Rectangular Duct Equivalent Diameter

Equivalent round diameter (Huebscher) and hydraulic diameter of a rectangular duct, with area, aspect ratio and velocities for a flow.

Method: Huebscher (1948); ASHRAE Handbook—Fundamentals (Duct Design)

Input parameters

Unit system: SI

Parameter	Value	Unit
Duct width	600.00	mm
Duct height	400.00	mm
Volume flow (0 = skip)	7,200.0	m³/h

Calculated results

Parameter	Value	Unit
Equivalent diameter (same friction at the same flow)	532.81	mm
Hydraulic diameter	480.00	mm
Duct area	0.24000	m²
Aspect ratio	1.5000	
Velocity in the rectangular duct	8.3333	m/s
Velocity in the equivalent round duct	8.9699	m/s

Formula and method

$$D_e = \frac{1.30\,(a\,b)^{0.625}}{(a+b)^{0.25}} \qquad D_h = \frac{2\,a\,b}{a+b} \qquad A = a\,b \qquad AR = \frac{\max(a,b)}{\min(a,b)}$$

$$v = \frac{\dot{V}}{A} \qquad v_e = \frac{4\,\dot{V}}{\pi D_e^2}$$

Variables

a	duct width	m
b	duct height	m
$\dot{V}$	volume flow	m³/s
D_e	equivalent diameter (same friction at the same flow)	m
D_h	hydraulic diameter	m
A	duct area	m²
AR	aspect ratio	–
v	velocity in the rectangular duct	m/s
v_e	velocity in the equivalent round duct	m/s

Method and standards

R.G. Huebscher's equation (ASHVE Transactions, 1948), as given in the Duct Design chapter of the ASHRAE Handbook—Fundamentals, and the hydraulic diameter 4A/P.

Assumptions and limits

- Huebscher's tests covered aspect ratios up to 8:1; beyond that the result is approximate.
- Same roughness and fluid in both ducts; turbulent flow.
- For pressure drop use D_e with the volume flow, or D_h with the true velocity; do not mix the two.

References

• Huebscher (1948)
• ASHRAE Handbook—Fundamentals (Duct Design)

Report details

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Release checks	3 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/rectangular-duct-equivalent-diameter

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Reopens the calculator with the inputs of this report.