Grille and Diffuser: Face and Free-Area Velocity

Face velocity and free-area (core) velocity of a supply or return grille from air flow, size and free-area ratio, and the number of grilles for a target velocity.

Method: Continuity v = V̇/A; core velocity on the free area

Input parameters

Unit system: SI

Parameter	Value	Unit
Total air flow	4,000.0	m³/h
Grille width	600.00	mm
Grille height	300.00	mm
Free-area ratio From the grille maker.	70.000	%
Number of grilles	2.0000	
Target face velocity (on the gross W × H, not the core) Lower for quiet rooms and return grilles near people.	2.0000	m/s

Calculated results

Parameter	Value	Unit
Face velocity	3.0864	m/s
Free-area (core) velocity	4.4092	m/s
Grilles needed for the target (rounded up)	4.0000	

Formula and method

$$v_f = \frac{\dot{V}}{nWH}, \quad v_c = \frac{v_f}{f}, \quad n_t = \left\lceil \frac{\dot{V}}{WHv_t} \right\rceil$$

Variables

$\dot{V}$	Total air flow	m³/s
W	Grille width	m
H	Grille height	m
f	Free-area ratio	-
n	Number of grilles	-
v_t	Target face velocity (on the gross W × H, not the core)	m/s
v_f	Face velocity	m/s
v_c	Free-area (core) velocity	m/s
n_t	Grilles needed for the target (rounded up)	-

Method and standards

Continuity.

Assumptions and limits

- Uniform flow. The target is a face velocity on the gross grille area W × H; the core velocity on the free area is higher by 1/f.

References

- Continuity v = V̇/A; core velocity on the free area

Report details

Report reference	FCC-6H6K-H0X3 (the same inputs always give the same reference)
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Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/hvac/ducts/grille-face-velocity

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.