Cyclone Pressure Drop (Shepherd–Lapple)

Pressure drop of a cyclone or multiclone tube from its inlet and outlet dimensions, gas flow and density by the Shepherd and Lapple velocity-head method.

Method: Shepherd and Lapple; Ind. Eng. Chem. 31 (1939) 972; 32 (1940) 605

Input parameters

Unit system: SI

Parameter	Value	Unit
Gas flow through one cyclone (actual)	7,200.0	m³/h
Gas density	0.85000	kg/m³
Inlet height	500.00	mm
Inlet width	250.00	mm
Gas outlet (vortex finder) diameter	500.00	mm
Shepherd–Lapple constant 16 for a plain tangential inlet; 7.5 with an inlet vane (Shepherd and Lapple, 1939).	16.000	

Calculated results

Parameter	Value	Unit
Cyclone pressure drop	88.756	mmWC
Number of inlet velocity heads	8.0000	
Inlet velocity	16.000	m/s
Inlet velocity pressure	11.095	mmWC

Notes for this case

- Shepherd and Lapple's method is empirical, accurate to about ±30 %; use the maker's figure for the final design.

Formula and method

$$v_i = \frac{Q}{a\,b} \qquad p_{d,i} = \frac{\rho\, v_i^2}{2} \qquad N_H = K\,\frac{a\,b}{D_e^2} \qquad \Delta p = N_H\, p_{d,i}$$

Variables

Q	gas flow through one cyclone	m³/s
ρ	gas density	kg/m³
a	inlet height	m
b	inlet width	m
D_e	gas outlet diameter	m
K	Shepherd–Lapple constant	–
Δp	cyclone pressure drop	Pa
N_H	number of inlet velocity heads	–
v_i	inlet velocity	m/s
$p_{d,i}$	inlet velocity pressure	Pa

Method and standards

The velocity-head method of Shepherd and Lapple (Industrial and Engineering Chemistry, 1939 and 1940), widely used for preliminary cyclone design.

Assumptions and limits

- Clean gas; dust loading usually lowers the pressure drop slightly.
- Empirical: accurate to about ±30 %; use the maker's figure for the final design.

- Collection efficiency is not calculated here.

References

- Shepherd and Lapple
- Ind. Eng. Chem. 31 (1939) 972; 32 (1940) 605

Report details

Report reference	FCC-C5DP-VACP (the same inputs always give the same reference)
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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/boilers-power-plant/emissions-stacks/cyclone-pressure-drop

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.