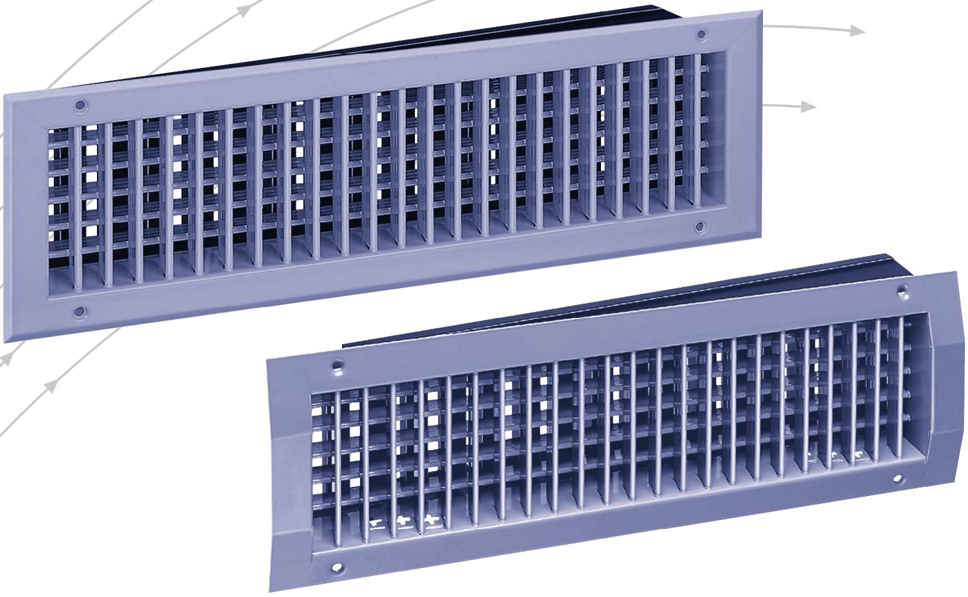
L-02-5-01e

Diffusion grilles type DG...

Dimensioning

Blowing in horizontally from walls and circular ducts



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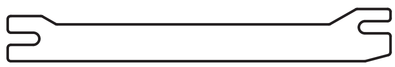
Contents

Explanatory note
The following calculation principles are based on tests and experience and are valid for the dimensioning of TROX HESCO diffusion grilles. The diagrams and data on the minimum distances are designed so that, when the dimensioning is correct, no draughts occur in the occupied zone (as long as no air stream gradients due to temperature differences are present).

Note:
In plants with large air change rates, it is not always possible to keep the occupied zone free of draughts. The good controllability of the TROX HESCO diffusion grilles with the individually adjustable air control blades makes it possible to guide the primary air movement so that draughts can be avoided at the main points where people are present.

The air control blades can be altered using a DG blade adjusting key.

DG blade adjusting key



DGSELF- blade adjusting key

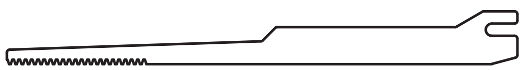
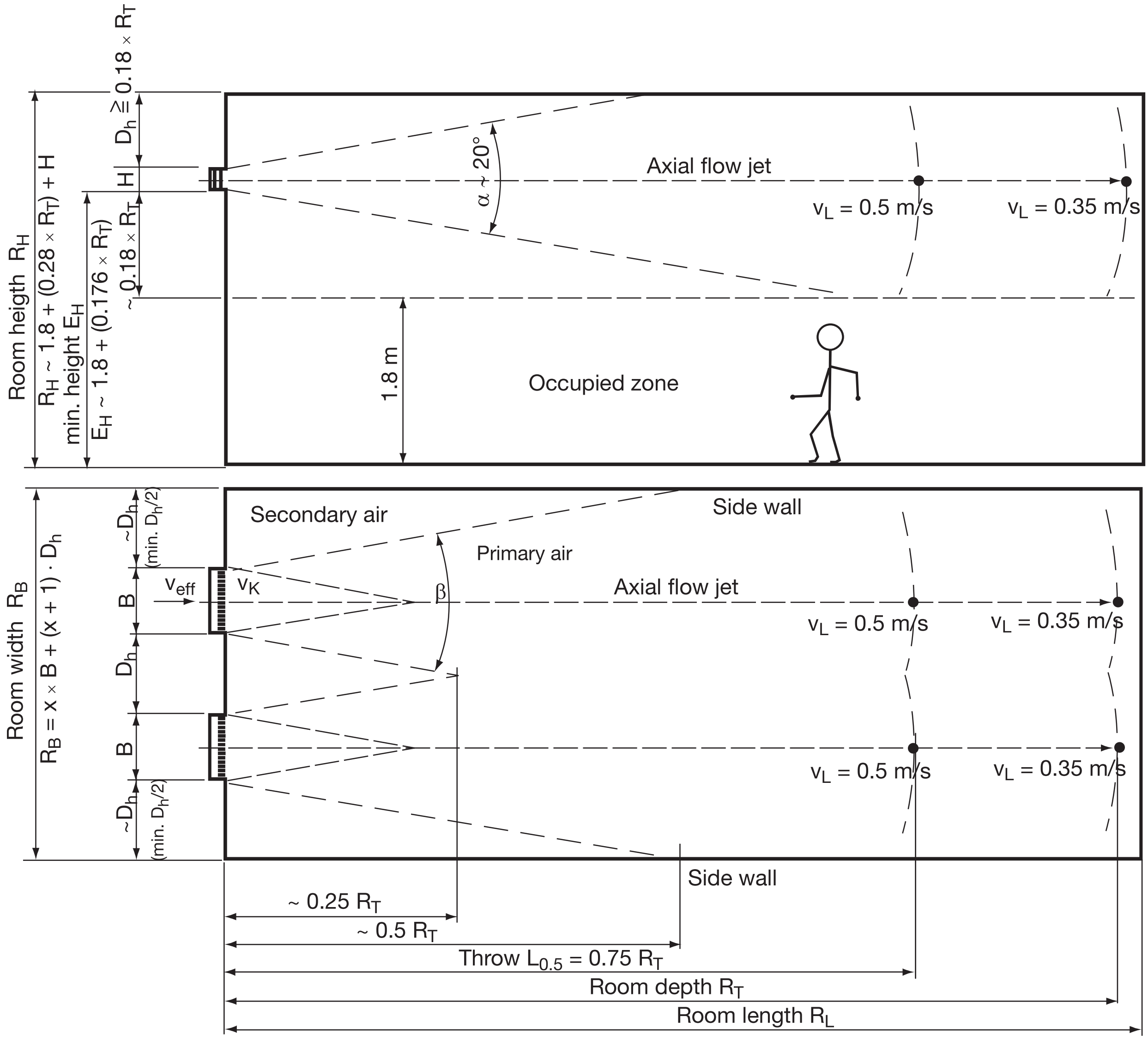


Diagram 1, undisturbed supply air stream (free air stream)

This diagram is applicable for TROX HESCO standard supply air grilles (single grilles) of the types: DG..., DGR..., DGL..., DGX..., DGSELF and DGVAR (without DG13) with blades in straight positions and unobstructed air stream spreading.

Minimum distances for unobstructed air stream spreading



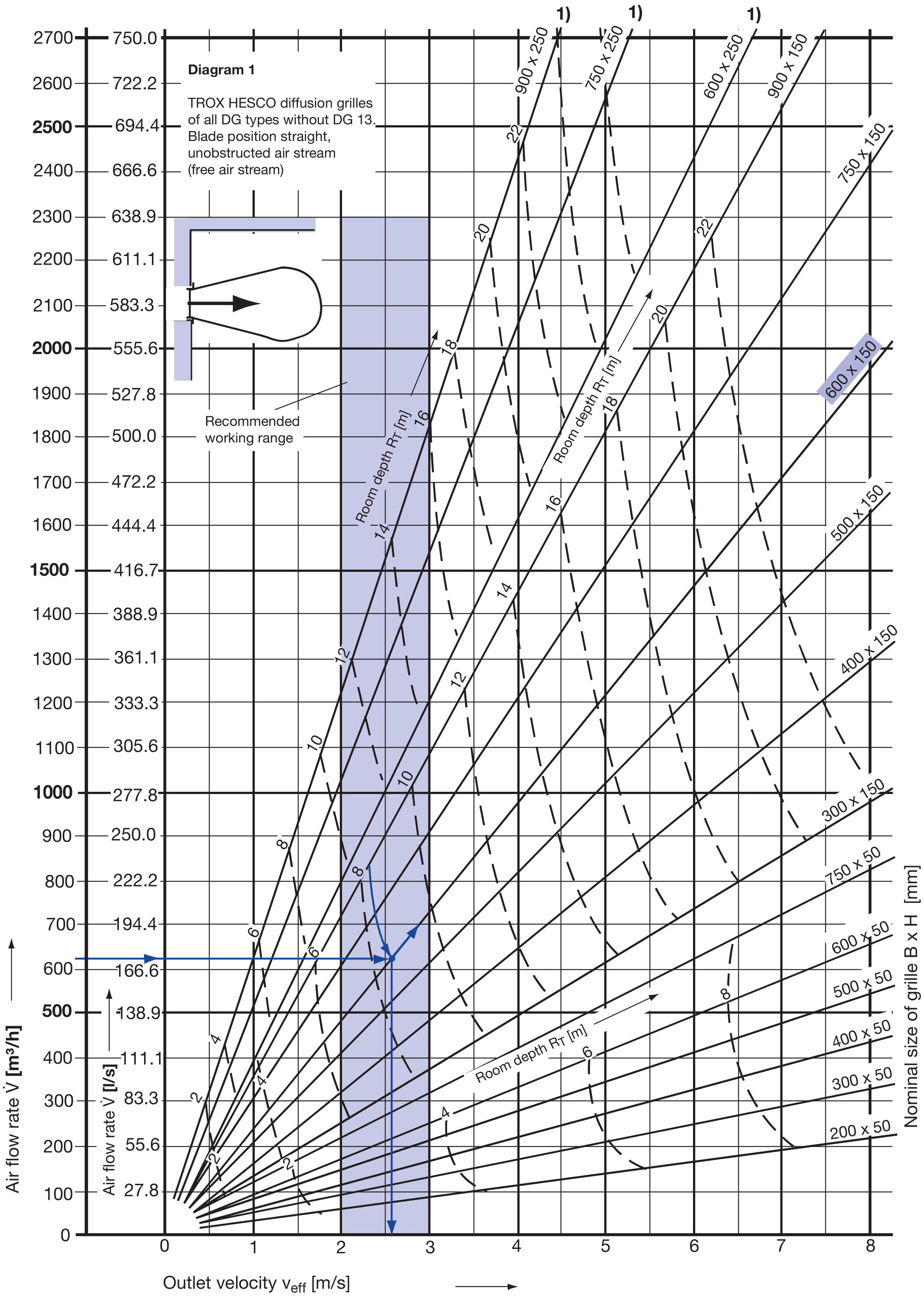
For grilles with blades in straight position, the air stream leaving the outlet diverges in the horizontal or vertical plane by the angle $\alpha = 20°$, Distance $D_h = 0.10 \times R_T$

Calculation example
Given
Room length R_L = 8.5 m, room width R_B = 5 m, room height R_H = 4.5 m, mounting height E_H = 3.0 m, air flow rate $\dot{V}$ = 1240 m³/h, resp. 344.4 l/s

Wanted
Grille dimension B x H, room depth R_T, outlet velocity v_{eff}, distance D_h, pressure drop Δp_s, sound power level L_{WA}, L_{WNC}, L_{WNR}

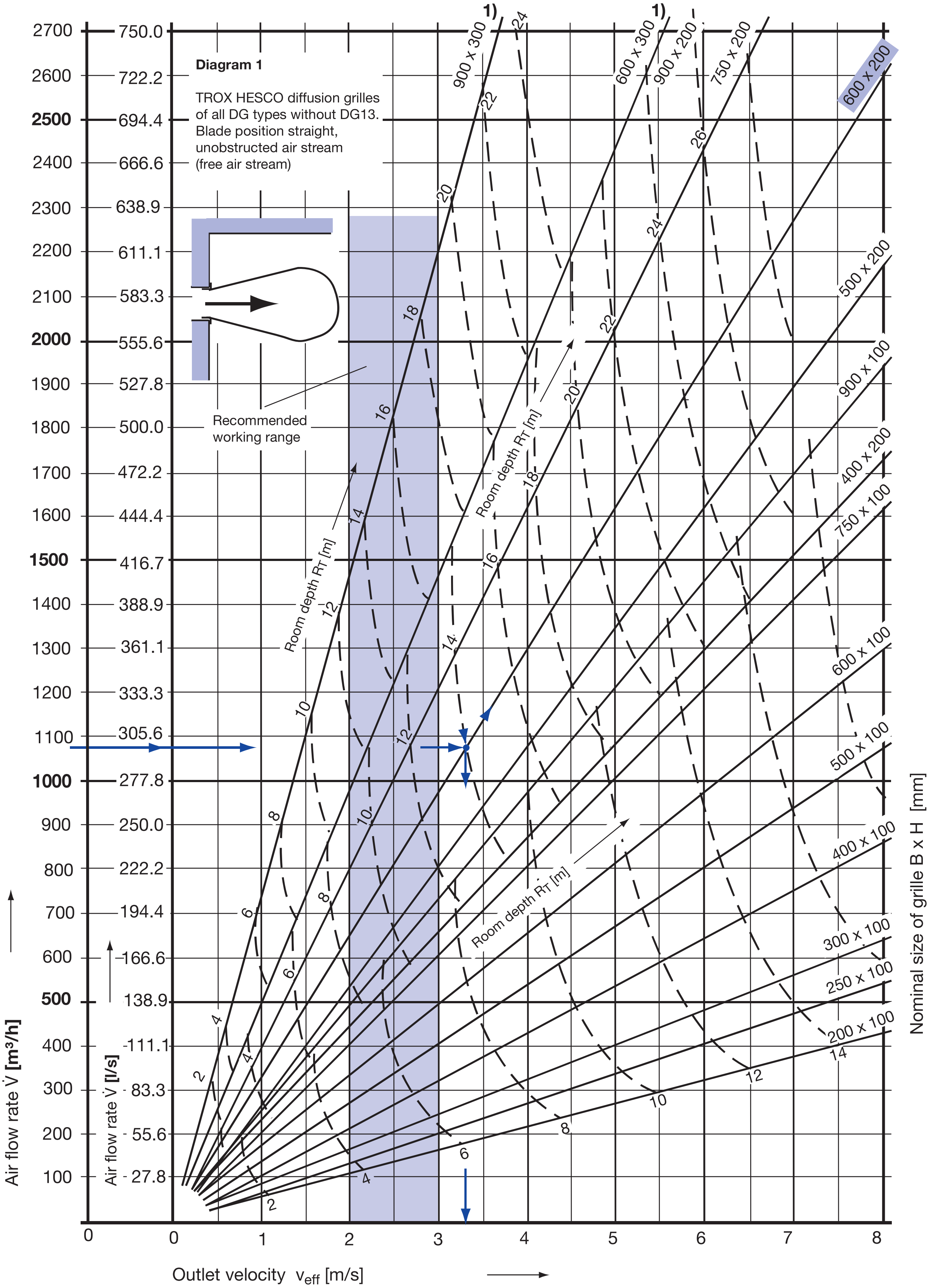
Solution
The large room height allows to select the air outlet according to diagram 1, page 4 (unobstructed air stream spreading)

Result
2 off DG1, 600 × 150 mm, room depth R_T = 8.4 m, outlet velocity v_{eff} = 2.6 m/s, $D_h = R_T \times 0.1 = 8.4 \times 0.1 = 0.84$ m,
pressure drop Δp_s ~ 2.5 Pa, (diagram page 19,
sound power level L_{WA} = 17 + 2 = 19 dB(A),
L_{WNC} = 19 - 4 = 15, L_{WNR} = 19 - 2 = 17.
More exact details for L_{WA} and Δp_s see page 21.



1) Not available out of stock types DGR...+ DGRA....
Generally: Dimension and types out of stock see price-list.

Note: In a light cooling case (transition period) and 2-speed operation $v_{eff} \geqq 1.5$ m/s



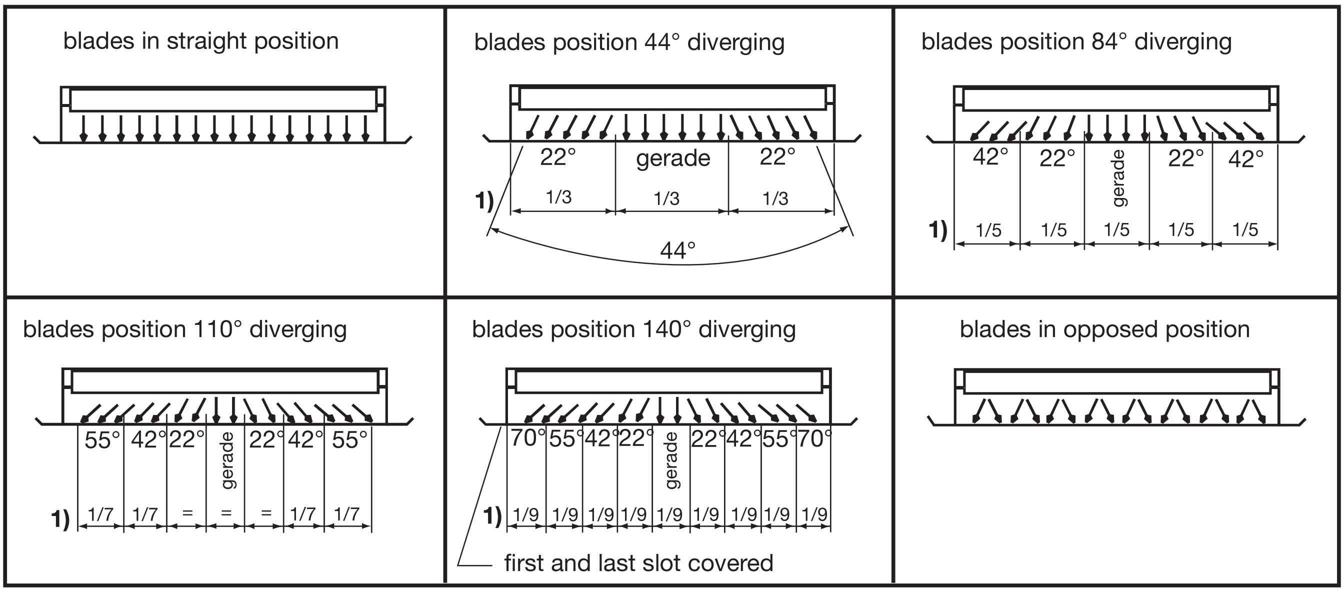
1) Not available out of stock types DG...5, ...35, ...5P, ...35P and ...7, ...17 and all DGR... + DGRA... types.
Generally: Dimension and types out of stock see price-list.

Note: In a light cooling case (transition period) and 2-speed operation $v_{eff} \geqq 1.5$ m/s

Blades positions

The divergence of the air stream and with its throw, can be controled by adjusting the vertical blades at the front of the grille. The adjustment is made with a specially designed 'DG-key' which is being supplied at no cost. The air stream drop can be affected by adjusting the horizontal blades at the back of the grille.

Some important positions of the vertical blades



1) approx. details

Correction coefficients to diagram 1 and 2

	Blades positions: diverging					
	straight	44°	84°	110°	140°	opposed
Divergence of air jet ∢ ß	20°	60°	80°	90°	180°	20°
Distance D_h horizontal blowing out	$0.10 \times R_T$	$0.29 \times R_{T44}$	$0.42 \times R_{T84}$	$0.6 \times R_{T110}$	–	$0.10 \times R_{Tg}$
Distanz D_v vertical blowing out *)	$0.25 \times R_T$	$0.76 \times R_{T44}$	$1.07 \times R_{T84}$	$1.25 \times R_{T110}$	$3.26 \times R_{T140}$	$0.25 \times R_{Tg}$
Room depth	R_T Diagr. 1 and 2	$R_{T44} = 0.77 \times R_T$	$R_{T84} = 0.56 \times R_T$	$R_{T110} = 0.42 \times R_T$	$R_{T140} = 0.35 \times R_T$	$R_{Tg} = 1.30 \times R_T$
Faktor of the outlet velocity v_{eff}	$v_{eff} = 1{,}0$	$v_{eff\ 44°} = 1.18$	$v_{eff\ 84°} = 1.35$	$v_{eff\ 110°} = 1.52$	$v_{eff\ 140°} = 1.97$	$v_{eff\ geg} = 1.97$

*) Detailed informations look diagram L 2.5-2e

Calculation example
Given
Room length $R_L = 7.0$ m, Room height $R_H = 5.5$ m, height $E_H = 4.0$ m,
air flow rate $\dot{V} = 1080$ m³/h, resp. 300 l/s, unobstructed air stream spreading, blades position 84° diverging

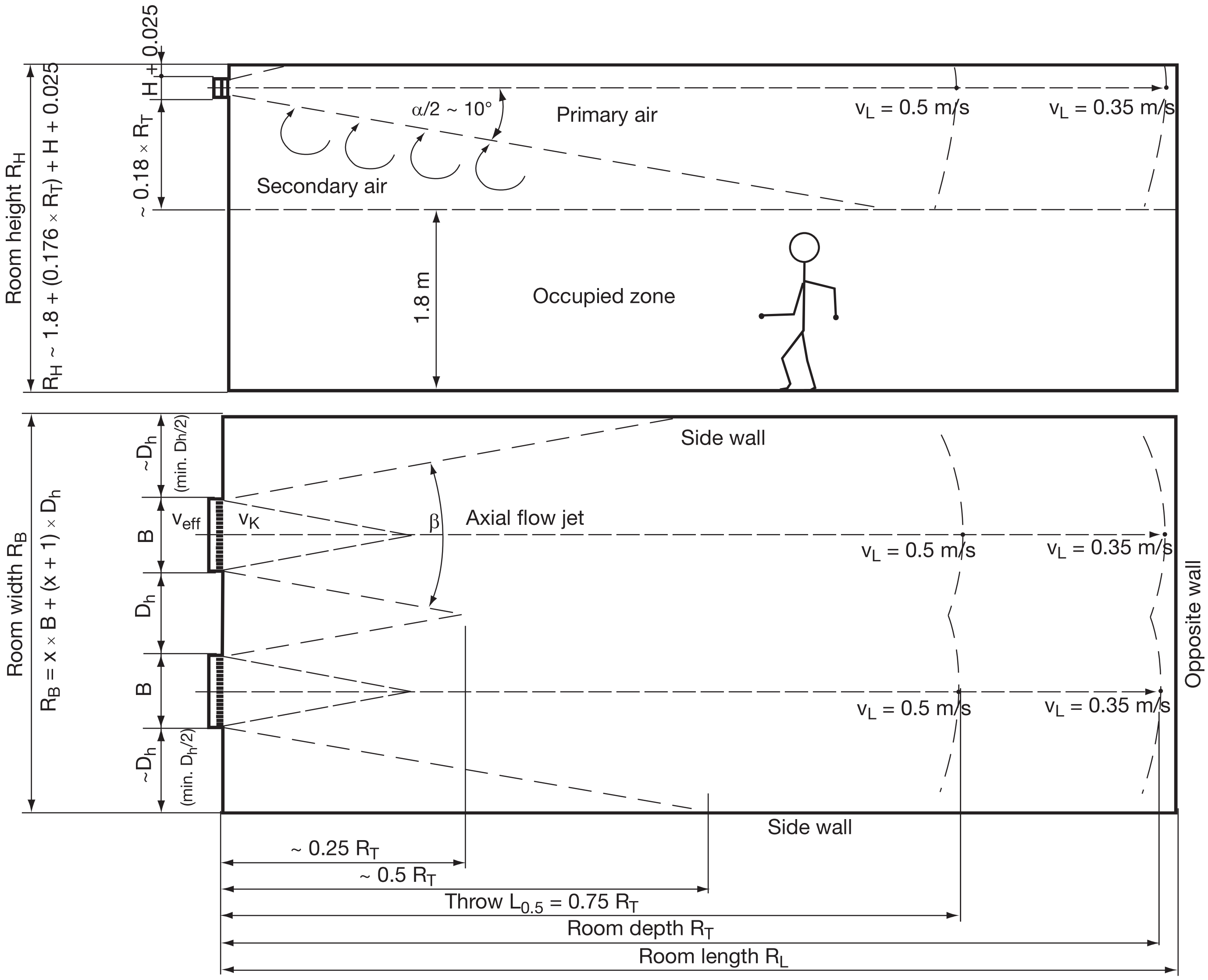
Wanted
Grille dimension B x H, room depth R_T und R_{T84}, outlet velocity v_{eff}, pressure drop Δp_s, sound power level L_{wA}, L_{wNC}, L_{wNR}

Solution
$R_{T84} = 0.56 \times R_T$ therefore $R_T = R_{T84}/0.56 = 7/0.56$ ~13 m. With this value you can select the required grille on diagram 1, page 5: 1 off DG1, 600 x 200 mm, $v_{eff} = 3.3$ m/s. Of diagram page 19 follows: $\Delta p_s = 4$ Pa, has to be corrected to 84° diverging.
Therefore $\Delta p_{s84} = 3.3 \times 1.50 = 4.95$ m/s ⇒ 8 Pa, sound power level $L_{wA} = 34 + 3 = 37$ dB(A), $L_{wNC} = 37 - 4 = 33$, $L_{wNR} = 37 - 2 = 35$. More exact details for L_{wA} and Δp_s see page 21.

Diagram 2, grilles installed at ceiling level (Coanda effect)

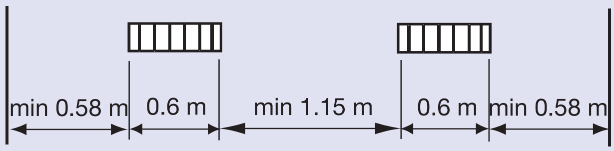
This diagram is applicable for TROX HESCO standard supply air grilles (single grilles) of the types: DG..., DGR..., DGL..., DGX..., DGSELF and DGVAR (without DG13) with blades in straight position, grilles installed at ceiling level.

Minimum distances



For grilles with blades in straight position, the air stream leaving the outlet diverges in the horizontal or vertical plane by the angle α /2 = 10°, distance $D_h = 0.10 \times R_T$

Calculation example
Given
Room length R_L = 12 m, room width R_B = 4.0 m, room height R_H = 4.0 m,
air flow rate $\dot{V}$ = 1060 m³/h resp. 294.4 l/s,

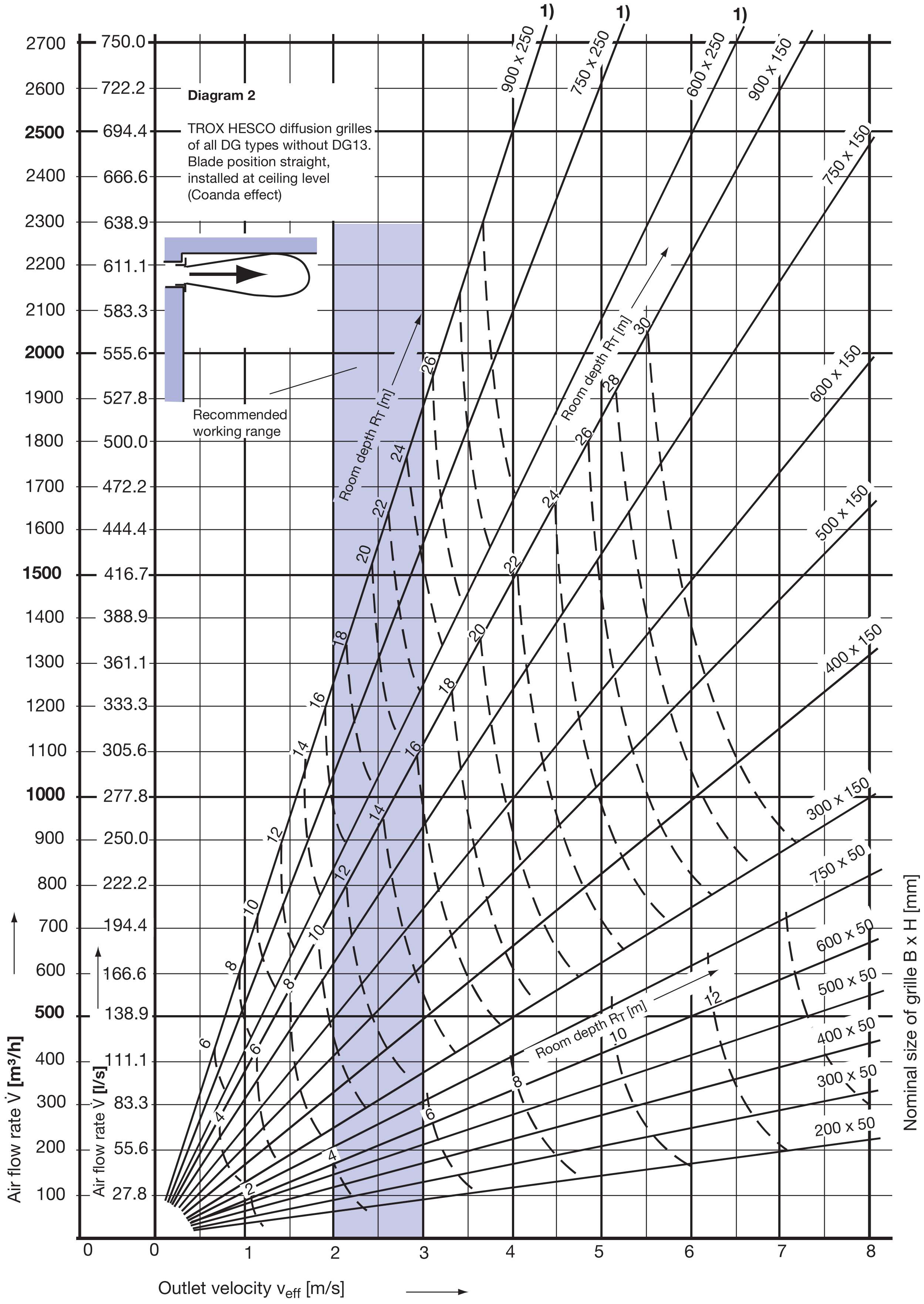


Wanted
Grille dimension B x H, room depth R_T, outlet velocity v_{eff}, distance D_h, pressure drop Δp_s, sound power level L_{wA}, L_{wNC}, L_{wNR}

Solution
Air outlet just under the ceiling, in diagram 2, page 9, has the result by $\dot{V}$ **per** grille = 530 m³/h.

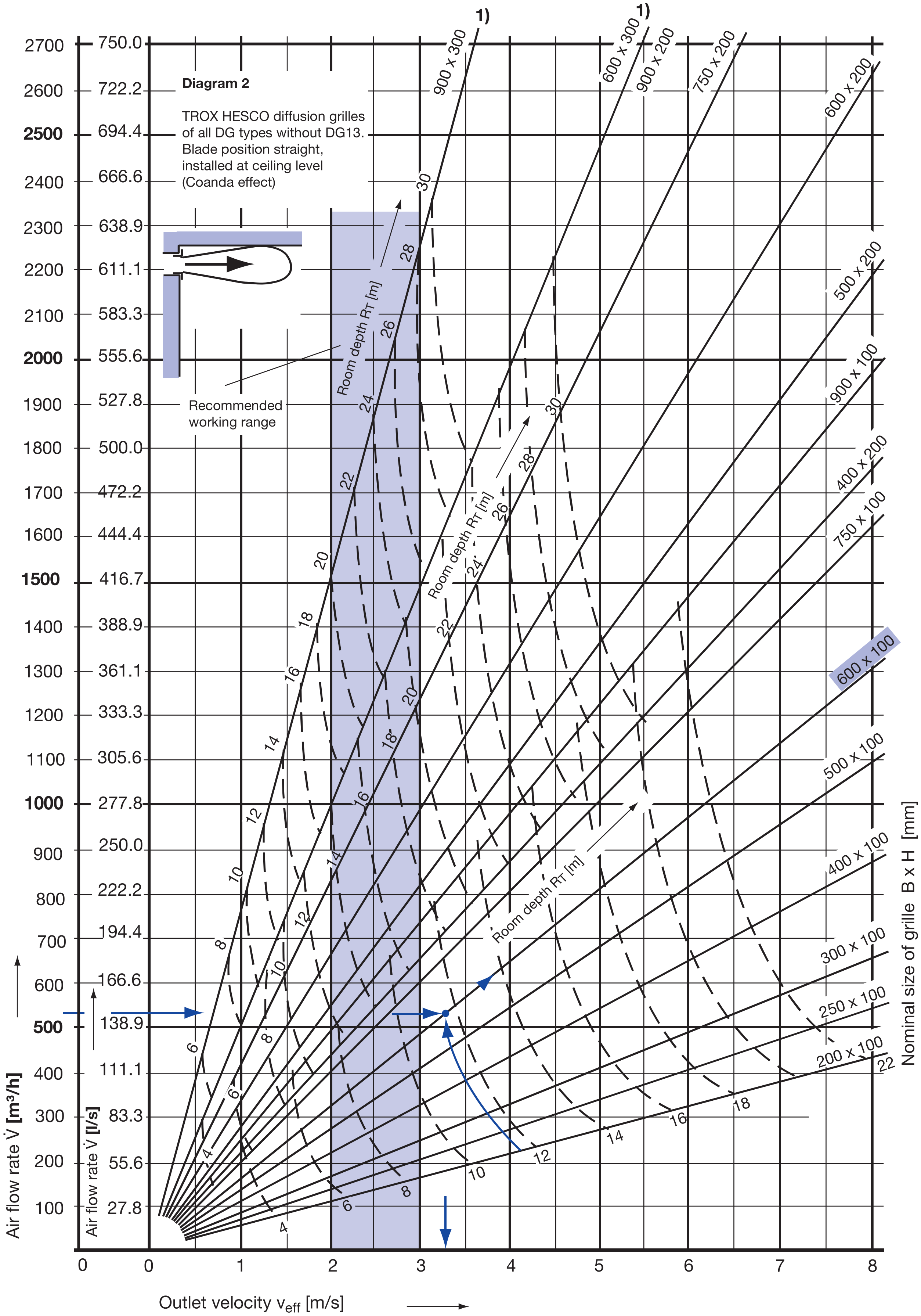
Result
2 off DG6 600 × 100 mm, damper position 50%, v_{eff} = 3.3 m/s, room depth R_T = 11.5 m, distance $D_h = R_T \times 0.1$ = 11.5 × 0.1 = min. 1.15 m. According diagram page19, follows: Δp_{s50} ~ 15 Pa, sound power level L_{wA} = 37 dB(A), L_{wNC} = 37 - 4 = 33, L_{wNR} = 37 - 2 = 35. More exact details for L_{wA} and Δp_s see page 25.

Technical Data



1) Not available out of stock types DGR...+ DGRA....
Generally: Dimension and types out of stock see price-list.

Note: In a light cooling case (transition period) and 2-speed operation $v_{eff} \geqq 1.5$ m/s

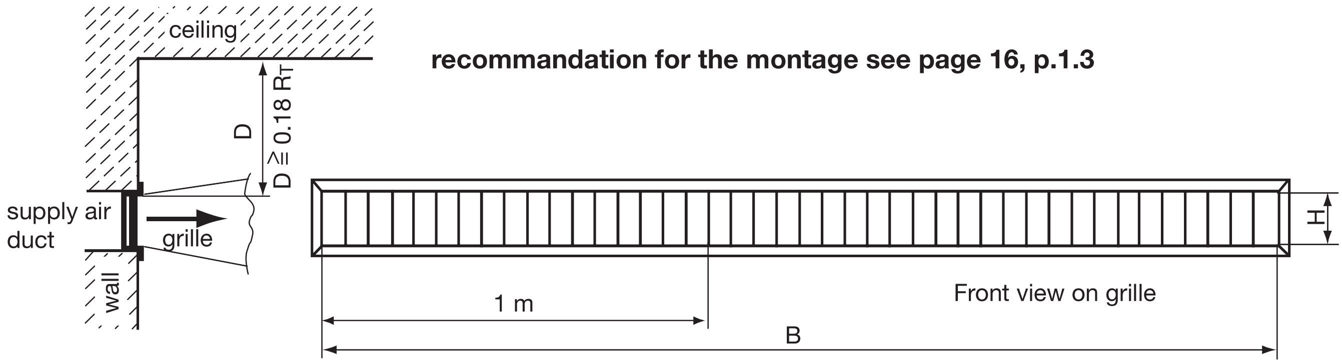


1) Not available out of stock types DG...5, ...35, ...5P, ...35P and ...7, ...17 and all DGR... + DGRA... types.
Generally: Dimension and types out of stock see price-list.

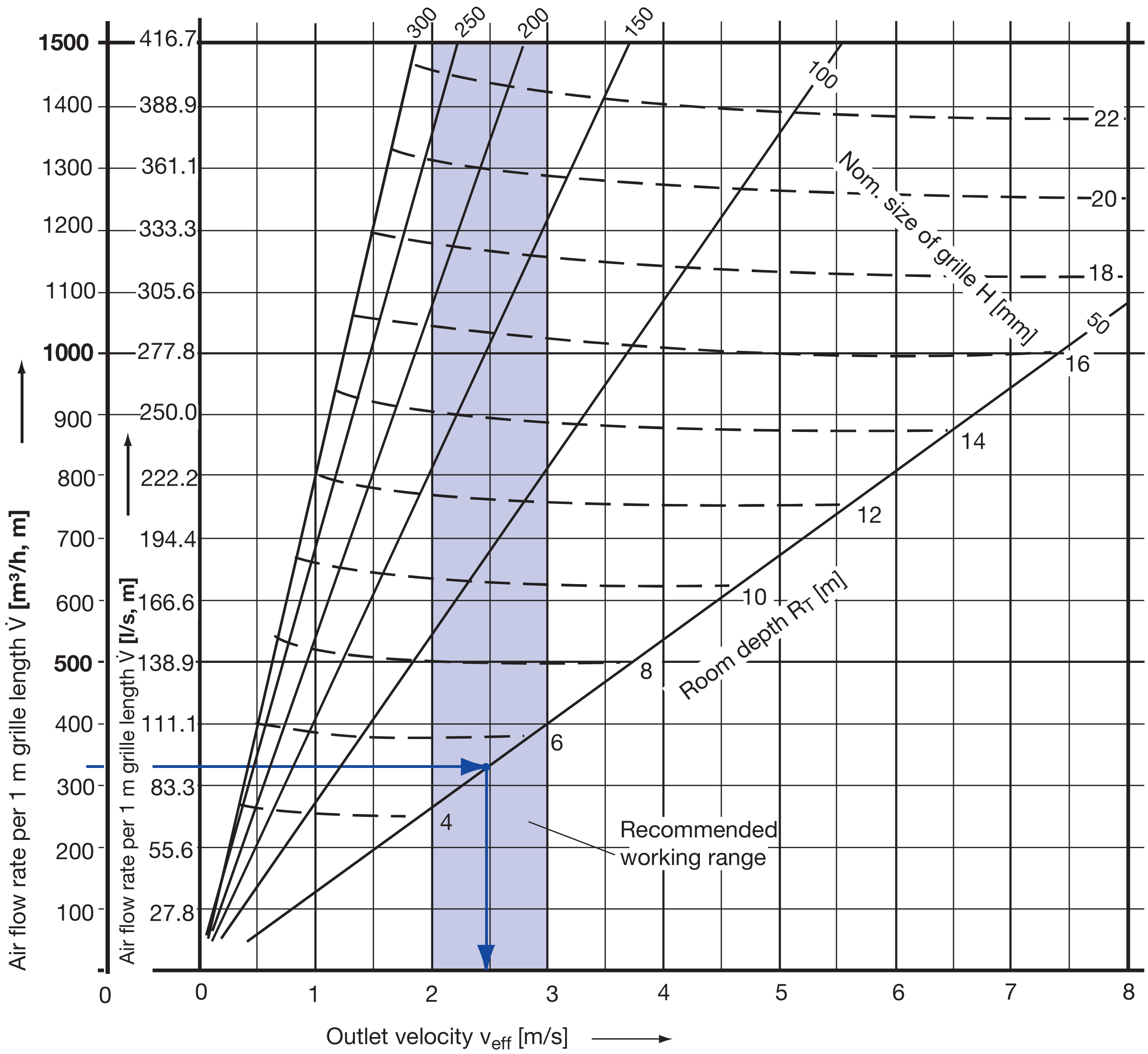
Note: In a light cooling case (transition period) and 2-speed operation $v_{eff} \geqq 1.5$ m/s

Diagram 3, unobstructed air stream spreading, continuous grilles (free air stream)

This diagram is applicable for TROX HESCO continuous supply air grilles (B/H > 16), types: DG1, 3, 5P, 6 and 8, with blades in straight position and unobstructed air stream spreading. Minimum distance D = 0.10 · R_T (grille to ceiling).



recommandation for the montage see page 16, p.1.3



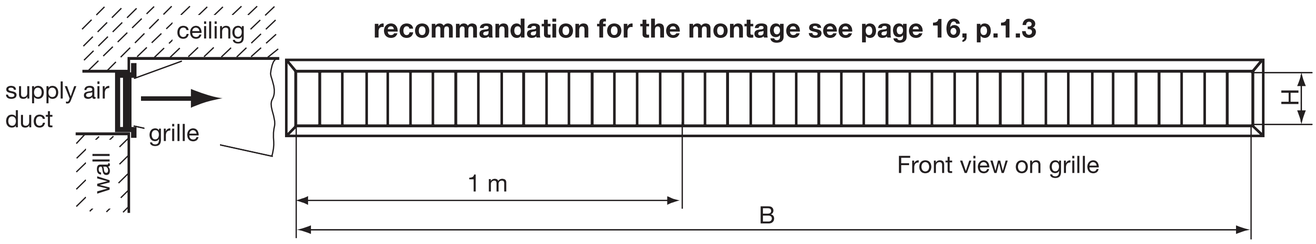
Note: In a light cooling case (transition period) and 2-speed operation $v_{eff} \geqq 1.5$ m/s

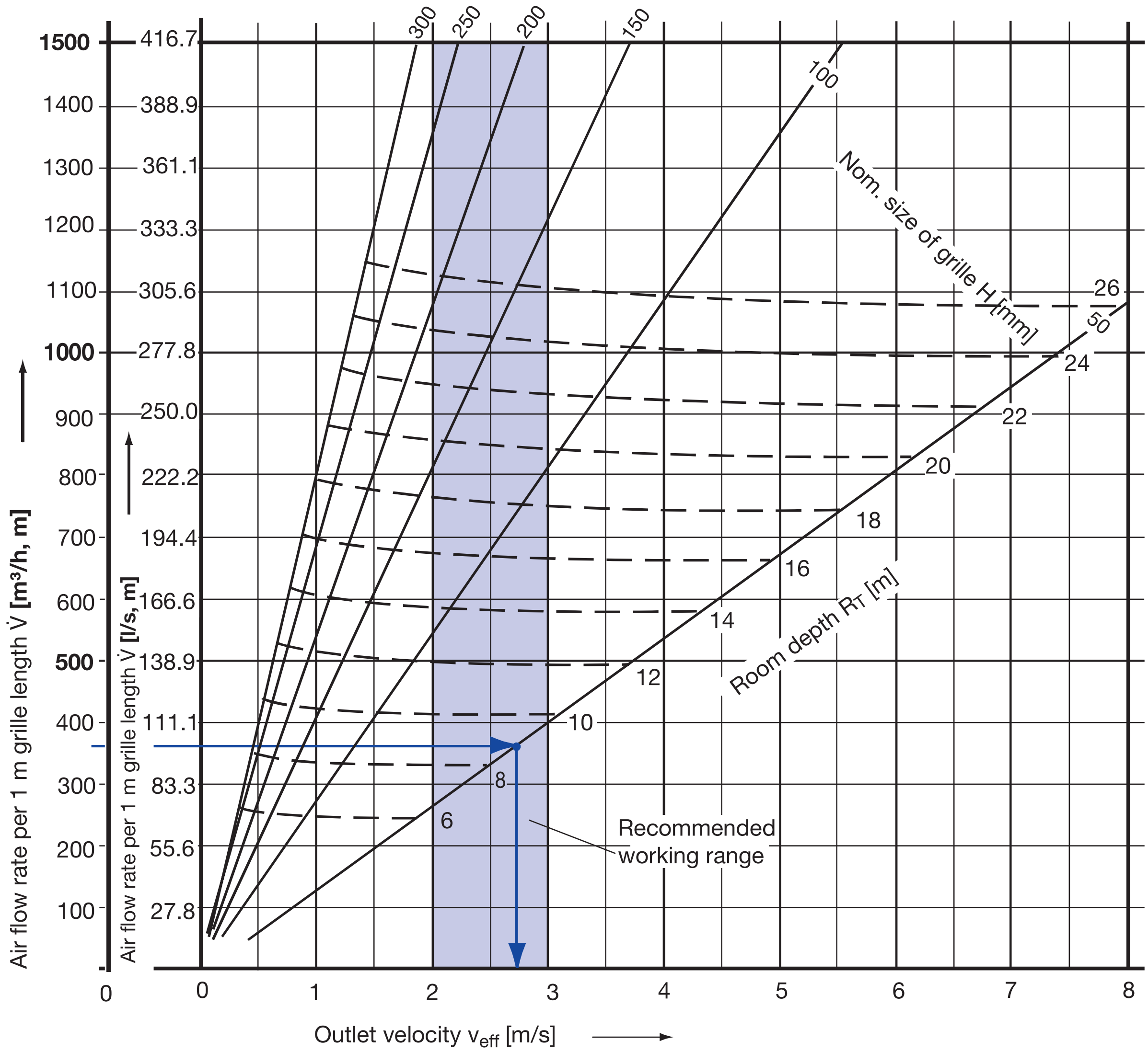
Calculation examples

Total air flow rate $\dot{V}$ = 1650 m³/h, resp. 458.3 l/s, room length R_L = 6.0 m, room width R_B = 5.0 m, grille length B ~R_B, therefore air flow rate $\dot{V}$ = 330 m³/h,m, resp. 91.7 l/s and grille dimension DG1, 5000 × 50 mm, room depth R_T = 5.5 m, v_{eff} = 2.4 m/s, pressure drop Δp_s, sound power level L_{wA} and L_{wNC}, L_{wNR} according to diagram page 19, drop of the air stream according to diagram page 15. More exact details for L_{wA} and Δp_s see page 21.

Diagram 4, unobstructed air stream spreading, continuous grilles (Coanda effect)

This diagram is applicable forTrox Hesco continuous supply air grilles (B/H > 16), types: DG1, 3, 5P, 6 and 8, with blades in straight position, grilles installed at ceiling level.





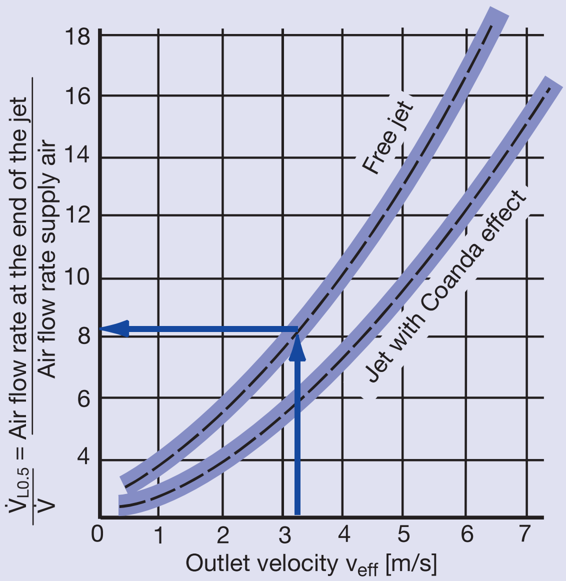
Note: In a light cooling case (transition period) and 2-speed operation $v_{eff} \geqq 1.5$ m/s

Calculation example:
Total air flow rate $\dot{V}$ = 1800 m³/h, resp. 500 l/s, room length R_L = 11.0 m, room width R_B = 5.0 m, grille length B ~R_B, therefore air flow rate per m grille length $\dot{V}$ = 360 m³/h,m, resp. 100.0 l/s, therefore grille dimension DG1, 5000 × 50 mm, room depth R_T = 9.0 m, v_{eff} = 2.7 m/s, pressure drop Δp_s, sound power level L_{wA} and L_{wNC}, L_{wNR} according to diagram page 19, drop of the air stream according to diagram page 14. More exact details for L_{wA} and Δp_s see page 21.

Turbulent air motion at the end of air stream ($L_{0.5}$)

Calculation example
1 off DG1 **600 × 100** mm, blades in straight position,“free stream“, air flow rate: $\dot{V}$ = 500 m³/h, resp. 139 l/s, outlet velocity v_{eff} = 3.1 m/s. It follows of diagram 9: $\dot{V}_{L0.5} / \dot{V} = 8.5$ [$\dot{V}_{L0.5} = \dot{V} \times 8.5$ = **4250 m³/h, resp. 1180 l/s**]

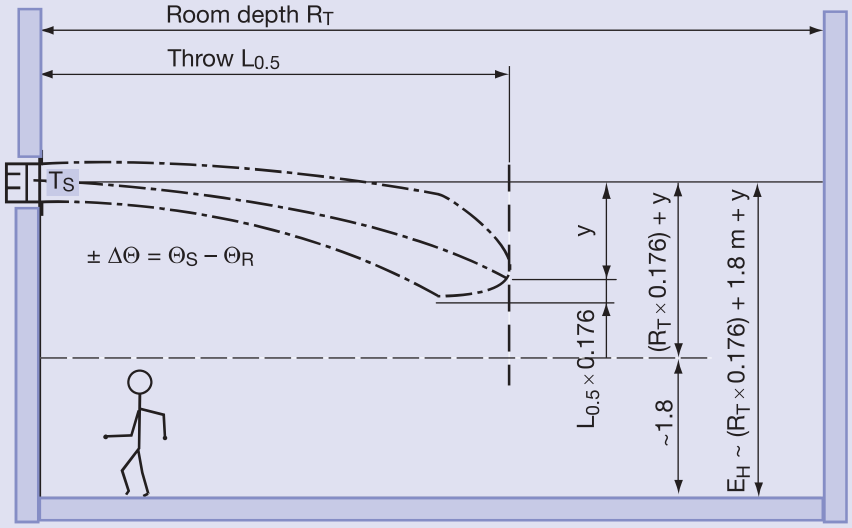
Diagram 9



Air stream drop at temperature differences

If the temperature in the air stream is warmer or cooler, the air stream will rise or drop accordingly. This drop or rise of the air stream can bewidely controlled by adjusting the horizontal blades of the diffusion grille. Divergently set diffusion grilles reduce the air stream deviation y.

Diagram 9 shows that the mixing of primary air with secondary air is very intensive. This results in a temperature adjustment between non-isothermal air stream and room temperature. So is i.e. the difference of temperature in the axial air stream after reaching the throw of air $\Delta\Theta_{L0.5} = 0.35 \times \Delta\Theta/v"$.



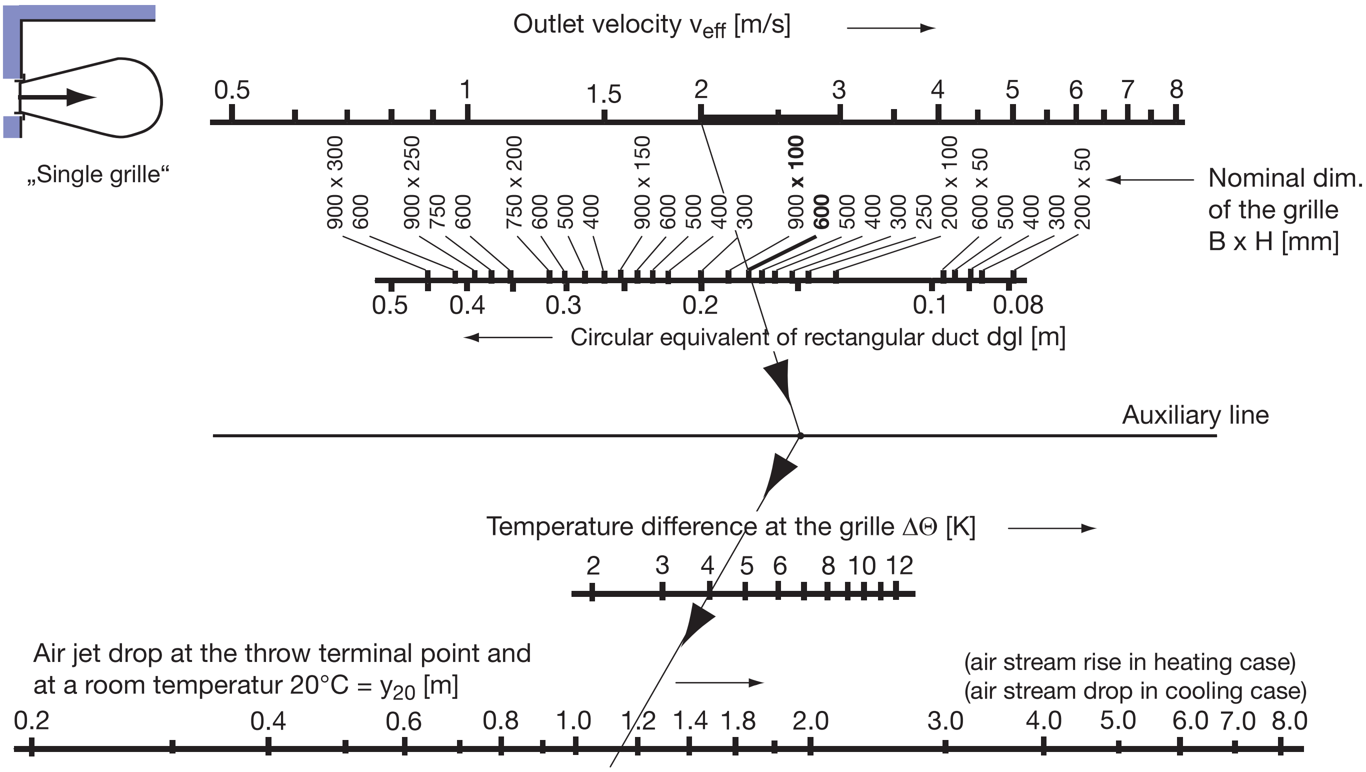
Notation

Θ_S = Air stream temperature at the grille (supply air)
Θ_R = Room temperature
$\Delta\Theta$ = Difference of temperatur (temperature supply air to room temperature)
y = air stream drop in cooling case (air stream rise in heating case)
R_T = Room depth acc. diagram (pages 4+5, 8+9, 10+11)
$L_{0.5}$ = Throw

Diagram 10

(relating to diagram 1)
Single air grille with unobstructed air stream spreading. (free air stream)

Drop of the axial flow stream at the terminal point at ΔΘ, straight blades, single grille, unobstructed air stream spreading.



Correction factors for different positions of blades

y at:	straight position of blades:		Factor 1
y at:	position of blades	44° div.:	Factor 0.4...0.5
y at:	position of blades	84° div.:	Factor 0.2...0.3
y at:	position of blades	110° div.:	Factor 0.1...0.2
y at:	opposed position of blades:		Factor 0.5...1.0

Recommendation
a) In the heating and/or cooling cases $v_{eff} \geqq 1.5$ m/s (always use divergent control blade arrangement)
b) Use DGVAR or DGSELF when room height RH ≧ 4.0 m

Calculation example

Air flow rate $\dot{V}$ = 330 m³/h, resp. 91.7 l/s, DG1, 600 × 100 mm, room depth R_T = 4.8 m, diagram 1, page 5, v_{eff} = 2 m/s. ΔΘ at the grille is 4 K(-), therefore air stream drop Y_{20} = 1.15 m.

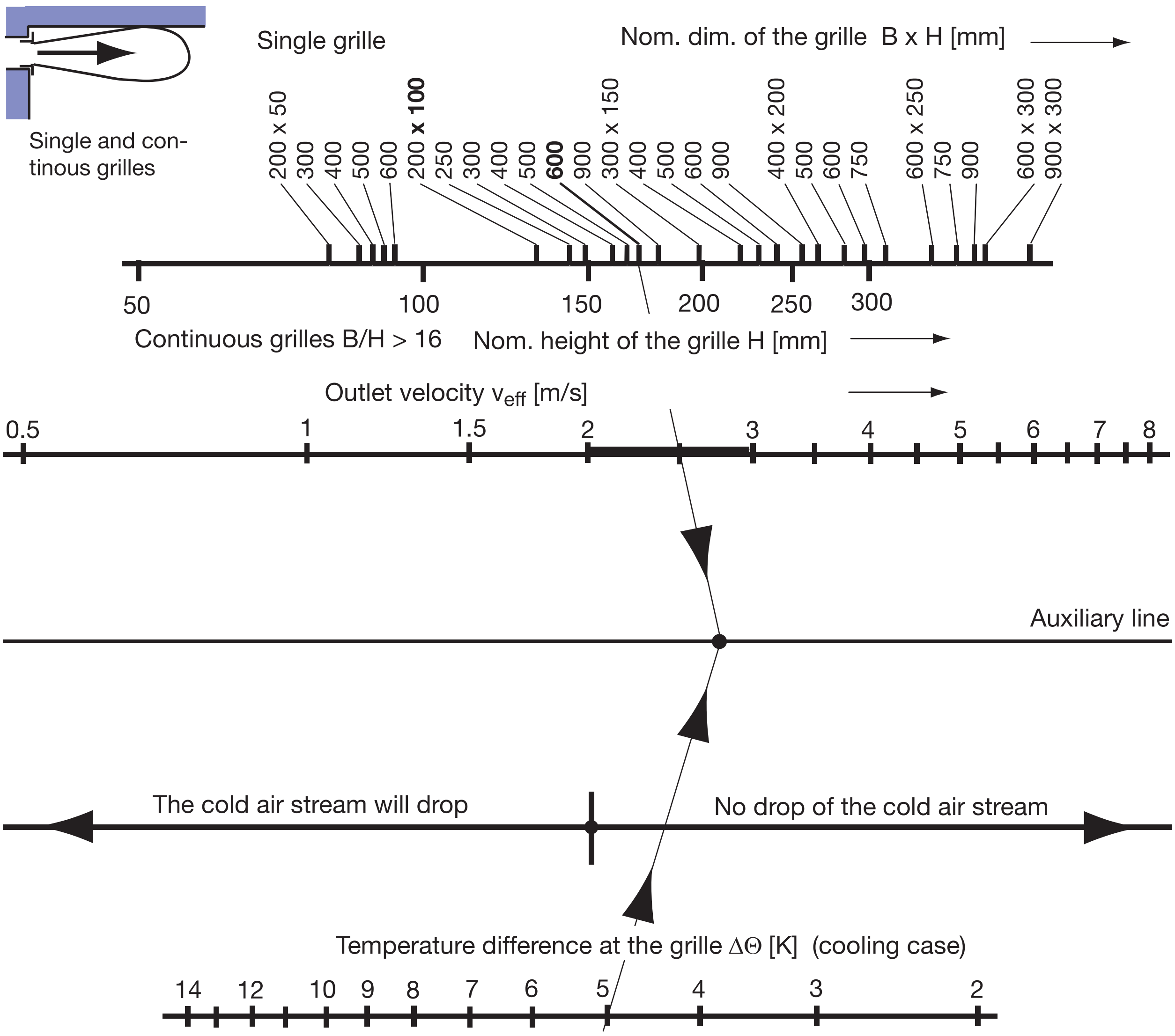
Problems are mainly encountered where cooled air is to be supplied through grilles. To avoid undue drop of the cold air stream in the occupied zone, following rules can help:
Select grilles with outlet velocity as high as possible. Select several small grilles iinstead of one or two large ones. Install grilles as high as possible above floor at alternative levels. Incline the horizontal blades at the back of the grille in order to compensate for any air stream drop or direct the cold air along ceiling level (refer also to following explanations 'Grilles installed at ceiling level'). Adjust the vertical blades at the grille front in opposed positions, to increase air entrainment and hence to achieve better mixing of the cold air stream with secondary air (drop at the air stream terminal point y' ~ 0,85 × Y_{20}).

Diagram 11

(relating to diagrams 2 + 4)

Single and continuous grilles, installed at ceiling level. (Coanda effect)

Cold air stream grilles installed close or at ceiling level have a tendency to adhere to the ceiling and do not drop under certain conditions, which depend on temperature difference, grille size and outlet velocity. It is important to ensure that the ceiling is absolutely flat, already small obstructions like light fittings, beams etc. can deflect the air stream and cause draft effects in the occupied zone.



Recommendation

a) In the heating and/or cooling cases $v_{eff} \geqq 1.5$ m/s (always use divergent control blade arrangement)

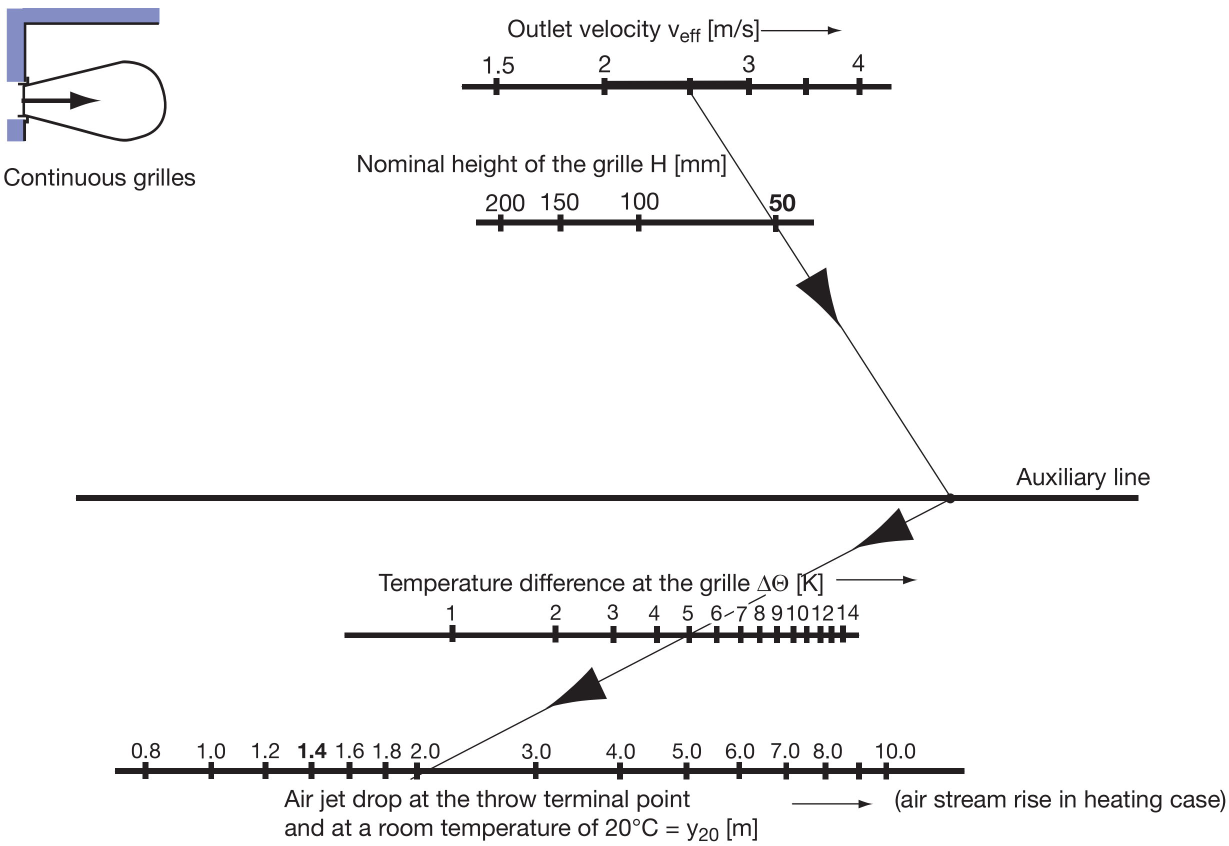
b) Use DGVAR or DGSELF when room height RH ≧ 4.0 m

Calculation example

Air flow rate $\dot{V}$ = 410 m³/h, resp. 113.9 l/s, room depth R_T = 9.0 m, diagram 2, page 9, DG1,
600 × 100 mm, v_{eff} = 2.5 m/s,
ΔΘ at the grille is 5 K (–), from diagram 11 we can see: No cold air stream drop will occur.

Diagram 12

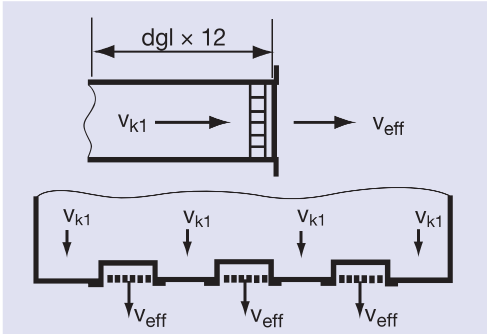
(relating to diagram 3)
Continuous grilles with blades in straight position, unobstructed air stream spreading (free air stream), drop of the axial air streams. Valig for grille dimension about 5000 mm.
Y_{20} values for other grille dimensions on request.



Recommendation
a) In the heating and/or cooling cases $v_{eff} \geqq 1.5$ m/s (always use divergent control blade arrangement)
b) Use DGVAR or DGSELF when room height RH $\geqq$ 4.0 m

Application examples for various DG-grilles

(see also table page 20)



1. Supply air

1.1 Air flow direction in duct = outlet direction by the grille, e.g. branch ducts.
For single grille at the duct terminal point, select: DG1 or DG6

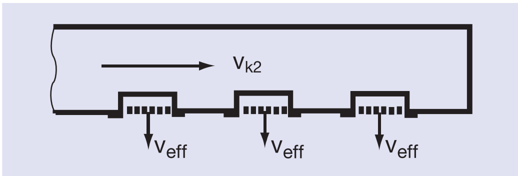
Continuous grille or several single grilles installed in one duct (e.g. in the false ceiling, at the balcony sill).

That means: dgl = same diameter value $Ø = \frac{2 \times B \times H}{(B + H)}$ [m]

Where small air velocities v_{k1} and small pressure differences in the duct prevail ⇒ DG1. Minor air flow adjustments are possible by turning horizontal blades (< 20 Pa).
Where pressure and velocity fluctuations are to be expected, select grilles with volume control devices: DG6.

1.2 Air flow direction in the duct is perpendicular to the air discharge direction at the grille

If a grille or several diffusion grilles are built into an air duct in this way, then on the one hand the air must be discharged evenly over the entire grille area and, on the other hand, the same volumetric air flow be discharged from all grilles. It is possible to satisfy these conditions in all cases when the various diffusion grille types are correctly employed.



We differentiate between

a) Pressure duct

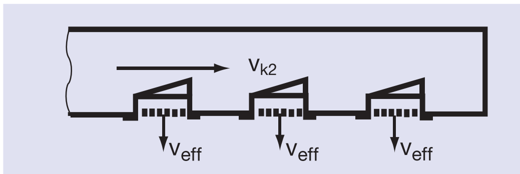
Ducts with large cross sectional area. Air velocity in duct is smaller than the outlet velocity at the grille
$v_{k2} < v''$, therefore: DG6
Ideal air distribution at the grille: $v_{k2} < 0.5 \times v_{eff}$
Efficient air distribution at the grille: $v_{k2} < 0.8 \times v_{eff}$

b) Flow duct

(see also description of prospectus DG5)
Ducts with large cross sectional area. Air velocity in duct is larger than the outlet velocity at the grille
$v_{k2} > v''$, therefore: DG5, DG7 oder DG17

DG5

Suitable for airconditioning systems, offers wide volume control.
Ideal air distribution at the grille: $v_{k2} < 2.5 \times v_{eff}$
Efficient air distribution at the grille: $v_{k2} < 5.2 \times v_{eff}$



DG7 and DG17

Suitable for warm air heating systems and industrial applications.
Ideal air distribution at the grille: $v_{k2} < 1.8 \times v_{eff}$
Efficient air distribution at the grille: $v_{k2} < 3.5 \times v_{eff}$

Note: See page 21 for information on v_{K2}

1.3 In supply air grilles, we recommend setting up active and passive zones, e.g. 1 m active, 1 m passive 1 m active and so on. This reduces the room depth (air throw) by as much as 66% (depending on the nominal height H).

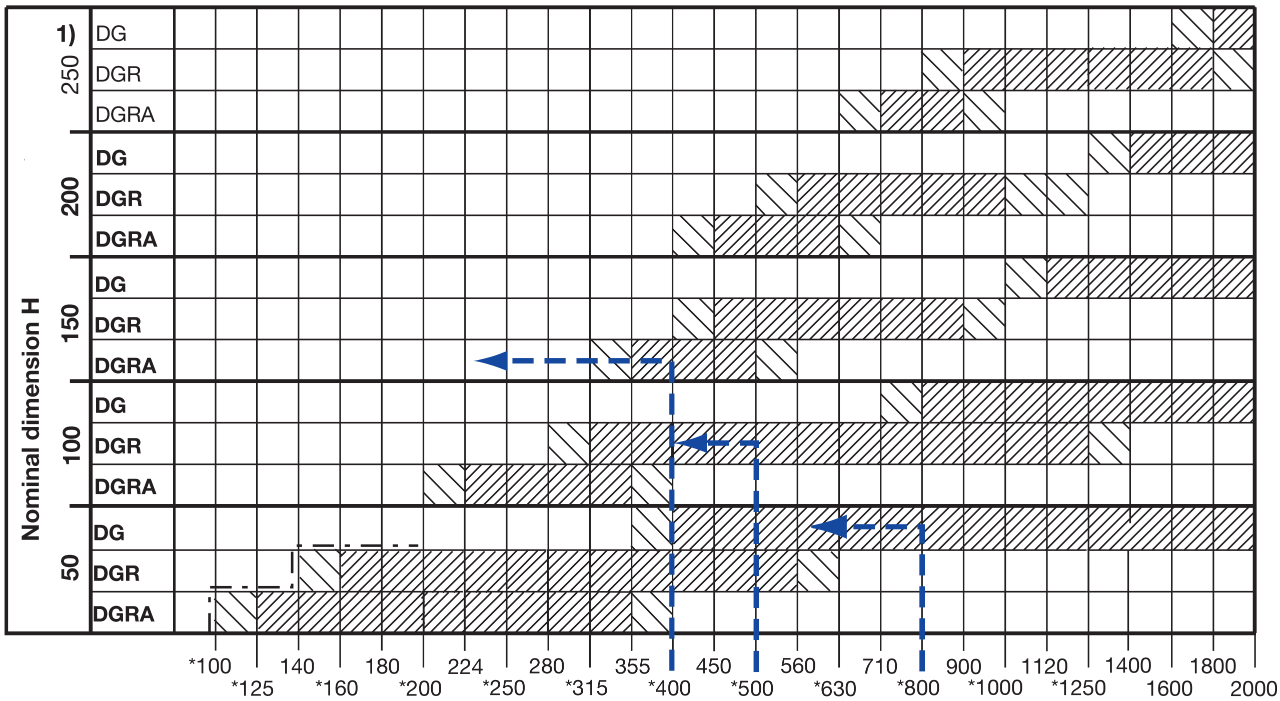
1.4 Diffusion grille DGVAR or DGSELF with temperature-dependent air stream deflection.
We recommend the use of the DGVAR or DGSELF type when the room height $R_H \geqq 4.0$ m.

2. Exhaust air

2.1 Single grilles: DG3 or DG1, eventually DG13. Several grilles for one duct, with small pressure differentials only: DG1 (Minor air flow adjustments are possible by changing the position of the horizontal blades at the grille front). Several grilles for one duct: DG8 or DG7.

3. Duct - Ø - range for the DGR... - types

The following table shows for which duct diameter range the appropriate nominal grille height H may be used.



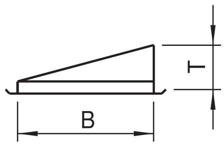
= extreme range

* = duct diameter as per EN 1506 and EN 12220 (former: DIN 24 154 sheet 2 preference series)

— - — - check depth of opening for DGR5 / 7 / 17

1) Nominal height of the grille H = 250 mm is for the types DGR and DGRA **not available** on stock.

Depth of montage T for DGR 5 / 7 / 17 and DGRA...



	B = nominal width	200	300	400	500	600	750	900 2)	[mm]
T	DGR5 and DGRA5	90	100	110	115	125	145	170	[mm]
	DGR7 / 17 and DGRA7 / 17	max.155 (100% open)							[mm]

2) Nominal width of the grille B = 900 mm is for th types DGR and DGRA **not available** on stock.

Determination of the minimal height of the mounting E_H OK FB until UK DG

Basis
- Isothermal case
- Free air stream (undisturbed spreading out of the air flow)
- Discharge immediately below and along the ceiling

Formula for the calculation of the mounting height E_H

for isothermal blowing in

$$E_{H(isoth)} = 1.8 + (R_T \times 0.1763) \quad [m]$$

for a cooling case

$$E_{H(-)} = 1.8 + (R_T \times 0.1763) + y \quad [m]$$

Formulas for the calculation of the room depth R_T for various blade positions (divergences)

$R_{Tstraight}$ blades in straight position

$$R_{Tstraight} = \frac{(E_H - 1.8)}{\tan(10°)} = \frac{(E_H - 1.8)}{0.1763} \quad [m]$$

$R_{T44°}$ blades position 44° diverging

$$R_{T44°} = \frac{(E_H - 1.8)}{0.7 \times 0.1763} \quad [m]$$

$R_{T110°}$ blades position 110° diverging

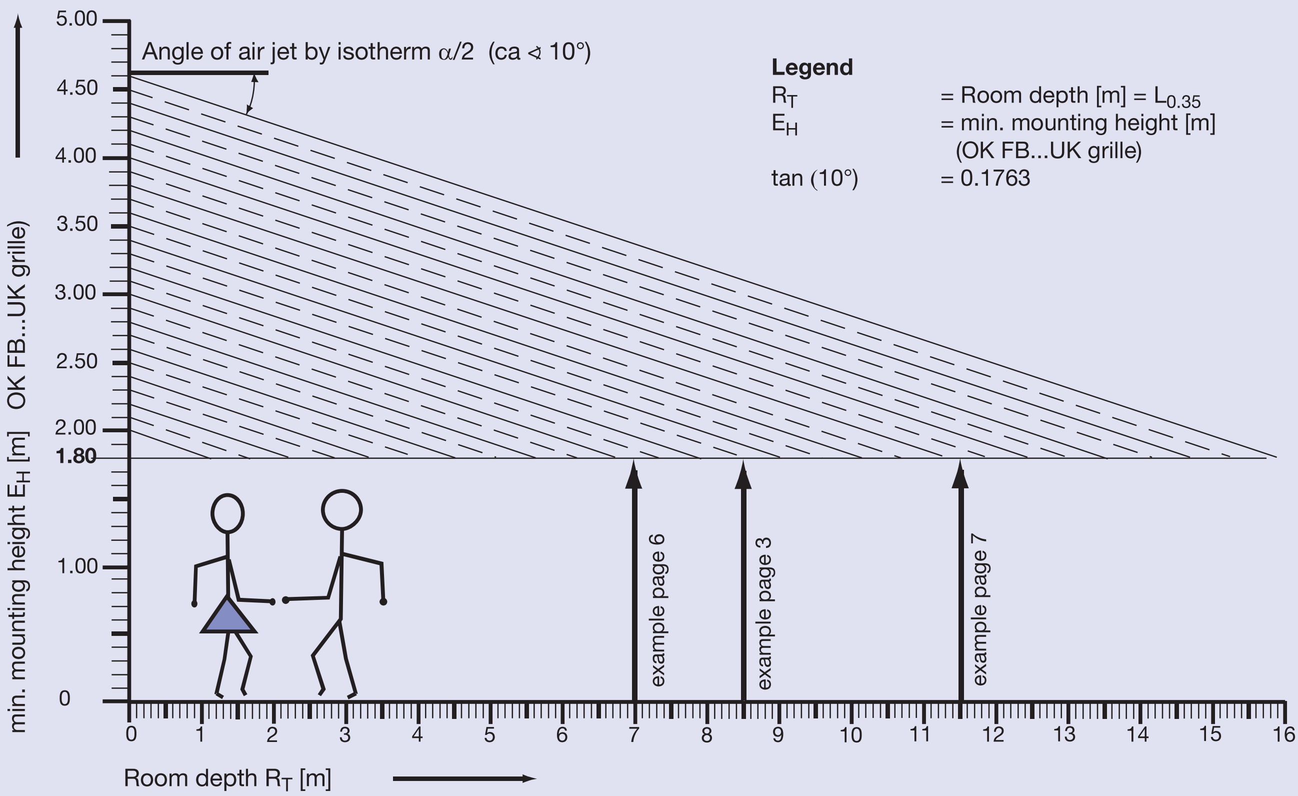
$$R_{T110°} = \frac{(E_H - 1.8)}{0.4 \times 0.1763} \quad [m]$$

$R_{T84°}$ blades position 84° diverging

$$R_{T84°} = \frac{(E_H - 1.8)}{0.5 \times 0.1763} \quad [m]$$

R_{Topp} blades in opposed position

$$R_{Topp} = \frac{(E_H - 1.8)}{1.2 \times 0.1763} \quad [m]$$



Legend

R_T = Room depth [m] = $L_{0.35}$

E_H = min. mounting height [m] (OK FB...UK grille)

tan (10°) = 0.1763

Sound power level L_{wA} and pressure drop Δp_s for diffusion grilles (overall view)

L_{wA} valid for nom. dimension B x H = 600 x 100 mm, nom. surface of ref. A_0 = 0.06, sound power level of ref. $W_0 = 10^{-12}$ W

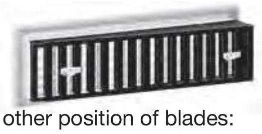
Supply air

DG1

other position of blades:
84° div.: v_{eff} × 1.50
110° div.: v_{eff} × 1.75
opp. : v_{eff} × 2.25
140° div.: v_{eff} × 2.25

v_{eff} [m/s]	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	
Δps [Pa]	1.5	2.4	2.8	4	5	6	8	10	13	15	18	v_{k1}
LwA [dB(A)]	12	16	20	24	28	31	34	36	38	41	44	

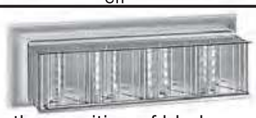
DG5



other position of blades:
110° div.: v_{eff} × 1.1
opp. : v_{eff} × 1.2
140° div.: v_{eff} × 1.35

v_{eff} [m/s]	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	
Δps [Pa]	14	21	27	35	43	55	64	73	82	93	110	v_{k2} = 3 m/s
LwA [dB(A)]	36	40	43	46	50	52	54	55.5	57	58.5	60	
Δps [Pa]	20	28	35	43	51	64	74	85	97	110	125	v_{k2} = 6 m/s
LwA [dB(A)]	48	50	52	54	56	58	59	60	61	62	63	
Δps [Pa]	30	38	48	56	64	75	86	98	108	116	132	v_{k2} = 9 m/s
LwA [dB(A)]	56	57	58	59	60	61	62	63	64	65	66	

DG6



other position of blades:
84° div.: v_{eff} × 1.25
110° div.: v_{eff} × 1.4
opp. : v_{eff} × 1.8
140° div.: v_{eff} × 1.8

v_{eff} [m/s]	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	
Δps [Pa]	1.5	2.5	3.5	5	7	8	12	14	17	21	24	v_{k1} 100 %
LwA [dB(A)]	12	16	21	25	29	33	36	39	41	43	45	
Δps [Pa]	5	9	13	17	21	24	30	37	43	51	60	v_{k1} 50 %
LwA [dB(A)]	21	29	35	38	41	43	45	48	51	53	55	

DG17

other position of blades:
110° div.: v_{eff} × 1.1
opp. : v_{eff} × 1.2
140° div.: v_{eff} × 1.35

v_{eff} [m/s]	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	
Δps [Pa]	18	23	29	36	42	52	60	67	75	82	90	v_{k2} = 6 m/s
LwA [dB(A)]	46	48	50	52	54	55.5	57	58	59	60	61	
Δps [Pa]	26	31	39	45	52	61	70	78	85	94	104	v_{k2} = 9 m/s
LwA [dB(A)]	55	56	57	58	59	60	61	62	63	64	65	

DG13

v_{eff} [m/s]	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	
Δps [Pa]	9.3	14	20	28	35	45	55	67	78	90	105	v_{k1}
LwA [dB(A)]	28	32	36	41	43	47	51	53	54	56	58	

Exhaust air

DG8

DG7

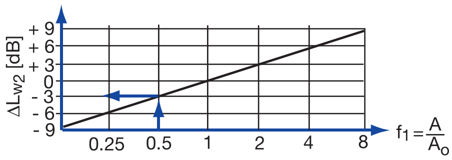
DG13

Grille	v_{eff} [m/s]	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	
DG8	Δps [Pa]	-2.5	-4.4	-6	-8	-10.5	-13	-16	-20	-24	-28	-32	v_{k3} 100 %
	LwA [dB(A)]	13	17	21	25	29	32	35	37.5	40	42.5	45	
DG7	Δps [Pa]	-18	-23	-27	-32	-37	-42	-47	-52	-57	-62	-68	v_{k4} = 6 m/s
	LwA [dB(A)]	39	40.5	42	44	46	47.5	49	50.5	52	53	54	
	Δps [Pa]	-28	-33	-38	-43	-48	-53	-58	-63	-68	-78	-88	v_{k4} = 9 m/s
	LwA [dB(A)]	52	53	54	55	56	57	58	59	60	61	62	
DG13	Δps [Pa]	-10.5	-16	-23	-32	-40	-52	-63	-76	-91	-105	-120	v_{k3}
	LwA [dB(A)]	35	38	42	47	49	52	56	58	60	61.5	63	

2. Correction ‚dimension of grille'

it is: $L_{wA} = L_{wA} + \Delta L_{w2}$ [dB]

given: $\Delta L_{w2} = 10 \times \log \frac{A}{A_o} = 10 \times \log \frac{A}{0.06}$



LwNC, LwNR:

$L_{WNC} = L_{wA} - 4$

$L_{WNR} = L_{wA} - 2$

Example (to page 19)

Given Outlet velocity v_{eff} = 2.9 m/s
Grille type = DG5
Grille size B × H = 600 × 50 mm
Position of blades = opposed position
Air velocity in the duct v_{k2} = 6.0 m/s

Wanted a) pressure drop Δp_s (static pressure drop in the duct in front of the diffuser)
b) sound power level L_{wA} of one diffuser, L_{wNC}, LwNR

Solution Page 19
Handling: $v_{eff\ corr.} = 2.9 \cdot 1.2 = 3.48$ m/s (count with f_4, because the blades ar in opposed position).
By DG5, $v_{eff\ corr.}$ = 3.48 m/s and v_{k2} = 6.0 m/s can be determined Δp_s and L_{wA}.

Conclusion

a) pressure drop Δp_s = 43 Pa (static pressure drop in the duct in front of the diffuser)

b) sound power level L_{wA} = 54 dB(A). This value corresponds to a grille B x H = 600 x 100 mm. Of the table 'correction of the grille dimension' we see:

$$f_1 = \frac{A}{A_o} = \frac{0.03}{0.06} = 0.5$$

The result is a correction of -3 dB.
Sound power level L_{wA} = 54 - 3 = 51 dB(A) / diffuser, L_{wNC} = 51 - 4 = 47 dB(A), L_{wNR} = 51 - 2 = 49 dB(A)

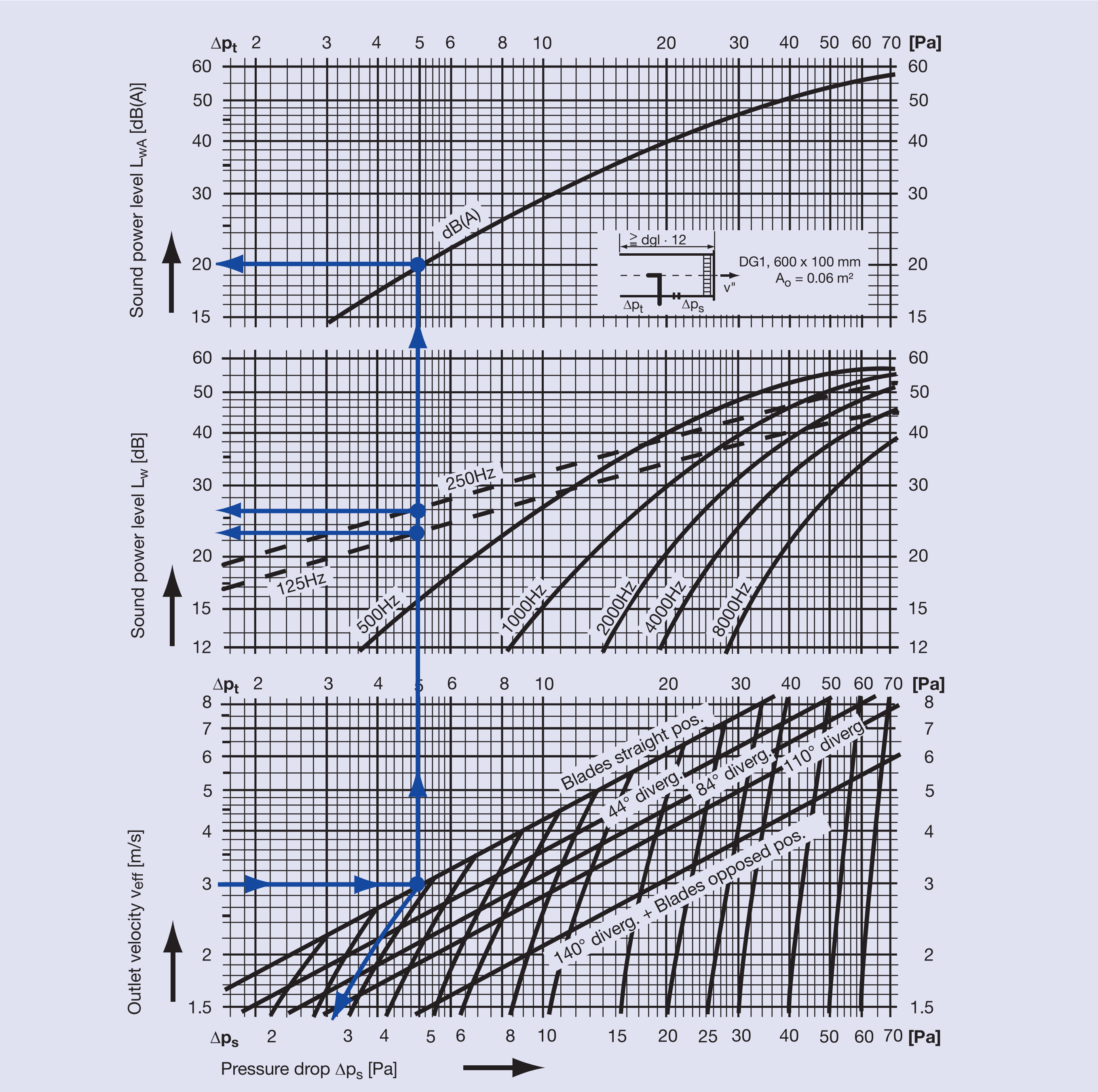
Table „same diameter value - Ø“ $dgl = \frac{2 \times B \times H}{(B + H)}$ [m]

H [mm]	B [mm] 200	250	300	400	500	600	750	900	
50	0.080	0.083	0.086	0.089	0.091	0.092	0.094	0.095	[m]
100	0.133	0.143	0.150	0.160	0.167	0.171	0.176	0.180	[m]
150	0.171	0.188	0.200	0.218	0.231	0.240	0.250	0.257	[m]
200	0.200	0.222	0.240	0.267	0.286	0.300	0.316	0.327	[m]
250	0.222	0.250	0.273	0.303	0.333	0.353	0.375	0.391	[m]
300	0.240	0.273	0.300	0.343	0.375	0.400	0.429	0.450	[m]

Sound power level DG1 supply air (without quantity adjustments)

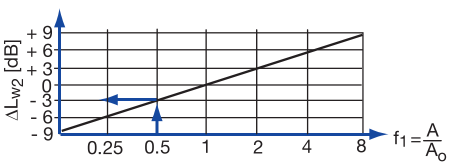
1. Sound power level L_{wA} and pressure drop Δp_t; Δp_s, DG1, B × H = 600 × 100 mm,
nom. surface of reference A_o = 0.06 m², sound power level of reference $W_o = 10^{-12}$ W

Tolerances: total level ± 2 dB, octave level ± 4 dB



2. Correction ‚dimension of grille‘
it is: $L_{wA} = L_{wA} + \Delta L_{w2}$ [dB]

given: $\Delta L_{w2} = 10 \times \log\left(\frac{A}{A_o}\right) = 10 \times \log\left(\frac{A}{0.06}\right)$



3. Correction factor for DG3
Δp_s DG3 = 0.8 x Δp_s DG1

4. L_{wNC} - u. L_{wNR} - values
$L_{wNC} = L_{wA} - 4$
$L_{wNR} = L_{wA} - 2$

Example: DG1, B x H = 300 x 100 mm; v_{eff} = 3 m/s
Diagram ⇒ Δp_s = 2.8 Pa; $L_{wA0.06}$ = 20 dB(A)
$L_{w0.06;125Hz}$ = 23 dB; $L_{w0.06;250Hz}$ = 26 dB a.s.o.

Correction: $\frac{A}{A_o} = \frac{0.03}{0.06} = 0.5 \Rightarrow \Delta L_{wA} = -3$ dB

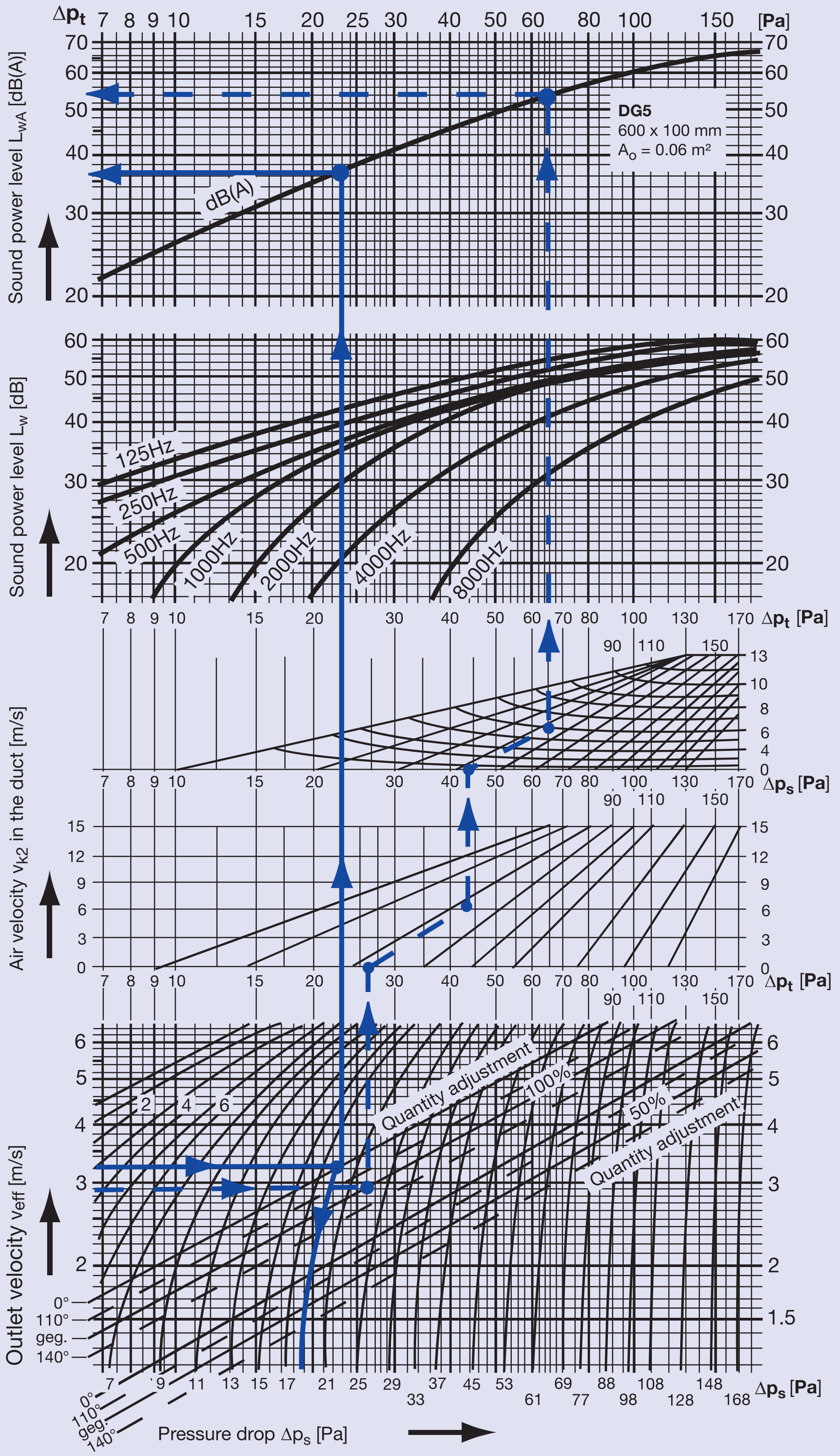
⇒ $L_{wA0.03}$ = 20 - 3 = 17 dB(A)

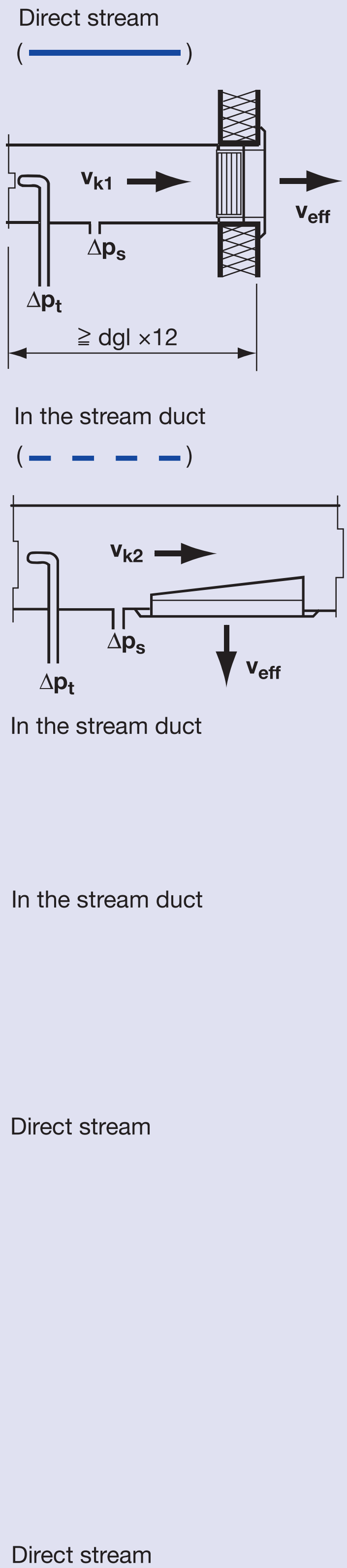
$L_{w0.03;125Hz}$ = 20 dB; $L_{w0.03;250Hz}$ = 23 dB a.s.o.
$L_{wNC0.03}$ = 17 - 4 = 13
$L_{wNR0.03}$ = 17 - 2 = 15

Sound power level DG5 supply air

1. Sound power level L_{wA} and pressure drop Δp_t; Δp_s, DG5, B × H = 600 × 100 mm
nom. surface of reference A_o = 0.06 m², sound power level of reference $W_o = 10^{-12}$ W

Tolerances: total level ± 2 dB, octave level ± 4 dB

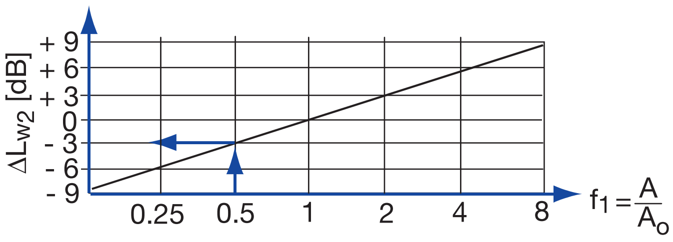




2. Correction 'dimension of the grille'

it is: $L_{wA} = L_{wA} + \Delta L_{w2}$ [dB]

given: $\Delta L_{w2} = 10 \times \log \frac{A}{A_o} = 10 \times \log \frac{A}{0.06}$



3. L_{wNC} - u. L_{wNR} - value

$L_{wNC} = L_{wA} - 4$

$L_{wNR} = L_{wA} - 2$

3. Conversion factors f for v_{k1} of v_{eff} (Direct stream)

Duct dimensions: $H + 10^{+2}_{0}$, $B + 15^{+5}_{0}$

by DGVAR + DGSELF: $H + 10^{+2}_{0}$, $B + 25^{+2}_{0}$

B x H	200 x 50		300 x 50	400 x 50	500 x 50	600 x 50	750 x 50		**[mm]**
f	0.585		0.599	0.606	0.610	0.613	0.616		**[-]**
B x H	200 x 100	250 x 100	300 x 100	400 x 100	500 x 100	600 x 100	750 x 100	900 x 100	**[mm]**
f	0.638	0.647	0.653	0.661	0.666	0.669	0.672	0.674	**[-]**
B x H			300 x 150	400 x 150	500 x 150	600 x 150	750 x 150	900 x 150	**[mm]**
f			0.673	0.681	0.686	0.690	0.693	0.695	**[-]**
B x H				400 x 200	500 x 200	600 x 200	750 x 200	900 x 200	**[mm]**
f				0.692	0.697	0.701	0.704	0.706	**[-]**
B x H						600 x 250	750 x 250	900 x 250	**[mm]**
f						0.707	0.711	0.713	**[-]**

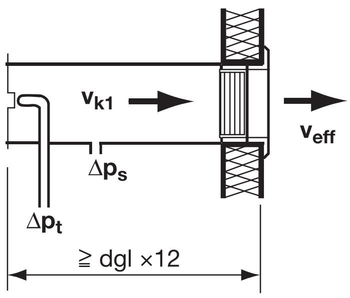
5. Examples

5.1 Direct stream (————)

Given $v_{eff} = 3.2$ m/s
DG5, 600 x 50 mm, 100% open, 0° diverging

Wanted
a) L_{wA} in dB(A), L_{wNC}, L_{wNR}
b) $\Delta p_s + \Delta p_t$ in Pa
c) v_{k1} in m/s

Solution
a) $L_{wA} = 37 - 3 = 34$ dB(A), $L_{wNC} = 34 - 4 = 30$, $L_{wNR} = 34 - 2 = 32$
b) $\Delta p_s = 19$ Pa, $\Delta p_t = 22$ Pa
c) $v_{K1} = 3.2 \times 0.613 = 2.0$ m/s

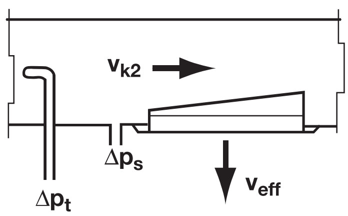


5.2 In the stream duct (— — — —)

Given $v_{eff} = 2.9$ m/s, $v_{K2} = 6.0$ m/s
DG5, 300 x 100 mm, 100%, opposed position

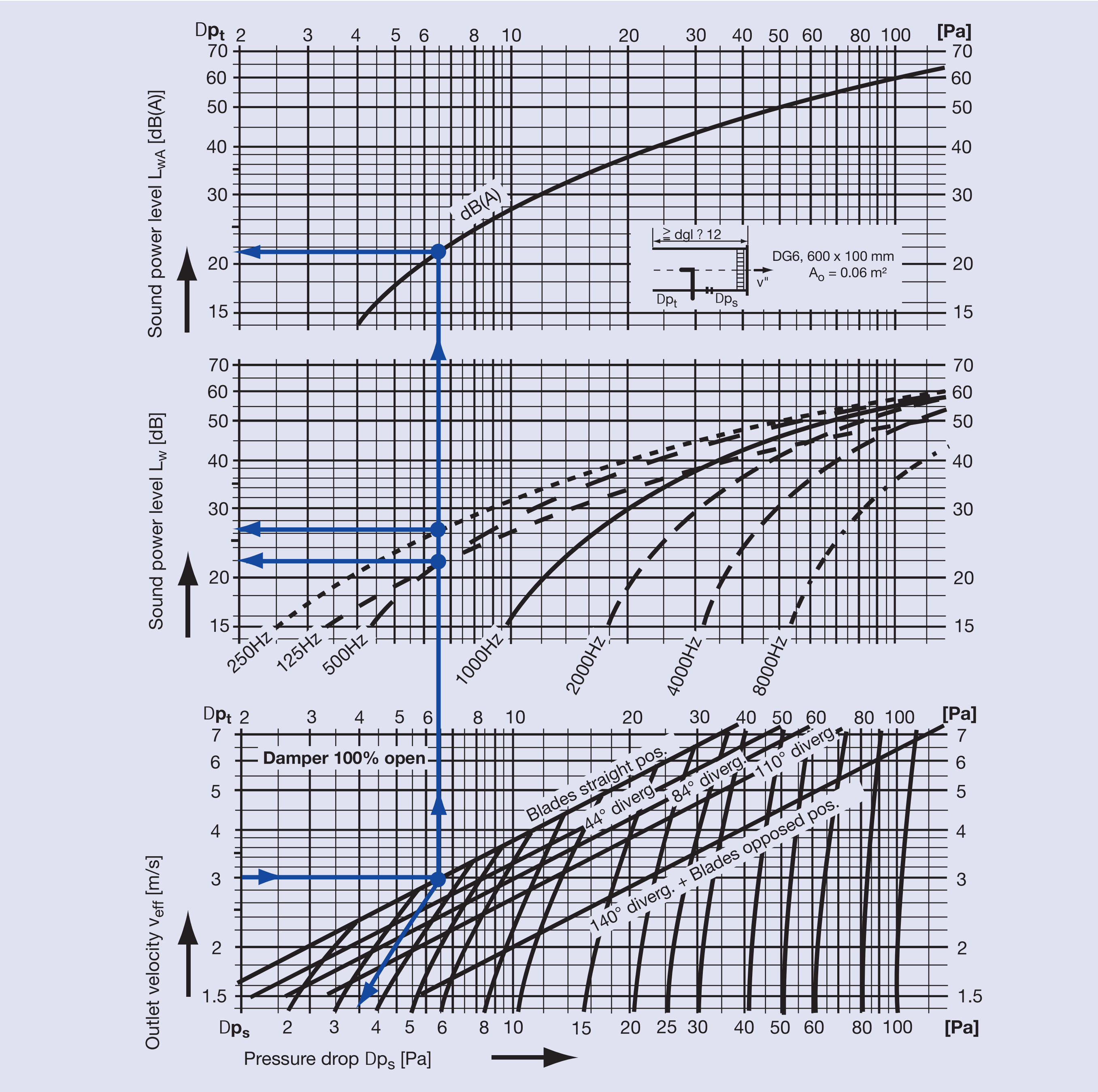
Wanted
a) L_{wA} in dB(A), L_{wNC}, L_{wNR}
b) $\Delta p_s + \Delta p_t$ in Pa

Solution
a) $L_{wA} = 54 - 3 = 51$ dB(A), $L_{wNC} = 51 - 4 = 47$, $L_{wNR} = 51 - 2 = 49$
b) $\Delta p_s = 43$ Pa, $\Delta p_t = 64$ Pa



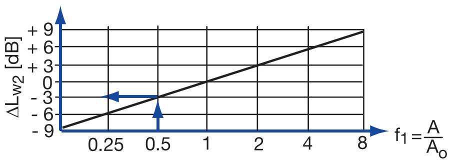
Sound power level DG6 supply air - damper 100% open

1. Sound power level L_{wA} and pressure drop Δp_t; Δp_s, DG6, B × H = 600 × 100 mm
nom. surface of reference $A_o = 0.06\ m^2$, sound power level of reference $W_o = 10^{-12}$ W
Tolerances: total level ± 2 dB, octave level ± 4 dB



2. Correction ‚dimension of grille'
it is: $L_{wA} = L_{wA} + \Delta L_{w2}$ [dB]

given: $\Delta L_{w2} = 10 \times \log\left(\frac{A}{A_o}\right) = 10 \times \log\left(\frac{A}{0.06}\right)$



3. Correction factor for DG8
Δp_s DG8 = 0.8 × Δp_s DG6

4. L_{wNC} - u. L_{wNR} - values
$L_{wNC} = L_{wA} - 4$
$L_{wNR} = L_{wA} - 2$

Example: DG6, B × H = 300 × 100 mm; v_{eff} = 3 m/s
Diagram ⇒ $L_{wA0.06} = 21$ dB(A)
$L_{w0.06;125Hz} = 22$ dB; $L_{w0.06;250Hz} = 27$ dB a.s.o.

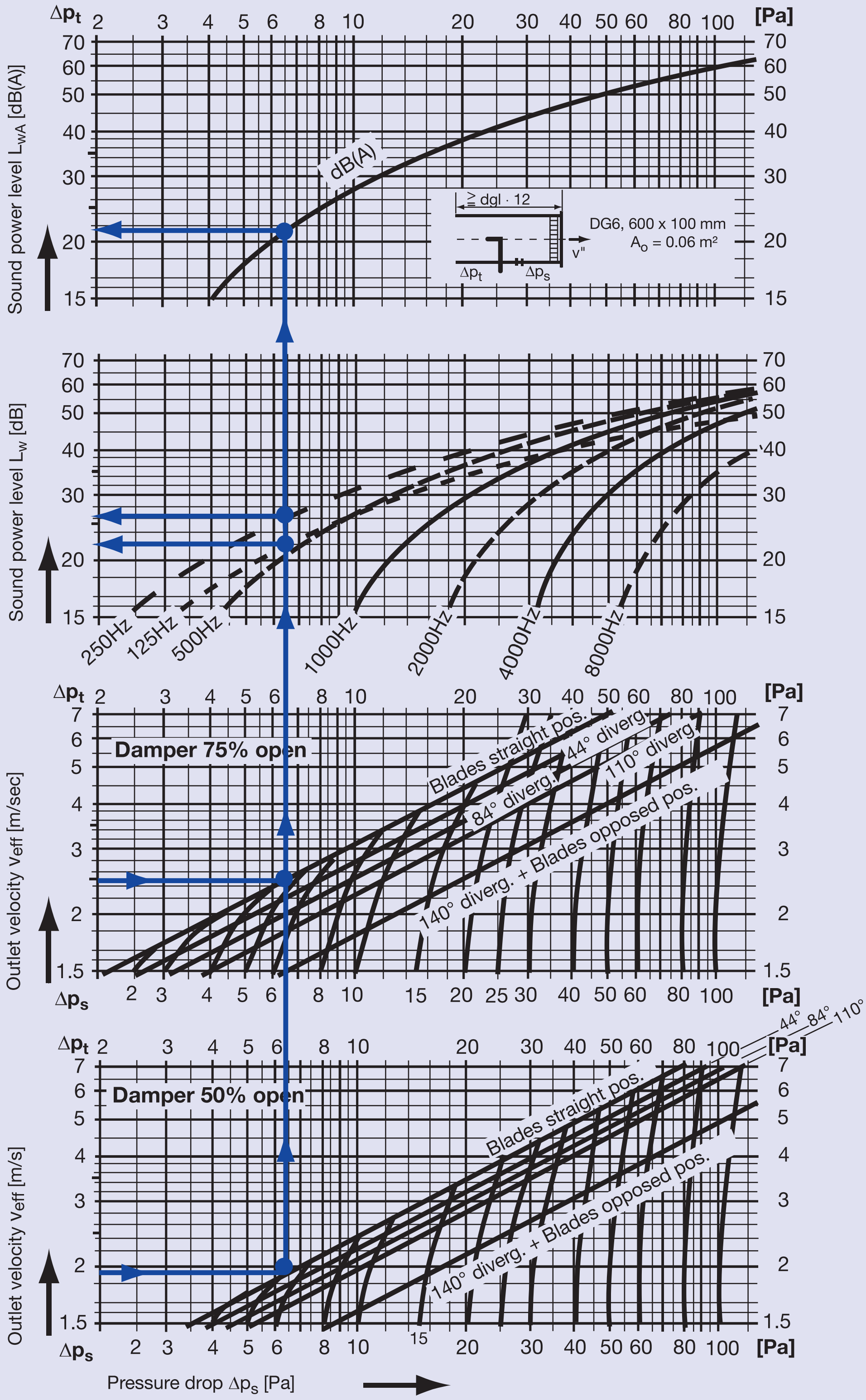
Correction: $\frac{A}{A_o} = \frac{0.03}{0.06} = 0.5 \Rightarrow \Delta L_{wA} = -3$ dB

$\Rightarrow L_{wA0.03} = 21 - 3 = 18$ dB(A)
$L_{w0.03;125Hz} = 19$ dB; $L_{w0.03;250Hz} = 24$ dB a.s.o.
$L_{wNC0.03} = 18 - 4 = 14$
$L_{wNR0.03} = 18 - 2 = 16$

Sound power level DG6 supply air - damper 75% + 50% open

1. Sound power level L_{wA} and pressure drop Δp_t; Δp_s, DG6, B × H = 600 × 100 mm
nom. surface of reference A_o = 0.06 m², sound power level of reference $W_o = 10^{-12}$ W

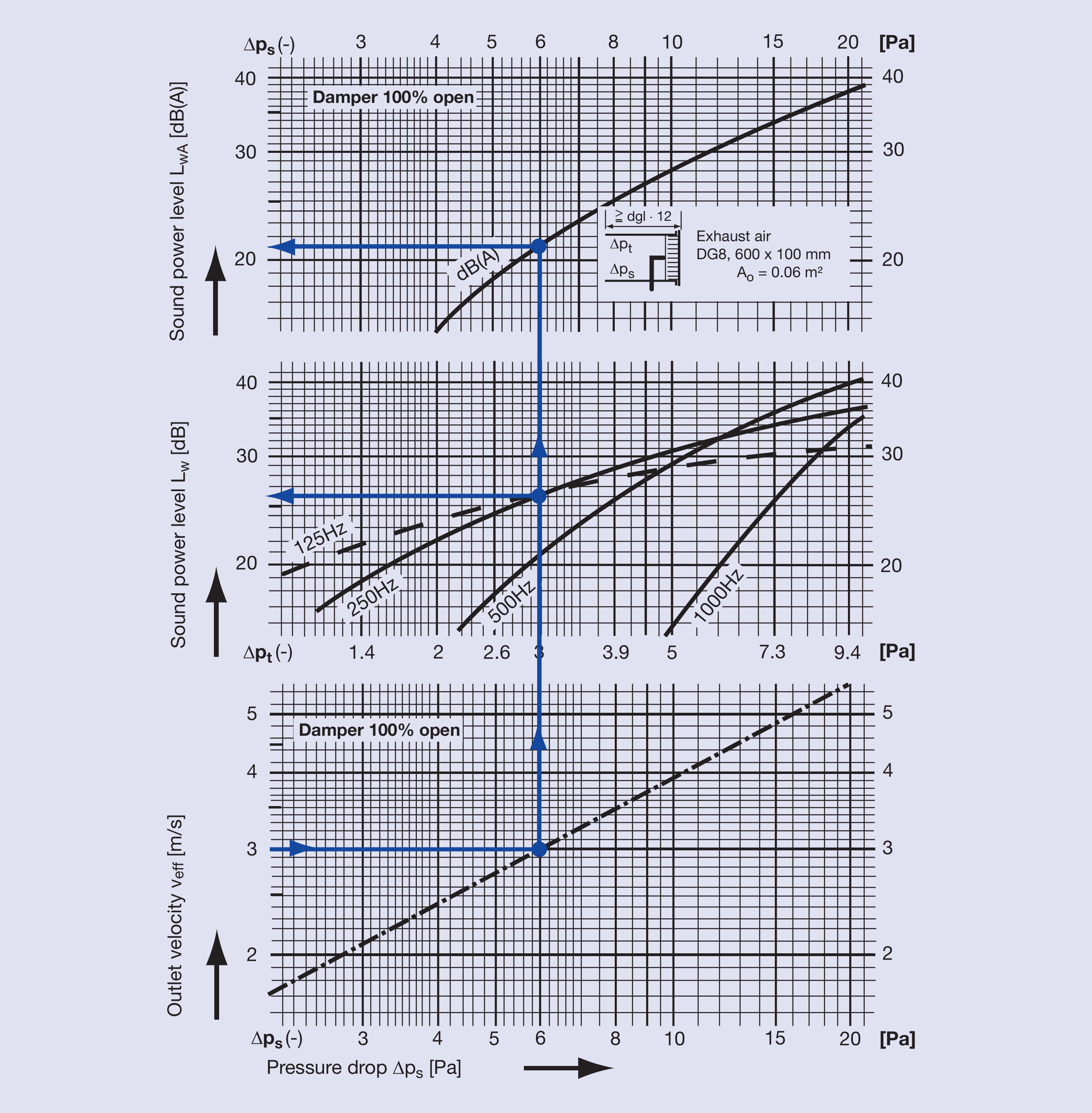
Tolerances: total level ± 2 dB, octave level ± 4 dB



Sound power level DG8 exhaust air - damper 100% open

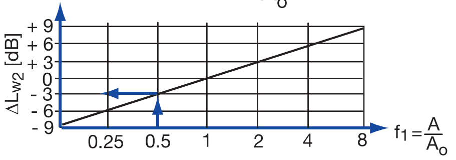
1. Sound power level L_{wA} and pressure drop Δp_t; Δp_s, DG8, B × H = 600 × 100 mm
nom. surface of reference A_o = 0.06 m², sound power level of reference $W_o = 10^{-12}$ W

Tolerances: total level ± 2 dB, octave level ± 4 dB



2. Correction, dimension of grille'
it is: $L_{wA} = L_{wA} + \Delta L_{w2}$ [dB]

given: $\Delta L_{w2} = 10 \times \log\left(\frac{A}{A_o}\right) = 10 \times \log\left(\frac{A}{0.06}\right)$



3. L_{wNC} - u. L_{wNR} - value
$L_{wNC} = L_{wA} - 4$
$L_{wNR} = L_{wA} - 2$

Example: DG8, B × H = 300 × 100 mm; v_{eff} = 3 m/s
Diagram ⇒ $L_{wA0.06}$ = 21 dB(A)
$L_{w0.06;125Hz}$ = 26 dB; $L_{w0.06;250Hz}$ = 26 dB a.s.o.

Correction: $\frac{A}{A_o} = \frac{0.03}{0.06} = 0.5 \Rightarrow \Delta L_{wA} = -3$ dB

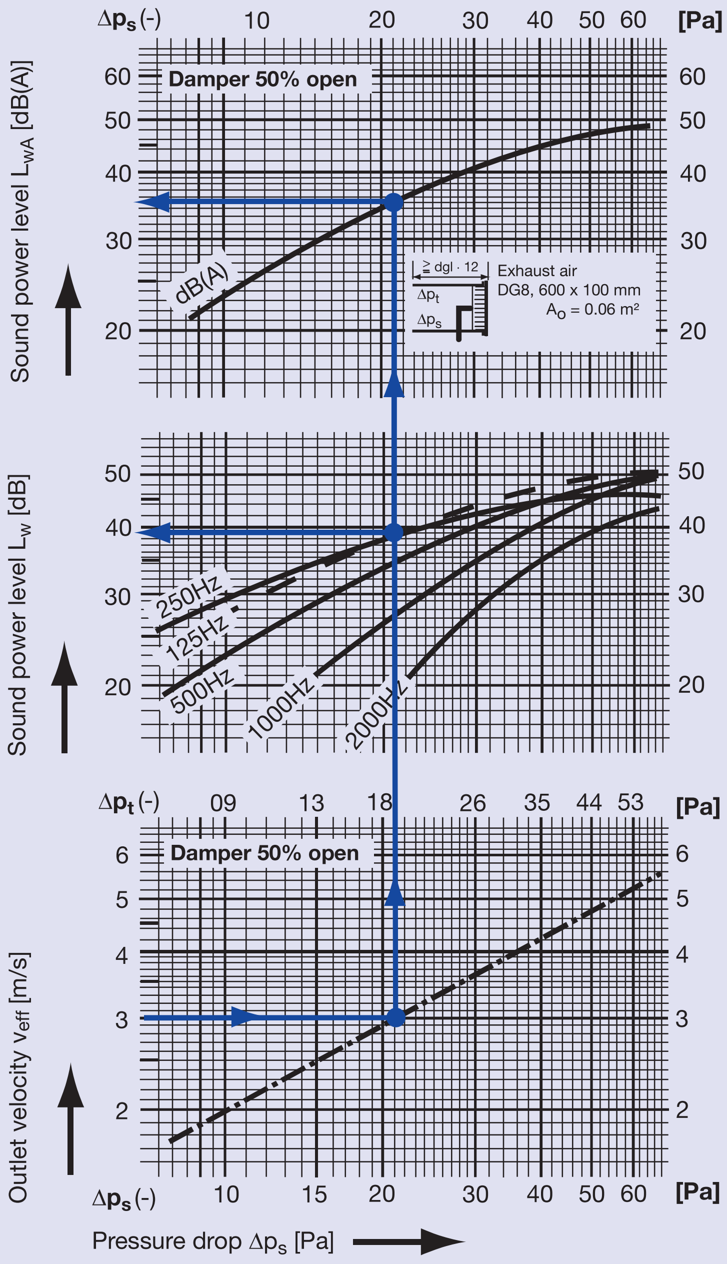
⇒ $L_{wA0.03}$ = 21 - 3 = 18 dB(A)

$L_{w0.03;125Hz}$ = 23 dB; $L_{w0.03;250Hz}$ = 23 dB a.s.o.
$L_{wNC0.03}$ = 18 - 4 = 14
$L_{wNR0.03}$ = 18 - 2 = 16

Sound power level DG8 exhaust air - damper 50% open

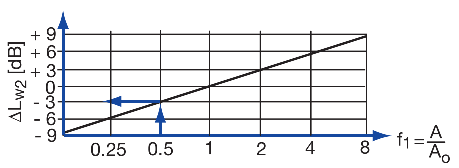
1. Sound power level L_{WA} and pressure drop Δp_t; Δp_s, DG8, B × H = 600 × 100 mm

nom. surface of reference A_o = 0.06 m², sound power level of reference $W_o = 10^{-12}$ W
Tolerances: total level ± 2 dB, octave level ± 4 dB



2. Correction ‚dimension of grille‘
it is: $L_{WA} = L_{WA} + \Delta L_{W2}$ [dB]

given: $\Delta L_{W2} = 10 \times \log\left(\frac{A}{A_o}\right) = 10 \times \log\left(\frac{A}{0.06}\right)$



3. L_{WNC} - u. L_{WNR} - value
$L_{WNC} = L_{WA} - 4$
$L_{WNR} = L_{WA} - 2$

Example: DG8, B × H = 300 × 100 mm; v_{eff} = 3 m/s
Diagram ⇒ $L_{WA0.06}$ = 35 dB(A)
$L_{W0.06;125Hz}$ = 39 dB; $L_{W0.06;250Hz}$ = 39 dB a.s.o.

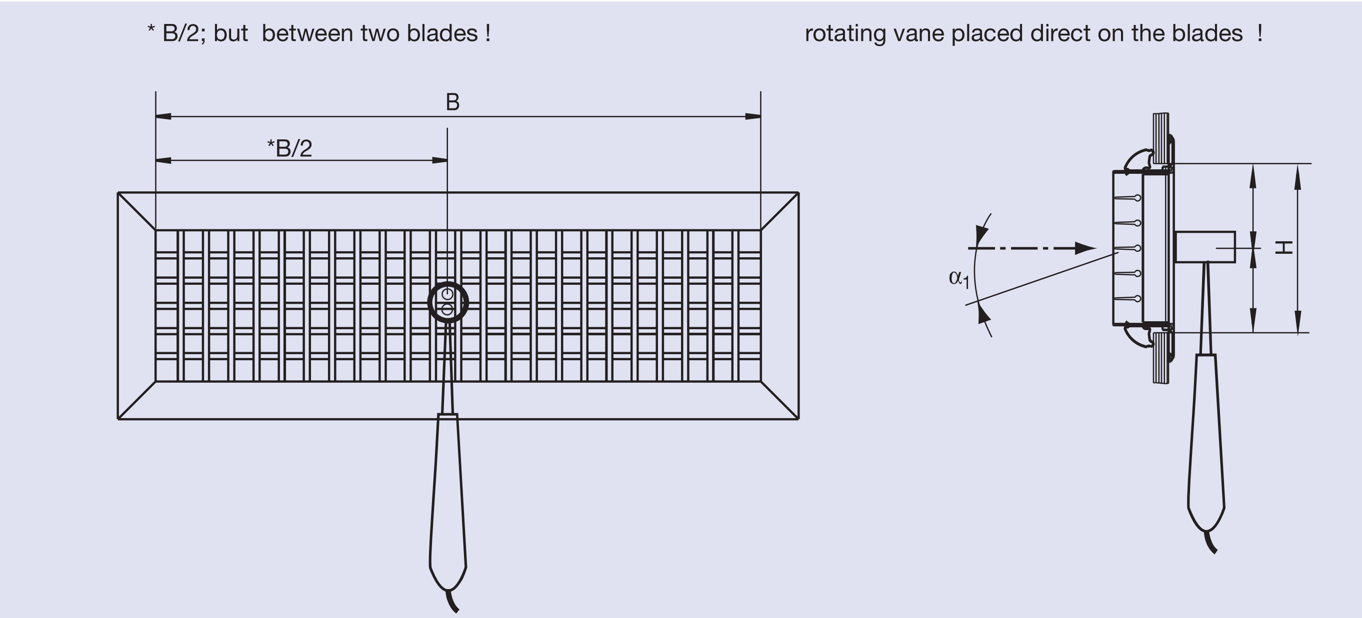
Correction: $\frac{A}{A_o} = \frac{0.03}{0.06} = 0.5 \Rightarrow \Delta L_{WA} = -3$ dB

⇒ $L_{WA0.03}$ = 35 - 3 = 32 dB(A)

$L_{W0.03;125Hz}$ = 36 dB; $L_{W0.03;250Hz}$ = 36 dB a.s.o.
$L_{WNC0.03}$ = 32 - 4 = 28
$L_{WNR0.03}$ = 32 - 2 = 30

Determination of volume air flow rate at TROX HESCO diffusion grilles

Supply air
Tests have shown that the most reliable measurements are obtained using a rotating vane anemometer. Care should be taken that the anemometer head lies on the grille blades. The figure shows the exact position of the head containing the vanes:



Observe the following

- With the blades set in the straight (neutral) position, make several measurements over the nominal width B of the grille and then take the average of these readings.
- For a divergent setting of the front blades, it is also an advantage to make several measurements. This is absolutely necessary with the DG5 grille type.

The measurements must, however, only be made in the central area, i.e. where the blades still have a straight setting. The measured value v_{gem} lies between the effective discharge velocity v_{eff} and the discharge velocity, referred to the grille nominal area.
To get the effective discharge velocity v_{eff}, the measured value v_{gem} has to be multiplied by a correction factor f_2.

$$v_{eff} = v_{gem} \times f_2 \quad [m/s]$$

The size of the correction factor f_2 is dependent on the setting of the air control blades.
This applies to all DG types (DG1, DG3, DG5, DG6, DG7, DG8, DG17, DGL, DGX and DGR).

Setting of the blades in front	Correction factor **f_2** for setting angle of the blades behind			
	α_1 = **0°**	α_1 = **22°**	α_1 = **42°**	α_1 = **55°**
0° straight	1.13	1.07	0.98	0.80
44°	1.03	0.93	0.88	0.80
84°	0.89	0.88	0.84	0.73
110°	0.74	0.77	0.76	0.70
140°	0.56	0.62	0.59	0.60
opposed	0.57	0.55	0.54	0.50

The supply air volume flow $\dot{V}_{ZL}$ of an air diffuser is calculated according to the formula below.

$$\dot{V}_{ZL} = v_{eff} \times A \times 3600 \times r \times \mu = v_{gem} \times f_2 \times A \times 3600 \times r \times \mu = v_{gem} \times f_2 \times A \times 2'700 \quad [m^3/h]$$

r = Area ratio A net = 0.77
μ = Contraction coefficient A nom= 0.974

Example

Given DG1, 600 × 100 mm, Blades in straight position.
v_{gem} (taken of measuring) = 2.8 m/s

Wanted a) Outlet velocity v_{eff}
b) Air flow rate $\dot{V}_{ZL}$ of the diffuser

Solution a) Outlet velocity v_{eff}
$v_{eff} = v_{gem} \times f_2 = 2.8 \times 1.13 = \mathbf{3.164\ m/s}$

b) Air flow rate $\dot{V}_{ZL}$ of the diffuser

Calculated
$$\begin{aligned}\dot{V}_{ZL} &= v_{eff} \times A \times 3600 \times r \times \mu \\ &= v_{gem} \times f_2 \times A \times 3600 \times r \times \mu \\ &= 2.8 \times 1.13 \times 0.6 \times 0.1 \times 3600 \times 0.77 \times 0.974 \\ &= 515\ m^3/h, \text{ diffuser}\end{aligned}$$

Exhaust air
Tests have shown that the most reliable measurements are obtained using a rotating vane anemometer. Care should be taken that the anemometer head lies on the grille blades (as shown in the figure).

To calculate the exhaust air velocity v“, the measured value v_{gem} has to be multiplied by a correction factor f_3.
The correction factor $\mathbf{f_3}$ is **1.053**. This is valid for all DG types (DG... and DGR...1 to 8, DG17, DGL..., and DGX...) with straight blade positions.

The exhaust air volume flow $\dot{V}_{AL}$ of an air diffuser is calculated according to the formula below.

$$\begin{aligned}\dot{V}_{AL} &= v_{eff} \times A \times 3600 \times r \times \mu \\ &= v_{gem} \times f_3 \times A \times 3600 \times r \times \mu \\ &= v_{gem} \times 1.053 \times A \times 2'700\end{aligned} \quad [m^3/h]$$

Maximum air velocity in ventilation and air conditioning systems (pipes and ducts)

Explanatory note: Recommendations from diverse energy-saving consultancy services

Air flow rate $\dot{V}$ [m³/h]	Air velocity v_{k2} max. [m/s]	Air flow rate $\dot{V}$ [m³/h]	Air velocity v_{k2} max. [m/s]
until 1000	3	**until 4000**	5
until 1500	3.5	**until 5500**	5.2
until 2000	4	**until 7000**	5.5
until 2500	4.2	**until 10000**	6
until 3000	4.5	**more than10000**	7

Technical Data

Definitions

Throw $L_{0.5}$ [m]

The throw is the horizontal or vertical axial distance $v_{L0.5}$ that an air stream travels from the air outlet before the maximum stream velocity is reduced to 0.5 m/s. The average stream velocity at this point is approx. ~ 0.3 m/s. The throw varies depending on the grille size, grille configuration, outlet velocity, blades position as well as the outlet arrangement within the room.

Room depth R_T [m] $\triangleq L_{0.35}$

To prevent draughts, the air velocity at the opposite wall should not exceed 0.35 m/s on the axis of the air stream. In the diagrams 1, 2, 3 and 4 for the dimensioning of the grille, the room depths are determined for an air throw of $L_{0.35}$. The mean air velocity at this point is 0.15...0.2 m/s.

Outlet velocity v_{eff} [m/s]

Our diagrams are based on the effective air velocity at the free area of the air outlet with blades in straight position. Refer also pages 28 + 29: Determination of volume flow rate at TROX HESCO diffusion grilles.
$v'' = \dot{V}/(A \times \mu \times r \times 3600)$ [m/s]. Whereas: $\dot{V}$ = air flow rate [m³/h], A = nominal area [m²], μ = contraction factor = 0.974, r = free area/nominal area = 0.77.

Standard single grilles

Standard single grilles are those outlets which we keep on stock and include grilles whose aspect ratio (grille length/height) or B/H is less than 16. Calculation according to diagram 1, pages 3, 4, 5 and diagram 2, pages 7, 8 and 9.

Continuous grilles

These are single grilles which are joint together to form continuous grille. Calculation according to diagram 3 and 4, pages 10 and 11, provided that the aspect ration B/H is greater than 16. For supply air grilles we recommend setting up alternating active and passive zones, e.g. 1 m active, 1 m passive, 1 m active and so on.

Positioning of the grilles

The supply air grilles must be positioned as to avoid that the primary air stream reaches the occupied zone and that light fittings, beams, columns, etc. obstruct or deflect the air stream.

Distance D [m]

In the calculation examples above, the minimum distances D necessary between grille and side wall and between grille and ceiling are given.

Note
Due to design changes the aerodynamic data and noise information may be subject to change.

Technical Data

Legend

Symbol	**Unit**	**Designation**
A	m²	Nominal surface (nominal cross-section of a grille)
A_o	m²	Nominal surface of reference in the acoustics = 0.06 m² (DG... 600 x 100 mm)
α	∢ Grad	Air stream divergence angle (with reference to H)
B	mm, m	Nominal width of grille
β	∢ Grad	Air stream divergence angle (with reference to B)
dgl	m	same diameter value = $\frac{2 \times B \times H}{(B + H)}$
div.	-	Divergent blade position of the front, vertical blades
D_h	mm, m	Distance of horizontal discharge between the DGs and distance between grille and side wall
D_v	mm, m	Distance of vertical discharge between the DGs and distance from the side wall
DG	-	Diffusion grilles, type of grille
E_H	m	Min. installation height (fitting height) OK FB...UK DG = top edge of the floor to bottom edge of the diffusion grille
f	-	Conversion factor for v^{k1} of v_{eff}
f_1	-	Correction factor for other grille dimensions $\left(\frac{A}{A_o}\right) = \left(\frac{A}{0.06}\right)$
f_2	-	Correction factor supply air
f_3	-	Correction factor exhaust air
H	mm, m	Nominal height of grille
L_{wA}	dB(A)	Sound power level, according to filter "A"
L_{wNC}	-	Maintained noise rating curve of the sound power level spectrum, $L_{wNC} = L_{wA}$-4 dB
Lw_{NR}	-	Maintained noise rating curve of the sound power level spectrum, $L_{wNR} = L_{wA}$-2 dB
ΔL_{w2}	dB	Acoustic power level difference referred to other grille sizes
$L_{0.5}$	m	Air throw for a final velocity of 0.5 m/s on the air stream axis
$L_{0.35}$	m	Air throw for a final velocity of 0.35 m/s on the air stream axis (≙ room depth R_T)
OK FB	-	Top edge of the floor
UK DG	-	Bottom edge of the diffusion grille
Δp_s	Pa	Pressure drop
Δp_t	Pa	Total pressure drop
R_H	m	Room height according to the plan of the building
R_T	m	Room depth (by free stream or Coanda effect) = $L_{0.35}$
$R_{T44...140}$	m	Room depth , diverging positions of blades 44°, 84°, 110° u. 140°
R_{Tg}	m	Room depth, opposed position of blades
R_B	m	Room width according to the plan of the building
r	-	Surface proportion (free surface/nominal surface = 0.77)
R_L	m	Room length according to the plan of the building

Technical Data

continued from page 31

Symbol	Unit	Designation
μ	-	Contraction number = 0.974
$\Delta\Theta$	K, Kelvin	Temperature difference Theta (room temperature - supply air temperature)
$\Delta\Theta_{L0.5}$	K, Kelvin	Temperature difference Theta at the end of the air stream (on the stream axis) for $L_{0.5}$
Θ_S	°C, Celsius	Air stream temperature Theta in the grille (supply air temperature)
Θ_R	°C, Celsius	Room air temperature Theta
T	mm	Depth of mounting for DGR5, DGR7 and DGR17
v_{eff}	m/s	Air velocity at the DG, referred to the net cross-section area when the blades are in the „straight“ position.
$v_{eff\ 44°...140°}$	m/s	Air velocity, diverging positions of blades 44°, 84°, 110° u. 140°
$v_{eff\ geg}$	m/s	Air velocity by opposed position of blades
v_L	m/s	Air velocity on the stream axis
$\dot{V}_{L0.5}$	m³/h	Air volume rate at the air throw distance $L_{0.5}$
$\dot{V}$	m³/h	Air volume rate
$\dot{V}_{ABL}$	m³/h	Air volume rate exhaust air
$\dot{V}_{ZUL}$	m³/h	Air volume rate supply air
v_{gem}	m/s	Measured air velocity at DG
v_k	m/s	Velocity in the stream core
v_{k1}	m/s	Incident air stream velocity in the supply air duct (pressure duct)
v_{k2}	m/s	Transfer air stream velocity in the supply air duct (flow duct)
v_{k3}	m/s	Air velocity in the exhaust air duct
v_{k4}	m/s	Transfer air velocity in the exhaust air duct
n	-	Number of diffusion grilles
y, y'	m	Air stream drop in the cooling case or air stream rise in the heating case
y_{20}	m	Air stream drop at a room temperature of 20° C