

Fan Identification

Fan Description	
Fan Location	

Data Collected

Fan Pressure Data

Inlet Dynamic Pressure	(p_{vi})		in.-H ₂ O	(N. 1)
Outlet Dynamic Pressure	(p_{vo})		in.-H ₂ O	(N. 1)
Static Differential Pressure	(Δp_s)		in.-H ₂ O	(N. 1)

Ducting Data

Inlet Duct Inside Diameter	(d_i)		inches	(N. 2)
Outlet Duct Inside Diameter	(d_o)		inches	(N. 2)

Environmental Data

Barometric Pressure	(p_b)		in.-Hg	(Rf. 1)
Absolute Temperature	(T_a)		°R	(Rf. 1)

Input Power Data

Input Power to Fan Drive Shaft	(W_i)		bhp	(Rf. 2)
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Fluid Properties

Air Density	(ρ)		- lb./ft. ³	(Eq. 1)
Gas Compressibility Factor	(K_p)	0.98		(Rf. 3)

Fan Specifications

Inlet

Inlet Gas Velocity	(V_i)	- fpm	(Eq. 2)
Inlet Duct Cross Sectional Area	(A_i)	- ft ²	(Eq. 3)
Inlet Volumetric Flow Rate	(Q_i)	- cfm	(Eq. 4)

Outlet

Outlet Gas Velocity	(V_o)	- fpm	(Eq. 2)
Outlet Duct Cross Sectional Area	(A_o)	- ft ²	(Eq. 3)
Outlet Volumetric Flow Rate	(Q_o)	- cfm	(Eq. 4)

Fan Performance

Average Volumetric Flow Rate	(Q_{avg})	- cfm	(Eq. 5)
Power Output of Fan	(W_o)	- hp	(Eq. 6)
Mechanical Efficiency of Fan	(η_f)	-	(Eq. 7)

Equations

Eq. 1) Air Density (ρ)

$$1.325 \times \left(\frac{P_b}{T_a} \right)$$

Eq. 2) Gas Velocity ($V_{(i,o)}$)

$$1,096.2 \times \sqrt{\frac{P_{v(i,o)}}{\rho}}$$

Eq. 3) Duct Cross Sectional Area ($A_{(i,o)}$)

$$\frac{\pi \times d_{(i,o)}^2}{4} \times \frac{1 \text{ ft}^2}{144 \text{ in}^2}$$

Eq. 4) Volumetric Flow Rate ($Q_{(i,o)}$)

$$V_{(i,o)} \times A_{(i,o)}$$

Eq. 5) Avg. Volumetric Flow Rate (Q_{avg})

$$\frac{Q_i + Q_o}{2}$$

Eq. 6) Power Output of Fan (W_o)

$$\frac{Q_{avg} \times \Delta p_s \times K_p}{6,362} \times \frac{0.746 \text{ kW}}{1 \text{ hp}}$$

Eq. 7) Mechanical Efficiency of Fan (η_f)

$$\frac{W_o}{W_i}$$

References

- Rf. 1)** Environmental data is based on local weather station readings, collected from www.wunderground.com
- Rf. 2)** Input power to fan drive shaft is calculated using the Motor Analysis Tool (MAT) on the previous page.
- Rf. 3)** Gas compressibility factor is estimated based on the static pressure differential using Table 3.1 of the DOE EERE Fan System Assessment Training Manual, 3rd Edition.

Notes

- N. 1)** A digital manometer was used to collect various pressure measurements.
- N. 2)** A tape measure was used to determine the size of various fan components.