Oil Burner Nozzle Flow and Turndown (Square-Root Law)

Oil flow of a pressure-atomising nozzle at minimum and maximum pressure from its rated flow and pressure (square-root law), and the turndown ratio.

Method: Orifice square-root law ṁ ∝ √Δp (constant discharge coefficient)

Input parameters

Unit system: SI

Parameter	Value	Unit
Rated flow	300.00	kg/h
Rated pressure drop	20.000	bar
Minimum pressure drop	7.0000	bar
Maximum pressure drop	25.000	bar

Calculated results

Parameter	Value	Unit
Flow at minimum pressure	177.48	kg/h
Flow at maximum pressure	335.41	kg/h
Turndown ratio	1.8898	

Formula and method

$$\dot{m} = \dot{m}_1 \sqrt{\Delta p / \Delta p_1}, \quad TD = \sqrt{\Delta p_{max} / \Delta p_{min}}$$

Variables

$\dot{m}_1$	Rated flow	kg/s
Δp_1	Rated pressure drop	Pa
Δp_{min}	Minimum pressure drop	Pa
Δp_{max}	Maximum pressure drop	Pa
$\dot{m}_{min}$	Flow at minimum pressure	kg/s
$\dot{m}_{max}$	Flow at maximum pressure	kg/s
TD	Turndown ratio	-

Method and standards

Square-root law of an orifice with a constant discharge coefficient, scaled from the nozzle's rated flow and pressure. A note appears when the turndown is above about 2:1.

Assumptions and limits

- Constant viscosity and discharge coefficient. The flow number of swirl pressure-jet nozzles changes somewhat with pressure and viscosity; use the maker's capacity table where you have it.
- The minimum pressure for good atomisation is not checked: take it from the nozzle maker.

References

- Orifice square-root law ṁ ∝ √Δp (constant discharge coefficient)

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/combustion/oil-nozzle-turndown

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.