a common duct (branch installation)

Type DUK-F-...

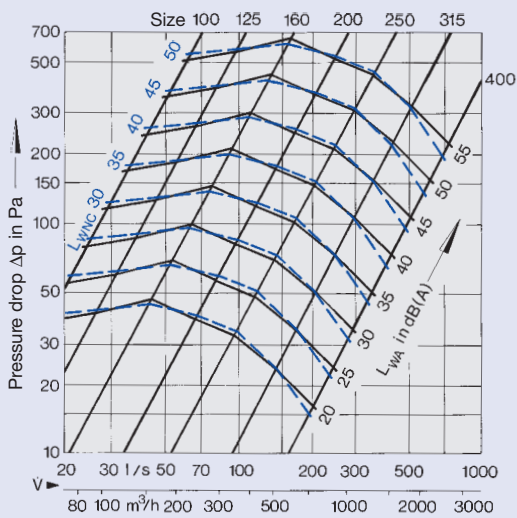


Type DUK-V-...

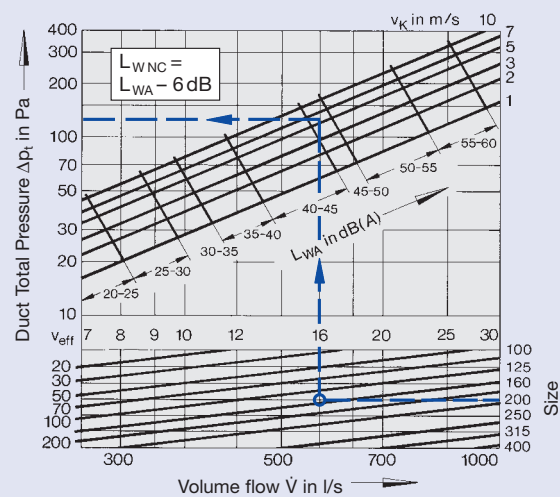


(see page 4!)

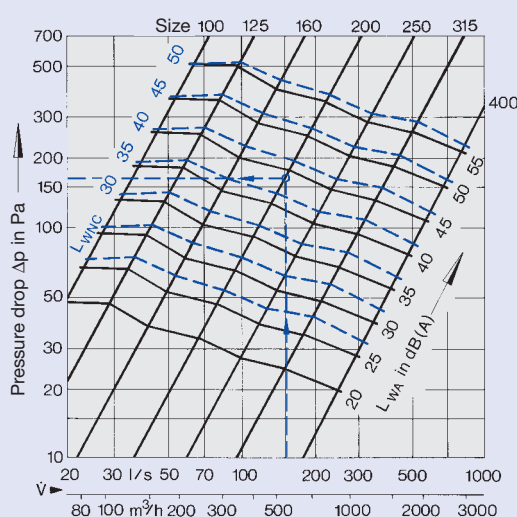
**7** Sound Power and Pressure Drop for axial installation DUK-F



**9** Sound Power and Pressure Drop for branch installation



**8** Sound Power and Pressure Drop for axial installation DUK-V



**Correction to Diagram 9**

Size	Swivel angle		$\Delta p_t$ 30°
	0°	30°	
	DUK-F / DUK-V $L_{WA} / L_{WNC}$	DUK-V $L_{WA} / L_{WNC}$	DUK-V
100	-6	-4	x 1.2
125	-4	-2	x 1.2
160	-2	0	x 1.2
200	0	2	x 1.2
250	2	4	x 1.2
315	4	6	x 1.2
400	6	8	x 1.2

**Correction to Diagram 8, for swivel angle  $\alpha = \pm 30^\circ$**

Size	100	125	160	200	250	315	400
$L_{WA} / L_{WNC}$	+3	+5	+3	+3	+2	+2	+1

# Order Details

## Specification Text

Jet nozzles type DUK suitable for long throw distances with optimum acoustic properties, preferably used for heating and cooling in critical areas. The adjustment facility – manual or automatic via internal or externally mounted electric actuation – allows variation in discharge angle to compensate for changing temperature differences, adjustment angular range 30° upwards to 30° downwards. The manually adjustable version can also be rotated through 360°.

The fixed jet nozzle type DUK-F consists of an aerodynamically shaped discharge nozzle deep-drawn in one piece, with fixing holes. Adjustable construction type DUK-V consists of a discharge nozzle with spherical outlet mounted in a housing, a mounting flange and in a circular duct rear connection spigot for direct connection to a circular duct. Also available with

rear-mounted duct connecting element with peripheral flange and optional spigot or saddle connection with flange for fixing to the side of rectangular or circular ducts; the rear contour of the saddle connection is profiled to the duct diameter.

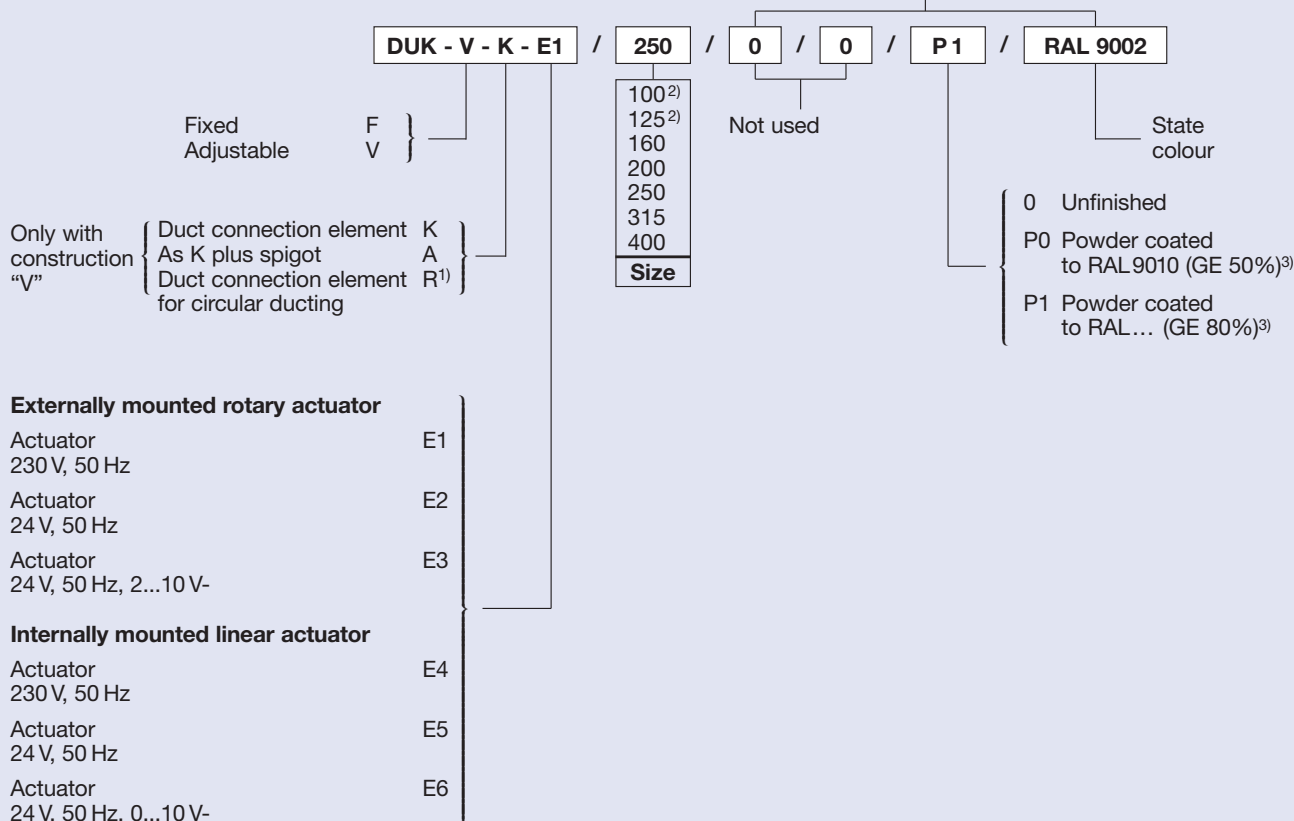
### Materials:

The discharge nozzle and face cover ring are in aluminium, the mounting for the eyeball is with two plastic rings colour white RAL 9010 (Temperature resistant up to max. 50 °C), the connection element and saddle connection are in galvanised sheet steel.

The surface can be pre-treated and powder coated in white (RAL 9010) or another RAL colour (the spigots remain galvanised finish).

## Order Code

These codes do not need to be completed for standard products



1) Please indicate the onsite duct diameter (ØR) as supplementary text.  
 2) For sizes 100 and 125, construction with actuator not available.  
 3) GE = Gloss level!

## Order Example:

Make: TROX  
 Type: DUK - V - K - E1 / 250 / P1 / RAL 9002