Duct Size from Flow and Velocity

Round diameter and rectangular width and height of an air or flue gas duct for a volume flow, design velocity and aspect ratio, with the equivalent diameter.

Method: Continuity equation; Huebscher (1948) equivalent diameter

Input parameters

Unit system: SI

Parameter	Value	Unit
Volume flow (actual)	72,000	m³/h
Design velocity From your specification or duct design standard; the calculator does not suggest one.	15.000	m/s
Aspect ratio of the rectangular duct (width / height)	1.6000	

Calculated results

Parameter	Value	Unit
Round duct inside diameter	1,302.9	mm
Rectangular duct width	1,460.6	mm
Rectangular duct height	912.87	mm
Flow area	1.3333	m²
Equivalent diameter of the rectangle (Huebscher)	1,253.7	mm

Formula and method

$$A = \frac{\dot{V}}{v} \qquad D = \sqrt{\frac{4A}{\pi}} \qquad a = \sqrt{A \cdot AR} \qquad b = \frac{a}{AR} \qquad D_e = \frac{1.30\,(ab)^{0.625}}{(a+b)^{0.25}}$$

Variables

$\dot{V}$	actual volume flow	m³/s
v	design velocity	m/s
AR	aspect ratio width / height	–
D	round duct inside diameter	m
a	rectangular duct width	m
b	rectangular duct height	m
A	flow area	m²
D_e	equivalent diameter of the rectangle	m

Method and standards

Continuity for the flow area; Huebscher's equivalent diameter (ASHRAE Handbook—Fundamentals, Duct Design).

Assumptions and limits

- Inside dimensions; add insulation, lining or refractory thickness for the outside size.
- Round the result to the standard sizes you use and recheck the velocity.
- The rectangle has the same area (same velocity) as the round duct, so its friction-equivalent diameter D_e is smaller than D and it has more friction per metre. For a rectangle equal in friction, use the equal-friction sizing calculator.

References

- Continuity equation; Huebscher (1948) equivalent diameter

Report details

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Calculator	Duct Size from Flow and Velocity
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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/duct-sizing-velocity

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.