Tunnel Jet Fan Thrust and Number of Fans

Thrust of a jet fan from its outlet diameter and jet velocity against the tunnel air speed, and the number of fans to overcome the tunnel's pressure loss.

Method: Momentum theory of tunnel jet fans

Input parameters

Unit system: SI

Parameter	Value	Unit
Jet fan outlet diameter	1.0000	m
Jet outlet velocity	34.000	m/s
Tunnel air velocity	3.0000	m/s
Air density	1.2000	kg/m³
Installation efficiency (wall and obstruction losses)	80.000	%
Tunnel cross-section	60.000	m²
Tunnel pressure loss to overcome	6.1183	mmWC

Calculated results

Parameter	Value	Unit
Static thrust (no tunnel flow)	1,089.5	N
Installed thrust at tunnel speed	794.70	N
Force needed Δp·A_t	3,600.0	N
Jet fans needed	5.0000	
Jet kinetic power per fan	18.522	kW

Notes for this case

• Momentum exchange: thrust T = k_ipAv_j(v_j − v_t); installation factors cover wall friction and niches. The required force is the tunnel pressure loss (friction, portals, vehicles, wind) times the tunnel area.

Formula and method

$$T = k_i \rho A v_j (v_j - v_t), \quad n = \left\lceil \frac{\Delta p_t A_t}{T} \right\rceil$$

Variables

D	Jet fan outlet diameter	m
v_j	Jet outlet velocity	m/s
v_t	Tunnel air velocity	m/s
ρ	Air density	kg/m³
k_i	Installation efficiency (wall and obstruction losses)	-
A_t	Tunnel cross-section	m²
Δp_t	Tunnel pressure loss to overcome	Pa
T_0	Static thrust (no tunnel flow)	N
T	Installed thrust at tunnel speed	N
F_{req}	Force needed Δp·A_t	N
n	Jet fans needed	-
P_{jet}	Jet kinetic power per fan	W

Method and standards

Jet fan sizing.

Assumptions and limits

- Steady flow; uniform tunnel velocity.

References

Momentum theory of tunnel jet fans

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/mechanical/fans/jet-fan-thrust

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Reopens the calculator with the inputs of this report.