Cyclone Cut Size and Collection Efficiency (Lapple)

Cut size (d50) of a cyclone dust collector by the Lapple method from its inlet and body dimensions and gas flow, with the collection efficiency for a chosen particle size.

Method: Lapple (1951) cut size; Chopey; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Gas flow at cyclone conditions	10,800	m³/h
Inlet width	250.00	mm
Inlet height	500.00	mm
Length of the cylindrical body	2.0000	m
Length of the cone	2.0000	m
Gas dynamic viscosity	2.5000e-05	Pa·s
Particle density	2,000.0	kg/m³
Gas density	0.85000	kg/m³
Particle size to evaluate	10.000	µm

Calculated results

Parameter	Value	Unit
Inlet velocity	24.000	m/s
Effective number of turns	6.0000	
Cut size (50 % collected)	5.5766	µm
Collection efficiency for the particle size	76.279	%

Formula and method

$$V_i = \frac{Q}{WH}$$

$$N_e = \frac{1}{H}\left(L_b + \frac{L_c}{2}\right)$$

$$d_{50} = \sqrt{\frac{9\mu W}{2\pi N_e V_i (\rho_p - \rho_g)}}$$

$$\eta_d = \frac{1}{1 + (d_{50}/d_p)^2}$$

Variables

Q	gas flow at cyclone conditions	m³/s
W	inlet width	m
H	inlet height	m
L_b	length of the cylindrical body	m
L_c	length of the cone	m
μ	gas dynamic viscosity	Pa·s

ρ_p	particle density	kg/m³
ρ_g	gas density	kg/m³
d_p	particle size	m
V_i	inlet velocity	m/s
N_e	effective number of turns	-
d_{50}	cut size	m
η_d	collection efficiency for d_p	-

Method and standards

Lapple's model treats the outer vortex as a settling chamber: particles must cross the inlet width during N_e turns. The cut size is the diameter collected with 50 % efficiency; the fractional efficiency curve 1/(1 + (d50/d)²) is the fit to Lapple's curve given by Chopey.

Assumptions and limits

- Standard tangential-inlet cyclone of the Lapple type (inlet about half the body diameter high and a quarter wide). The dimensions are not checked against that geometry; for other proportions the result is only indicative.
- The 10–30 m/s inlet velocity warning is a common design range, not a limit from the method.
- Efficiency curve for a single particle size; integrate over the size distribution for the overall efficiency.
- Re-entrainment and hopper leakage not included.

References

- Lapple (1951) cut size
- Chopey
- Handbook of Chemical Engineering Calculations (efficiency curve)

Report details

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

This calculator online

https://calc.firecad.com/boilers-power-plant/emissions-stacks/cyclone-cut-size

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.